18ECP101L-MASSIVE OPEN ONLINE COURSE-I

SEMESTER V

YEAR: NOV 2022

Introduction to Systems Engineering

Report Submitted by

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Faculty in-charge

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INSTITUTE OF SCIENCE & TECHNOLOGY
Deemed to be University u/s 3 of UGC Act, 1956

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COLLEGE OF ENGINEERING AND TECHNOLOGY

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

S.R.M. Nagar, Kattankulathur - 603203, Kancheepuram District

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COLLEGE OF ENGINEERING AND TECHNOLOGY

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Kattankulathur, Chengalpattu District - 603203

BONAFIDE CERTIFICATE

Register No: RA20110040100

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Date: **Faculty In-charge**

Year Coordinator

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1. COURSE DETAILS

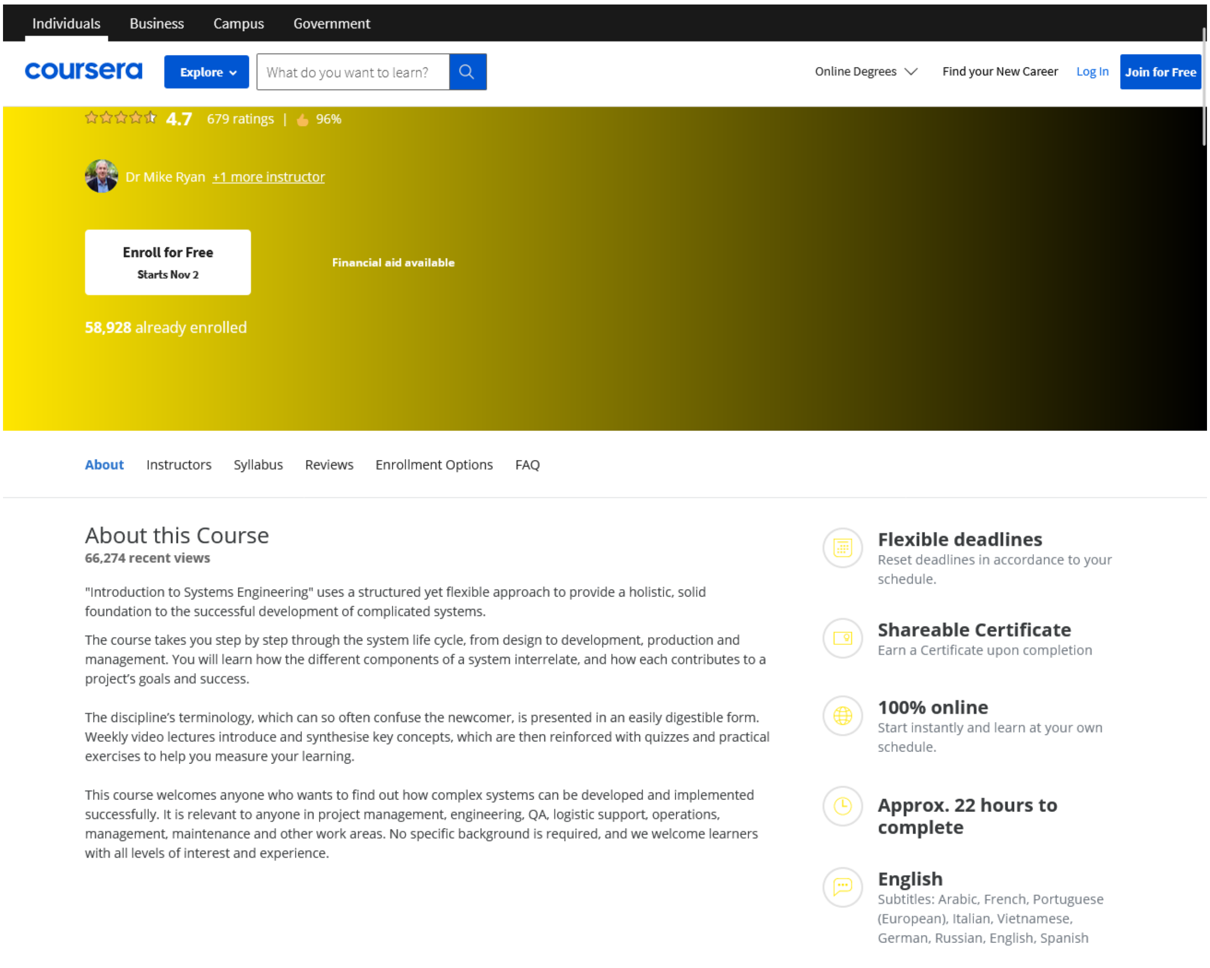
COURSE PLATFORM- Coursera

COURSE TITLE- Introduction to Systems Engineering

OFFERING UNIVERSITY- The University of New South Wales, Sydney

COURSE DURATION- 22 hours

DASHBOARD:



2. INSTRUCTOR PROFILE

Dr Mike Ryan (Senior Lecturer) at UNSW Sydney

Dr Mike Ryan holds bachelors, masters, and PhD degrees in electrical engineering. He is a Fellow of Engineers Australia (FIEAust), a Chartered Professional Engineer (CPEng) in the electrical and ITEE colleges, a Senior Member of IEEE (SMIEEE), a Member of the Australian Institute of Management (AIMM), and a member of the International Council on Systems Engineering (INCOSE). Since 1981, he has held a number of positions in communications and systems engineering and in management and project management.

Since 1998, he has been with the School of Engineering and Information Technology, UNSW, in Canberra where he is currently a Senior Lecturer. His research and teaching interests are in communications and information systems, requirements engineering, systems engineering, and project management—he also regularly consults in those fields.

He is the Editor-in-Chief of an international journal, the Conference Chair of two major international conferences each year, and is the Chair of the Requirements Working Group (RWG) of INCOSE. He is the author or co-author of twelve books, three book chapters, and over 180 technical papers and reports.

Dr Ian Faulconbridge (Inductry Fellow) at UNSW Sydney

Dr Ian Faulconbridge has doctorate, masters, and bachelors degrees in engineering and an MBA in project management. He is a Fellow of Engineers Australia (FIEAust), a Chartered Professional Engineer (CPEng) in the electrical and aerospace colleges, and is a Registered Professional Engineer of Queensland (RPEQ). He is also a Senior Member of IEEE (SMIEEE) and a member of the International Council on Systems Engineering (INCOSE).

Since 1990, he has held a number of engineering, project management and academic positions in the fields of avionics, simulation, radar, communications and information systems. He is the director of an engineering and project management consultancy and is an Industry Fellow with the School of Engineering and Information Technology, UNSW, in Canberra.

He is the author or co-author of a number of books covering project management, systems engineering, radar and avionics, and is the co-author of a book chapter covering the design of engineering educational programs. Additionally, he has written a number of academic papers, technical reports and professional papers covering a range of technical and management topics.

3. INTRODUCTION OF THE COURSE

Systems engineering provides the framework within which complex systems can be adequately defined, analysed, specified, manufactured, operated, and supported. The focus of systems engineering is on the system as a whole, and the maintenance of a strong interdisciplinary approach.

Project management, quality assurance, integrated logistics support, and a wide variety of engineering disciplines are but a few of the many disciplines that are part of a coordinated systems engineering effort.

"Introduction to Systems Engineering" uses a structured yet flexible approach to provide a holistic, solid foundation to the successful development of complicated systems.

The course takes you step by step through the system life cycle, from design to development, production and management. You will learn how the different components of a system interrelate, and how each contributes to a project’s goals and success.

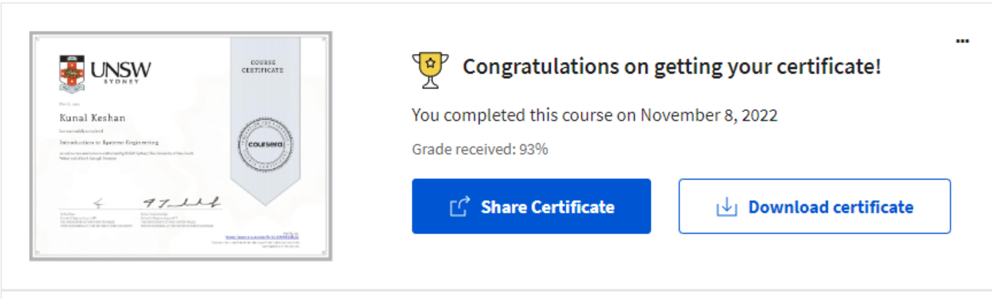
The discipline’s terminology, which can so often confuse the newcomer, is presented in an easily digestible form. Weekly video lectures introduce and synthesise key concepts, which are then reinforced with quizzes and practical exercises to help you measure your learning.

This course welcomes anyone who wants to find out how complex systems can be developed and implemented successfully. It is relevant to anyone in project management, engineering, QA, logistic support, operations, management, maintenance and other work areas. No specific background is required, and we welcome learners with all levels of interest and experience.

4. COURSE TIMELINE

DATE OF ENROLLMENT: 22nd August 2022

DATE OF COMPLETION: 8th November 2022



5. SYLLABUS

WEEK 1

Course Welcome & Module 1 (Introduction to Systems and System Life Cycle)

Welcome to 'Introduction to Systems Engineering'! To help you in getting started with this course, we have a course introduction video that will provide you with an overview of the course syllabus.We then begin the course with this introductory module in which we address the nature of systems and the concept of a system life cycle. We identify what is meant when we say that something is a system and we narrow down the very broad definitions to focus on the human-made or modified systems that are our focus in systems engineering. We then look at the broad phases and activities that a system moves through during its life cycle, from early identification of the need for the system, exploration of options, functional design, physical design, detailed design and development, construction and production, utilization and support and then, finally, retirement. To provide greater detail for this module, we recommend (but do not require) that students refer to pages 1-19 of our textbook "Systems Engineering Practice"--see reading on Course Notes and Text Books.

^Show less

11 videos, 6 readings, 1 practice quiz **expand**

Graded: Module 1 Extension Exercise

WEEK 2

Systems Engineering and its Relevance and Benefits

In this module, we describe the discipline of systems engineering and outline its relevance and benefits. We introduce what we mean by the 'systems engineering' and provide a framework within which we can consider the major processes, activities, and artefacts throughout the remainder of the course. In doing so, it will have become evident to you that the systems engineering approach has a number of advantages, so we then examine in a little more detail the relevance and benefits of systems engineering.To provide greater detail for this module, we recommend (but do not require) that students refer to pages 19-31 of our textbook "Systems Engineering Practice"--see reading on Course Notes and Text Books.

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9 videos, 2 readings, 1 practice quiz **expand**

Graded: Module 2 Extension Exercise

WEEK 3

Needs and Requirements

Before we look at the various systems engineering activities in more detail in forthcoming modules, in this module we look at what we mean when we refer to the 'needs' and 'requirements' for a system. We examine the needs and requirements views developed by business management, business operations, and systems designers. We will also consider in this module how we might go about developing a set of requirements—we call that process 'requirements engineering'. To provide greater detail for this module, we recommend (but do not require) that students refer to pages 43-54 of our textbook "Systems Engineering Practice"--see reading on Course Notes and Text Books.

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8 videos, 2 readings, 1 practice quiz **expand**

Graded: Module 3 Extension Exercise

WEEK 4

Requirements Elicitation and Elaboration

In this module, we explore requirements engineering and the processes by which requirements are elicited and defined formally through a process called elaboration (which involves derivation and decomposition of lower-level requirements from their parent requirements). We also look in this module at some simple requirements engineering tools and illustrate how they might be useful to you. Finally, we examine the notion of traceability, which ensures that we know where each requirement comes from, what requirements are related to it, and what requirements were derived from it. At the end of this module, you should be prepared to attempt the mid-course exam. To provide greater detail for this module, we recommend (but do not require) that students refer to pages 54-73 of our textbook "Systems Engineering Practice"--see reading on Course Notes and Text Books.

^Show less

7 videos, 3 readings, 2 practice quizzes **expand**

Graded: Module 4 Extension Exercise

Graded: Mid-Course Exam - (Modules 1 -4)

WEEK 5

Conceptual Design

In this module we examine Conceptual Design, during which we investigate how business needs and requirements and stakeholder needs and requirements are translated into a system-level understanding of the requirements of our system. This understanding will tell us what the system needs to do, how well it needs to perform, and what other systems it needs to interact with in order to meet the stakeholder and business needs and requirements. We then look at the concept of system level synthesis where we make some high-level design decisions before reviewing our work in preparation of the core design effort normally associated with preliminary and detailed design. To provide greater detail for this module, we recommend (but do not require) that students refer to pages 81-130 of our textbook "Systems Engineering Practice"--see reading on Course Notes and Text Books.

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7 videos, 2 readings, 1 practice quiz **expand**

Graded: Module 5 Extension Exercise

WEEK 6

Preliminary and Detailed Design

In this module we pick up from where we left off at the end of Conceptual Design and we start to make some more detailed design decisions. During preliminary design, we will look at identifying the various subsystems that will need to come together to form our system. What do these subsystems need to be able to do? How do they need to inter-relate? Can we source these subsystems off the shelf or do they need to be designed from the ground up? These are key questions of preliminary design. For the subsystems that need to be designed or modified, some level of detailed design will be required. We will look at detailed design process and talk about tools like prototyping and how these tools help to refine the detailed design. To provide greater detail for this module, we recommend (but do not require) that students refer to pages 133-190 of our textbook "Systems Engineering Practice"--see reading on Course Notes and Text Books.

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7 videos, 2 readings, 1 practice quiz **expand**

Graded: Module 6 Extension Exercise

WEEK 7

Construction, Production, and Utilisation

We now move onto the construction and production of the system based on the detailed design from the previous stage. During construction and production, we look at critical systems engineering activities such as configuration audits and system verification. The system then enters the utilisation phase where we explore how systems engineering may continue to be involved via modification and upgrade projects. We finish this section by looking briefly at some of the issues we face when trying to dispose of or retire systems that are no longer required. To provide greater detail for this module, we recommend (but do not require) that students refer to pages 193-211 of our textbook "Systems Engineering Practice"--see reading on Course Notes and Text Books.

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7 videos, 2 readings, 1 practice quiz **expand**

Graded: Module 7 Extension Exercise

WEEK 8

Systems Engineering Management

In this final module, we explore some of the key management issues that systems engineering must address in order to maintain balance and control across the systems engineering effort. We look specifically at issues such as verification and validation management, configuration management, technical risk management and the management of the technical review and audit program. We also explore some of the broad strategies that may be adopted when executing a systems engineering process. Whilst we have used what is generally referred to as a waterfall approach throughout the course to explain systems engineering, in this module we also briefly introduce alternatives such as incremental and evolutionary development. We conclude the module by emphasising the importance of planning throughout the systems engineering program and the development of a governing plan known as the systems engineering management plan or SEMP. To provide greater detail for this module, we recommend (but do not require) that students refer to pages 213-246, 285-294, and 297-309 of our textbook "Systems Engineering Practice"--see reading on Course Notes and Text Books.

^Show less

7 videos, 1 reading, 1 practice quiz **expand**

WEEK 9

Final Exam and Information About Further Study

Having finished the modules, you are now in a position to complete the final exam covering Modules 6 to 9. Before you finish the course we also thought that you may be interested in knowing about the Master of Systems Engineering program offered by UNSW Canberra--all courses can be completed online at any time, and entry is available to those with any undergraduate degree and there are entry pathways available for those without a first degree.

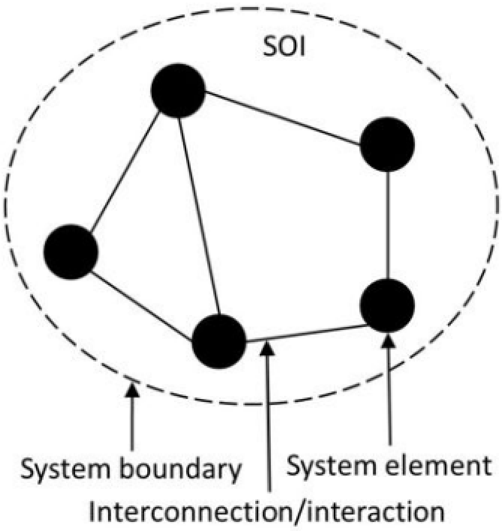
2 videos **expand**

Graded: Final Exam - (Modules 5-8)

6. WEEK 1 CONTENTS

Before we begin to address the discipline associated with engineering a system, we need to consider what is meant by a system. There are physical systems such a solar systems, river systems, railway systems, satellite systems, communication systems, information systems, pulley systems, nervous systems, just to name a few. There are philosophical systems, social systems, religious systems, gambling systems, banking systems, systems of government, and many more. Before we continue, therefore, we should briefly consider what we mean by a system in the context of systems engineering.

A system as a combination of interacting elementsorganized to achieve one or more stated purposes.



The purpose of the system is called its mission—in the broadest sense, the mission of the system is to provide a solution to a business problem.
When we refer to a system as comprising system elements that are interconnected in order to achieve the system's mission, we imply that all three of those principal aspects result from conscious choice. That is, we are referring to systems that have been deliberately designed, or

engineered— hence our interest in systems engineering. Further, a system that has been engineered to perform a specified mission must be able to perform that mission with relative autonomy—that is, it must be managerially and operationally independent (and may well have been procured independently).

There are numerous ways to classify systems—here we identify the four main types in order to be clear as to which type of system we refer:

- Closed/open systems. An open system interacts with its operating environment—it accepts inputs from that environment across its boundary and returns outputs across the same boundary to the external environment. A closed system is isolated from its external environment. We are only interested in useful systems, which aretherefore open.
- Natural/human-made/human-modified systems. Natural systems contain natural elements that result from natural processes; human-made systems come into existence through the efforts of humans and may contain human-made elements or natural elements adapted to human-designed purposes. Natural systems that have been modified for human purposes are called human-modified systems. The systems engineering for natural systems is certainly not conducted by humans, so we are only interested in human-made/modified systems.
- Physical/conceptual systems. Physical systems exist in a physical form; conceptual systems do not have a physical form. We focus here on physical systems.
- Precedented/unprecedented systems. In a precedented system, similar such systems (or, at least, the majority of system elements) have been produced before. An unprecedented system is one that has not been previously produced. Systems that comprise mostly unprecedented elements are the result of research and development effort. Here we focus on systems that comprise largely precedented elements—that is, those to which engineering is appropriate.

7. WEEK 2 CONTENTS

Systems engineering is predominantly related to the Acquisition Phase and, to a lesser extent, the Utilization Phase of the system life cycle. For these two major phases, we use life-cycle activities based on those defined by Blanchard and Fabrycky. In the Acquisition Phase, the activities are Conceptual Design, Preliminary Design, Detailed Design and Development, and Construction and/or Production. In the Utilization Phase, the activities are Operational Use and System Support, which are undertaken in parallel.

The significance of focusing on the system life cycle is that decisions made early in Conceptual Design are informed by the intended activities later in Acquisition Phase in the Utilization Phase. For example, the design of an aircraft airframe must take into account the maintenance and operation of that airframe during the Utilization Phase—it would be pointless to design the best airframe in the world if it did not have the necessary access points to allow maintenance personnel to service it or operators to operate it in the intended environment.

Acquisition Phase

The Acquisition Phase comprises four main activities of Conceptual Design, Preliminary Design, Detailed Design and Development, and Construction and/or Production. Each of these activities is described in more detail in the following sections, which outline the major tasks undertaken and the main artefacts produced in each.

Conceptual Design

Conceptual Design is aimed at producing a set of clearly defined requirements, at the system level, and in logical terms. Although clearly defining the requirements of the system would seem a logical (and essential) first step, it is often poorly done and is commonly the direct cause of problems later in the development process. Business managers and stakeholders sometimes prefer to describe their requirements in loose and ambiguous terms to protect themselves from changes in their needs and their business environment. The Conceptual Design process aims to avoid this ambiguity by providing a formal process by which the Business Needs and Requirements (BNR) are articulated and confirmed by business management, and then elaborated by stakeholders at the business operations level into a set of Stakeholder Needs and Requirements (SNR), which are further elaborated by requirements engineers into a set of system requirements in the System Requirement Specification (SyRS). There may be one SyRS for the entire capability system, but it is more likely that there is one SyRS for each of the constituent elements of capability—the major materiel system, personnel, support, training, facilities, and so on.

Preliminary Design

The aim of Preliminary Design is to convert the FBL into an upper-level physical definition of the system configuration or architecture (the hows of the system). Preliminary Design is therefore the stage where logical design is translated into physical design; or where focus shifts from the problem domain into the solution domain. The result of the Preliminary Design process is a subsystem-level design known as the Allocated Baseline (ABL) in which the logical groupings defined in the FBL have been defined in more detail, and then re-grouped and allocated to subsystem-level physical groupings (called configuration items (CI)), which combine to form the upper-level physical design of the system. At the centre of the ABL are a series of Development Specifications, which contain the subsystem-level requirements grouped by configuration item.

Detailed Design and Development

The ABL developed during Preliminary Design is used in the Detailed Design and Development process to complete development of the individual subsystems, assemblies, and components in the system. Prototyping may occur and the system design is confirmed by test and evaluation. The result of the Detailed Design and

Development process is the initial establishment of the Product Baseline (PBL) as the system is now defined by the numerous products (subsystems, assemblies, and components) making up the total system (as well as the requisite materials and processes for manufacturing and construction). The definition of the system at this stage should be sufficiently detailed to support the commencement of the Construction and/or Production activities.
The PBL is established at the Critical Design Review (CDR). The CDR is the final design review resulting in the official acceptance of the design and the subsequent commencement of Construction and/or Production activities; CDR evaluates the detailed design; determines readiness for production/construction; and ensures design compatibility, including a detailed understanding of all external and internal interfaces.

Construction and/or Production
The final activity within the Acquisition Phase is Construction and/or Production. System components are produced in accordance with detailed design specifications in the PBL and the system is ultimately constructed in its final form. Formal test and evaluation activities (acceptance tests) will be conducted to ensure that the final system configuration meets the requirements in the SyRS.

Utilization Phase and Retirement Phase
On acceptance from the supplier, the system moves into the Utilization Phase. The major activities during this phase are Operational Use and System Support. Systems engineering activities may continue during the Utilization Phase to support any modification activity that may be required.
Modifications may be necessary to rectify performance shortfalls, to meet changing operational requirements or external environments to enable ongoing support for the system to be maintained, or to enhance current performance or reliability. The system life cycle ends with retirement of the system in the Retirement Phase, which may well overlap with the introduction into service of the replacement system.

8. WEEK 3 CONTENTS

Writing well-formed requirements can be achieved by using the following guidelines 3:

- Ensure each requirement is a necessary, short, definitive statement.
- Define the appropriate conditions (qualitative or quantitative measures) for each requirement.
- Ensure that each requirement is verifiable through the discipline associated with writing a verification statement for every requirement statement.
- Avoid over-specification, unnecessary constraints and unbounded statements.
- Ensure readability by defining standard templates for describing requirements; using natural language simply, consistently and concisely; using short sentences and paragraphs, as well as lists and tables; supplementing natural language with other descriptions where appropriate, such as equations if they are the most unambiguous way of describing requirements; and using diagrams where appropriate to show relationships between entities.

Requirements must be placed into a structured format. For example, a paper-based format for a specification uses columns to contain most of the information required to be recorded along with the requirements. Note that it is normally not possible to include all the information on a single sheet of paper in a manageable way. The difficulties with paper-based formats for specifications can be overcome with the use of automated requirements management tools.

There are a large number of tools that may assist in requirements engineering, including the context diagram, functional flow block diagrams (FFBD), requirements breakdown structure (RBS), and N2 diagrams. Other tools include structured analysis, data flow diagrams (DFD), control flow diagrams (CFD), IDEF diagrams, behaviour diagrams, action diagrams, state/mode diagrams, process flow diagrams, function hierarchy diagrams, state transition diagrams (STD), entity relationship diagrams (ERD), structured analysis and design, object-oriented analysis (OOA), unified modelling language (UML), structured systems analysis and design methodology (SSADM), and quality function deployment (QFD). Each of these techniques focuses on gathering requirements in a formal systematic way.

In this text we focus on the philosophy of requirements engineering using the upper-level tools of the context diagram, FFBD, and RBS. This section provides a brief introduction to the RBS and FFBD, which are used in the remaining chapters to illustrate the processes, activities and steps necessary to implement the methodology presented.

9. WEEK 4 CONTENTS

Before any work can commence on developing the system, the basic BNR must be articulated clearly and completely by business management. It would appear obvious that an understanding of what is to be achieved must be clearly articulated by the business before any further work is undertaken.

Yet, a surprising number of system developments commence without a clear and complete understanding of the fundamental business needs and requirements. Not surprisingly most of these developments founder or, at the very least, are introduced into service with poor levels of user acceptance.

Identify Major Stakeholders and Constraints

Business management begin the definition of BNR with the identification of the major stakeholders who are to be engaged to elicit business needs and requirements and to verify design artefacts as the design progresses. They also must identify the business, project, external, and design constraints that provide important context within which to consider the system requirements, as well as being the source of many requirements.

Identify Major Stakeholders

A stakeholder is commonly defined as someone who has a stake in the project—that is, someone who is affected by the system in some way, or can affect the system in some way. However, the identification of stakeholders cannot involve simply listing those who have, or perceive themselves to have, a stake in the project—in most systems this is not a useful definition since it is often difficult to find someone who is not affected by the system in some way. Even in a simple system such as an automatic teller machine (ATM) network for a bank, there may be millions of stakeholders by such a definition. This is also true in committee-based organizations such as public service organizations, where the number of potential stakeholders is almost limitless.

Identify External Constraints

External constraints on system development arise from the requirement for conformance to national and international laws and regulations, compliance with industry-wide standards, as well as ethical and legal considerations.

Other external constraints include the requirement for interoperability and the capabilities required for interfacing with other systems. Additionally, the capability of competitors, as well as the availability of human resources, specific skill sets, technologies and tools might provide external constraints. Again, an important aspect of top-down design is to understand these constraints while considering needs and requirements.

Identify Design Constraints

Design constraints include those factors that directly affect the way in which the system design can be conducted. Typical constraints include the state-of-the-art of relevant technologies as well as extant methodologies and tools to assist in the design, development, construction and production of the system. Such issues must be addressed by business management who will address the risk associated with embracing new technologies, the impact of upgrading construction facilities, workforce re-skilling issues, and so on.

10. WEEK 5 CONTENTS

DETAILED DESIGN OF HARDWARE

It is not possible to cover all of the categories of hardware associated with complex system developments. It may be useful to consider what the term may mean to engineers from different engineering disciplines as follows:

- Electrical/electronic engineer. Hardware may be an electrical or electronic system of some description that relies on a combination of electronic components arranged in such a way as to manage, condition, or distribute electrical power or signals.
- Civil engineer. Hardware may be the foundations and structural components of a bridge or other piece of physical infrastructure.
- Mechanical engineer. Hardware may be a physical system such as an engine, chassis, or drive train.
- Aeronautical engineer. Hardware may be the structures and components associated with the wings and fuselage of an aircraft.
- Software engineer. Hardware may be considered to be anything that is not software including computer processors, network infrastructure, and human-machine interfaces.

DETAILED DESIGN OF SOFTWARE

In parallel with the effort associated with determining, proving and documenting the hardware, software engineers will be completing their own detailed design process for the software elements of the design. Software development process standards exist to guide software developers in their quest to design successful software. Software development methodologies are an area of rapid change, significant research and publication, and heated debate. There appears to be supporters and detractors associated with just about every software development methodology or strategy. Software development, like systems engineering, does not have a ‘one size fits all’ solution. The characteristics of the system within which the software is to be developed should help software engineers to choose the most appropriate methodology for the situation.

INTEGRATING SYSTEM ELEMENTS

Detailed Design has now reached a stage where all system elements (hardware and software) have been designed completely, as have the interfaces between the elements and between the elements and external systems. In the case of both software and hardware, the design teams have proven their design by releasing elements of the design and testing their design against the requirements. This process may have resulted in a series of redesigns and tests, but the result is a series of designs that have been completed. In many cases, subsystem and system-level design will need to be confirmed by a series of integration and test stages. Low-level items of the design (although individually tested and confirmed) may need to be integrated together to form the next higher level of assembly in the system hierarchy and tested against the relevant requirements documents.

11. WEEK 6 CONTENTS

At the end of Detailed Design and Development, the PBL has been established and the production process is in place and has been proven (most likely with the trial production of selected system elements). The system can now move into Construction and/or Production. Some system development projects are aimed at producing only one copy of the system. There are many examples of one-off system developments including high-rise buildings and large ships such as cruise liners. In these projects, the construction process may blend with the detailed design and integration process.

For example, when building a single ship, a prototype may be developed to support detailed design, development and integration. This prototype may pass through stages of test and evaluation during which the design is refined. Ultimately, however, the design and development will be finished by which time the 'prototype' may have matured into the final system that is offered to the customer for acceptance.

With other system developments, many copies of the system may be produced once one or two prototypes have been proven. An aircraft system is an example of a system where many copies (aircraft) are likely to be produced after an initial aircraft (or even a small batch of aircraft) has been produced as prototypes to support design verification and user validation before the production is allowed to proceed.

Production Requirements

Production requirements need to be considered early in the Acquisition Phase to ensure that production risks are identified and addressed as early as possible. This is particularly true when there are one or more of the system elements that make use of novel technologies (with which existing production processes may be unfamiliar). As with all other technical requirements, the earlier that production issues are identified in the acquisition, the easier they can be addressed. To that end, although Construction and/or Production is being considered following detailed design, production engineers should be working with the rest of the design team from the earliest possible stages of the system development to ensure that production and construction issues are appropriately addressed. In short, the systems engineering effort must make sure that the design that flows out of the preceding stages is able to be produced.

Typical construction and production issues that need to be addressed and monitored throughout the entire systems engineering process include:

- material availability (lead times), ordering, and handling;
- availability of skill sets (including any training);
- availability of production tools and equipment;
- fabrication requirements including production requirements, assembly drawings and instructions;
- processing and process control;
- assembly, inspection and test; and
- packaging, storage, and handling.

12. WEEK 7 CONTENTS

Once the system has passed the necessary testing and audits, it is ready to enter operational service or use—the Utilization Phase. The major activities during the Utilization Phase include operational use, system support and modifications. The influence of systems engineering over these activities is relatively minor and is normally confined to modifications, which should be made to the system in accordance with sound configuration management procedures.

Configuration management continues to play a role during the Utilization Phase to ensure that the configuration of the system is managed and updated, even if modifications occur. Differences between system documentation and the physical system tend to result when systems are operated and maintained in an environment void of configuration management practices. These differences make maintenance and operation difficult and potentially dangerous. Accurate documentation supports the need to understand the design and capability of the system especially if there are slight differences in configuration across a fleet of systems (for example, an aircraft fleet). Modifications made in accordance with configuration management practices enhance supportability and operations, but unmanaged modifications adversely impact training, support, safety and operations in the long run.

Retirement Phase

The Retirement Phase is the final stage in the system life cycle. Functions associated with phase-out and disposal include transportation and handling, decomposition, and processing of the retiring system. A Retirement Concept should be developed as one of the LCD during the early stages of the Acquisition

Phase of a system. If considered early, disposal and phase-out issues will form some of the criteria against which the system is designed (‘design for disposability’). It is important, however, that system designers focus on retirement, rather than the more limiting issues of disposal—planning for disposal is important, but a system may retire from a number of life cycles before it is ultimately disposed of.

There can be any number of reasons why the system may require retirement.

- The system may have reached the end of its life and no longer be usable and/or supportable.
- The system may still largely be useful, but one or more critical components may be unusable or unsupportable.
- The system may still be perfectly useful, but it (or a significant subsystem of it) is being retired because:
    - the business need for the system may have disappeared (for example, the owner’s business direction may change, or the owner may be retiring and winding up the business); or
    - the business need is still valid but the business owner is forced to retire the system (due to issues such as cash flow, the operating license is revoked, scandal, public pressure, or disputes between business partners).
- The system (or one of its critical components) may be damaged beyond economical repair (by accident, natural disaster, act of war, or vandalism).

13. WEEK 8 CONTENTS

Systems engineering management is responsible for planning and directing the systems engineering effort, monitoring and reporting on that effort to the appropriate areas, and reviewing and auditing the effort at critical stages in the system life cycle. In this chapter we consider the major systems engineering management elements of technical review and audit management, test and evaluation, technical risk management, configuration management, the use of specifications and standards, and systems engineering management planning.

Technical Risk management

Risk is defined as the possibility of a loss or injury, or the possibility of some disadvantage or destruction. Systems engineering management is concerned with the management of technical risk—that is, the risk associated with the technical aspects of the system life cycle. Broadly speaking, there are two major categories of risk; internal risk and external risk. Internal risks are those that are within the control of the customer's organisation; external risks are beyond the control of the project office. An example of an internal technical risk may be the risks associated with inappropriately staffing the project office with qualified technical staff. This risk can normally be managed from within the project office. An external risk may be the introduction of some new legislation that places more stringent requirements on the system, leading to some changes to the user requirements.

Configuration Management

The term configuration can be defined as the relative disposition or arrangement of parts of something. In the context of systems engineering, the 'something' is a system element, which is normally a configuration item (CI) that forms a part of the overall system and the ‘relative disposition or arrangement of parts’ is called a baseline. To that end, configuration management (CM) is the act of controlling and managing the physical and functional make-up (defined in the baselines) of the configuration items that comprise the system.

The main aims of CM are to identify the functional and physical characteristics of selected system components, designated as configuration items, during the Acquisition Phase; to control changes to those characteristics; and to record and report on the change processing and implementation status.

Verification and Validation

The entire systems engineering process aims to produce a system that is both verified against the documentation produced during the systems engineering process, and validated against the original needs, goals and objectives that initiated the system development in the first case. Often these two associated aims are combined into the term verification and validation (V&V). V&V ensures not only that we have ‘built the system right’ (verify) but we have also ‘built the right system’ (validate). A well-managed approach to test and evaluation aims to support the delivery of a system that is both verified and validated. Other systems engineering management functions including technical reviews and configuration audits also support the overall V&V objective.

14. WEEK 9 CONTENTS

Systems engineering is a broad subject and to cover the entire systems engineering effort, a Systems Engineering Management Plan (SEMP), is formulated to detail the required effort. The contract SEMP is normally constructed by the customer in accordance with the requirements in the contractual documentation and reviewed and approved by the customer.

Once approved, the SEMP becomes the governing plan controlling the entire systems engineering effort and all technical aspects of the project. Changes to the SEMP must be reviewed and approved as they occur and theSEMP is normally reviewed at each of the formal design reviews. The SEMP should cover all of the major systems engineering functions. It may do so by referring to other subordinate plans such as the Configuration Management Plan (CMP), the RMP, the TRAP, and the TEMP, specification lists/trees, and CI lists. Internal company design plans and processes should also be referenced by the SEMP if applicable. In this way, the SEMP completely defines the engineering management and processes to be applied to the project.

In addition to engineering management and processes, the SEMP should also detail positions of particular responsibility within the design team, including chief designers, software and hardware team leaders, project managers, and testing personnel. Part of the SEMP approval process should include an assessment of the skills and qualifications of these key personnel. Naturally, if this information is found in other management plans, the SEMP needs to refer to that plan. The content of the SEMP should be maintained throughout the system design and development effort. Changes to the SEMP must be approved by the customer organization as this ensures visibility into changes that may expose the project to unexpected risks (such as a change in key personnel).

Due to its coverage of the entire systems engineering effort for the project, the SEMP is a fundamental source of information when evaluating the ability and capacity of a contractor to perform the technical activities associated with the system development (as well as providing a good indication of their understanding of the system and what is needed to bring it into being). It is common, therefore, for customers to request for a draft SEMP to be submitted as part of the solicitation process for a project.

15. COURSE GRADE DETAILS

Week 1

1.
Question 1
What does a logical description of a system articulate? (Choose the most CORRECT statement).
1 / 1 point

- A logical description identifies what the system will do.
- A logical description identifies any special materials or processes required to construct and/or build the system.
- A logical description identifies how the system components will be manufactured.
- A logical description identifies what the system components are.

A logical description identifies the project's budget, schedule and quality requirements.
Correct
Yes that is correct. A system can be described in two broad ways - in logical (functional) terms and in physical terms. A logical description articulates what the system will do, how well it will do it, under what conditions it will perform and what other systems will be involved with its operation.

2.
Question 2
Systems engineering is most applicable to which ONE of the following types of systems?
0 / 1 point

- Human-made, conceptual systems
- Largely unprecedented system
- Open systems
- Human-made, largely unprecedented systems

Natural, open systems
Incorrect
Sorry, that is incorrect. Systems engineering applies to human-made/modified, open, physical systems that comprise largely precedented elements.

3.
Question 3
There are four phases in a generic system life cycle. Identify ONE of them.
1 / 1 point

- Acquisition

- Conceptual Design
- System Support
- Disposal

Research and Development
Correct
Yes, that is correct. The four phases in a generic system life cycle are: Pre-Acquisition Phase, Acquisition Phase, Utilisation Phase, and Retirement Phase.

4.
Question 4
Which ONE of the following lists includes ONLY Acquisition Phase activities for the Blanchard & Fabrycky life cycle?
0 / 1 point

- Conceptual Design, Preliminary Design.
- Detailed Design & Development, System Support.
- Conceptual Design, Preliminary Design, Detailed Design & Development, Construction and/or Production, Retirement.
- Conceptual Design, Preliminary Design, Detailed Design & Development, Disposal

Pre-Acquisition, Conceptual Design, Preliminary Design, Detailed Design & Development, Construction and/or Production, Retirement.
Incorrect
Sorry, that is incorrect. The Acquisition Phase of the Blanchard & Fabrycky life cycle comprises the following activities (in correct order): Conceptual Design, Preliminary Design, Detailed Design & Development, and Construction and/or Production. System retirement occurs as part of the Retirement Phase.

5.
Question 5
Which ONE of the following major reviews formalises the Conceptual Design activity of the Acquisition Phase of the system life cycle?
1 / 1 point

- System Design Review
- System Readiness Review
- Test Readiness Review
- Production Readiness Review

Functional Configuration Audit
Correct
Yes, that is correct. The System Design Review approves the Functional Baseline, which contains the System Requirement Specification (SyRS), and ends the Conceptual Design activity of the system life cycle.

6.
Question 6
The Functional Baseline is established at which ONE of the following reviews?
1 / 1 point

- Functional Configuration Audit
- Test Readiness Review
- Formal Qualification Review
- System Design Review

System Readiness Review
Correct
Yes, that is correct. The System Design Review establishes the Functional Baseline, which contains the System Requirement Specification (SyRS), and ends the Conceptual Design activity of the system life cycle.

7.
Question 7
Which ONE of the following major reviews formalises the System Requirement Specification (SyRS)?
1 / 1 point

- Test Readiness Review
- System Readiness Review
- System Design Review
- Functional Configuration Audit

Production Readiness Review
Correct
That is correct. It is the System Design Review that approves the Functional Baseline, which contains the System Requirement Specification (SyRS), and ends the Conceptual Design activity of the system life cycle.

8.
Question 8
Which ONE of the following major reviews formalises the Preliminary Design activity of the system life cycle?
1 / 1 point

- Conceptual Design Review
- Preliminary Design Review
- Formal Qualification Review
- Functional Configuration Audit

Physical Configuration Audit
Correct
Yes, that is correct.

The Preliminary Design Review establishes the Allocated Baseline, which contains the Development Specifications, and ends the Preliminary Design activity of the system life cycle.

9.
Question 9
Which ONE of the following major reviews establishes the Allocated Baseline?
1 / 1 point

- Formal Qualification Review
- Physical Configuration Audit
- Preliminary Design Review
- Conceptual Design Review

Functional Configuration Audit
Correct
Yes, that is correct. The Preliminary Design Review establishes the Allocated Baseline, which contains the Development Specifications, and ends the Preliminary Design activity of the system life cycle.

10.
Question 10
Which ONE of the following major reviews formalises the Development Specifications?
0 / 1 point

- Formal Qualification Review
- System Development Review
- Production Readiness Review
- System Readiness Review

Preliminary Design Review
Incorrect
Sorry, that is incorrect. It is the Preliminary Design Review that establishes the Allocated Baseline, which contains the Development Specifications, and ends the Preliminary Design activity of the system life cycle.

11.
Question 11
Which ONE of the following major reviews ends the Detailed Design & Development activity of the system life cycle?
1 / 1 point

- Functional Configuration Audit
- Physical Configuration Audit
- Test Readiness Review
- Critical Design Review

Formal Qualification Review
Correct
Yes, that is correct. The Critical Design Review completes the Product Baseline, which contains the Product Specifications, and ends the Detailed Design & Development activity of the system life cycle.

12.
Question 12
The Product Baseline is established at which ONE of the following major reviews?
1 / 1 point

- Test Readiness Review
- Critical Design Review
- Physical Configuration Audit
- Functional Configuration Audit

Formal Qualification Review
Correct
Yes that is correct. The Critical Design Review completes the Product Baseline, which contains the Product Specifications, and ends the Detailed Design & Development activity of the system life cycle.

13.
Question 13
Which ONE of the following reviews formalises the Product Specifications?
1 / 1 point

- Critical Design Review
- Formal Qualification Review
- Conceptual Design Review
- Product Configuration Audit

Product Design Review
Correct
Yes, that is correct. The Critical Design Review completes the Product Baseline, which contains the Product Specifications, and ends the Detailed Design & Development Design activity of the system life cycle.

14.
Question 14

Which ONE of the following major reviews ends the Acquisition Phase?
1 / 1 point

- Test Readiness Review
- Functional Configuration Audit
- Preliminary Design Review
- Formal Qualification Review

Physical Configuration Audit
Correct
Yes, that is correct. The Formal Qualification Review ends the Acquisition Phase by verifying that the delivered system complies with the System Requirement Specification (SyRS).

15.
Question 15
Identify the ONE activity conducted in the Utilisation Phase of the Blanchard & Fabrycky life cycle.
1 / 1 point

- Retirement
- Conceptual Design
- Pre-Acquisition
- Operational Use

Detailed Design & Development
Correct
Yes, that is correct. The Blanchard & Fabrycky life cycle's Utilisation Phase comprises two activities - Operational Use and System Support.

Week 2

1.
Question 1
There are many definitions of systems engineering, but all agree on the key focuses of the discipline. Which ONE of the following is a key focus of the systems engineering discipline?
1 / 1 point

- Management.
- Reduction of overall documentation produced during acquisition
- Reduction on overall project staff required.
- Bottom-up approach.

Project management.

Correct

Yes, that is correct. The many definitions of SE all agree on the following key focuses of the discipline: Requirements Engineering, Top-down Approach, Focus on Life Cycle, System Optimisation and Balance, Integration of Disciplines and Specialties, and Management.

2.

Question 2

Identify the ONLY CORRECT statement with regard to the perception that system engineering (SE) adds unnecessary complexity, cost, and time to development projects.

1 / 1 point

- SE efforts can result in an increase in early costs but can also result in significant cost savings later in construction and/or production.
- SE efforts early in acquisition cannot result in significant cost savings later in construction and/or production.
- The perception that SE adds unnecessary complexity, cost, and time to development projects is incorrect because implementing SE is actually cheap and simple.
- SE adds unnecessary complexity, cost, and time to development projects--SE is actually an overhead that cannot be justified.

SE efforts early in acquisition cannot result in significant cost savings later in operational use and system support.

Correct

Yes, that is correct. Early SE efforts can result in significant cost savings later in construction and/or production, operational use and system support, system retirement (disposal). Any increases in cost due to systems engineering are generally felt in the very early design phases (particularly Conceptual Design), but this additional early effort results in significant cost savings in later phases. Appropriate SE can therefore ensure that the savings achieved far outweigh the cost of implementing appropriate procedures and methodologies.

3.

Question 3

Consider the classic analysis, synthesis and evaluation (A-S-E) process that is applied throughout the system life cycle. Which ONE of the following statements is CORRECT?

1 / 1 point

- Initially the A-S-E process is applied at the sub-system level.
- During the latter stages of the A-S-E process the customer is heavily involved.
- The A-S-E loop is applied once during early Conceptual Design, it does not require iteration during latter activities of the system life cycle
- During the earlier stages of A-S-E, BOTH the customer AND the contractor are heavily involved.

During the latter stages of the A-S-E process the contractor is mainly responsible for the continuing effort which is monitored by the customer.

Correct

Yes that is correct. The classic analysis-synthesis-evaluation process is initially applied at the systems level, and then at lower levels. During the earlier stages of the analysis-synthesis-evaluation process the customer is heavily involved. During the latter stages the contractor is mainly responsible for the continuing effort which is monitored by the customer.

4.
Question 4
Which ONE of the following is a potential benefit of applying systems engineering discipline during the development of a system?
1 / 1 point

- Reduces overall schedule by helping to reduce costly changes later in the lifecycle.
- Reduces overall documentation requirements.
- Reduces the overall requirement for personnel resources.
- Ensures that the system can be developed as quickly as possible.

Reduces overall need for reviews and audits.
Correct
Yes that is correct. There are a number of potential benefits from the successful implementation of systems engineering processes and methodologies including:

- the scope for saving money during all phases of the system life cycle cost;
- reducing the overall schedule;
- reducing technical risk
- producing a quality system due to the accurate reflection of requirements.

5.
Question 5
Which ONE of the following statements is CORRECT with regard to the relevance of systems engineering?
1 / 1 point

- Systems engineering is only relevant to defence and aerospace projects (because of their complexity).
- Systems engineering is most relevant to the contractor.
- Systems engineering can be applied to all systems if care is taken to tailor processes appropriately.
- Application of systems engineering will always increase project cost.

Systems engineering is only relevant to large projects because the cost of implementation can only be absorbed in large budgets.
Correct
That is correct--providing care is taken to tailor the activities to be cognizant of project size, complexity and schedule. Thoughtless application of systems engineering can increase project cost, complexity, and schedule without any reduction in risk.

6.
Question 6
Which ONE of the following statements is CORRECT with regard to the effect of the application of systems engineering on the cost of the system?
1 / 1 point

- Systems engineering reduces the cost of the Acquisition Phase.
- The focus of systems engineering on the entire system life cycle produces savings over the entire life cycle.
- Systems engineering provides cost savings for the customer but those savings are due to increased costs for the customer.
- The additional effort to undertake systems engineering activities means that the system will always cost more over its life cycle.

Systems engineering reduces the cost of each phase and activity in the system life cycle.
Correct
That is correct. Although systems engineering adds complexity, cost and time to the Acquisition Phase, the early additional effort is an investment that will be returned throughout the system life cycle.

7.
Question 7
Identify the ONLY CORRECT statement regarding to requirements traceability?
1 / 1 point

- Requirements traceability is used by the contractor to be able to keep track of the customer requirements and to ultimately show that they have been met. It does not apply to the requirements that are generated by the contractor's designers.
- Backward traceability is required so that design decisions can be traced from any given system-level requirement down to a detailed design decision.
- Forward traceability is used to completely define and justify all lower-level requirements.
- Requirements traceability is established in conceptual design but is not required once the system development commences.

Forward traceability is required so that design decisions can be traced from any given system-level requirement down to a detailed design decision.
Correct
That is correct. Forward traceability assists in ensuring that all requirements have been met somewhere in the design.

8.
Question 8
Which ONE of the following statements is CORRECT with regard to system optimisation and balance?

1 / 1 point

- To achieve optimal subsystem performance, the system performance may need to be suboptimal.
- The system performance is of vital importance, not the individual performance of subsystems.
- Optimal performance is obtained by optimising each of the individual subsystems.
- Systems engineering focuses on optimising component and subsystem performance so that the resulting system performance is optimal.

The subsystem performance is of vital importance, not the performance of the system.
Correct
That is correct. To achieve optimal system performance, the performance of subsystems may need to be suboptimal.

9.
Question 9
Consider the classic analysis, synthesis and evaluation (A-S-E) process that is applied throughout the system life cycle. Which ONE of the following statements is CORRECT?
1 / 1 point

- Initially the process is applied at the component level.
- During the latter stages of the A-S-E process the customer is heavily involved.
- During the latter stages the Customer is mainly responsible for the continuing effort which is monitored by the Contractor.
- Initially the process is applied at the systems level, and then at lower levels.

Initially the A-S-E process is applied at the sub-system level.
Correct
Yes that is correct. The classic analysis-synthesis-evaluation process is initially applied at the systems level, and then at lower levels. During the earlier stages of the analysis-synthesis-evaluation process the customer is heavily involved. During the latter stages the contractor is mainly responsible for the continuing effort which is monitored by the customer.

10.
Question 10
Identify the ONLY CORRECT statement regarding the application of good requirements engineering practices?
0 / 1 point

- The additional time taken to formalise requirements is not warranted when the system is well known.
- The major effort in requirements engineering is toward the end of the Acquisition Phase to ensure that the system meets its requirements.

- System failures, cost overruns, and schedule problems are often the direct result of poor requirements-engineering practices.
- A strong focus on requirements engineering is not necessary because good designers will be able to correct for any deficiencies or gaps in requirements.

Early on, requirements only need to be stated for the Acquisition Phase--how the system is going to be used can be described later in the project.
Incorrect
That is not correct. An early focus on getting the requirements right can reduce the potential for costly and time-consuming changes later--the major effort in requirements engineering is therefore at the start of the Acquisition Phase.

Week 3

1.
Question 1
In terms of briefly describing a functional requirement, which ONE of the following statements is CORRECT?
1 / 1 point

- ... a capability stated in the language of the stakeholder.
- ... some restriction on the way in which the system should be developed.
- ... a service.
- ... some restriction on the operation of the system.

... some attribute the system should possess.
Correct
Yes, that is correct. Functional requirements are statements of the services and functions that the system should provide, the things it should do, or some action it should take.

2.
Question 2
Which ONE of the following statements is CORRECT with regard to requirements (as opposed to needs)? Requirements are:
1 / 1 point

- ... contained in the various life-cycle concepts.
- ... formal statements that are structured and can be validated.
- ... contained in the OpsCon.
- ... statements made at only a high-level of design.

... contained in the ConOps.
Correct

Yes, that is correct. Requirements are formal statements that are structured and can be validated—there may be more than one requirement that can be defined for any need. Requirements are generated from needs through a process of requirements analysis.

3.
Question 3
Which ONE of the following statements if CORRECT with regard to the emergent properties of a system?
1 / 1 point

- Emergent properties are best obtained through a bottom-up definition of the system.
- Emergent properties are always desirable.
- Emergent properties are described in the subsystem specifications.
- Emergent properties are those that are possessed by the system as a whole.

Emergent properties are verified at the system element level and then again when the system is integrated.
Correct
That is correct. Emergent properties are those that are possessed by the system as a whole, only emerging as the individual system elements have been integrated.

4.
Question 4
Which ONE of the following statements is CORRECT in relation to verification requirements?
1 / 1 point

- Verification Requirements identify the functions that are necessary to operate the system.
- Verification requirements identify maintenance functions that are necessary to maintain the system or return it to operational use.
- Verification requirements identify how the system will be tested
- Verification requirements determine how well a system is to perform functional requirements.

Verification requirements describe the services and functions that the system must provide.
Correct
Yes, that is correct. Verification requirements identify how the system will be tested. The definition of functional requirements and performance requirements is not complete until verification requirements are also included. Verification requirements articulate how each functional and performance requirement is to be verified.

5.
Question 5
Which ONE of the following is an appropriate piece of information that may be associated with a requirement as an attribute?

1 / 1 point

- correctness
- some description of how it will be achieved
- implementation dependence
- a unique identifier

consistency
Correct
Yes, that is correct. To support analysis and management, requirements should be recorded with associated attributes including: a unique identifier, short title, priority, risk, source, rationale, history, relationship to other requirements, and type.

6.
Question 6
Which ONE of the following documents contains the system requirements?
1 / 1 point

- BRS
- LCD
- ConOps
- SyRS

StRS
Correct
Yes, that is correct. The system requirements are contained in the System Requirements Specification (StRS).

7.
Question 7
Which ONE of the following documents contains the stakeholder needs?
1 / 1 point

- LCD
- ConOps
- BRS
- SyRS

StRS
Correct
Yes, that is correct. The stakeholder needs are contained in the life-cycle concepts that are captured in the life-cycle concept documents (LCD).

8.
Question 8

Which of the following statements is the ONLY CORRECT statement for the Stakeholder Needs and Requirements Definition Process?
0 / 1 point

- ... develops the enterprise strategies which guide the system's development.
- ... transforms needs into the SyRS.
- ... is the principal responsibility of system designers.
- ... prepares the ConOps.

... is the principal responsibility of business operations.
Incorrect
Sorry, that is not correct. The Stakeholder Needs and Requirements Definition Process transforms needs into stakeholder requirements, which are documented in the Stakeholder Requirements Specification (StRS). Enterprise strategies are prepared by enterprise management.

9.
Question 9
Which ONE of the following is a characteristic of a good individual requirement?
1 / 1 point

- is necessary
- is critical
- is agreed by all stakeholders
- is balanced

contains within it some description of how it will be achieved
Correct
Yes, that is correct. The characteristics of a good requirement are: necessary, singular, correct, unambiguous, feasible, appropriate to level, complete, conforming, and verifiable.

10.
Question 10
Which ONE of the following documents contains the stakeholder requirements?
1 / 1 point

- SyRs
- BRS
- PLCD
- ConOps

StRS
Correct
Yes, that is correct. The stakeholder requirements are contained in the Stakeholder Requirements Specification (StRS).

11.
Question 11
Which of the following statements is the ONLY CORRECT statement for the ConOps? The ConOps:
1 / 1 point

- ... describes what the system will do, how well, and why.
- .... is used to communicate overall quantitative and qualitative system characteristics to the acquirer, user, supplier and other organizational elements.
- ... is at the system level.
- ... describes system characteristics of the to-be-delivered system from the user's viewpoint.

... serves as a basis for the organization to direct the overall characteristics of the future business and systems.
Correct
Yes, that is correct. The ConOps is developed at the organisational level to address the leadership's intended way of operating the organisation.

12.
Question 12
Which of the following statements is the ONLY CORRECT statement for the OpsCon? The OpsCon:
1 / 1 point

- ... describes what the system will do, how well, and why.
- ... is the basis for the derivation of preliminary life-cycle concepts.
- ... is at the organization level.
- .... addresses the leadership's intended way of operating the organization.

... may refer to the use of the system to forward the organization's goals and objectives
Correct
Yes, that is correct. The OpsCon is developed at the business management and operational levels to describe what the system will do, how well, and why.

13.
Question 13
Which ONE of the following documents contains the business requirements?
1 / 1 point

- ConOps
- StRS
- OpsCon
- SyRS

BRS

Correct
Yes, that is correct. The business requirements are contained in the Business Requirements Specification (BRS).

14.
Question 14
Which ONE of the following documents contains the business needs?
1 / 1 point

- SyRS
- BRS
- Preliminary life-cycle concept documents (PLCD)
- ConOps

LCD
Correct
Yes, that is correct. Business needs are contained in the preliminary life-cycle concepts that are captured in the preliminary life-cycle concept documents (PLCD).

15.
Question 15
Which of the following statements is the ONLY CORRECT statement for the Business Needs and Requirements Definition Process?
1 / 1 point

- ... refines the life-cycle concepts.
- ... transforms needs into the SyRS.
- ... is the principal responsibility of enterprise management.
- ... prepares the preliminary life-cycle concepts.

... is the principal responsibility of system designers.
Correct
Yes, that is correct. The Business Needs and Requirements Definition Process prepares the preliminary life-cycle concepts (including the preliminary OpsCon) and documents them in the PLCD, which is the principal responsibility of business management.

Week 4

1.
Question 1
In terms of briefly describing derived requirements, which ONE of the following statements is CORRECT?
1 / 1 point

- ... are implied by a higher-level requirement.

- … can be directly broken out from the higher-level requirement.
- ... can be gathered by structured workshop.
- ... can be attributed directly to the source.

... are explicitly required by a higher-level requirement.
Correct
Yes, that is correct. Derived requirements are implied by a higher-level requirement. Derivation entails designers drawing some inference from the higher-level requirements to obtain lower-level statements.

2.
Question 2
In terms of briefly describing elicited requirements, which ONE of the following statements is CORRECT?
1 / 1 point

- ... are implied by a higher-level requirement.
- ... can be gathered by structured workshop.
- … can be directly broken out from the higher-level requirement.
- ... are explicitly required by a higher-level requirement.

... are developed by the system designer / requirements engineer based on their inferences from the higher-level requirement.
Correct
Yes, that is correct.

Elicited requirements can be traced directly to the source and are gathered by structured workshop or interview.

3.
Question 3
In terms of briefly describing backward traceability of requirements, which ONE of the following statements is CORRECT?
0 / 1 point

- ... ensures that only endorsed requirements are included.
- ... assists designers in decomposing and deriving requirements.
- ... gives confidence that each requirement has been addressed in the design.
- ... helps trace design decisions from any given parent requirement down to a child requirement.

... assists in showing stakeholders how their needs have been met.
Incorrect
Sorry, that is not correct. Showing stakeholders how their needs have been met is aided by forward traceability. Backward traceability assists in scope management by ensuring that

additional requirements (not formally endorsed by the customer) have not crept (through requirements creep) into the design.

4.
Question 4
Which ONE of the following statements is CORRECT in relation to traceability of requirements?
1 / 1 point

- Forward traceability ensures that all requirements at one level are traceable back to at least one requirement at the higher level.
- Backward traceability provides confidence that all requirements at one level of design have been addressed in the next level of design.
- Forward traceability ensures that requirements creep does not occur.
- Each requirement must be traceable to at least one requirement at a higher level in the design.

Requirements creep (the inclusion of unendorsed requirements) does not have any impact on design space.
Correct
Yes, that is correct. Each requirement must be traceable to at least one requirement at a higher level in the design. Forward traceability provides confidence that all requirements at one level of design have been addressed in the next level of design. Backward traceability ensures that all requirements at one level of design are traceable back to at least one requirement at the higher level.

5.
Question 5
In terms of briefly describing forward traceability of requirements, which ONE of the following statements is CORRECT?
1 / 1 point

- ... ensures that only endorsed requirements are included.
- ... assists designers in decomposing and deriving requirements.
- ... assists with providing justification as to why a requirement exists.
- ... gives confidence that each requirement has been addressed in the design.

... helps avoid requirements creep.
Correct
Yes that is correct.
Forwards traceability gives us confidence that each requirement has been addressed in the design. Through forward traceability, design decisions can be traced from any given system-level requirement (a parent requirement) down to a detailed design decision (a child requirement).

6.

Question 6
Which ONE of the following lists/statements describes valid methods for identifying (eliciting) requirements?
1 / 1 point

- engagement with a single key person such as the key relevant line manager to provide requirements in the most efficient manner
- avoiding showing stakeholders any physical examples of the system so that they can stay thinking in functional terms
- using specification documentation from a previous system and tailoring it for this development
- structured workshops, brainstorming and problem-solving sessions

meeting with a small single group (such as a group of key operators of the system)
Correct
Yes, that is correct. Methods for identifying (eliciting) requirements include: structured workshops, brainstorming and problem-solving sessions; interviews, surveys, and questionnaires; observations of the workplace, market analysis and documentation review; prototypes, simulations and use cases; and competitive system assessment and trials.

7.
Question 7
Which ONE of the following statements best represents a major problem faced by requirements engineers when eliciting requirements?
0 / 1 point

- Stakeholders want to take charge of the requirements engineering process to make sure that it suits their business purposes.
- Stakeholders do not want to proceed unless they can trace the functional requirements back to their business requirements.
- Stakeholders have a very clear idea of how they wish to employ the system and may even have an exemplar system in mind.
- Application domain information is not collected in one place and may involve specialist terminology.

Stakeholders are too interested in the system development and continually wish to be involved.
Incorrect
Sorry, that is not correct. Stakeholders are encouraged to trace the functional requirements back to their business requirements--the opposite is normally a problem when stakeholders arbitrarily state requirements at very low levels without being able to justify them in the context of business requirements.

8.
Question 8

Identify which ONE of the following statements is CORRECT with regard to the Functional Flow Block Diagram (FFBD).
1 / 1 point

- Functions in the FFBD can be conducted sequentially or in parallel.
- FFBDs are used to describe the Product Baseline.
- The FFBD is grouped by configuration item.
- The FFBD is grouped by physical project elements.

The FFBD contains other project-related information, apart from requirements.
Correct
Yes, that is correct. The FFBD is useful to show the interrelationship of the functions to be performed by a system--functions can be conducted sequentially or in parallel, and sometimes alternate paths can be taken. Like the RBS, FFBDs are illustrated hierarchically.

9.
Question 9
Identify which ONE of the following statements is CORRECT with regard to the Requirements Breakdown Structure (RBS)?

1 / 1 point

- The RBS is grouped by physical project elements.
- The RBS summarises the Product Baseline.
- The RBS allows multiple people to work on the analysis simultaneously through allocation of responsibility for sections of requirements.
- The RBS is grouped by configuration item.

The RBS contains other project-related information, apart from requirements.
Correct
Yes, that is correct. The tree structure of the functional hierarchy of the RBS allows multiple people to work on the analysis simultaneously.

10.
Question 10
In terms of briefly describing decomposed requirements, which ONE of the following statements is CORRECT?
1 / 1 point

- ... are developed by the system designer / requirements engineer.
- ... are implied by a higher-level requirement.
- ... can be gathered by structured workshop.
- ... can be attributed directly to the source.

... are explicitly required by a higher-level requirement.

Correct
Yes, that is correct. Decomposed requirements are explicitly required by a higher-level requirement. Decomposition entails breaking a higher-level requirement into those lower-level requirements that are explicitly required by it.

Mid-Course Exam

1.
Question 1
What does a logical description of a system articulate? (Choose the most CORRECT statement).
1 / 1 point

- A logical description identifies how the system components will be manufactured.
- A logical description identifies any special materials or processes required to construct and/or build the system.
- A logical description identifies how the system components will be integrated.
- A logical description identifies what the system will do.

A logical description identifies what the system components are.
Correct
Yes that is correct. A system can be described in two broad ways - in logical (functional) terms and in physical terms. A logical description articulates what the system will do, how well it will do it, under what conditions it will perform and what other systems will be involved with its operation.

2.
Question 2
Identify the ONE activity conducted in the Utilisation Phase of the Blanchard & Fabrycky life cycle.
1 / 1 point

- Detailed Design & Development
- Conceptual Design
- Operational Use
- Retirement

Pre-Acquisition
Correct
Yes, that is correct. The Blanchard & Fabrycky life cycle's Utilisation Phase comprises two activities - Operational Use and System Support.

3.
Question 3
Which ONE of the following is a potential benefit of applying systems engineering discipline during the development of a system?

1 / 1 point

- Reduces overall need for reviews and audits.
- Reduces overall documentation requirements.
- The disciplined approach to requirements engineering leads to a product that meets the original intended purpose more completely.
- Ensures that the system can be developed as quickly as possible.

Reduces the overall requirement for personnel resources.
Correct
Yes that is correct. There are a number of potential benefits from the successful implementation of systems engineering processes and methodologies including:
- the scope for saving money during all phases of the system life cycle cost;
- reducing the overall schedule;
- reducing technical risk
- producing a quality system due to the accurate reflection of requirements.

4.
Question 4
Which of the following statements is the ONLY CORRECT statement for the Business Needs and Requirements Definition Process?
0 / 1 point

- ... is the principal responsibility of business operations.
- ... prepares the ConOps.
- ... transforms needs into the StRS.
- ... prepares the preliminary life-cycle concepts.

... develops the enterprise strategies which guide the system's development.
Incorrect
Sorry, that is not correct. The Business Needs and Requirements Definition Process is the principal responsibility of business management. Business operations are responsible for the Stakeholder Needs and Requirements Definition Process.

5.
Question 5
Which ONE of the following lists/statements describes valid methods for identifying (eliciting) requirements?
1 / 1 point

- avoiding showing stakeholders any physical examples of the system so that they can stay thinking in functional terms
- using specification documentation from a previous system and tailoring it for this development
- competitive system assessment and trials

- making use of only one type of communication with stakeholders to ensure that all information is provided in a common format

engagement with a single key person such as the key relevant line manager to provide requirements in the most efficient manner
Correct
Yes, that is correct. Methods for identifying (eliciting) requirements include: structured workshops, brainstorming and problem-solving sessions; interviews, surveys, and questionnaires; observations of the workplace, market analysis and documentation review; prototypes, simulations and use cases; and competitive system assessment and trials.

6.
Question 6
Which ONE of the following major reviews ends the Acquisition Phase?
1 / 1 point

- Test Readiness Review
- Formal Qualification Review
- Preliminary Design Review
- Physical Configuration Audit

Functional Configuration Audit
Correct
Yes, that is correct. The Formal Qualification Review ends the Acquisition Phase by verifying that the delivered system complies with the System Requirement Specification (SyRS).

7.
Question 7
In terms of briefly describing decomposed requirements, which ONE of the following statements is CORRECT?
1 / 1 point

- ... are developed by the system designer / requirements engineer.
- ... are obtained by breaking a higher-level requirement into those lower-level requirements that are explicitly required by it.
- ... can be gathered by structured workshop.
- ... are implied by a higher-level requirement.

... are directly stated by the system designer / requirements engineer.
Correct
Yes, that is correct. Decomposed requirements are explicitly required by a higher-level requirement. Decomposition entails breaking a higher-level requirement into those lower-level requirements that are explicitly required by it.

8.

Question 8
Identify the ONLY CORRECT statement regarding the application of good requirements engineering practices?
1 / 1 point

- The additional time taken to formalise requirements is not warranted when the system is well known.
- Getting the requirements right early can reduce the potential for costly and time-consuming changes later.
- The additional cost of undertaking requirements engineering activities early in Conceptual Design cannot be justified.
- Early on, requirements only need to be stated for the Acquisition Phase--how the system is going to be used can be described later in the project.

A strong focus on requirements engineering is not necessary because good designers will be able to correct for any deficiencies or gaps in requirements.
Correct
That is correct. System failures, cost overruns, and schedule problems are often the direct result of poor requirements-engineering practices.

9.
Question 9
Which ONE of the following statements is CORRECT with regard to requirements (as opposed to needs)? Requirements are:

1 / 1 point

- ... statements made at only a high-level of design.
- ... generated through mission (or business) analysis or through requirements analysis.
- ... statements made at only a low level of design.
- ... contained in the OpsCon.

... contained in the ConOps.
Correct
Yes, that is correct. Requirements are formal statements that are structured and can be validated—there may be more than one requirement that can be defined for any need. Requirements are generated from needs through a process of requirements analysis.

10.
Question 10
Which ONE of the following statements if CORRECT with regard to the emergent properties of a system?

1 / 1 point

- Emergent properties are always desirable.

- Emergent properties are best obtained through a bottom-up definition of the system.
- Emergent properties are described in the subsystem specifications.
- Emergent properties depend for their existence on the interaction of the system elements.

Emergent properties are verified at the system element level and then again when the system is integrated.
Correct
That is correct. Emergent properties are those that are possessed by the system as a whole, only emerging as the individual system elements have been integrated.

11.
Question 11
Consider the classic analysis, synthesis and evaluation (A-S-E) process that is applied throughout the system life cycle. Which ONE of the following statements is CORRECT?

1 / 1 point

- During the earlier stages of A-S-E the customer is heavily involved.
- Initially the process is applied at the component level.
- During the latter stages of the A-S-E process the customer is heavily involved.
- During the latter stages the Customer is mainly responsible for the continuing effort which is monitored by the Contractor.

During the earlier stages of A-S-E BOTH the customer AND the contractor are heavily involved.
Correct
Yes that is correct. The classic analysis-synthesis-evaluation process is initially applied at the systems level, and then at lower levels. During the earlier stages of the analysis-synthesis-evaluation process the customer is heavily involved. During the latter stages the contractor is mainly responsible for the continuing effort which is monitored by the customer.

12.
Question 12
Which of the following statements is the ONLY CORRECT statement for the OpsCon? The OpsCon:
1 / 1 point

- ... is developed by the organization leadership at the enterprise level.
- .... addresses the leadership's intended way of operating the organization.
- ... is frequently embodied in long-range strategic plans and annual operational plans.
- ... serves as a basis for the organization to direct the overall characteristics of the future business and systems.

... describes what the system will do, how well, and why.
Correct
Yes, that is correct. The OpsCon is developed at the business management and operational levels to describe what the system will do, how well, and why.

13.
Question 13
Which of the following statements is the ONLY CORRECT statement for the System Requirements Definition Process?
1 / 1 point

- ... refines the life-cycle concepts.
- ... transforms stakeholder requirements into the System Requirements Specification (SyRS).
- ... develops the enterprise strategies which guide the system's development.
- ... transforms needs into the Stakeholder Requirements Specification (StRS).

... prepares the ConOps.
Correct
Yes, that is correct. The System Requirements Definition Process transforms the stakeholder requirements in the Stakeholder Requirements Specification (StRS) into the System Requirements Specification (SyRS), which is the principal responsibility of system designers.

14.
Question 14
Which ONE of the following statements is CORRECT in relation to verification requirements?
1 / 1 point

- Verification Requirements identify the functions that are necessary to operate the system.
- Verification requirements identify maintenance functions that are necessary to maintain the system or return it to operational use.
- Verification requirements determine how well a system is to perform functional requirements.
- Verification requirements describe the services and functions that the system must provide.

Verification requirements articulate how each functional and performance requirement is to be verified.
Correct
Yes, that is correct. Verification requirements identify how the system will be tested. The definition of functional requirements and performance requirements is not complete until verification requirements are also included. Verification requirements articulate how each functional and performance requirement is to be verified.

15.
Question 15
Identify which ONE of the following statements is CORRECT with regard to the Requirements Breakdown Structure (RBS)?
1 / 1 point

- The RBS is grouped by physical project elements.
- The RBS summarises the Product Baseline.
- The RBS contains other project-related information, apart from requirements.
- The RBS is grouped by logical function.

The RBS is grouped by configuration item.
Correct
Yes, that is correct. The tree structure of the functional hierarchy of the RBS groups logical functions.

16.
Question 16
Which ONE of the following reviews formalises the Product Specifications?
1 / 1 point

- Product Configuration Audit
- Conceptual Design Review
- Formal Qualification Review
- Critical Design Review

Product Design Review
Correct
Yes, that is correct. The Critical Design Review completes the Product Baseline, which contains the Product Specifications, and ends the Detailed Design & Development Design activity of the system life cycle.

17.
Question 17
The Product Baseline is established at which ONE of the following major reviews?

1 / 1 point

- Critical Design Review
- Test Readiness Review
- Formal Qualification Review
- Physical Configuration Audit

Functional Configuration Audit
Correct

Yes that is correct. The Critical Design Review completes the Product Baseline, which contains the Product Specifications, and ends the Detailed Design & Development activity of the system life cycle.

18.
Question 18
Which ONE of the following major reviews ends the Detailed Design & Development activity of the system life cycle?
1 / 1 point

- Formal Qualification Review
- Critical Design Review
- Physical Configuration Audit
- Functional Configuration Audit

Test Readiness Review
Correct
Yes, that is correct. The Critical Design Review completes the Product Baseline, which contains the Product Specifications, and ends the Detailed Design & Development activity of the system life cycle.

19.
Question 19
Which ONE of the following major reviews formalises the Development Specifications?
1 / 1 point

- System Readiness Review
- Production Readiness Review
- Formal Qualification Review
- System Development Review

Preliminary Design Review
Correct
Yes, that is correct.
The Preliminary Design Review establishes the Allocated Baseline, which contains the Development Specifications, and ends the Preliminary Design activity of the system life cycle.

20.
Question 20
Which ONE of the following is a characteristic of a good individual requirement?
0 / 1 point

- is singular
- is balanced

- is critical
- contains within it some description of how it will be achieved

is agreed by all stakeholders
Incorrect
Sorry, that is incorrect. The characteristics of a good requirement are: necessary, singular, correct, unambiguous, feasible, appropriate to level, complete, conforming, and verifiable. Balance is a characteristic of a set of requirements, not of an individual requirement.

21.
Question 21
Which ONE of the following major reviews establishes the Allocated Baseline?
1 / 1 point

- Functional Configuration Audit
- Formal Qualification Review
- Conceptual Design Review
- Physical Configuration Audit

Preliminary Design Review
Correct
Yes, that is correct. The Preliminary Design Review establishes the Allocated Baseline, which contains the Development Specifications, and ends the Preliminary Design activity of the system life cycle.

22.
Question 22
Which ONE of the following major reviews formalises the Preliminary Design activity of the system life cycle?
1 / 1 point

- Physical Configuration Audit
- Formal Qualification Review
- Functional Configuration Audit
- Preliminary Design Review

Conceptual Design Review
Correct
Yes, that is correct.

The Preliminary Design Review establishes the Allocated Baseline, which contains the Development Specifications, and ends the Preliminary Design activity of the system life cycle.

23.
Question 23

The Functional Baseline is established at which ONE of the following reviews?
1 / 1 point

- System Readiness Review
- System Design Review
- Formal Qualification Review
- Functional Configuration Audit

Test Readiness Review
Correct
Yes, that is correct. The System Design Review establishes the Functional Baseline, which contains the System Requirement Specification (SyRS), and ends the Conceptual Design activity of the system life cycle.

24.
Question 24
Which ONE of the following major reviews formalises the System Requirement Specification (SyRS)?
1 / 1 point

- Test Readiness Review
- System Readiness Review
- Functional Configuration Audit
- System Design Review

Production Readiness Review
Correct
Yes, that is correct. It is the System Design Review that approves the Functional Baseline, which contains the System Requirement Specification (SyRS), and ends the Conceptual Design activity of the system life cycle.

25.
Question 25
Which ONE of the following major reviews formalises the Conceptual Design activity of the Acquisition Phase of the system life cycle?
1 / 1 point

- System Design Review
- Test Readiness Review
- Production Readiness Review
- System Readiness Review

Functional Configuration Audit
Correct

Yes, that is correct. The System Design Review approves the Functional Baseline, which contains the System Requirement Specification (SyRS), and ends the Conceptual Design activity of the system life cycle.

26.
Question 26
Systems engineering is most applicable to which ONE of the following types of systems?
1 / 1 point

- Human-made, conceptual systems
- Largely unprecedented systems
- Natural, open systems
- Physical, open systems

Human-made, largely unprecedented systems
Correct
Yes, that is correct. Systems engineering applies to human-made/modified, open, physical systems that comprise largely precedented elements.

27.
Question 27
Which ONE of the following lists includes ONLY Acquisition Phase activities for the Blanchard & Fabrycky life cycle?
0 / 1 point

- Conceptual Design, Preliminary Design, Detailed Design & Development, Disposal
- Pre-Acquisition, Conceptual Design, Preliminary Design, Detailed Design & Development, Construction and/or Production, Retirement.
- Preliminary Design, Detailed Design & Development, Construction and/or Production.
- Conceptual Design, Preliminary Design, Detailed Design & Development, Construction and/or Production, Retirement.

Detailed Design & Development, System Support.
Incorrect
Sorry, that is incorrect. The Acquisition Phase of the Blanchard & Fabrycky life cycle comprises the following activities (in correct order): Conceptual Design, Preliminary Design, Detailed Design & Development, and Construction and/or Production. System retirement occurs as part of the Retirement Phase.

28.
Question 28
There are four phases in a generic system life cycle. Identify ONE of them.
1 / 1 point

- System Support

- Conceptual Design
- Disposal
- Research and Development

Retirement
Correct
Yes, that is correct. The four phases in a generic system life cycle are: Pre-Acquisition Phase, Acquisition Phase, Utilisation Phase, and Retirement Phase.

29.
Question 29
In terms of briefly describing a capability system, which ONE of the following statements is CORRECT?
1 / 1 point

- A capability system delivers a capability, so can only be defined in physical terms
- A capability system comprises personnel, organisation and doctrine but not hardware and software.
- The elements of a capability system may be acquired separately.
- A capability system joins a number of resources together in a random manner in order to be able to deliver the emergent properties of a capability.

A capability system comprises capability elements, which are functional not physical.
Correct
Yes, that is correct.
A capability system comprises such resources as personnel, organisation, doctrine, materials, facilities, data, hardware and software. Although all of these elements may be acquired simultaneously, it is most likely that the customer will hire personnel and train them under separate arrangements to the contract that acquired the hardware and software. Additionally, the facilities may be acquired under another contract.

30.
Question 30
Which one of the following is a major element of a capability system?
1 / 1 point

- Data
- Review and audit
- Budget
- Test and evaluation

Configuration management
Correct
Yes that is correct.

A capability system is much more than an aggregation of hardware or software and must be described in terms of such resources as personnel, organisation, doctrine, materials, facilities, data, hardware and software.

Week 5

1.
Question 1
In terms of briefly describing a stakeholder of a system, which ONE of the following statements is CORRECT?
1 / 1 point

- ... the party responsible for producing the system.
- ... someone who must be involved in either operating or supporting the system once it has been developed.
- ... someone who determines the design and development of the system.
- ... someone who can affect or is affected by the system.

... the organisation that is paying for the system to be acquired.

Correct
Yes that is correct. A stakeholder is someone who affects or is affected by the system. A stakeholder has a right to influence system requirements.

2.
Question 2
We spoke about using a Requirements Breakdown Structure or RBS to help us record our system requirements. In regards to an RBS, which ONE of the following statements is CORRECT?
1 / 1 point

- An RBS is particularly useful when only one person is working on the requirements analysis effort.
- The contractor establishes the RBS to explore solution options.
- An RBS documents the solution proposed by tenderers during a tendering process.
- An RBS helps when multiple people are working on the requirements analysis at the same time.

An RBS is used to ensure requirements statements reflect stakeholder expectations.
Correct
Yes, that is correct. An RBS helps when multiple people are working on the requirements at the same time and helps avoid duplication of requirements or omission of requirements.

3.
Question 3

Which ONE of the following is CORRECT with regard to lifecycle concepts?
1 / 1 point

- Logistics concepts are primarily focussed on identifying spare parts, warehousing and transportation requirements.
- The contractor is responsible for establishing logistics support concepts associated with the system.
- Lifecycle concepts (including construction considerations, logistics support, and disposal) must be considered as early as possible in the systems engineering process.
- Lifecycle concepts such as logistics support are considered as the system starts to enter the operational service.

Systems engineering addresses critical issues such as system function and performance. Lifecycle issues can then be considered by other disciplines.
Correct
Yes, that is correct. By considering lifecycle concepts such as construction, maintenance, engineering support and even disposal during the earliest stages, systems engineering helps ensure that the resulting system not only meets requirements but is also easy and cost-effective to construct, support and dispose of.

4.
Question 4
Which ONE of the following is associated with recording a rationale with each requirement (or group of requirements).
1 / 1 point

- Requirement rationales are useful during conceptual design but are rarely used after that.
- The author of the requirement is best placed to record rationale at the same time that the requirement is written.
- Requirement rationales are used to document and explain the systems engineering strategy being used.
- Requirement rationales are only assigned to interface requirements.

Recording a rational for each requirement is only possible if using a requirements management tool.
Correct
Yes, that is correct. Assigning a rationale to each requirement or each group of requirements is considered good practice because it helps explain why the requirement is there, at the time it is written. It also serves as a reminder to people well after the requirement was written.

5.
Question 5
Which ONE of the following is CORRECT with regard to the validation of requirements?
1 / 1 point

- Validation is a project management responsibility.
- Validation does not need to be considered until the system enters service.
- Validation is primarily the responsibility of the developer of the solution.
- The terms verification and validation can be used interchangeably systems engineering.

Validation is primarily the responsibility of the customer of the solution.
Correct
Yes, that is correct. Validation means to confirm that the system meets its intended purpose. It is therefore the principal responsibility of the customer.

6.
Question 6
Which ONE of the following is CORRECT with regard to the verification of requirements?
1 / 1 point

- Verification of system requirements is only of interest to the designers of the system.
- Agreement on how requirements are to be verified can be left until just before test and evaluation commences.
- Verification will detect requirements that are missing from the specifications.
- The terms verification and validation can be used interchangeably systems engineering.

Verification is of interest to both the customer and the contractor associated with a system development.
Correct
Yes, that is correct. There is little point in articulating a requirement without considering how to know that the requirement has been achieved--that is particularly important to confirm completion of the contract between the customer and contractor.

7.
Question 7
With regard to the development of operational scenarios, which ONE of the following statements is CORRECT?
1 / 1 point

- The information contained in operational scenarios is provided by the contractor.
- Operational scenarios are discarded after conceptual design as they are not relevant to future systems engineering phases and activities.
- Operational scenarios describing system operation is considered BEFORE the need for the system is established.
- It is not necessary to describe every possible scenario that relates to the use of the system, BUT all types of operation should be represented in some way.

The information contained in operational scenarios is provided by the system designers.
Correct

Yes, that is correct. Developing a range of operational scenarios is considered a valuable exercise for the stakeholders to do during conceptual design. Examination of operational scenarios begins with a description of the general operational environment for the system, which identifies all of the environmental factors that may have an effect on the operation of the system. Specific operational scenarios are described in the users' language to depict a range of circumstances under which the system is to operate. It IS NOT necessary to describe every possible scenario, BUT all types of operation should be represented. Specific operational scenarios, also called use cases, may form the basis of verification activities later in the systems engineering process.

8.
Question 8
Which ONE of the following statements is CORRECT with regard to the feasibility analysis conducted during the definition of business requirements?
1 / 1 point

- The feasibility analysis will result in agreed system level requirements.
- The feasibility analysis assists in managing stakeholder expectations regarding possible solutions.
- Feasibility analysis should be conducted without worrying about the available solutions.
- During feasibility analysis, each solution option is thoroughly tested against detailed system requirements.

Feasibility analysis will not include any market survey to identify available solutions.
Correct
Yes, that is correct. The feasibility analysis assists stakeholders to focus their efforts on the most likely solution space(s), which helps in managing stakeholder expectations.

9.
Question 9
Which ONE of the following statements is CORRECT with regard to the context diagram?
1 / 1 point

- The context diagram illustrates detailed systems elements inside and outside of the system boundary.
- The context diagram is best developed early in conceptual design to capture boundaries and scope.
- The context diagram is best developed as late as possible in conceptual design.
- The context diagram must show detailed internal interfaces for our system.

A system must have only one context diagram.
Correct
Yes that is correct. The context diagram helps us illustrate the scope and boundaries of our system.

10.
Question 10
Which ONE of the following is a statement that would be found in the system requirements, rather than in higher-level or lower-level requirements?
0 / 1 point

- The Aircraft shall operate with a maximum all-up weight of xx kg.
- The Aircraft shall be turned around to its next flight within 30 minutes.
- The Engines shall operate for xx hours at zz rpm.
- The Aircraft shall be capable of operating from a Class X airport.

The Aircraft shall provide class-leading comfort for passengers.
Incorrect
Sorry that is not correct. System requirements need to be specific enough to describe what the system needs to be able to do (in order to satisfy the stakeholder requirements). This statement would be expected to be found at the level of stakeholder requirements, rather than at the system level.

11.
Question 11
Which ONE of the following is a statement that would be found in the stakeholder requirements, rather than lower-level requirements?
1 / 1 point

- The Aircraft shall operate from a runway of xyz surface.
- The Aircraft shall operate with a maximum all-up weight of xx kg.
- The Aircraft shall be registered on the Federal Aviation Authority airworthiness register
- The Engines shall operate for xx hours at zz rpm.

The Aero-bridge attached to the aircraft shall load passengers within 30 minutes.
Correct
Yes that is correct. Stakeholder requirements tend to focus on what the problem or capability gap that needs to be solved, rather than looking at system requirements.

12.
Question 12
Which ONE of the following is an action undertaken at System Requirement Review (SRR)?
1 / 1 point

- approve detailed interface specifications.
- confirm verification method associated with each requirement.
- establish the detailed design requirements.
- approve the systems engineering planning process.

establish traceability between system and subsystem requirements.

Correct
Yes that is correct. SRR progressively reviews requirements and requirement attributes such as priority and verification method. SRRs may result in the need to re-work sets of requirements. SRRs may also confirmation that we are happy with sets of requirements (no additional work required).

13.
Question 13
Which ONE of the following is something that would happen at System Design Review (SDR)?
1 / 1 point

- reviews requirement attributes such as priority
- approves the system engineering management planning for subsequent phases
- approves the detailed design of component interfaces
- continue to work on our system requirements

establishes the detailed design for the system
Correct
Yes that is correct.
SDR is a technical meeting that aims to review the proposed solution against the (revised) system requirements. Traceability is confirmed (both forwards and backwards) as is the agreed verification process to be applied to the requirements. We would also review and agree on the planning for the subsequent phases.

14.
Question 14
Which ONE of the following statements is correct with regard to Conceptual Design?
1 / 1 point

- … is problem-domain design.
- … translates system-level requirements into detailed design requirements for the system elements.
- … is solution-domain design.
- … starts with a complete understanding of what the system needs to be able to do, how well it needs to do it, under what conditions it needs to perform and what other (external) systems will be involved with the system under development.

… is the responsibility of the developer (or solution provider).
Correct
Yes that is correct. Conceptual Design (or logical design or problem-domain design), which aims to articulate the needs, to analyse and document the system-level requirements flowing from the needs, and to complete a logical design of the system. The major product is a complete understanding of what the system needs to be able to do, how well it needs to do it, under what conditions it needs to perform and what other (external) systems will be involved with the system under development. Conceptual Design is the responsibility of the customer.

Week 6

1.
Question 1
Which ONE of the following statements is CORRECT with regard to requirements creep?
1 / 1 point

- Requirements creep is the process that allows the requirement set to keep up with emerging technology
- Requirements creep introduces additional and unendorsed requirements that compete with endorsed requirements for system resources.
- Requirements creep mainly refers to the process of making our requirements more detailed as they pass through design
- Requirements creep helps ensure that the system even better than the stakeholders needed in the first place.

Requirements creep allows critical requirements that were left out of system-level design to be captured in lower level design requirements.
Correct
Yes, that is correct. Requirements creep is the term given to the tendency for our requirements to get enhanced and embellished beyond what is required. Requirements creep tends to occur as requirements pass from system to sub-system and from subsystem to component level as these transitions provide opportunities for new or enhanced requirements to be added to the relevant requirements set. Backward traceability and requirements rationale help protect us from requirements creep.

2.
Question 2
Which review evaluates the Detailed Design of the system?
1 / 1 point

- System Design Review
- System Requirements Review
- Preliminary Design Review
- Critical Design Review

Equipment Design Review
Correct
Yes that is correct. The Critical Design Review evaluates the system Detailed Design.

3.
Question 3
Which ONE of the following major reviews formalises the Preliminary Design activity of the system life cycle?

1 / 1 point

- Functional Configuration Audit
- Preliminary Design Review
- Conceptual Design Review
- Physical Configuration Audit

Formal Qualification Review
Correct
Yes, that is correct. The Preliminary Design Review ends the Preliminary Design activity of the system life cycle.

4.
Question 4
Which ONE of the following major reviews establishes the subsystem level design of our system?
1 / 1 point

- Preliminary Design Review
- Functional Configuration Audit
- Physical Configuration Audit
- Conceptual Design Review

Formal Qualification Review
Correct
Yes, that is correct. The Preliminary Design Review establishes the subsystem level design.

5.
Question 5
Which of the following statements is CORRECT in regard to requirements traceability?
1 / 1 point

- Requirements traceability is established by the contractor to manage sub-contractors.
- Requirements traceability should be established only when requirements creep becomes a problem.
- Requirements traceability helps guarantee successful system verification.
- Requirements traceability helps protect against requirements creep by highlighting requirements that do not seem to have a reason for existing.

Forward traceability is used to completely define and justify all lower-level requirements.
Correct
Yes, that is correct. Backwards traceability (from lower level to upper level) provides some justification for the lower level requirements' existence. Traceability helps guard against the problem known as requirements creep.

6.

Question 6
Which ONE of the following statements is CORRECT for a developmental design option?
1 / 1 point

- There may be problems with form, fit or function.
- The effort involved in a developmental design is LIKELY to be insignificant.
- Maintenance and support issues will need to be considered and resolved when items have been designed specifically for the system.
- There may be problems with size, weight, colour.

The system is NOT LIKELY to match the criteria in terms of form, fit and function.
Correct
Yes, that is correct.
A developmental design option:
- Equipment is likely to be more expensive.
- The system is likely to match the criteria in terms of form, fit and function.
- The effort involved in a developmental design is not likely to be insignificant.
- Maintenance and support issues will need to be considered and resolved when items have been designed specifically for the system.

7.
Question 7
Which ONE of the following statements is CORRECT with regard to the difference between Conceptual Design and Preliminary Design?
1 / 1 point

- Preliminary Design results in the allocation of system-level requirements to individual subsystems within the design.
- Preliminary Design results in a thorough understanding of what the system needs to be able to do.
- Preliminary Design is focused on the system level.
- Conceptual Design results in the allocation of system-level requirements to individual subsystems within the design.

Sub-ystems are defined and designed in Conceptual Design.
Correct
Yes, that is correct.
Conceptual Design is focused on functional design, and is at the system level, resulting in a thorough understanding of what the system needs to be able to do in order to meet stakeholder needs.

Preliminary Design is focused more on physical (or actual) design, and is focused on the subsystem level. Preliminary Design results in system-level requirements being allocated to individual subsystems for satisfaction. Preliminary Design also identifies internal interfaces and investigates subsystem level design options.

8.
Question 8
Describing and defining all lower-level components that make up the subsystems (including hardware and software products and their inter-relationships) is undertaken during which ONE of the following activities/phases?
1 / 1 point

- Detailed Design and Development
- Pre-Acquisition
- System Support
- Operational Use

Utilisation
Correct
Yes, that is correct. During Detailed Design and Development lower-level components that make up the subsystem are either procured off-the shelf or designed (if they are unique to the system under development).

9.
Question 9
Which ONE of the following statements is CORRECT for a COTS design option?
0 / 1 point

- Maintenance and support is not likely to be already be in place for a COTS product.
- Form, fit and function requirements will all be perfectly accommodated by the COTS product.
- COTS equipment is likely to be more expensive.
- COTS equipment is not likely to be readily available.

COTS equipment is likely to be readily available.
Incorrect
Sorry, that is not correct. On the contrary, COTS equipment is likely to be readily available, and cheaper, with maintenance and support probably already be in place.

10.
Question 10
Modified COTS items are likely to have the same advantages as COTs, but there are some other disadvantages particular to Modified COTS. Which ONE of the following statements is CORRECT for a Modified COTs design option?
0 / 1 point

- The modification process would not cost a lot more than initially estimated.
- Some maintenance and support for the COTS item may be voided if the item is modified.
- The effort to modify the COTS item is easily estimated.
- Maintenance and support is not voided if the COTS item is modified.

The modification process does not take a lot longer.
Incorrect
Sorry, that is not correct.
The additional disadvantages of a Modified COTs design option include:
- Some warranties, and maintenance and support arrangements may be voided if the item is modified.
- The effort to modify the item is easily underestimated.
- The modification process can take a lot longer.
- The modification process can cost a lot more than initially estimated.

Week 7

1.
Question 1
Which of the following statements is CORRECT in relation to modifications made to the system during the Utilisation Phase?
1 / 1 point

- Modifications would not be an action undertaken to address changing system-level requirements caused by a changing operational environment.
- The requirements associated with a modification program do not need to be documented so Systems Engineering is irrelevant to modification programs
- Modifications may be undertaken to ensure that the system continues to meet operational and support requirements.
- It is OK for modifications to be done informally and in an almost ad-hoc manner not involving systems engineering process.

Modifications would not be an action undertaken to address changing system-level requirements caused by a changing support environment.
Correct
Yes, that is correct.
Modifications to our systems during the utilisation phase are almost inevitable. Requirements will change, our environment will change, technology will change causing us to address obsolescence and enhance supportability so on. Modifications are a “reinvigoration” of the systems engineering process because a modification is like a mini systems engineering process all over again where we have a complex problem that need to be understood, solved and implemented. If expandability and upgradeability is designed into our systems, the feasibility of future growth and modifications will be enhanced.

2.
Question 2
Which ONE of the following statements is CORRECT with regard to configuration audits?
1 / 1 point

- Physical configuration audits make use of activities like inspections during construction and production to confirm alignment between as-built systems and their documentation.
- We wait until after the system is completed constructed before performing a physical audit.
- Physical configuration audits are used to design the Physical Architecture.
- Accurately documented systems (confirmed by configuration audits) are only vaguely useful during the utilisation phase.

Configuration audits are the contractor's problem and do not interest the customer.
Correct
Yes that is correct.
Configuration audits are used to confirm an accurate description of the “as built” system. There are two types of audits conducted by systems engineers; functional audits and physical audits. A functional configuration audit makes heavy use of verification results to confirm that the system’s functionality is accurately reflected in the system’s documentation. A physical configuration audit confirms that the physical description of the system is consistent with the as built item. This normally needs to be done during construction and production as this is where we are able to confirm as-built configuration.

3.
Question 3
Which ONE of the following statements is CORRECT with regard to verification?
1 / 1 point

- Verification is the sole responsibility of the contractor and does not involve the customer.
- Popular methods of verification include testing, demonstrating, inspecting and analysing our system's compliance to requirements.
- Verification is only of interest at the end of the production stage.
- Verification basically means the same thing as the term "test".

Verification focuses on confirming that the system meets stakeholder expectations.
Correct
Yes that is correct.
Popular verifications methods include testing, inspecting, demonstrating and analysing elements of our system.

4.
Question 4
Lifecycle concepts that were established earlier need to be put place as the system transitions into service. Which of the following is TRUE with respect to lifecycle concepts and transition.
1 / 1 point

- Issues such as facilities, spares, training, personnel support and retirement planning should influence the design of the system

- Lifecycle disciplines such as ILS should work independently from the engineers involved in system design.
- Lifecycle concepts are established as the system enters the utilisation phase.
- Lifecycle concepts are developed by the contractor after the contract has been awarded.

It is not desirable to be bothered by lifecycle issues like support during the system design process.
Correct
Yes, that is correct.
Lifecycle concepts help us transition the system to operational use by our stakeholders and then sustain the capability throughout its life. Issues include the facilities that will house the system and its associated support system, the personnel who will use and support the system, any training systems that will be used to train our users and support personnel, the maintenance and engineering support system including associated support equipment, consumables and spare parts, and of course the operating procedures that will be used to guide users in the operation of the system.

5.
Question 5
Our systems generally require a range of different support levels. Which of the following is TRUE in relation to supporting our system.
0 / 1 point

- The customer should consider support requirements as the end-users' problems and not let them distract from the design process.
- Business stakeholders and system stakeholders should consider support requirements after the system has entered the Utilisation Phase.
- Our requirements for support should not be allowed to interfere with the engineering design process
- Influencing our design with supportability in mind will result in a system that performs badly against our requirements.

Engineering support is a deeper level of support involving higher levels of knowledge about our system.
Incorrect
Sorry, that is not correct.
By the time we have reached the Utilisation Phase, it is too late to incorporate support requirements in the system design.

Week 8

1.
Question 1

Many different disciplines are involved with solving complex technical problems. Which ONE of the following is true in relation to Systems Engineering and these other disciplines?
1 / 1 point

- Systems engineering provides project management with instructions on how to manage scope and cost risks.
- Systems engineering is generally seen as a superior discipline to project management.
- Systems engineering is always more important that integrated logistics support.
- Systems engineers need to commence working with ILS professionals during the transition period.

Interdisciplinary collaboration involving systems engineering generally works best if it starts from the very earliest stages in our projects.
Correct
Yes, that is correct.
Systems engineering rarely, if ever, exists in its own right, independent from other professional disciplines. Bringing a solution to a complex problem into existence will involve a lot of different disciplines working together.

2.
Question 2
Which ONE of the following statements is CORRECT with regard to AT&E?
1 / 1 point

- These T&E activities are principally focused on sub-system-level requirements in the detailed design specifications.
- AT&E is the contractor's responsibility and does not directly involve the customer.
- These T&E activities are principally focused on system-level requirements in the System Requirement Specification.
- These T&E activities principally inform modifications to the fielded system.

AT&E is generally a very simple process that is relatively quick and inexpensive
Correct
Yes, that is correct.
Acceptance Test and Evaluation (AT&E) activities are undertaken to verify that the delivered system meets the System Requirement Specification before being accepted from the contractor.

3.
Question 3
Which ONE of the following statements is CORRECT with regard to DT&E?
1 / 1 point

- These T&E activities are principally focused on system-level requirements in the System Requirement Specification.

- These T&E activities principally inform the formal verification that the system meets the requirements of the System Requirement Specification.
- These T&E activities principally inform modifications to the fielded system.
- These T&E activities are principally the responsibility of the contractor.

These activities are the responsibility of the contractor and therefore do not need to be planned.
Correct
Yes, that is correct.
Developmental Test and Evaluation (DT&E) activities are undertaken throughout the Acquisition Phase to support the design and development effort.

4.
Question 4
Which ONE of the following statements is CORRECT with regard to reviews and audits?
1 / 1 point

- Reviews may be undertaken by the customer at any time they choose to ensure that the contractor is always compliant with the contract.
- Design reviews are a standard part of doing business and therefore do not need to be planned, scheduled or costed.
- Reviews should be managed and run like professional technical meetings.
- The length, duration, location and attendees for each review are decided at the Preliminary Design Review.

A COTS-based project would tend to have more reviews than a developmental project.
Correct
Yes, that is correct.
Reviews and audits are a vital part of the systems engineering effort because they provide a formal evaluation of the design maturity and reduce technical risk.

5.
Question 5
Which ONE of the following BEST describes the content of the SEMP?
1 / 1 point

- Details the systems engineering strategy including all the major systems engineering functions as well as positions of responsibility and resources to be applied to the project.
- Documents the results of the acceptance testing program.
- Contains the information required to ensure that stakeholders are kept informed on the detailed design process.
- Contains details of the project budget and cash flow.

Contains contractual documentation associated with the relationship between the contractor and the customer.

Correct
Yes that is correct.
The Systems Engineering Management Plan (SEMP) details the systems engineering strategy to be adopted by the project. This will also include all the major systems engineering functions required for the project as well as positions of responsibility, resource requirements, and management of activities such as technical reviews, configuration management, and requirements engineering.

6.
Question 6
Which of the following is ONE of the main options for treating risk?
1 / 1 point

- Analysis
- Acceptance
- Identification
- Monitoring

Evaluation
Correct
Yes that is correct.
The main options for treating risk are: avoidance, mitigation (or weakening the risk), transfer, and acceptance.

7.
Question 7
Which ONE of the following statements is true of the waterfall approach to development.
1 / 1 point

- The waterfall approach is universally applicable and does not need to be tailored or adjusted to suit individual projects.
- Systems engineering management is not concerned with development strategies like the waterfall approach.
- The waterfall approach is ideally suited to dealing with requirements that change continually through the project.
- The waterfall approach can be suited to situations where requirements are established early and do not change during the process.

The waterfall approach is a theoretical process that does not work in real situations.
Correct
Yes that is correct.
The waterfall approach develops the whole system in one pass; starting at the system level at the top then cascading down to the subsystem level and then finishing with the component level, in that order. The waterfall approach can be effective but is not effective all of the time. It relies on a thorough and complete understanding of the problem and the desired solution. It assumes the accurate translation of needs into comprehensive system level requirements. It

works best when requirements do not change very often. It assumes that technology is available and works best when that technology remains relatively stable over the course of the system development. It assumes that sufficient time and enough money is available to solve the entire problem in one pass.

8.
Question 8
Which of the following is ONE of the main configuration management (CM) functions?
1 / 1 point

- managing and controlling changes to the items under control
- managing stakeholder expectations
- test and evaluation
- conducting technical reviews

software design and development
Correct
Yes that is correct.
Configuration management includes the need to identify what is to be placed under control, being able to manage change to those items under control, being able to report on the status of those items and being able to audit the elements against their documentation to confirm the correct operation of the configuration management system.

Week 9 (Final Exam)

1.
Question 1
In terms of briefly describing a stakeholder of a system, which ONE of the following statements is CORRECT?
1 / 1 point
Correct
2.
Question 2
Which ONE of the following major reviews establishes the subsystem level design of our system?
1 / 1 point
Correct
3.
Question 3
Which of the following statements is CORRECT in relation to modifications made to the system during the Utilisation Phase?
1 / 1 point
Correct
4.
Question 4

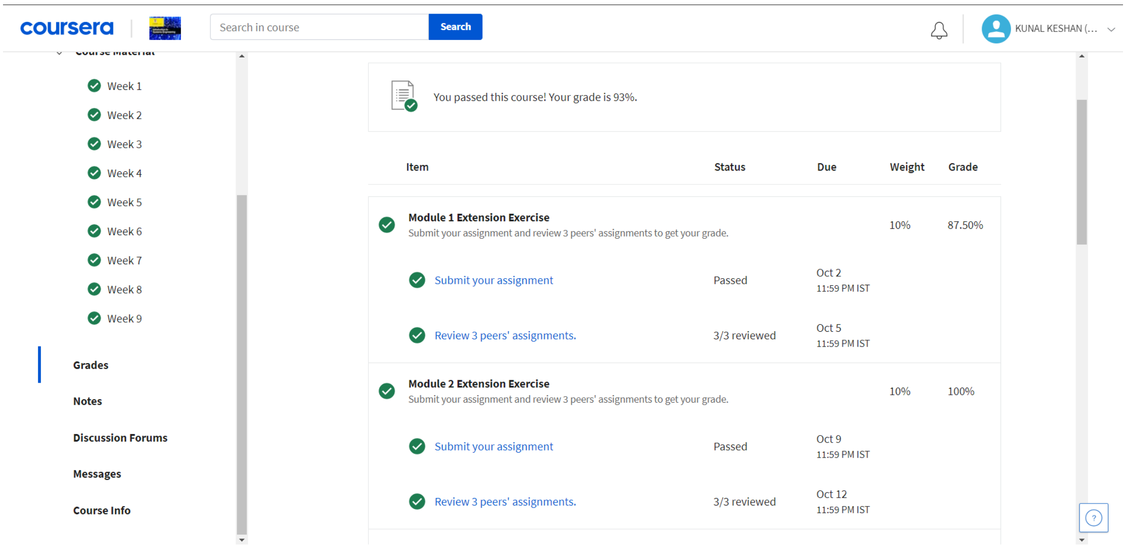
Which ONE of the following statements is CORRECT with regard to DT&E?
1 / 1 point
Correct
5.
Question 5
We spoke about using a Requirements Breakdown Structure or RBS to help us record our system requirements. In regards to an RBS, which ONE of the following statements is CORRECT?
0 / 1 point
Incorrect
6.
Question 6
Which ONE of the following statements is true of the waterfall approach to development.
1 / 1 point
Correct
7.
Question 7
Which ONE of the following statements is CORRECT for the detailed design and development process?
1 / 1 point
Correct
8.
Question 8
Which ONE of the following is CORRECT with regard to lifecycle concepts?
1 / 1 point
Correct
9.
Question 9
Which ONE of the following statements is CORRECT with regard to requirements creep?
1 / 1 point
Correct
10.
Question 10
Which ONE of the following statements is CORRECT with regard to making use of available design space?
1 / 1 point
Correct
11.
Question 11
Which major review ends the Detailed Design & Development activity of the system life cycle?
1 / 1 point
Correct
12.
Question 12

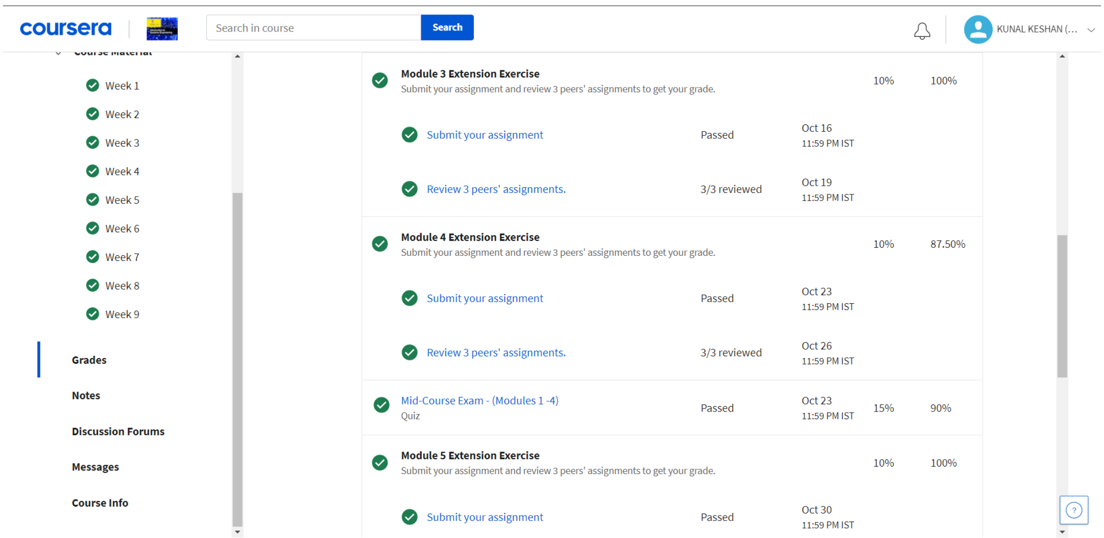
Modified COTS items are likely to have the same advantages as COTs, but there are some other disadvantages particular to Modified COTS. Which ONE of the following statements is CORRECT for a Modified COTs design option?
1 / 1 point
Correct
13.
Question 13
Which ONE of the following is associated with recording a rationale with each requirement (or group of requirements).
0 / 1 point
Incorrect
14.
Question 14
Which ONE of the following is CORRECT with regard to the validation of requirements?
1 / 1 point
Correct
15.
Question 15
Which of the following is ONE of the main configuration management (CM) functions?
1 / 1 point
Correct
16.
Question 16
Which ONE of the following is CORRECT with regard to the verification of requirements?
1 / 1 point
Correct
17.
Question 17
Which ONE of the following statements is CORRECT for a COTS design option?
0 / 1 point
Incorrect
18.
Question 18
With regard to the development of operational scenarios, which ONE of the following statements is CORRECT?
1 / 1 point
Correct
19.
Question 19
Which of the following is ONE of the main options for treating risk?
1 / 1 point
Correct
20.
Question 20
Which ONE of the following statements is CORRECT with regard to the feasibility analysis conducted during the definition of business requirements?

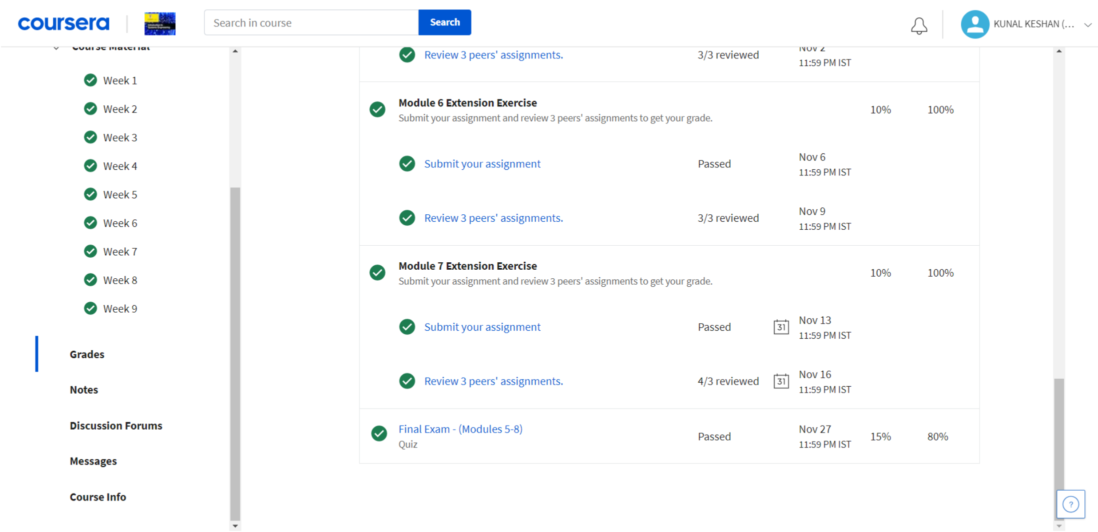
1 / 1 point
Correct
21.
Question 21
Describing and defining all lower-level components that make up the subsystems (including hardware and software products and their inter-relationships) is undertaken during which ONE of the following activities/phases?
1 / 1 point
Correct
22.
Question 22
Which ONE of the following statements is CORRECT with regard to the difference between Conceptual Design and Preliminary Design?
0 / 1 point
Incorrect
23.
Question 23
Which ONE of the following statements is CORRECT with regard to the context diagram?
1 / 1 point
Correct
24.
Question 24
Which ONE of the following is a statement that would be found in the system requirements, rather than in higher-level or lower-level requirements?
0 / 1 point
Incorrect
25.
Question 25
Which ONE of the following statements is CORRECT for a developmental design option?
0 / 1 point
Incorrect
26.
Question 26
Which ONE of the following BEST describes the content of the SEMP?
1 / 1 point
Correct
27.
Question 27
Our systems generally require a range of different support levels. Which of the following is TRUE in relation to supporting our system.
1 / 1 point
Correct
28.
Question 28
Which of the following statements is CORRECT in regard to requirements traceability?
1 / 1 point

Correct
29.
Question 29
Which ONE of the following is a statement that would be found in the stakeholder requirements, rather than lower-level requirements?
1 / 1 point
Correct
30.
Question 30
Which ONE of the following statements is CORRECT with regard to reviews and audits?
1 / 1 point
Correct

Course Grades



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Week 1
Week 2
Week 3
Week 4
Week 5
Week 6
Week 7
Week 8
Week 9
Grades
Notes
Discussion Forums
Messages
Course Info
Review 3 peers' assignments.
3/3 reviewed
11:59 PM IST
Module 6 Extension Exercise
Submit your assignment and review 3 peers' assignments to get your grade.
10%
100%
Submit your assignment
Passed
Nov 6
11:59 PM IST
Review 3 peers' assignments.
3/3 reviewed
Nov 9
11:59 PM IST
Module 7 Extension Exercise
Submit your assignment and review 3 peers' assignments to get your grade.
10%
100%
Submit your assignment
Passed
Nov 13
11:59 PM IST
Review 3 peers' assignments.
4/3 reviewed
Nov 16
11:59 PM IST
Final Exam - (Modules 5-8)
Quiz
Passed
Nov 27
11:59 PM IST
15%
80%

16. COURSE OUTCOMES

Many useful systems are, in effect, modifications of previous designs. The proportions of the subsystems may be changed, but no substantial function has been added or left out. Chemical-processing plants and information systems, for example, are likely to be of this sort. The basic task of the systems engineer in such a situation is relatively straightforward; it is essentially a matter of reoptimizing the existing design to meet the new conditions.

The development of radically new systems

Radically new systems concepts are like inventions in ordinary engineering. Usually offering a substantial advance in overall performance, more than would be expected from a modest reproportioning of a known system, these clearly deserve special attention. On the other hand, in many cases it is impossible to predict accurately in advance of the development just what performance may be achievable in one or more of the critical elements of the new system. This leaves the systems engineer with a special problem in planning, which is usually addressed by establishing a minimum acceptable level of performance for the critical elements, with the rest of the system so arranged that whatever is realized beyond this level will appear as growth potential in the overall capabilities of the system. Thus definitive optimization studies may be postponed until the system is better understood.

Long-term systems development

Thus far the description of systems engineering may seem to suggest that systems engineering efforts are essentially episodic. In many situations, however, there are important elements of continuity in what the systems engineer actually does. He is likely, in fact, to work on a series of similar problems as part of a long-term effort. In the case of telephone engineering, systems engineering groups have been set up formally as permanent parts of the overall organizational structure, each group having cognizance over some wide area of telephone technology. Thus continuity in this case may extend over many years.

Applications to government and social problems

Thus far, systems engineering has been dealt with in relation to two principal fields of application. One field is industry, in which the prospects of a further expansion of systems engineering appear bright. Existing applications furnish many good models, and it seems likely that such extensions can take place without raising many unusual problems. The other major field of application has been in military and space systems, and this may have been the principal force in shaping the systems engineering field. The possibility of new applications of systems ideas in nonmilitary areas of government also has come under consideration in the realm of worldwide basic social and economic problems. On the other hand, systems engineering as practiced in other contexts does not automatically transfer easily to this new environment. General interest in the subject dates, however, only from the late 1960s, and the field is incompletely explored.

17. PROOF OF COURSE COMPLETION

Completed by **Kunal Keshan**

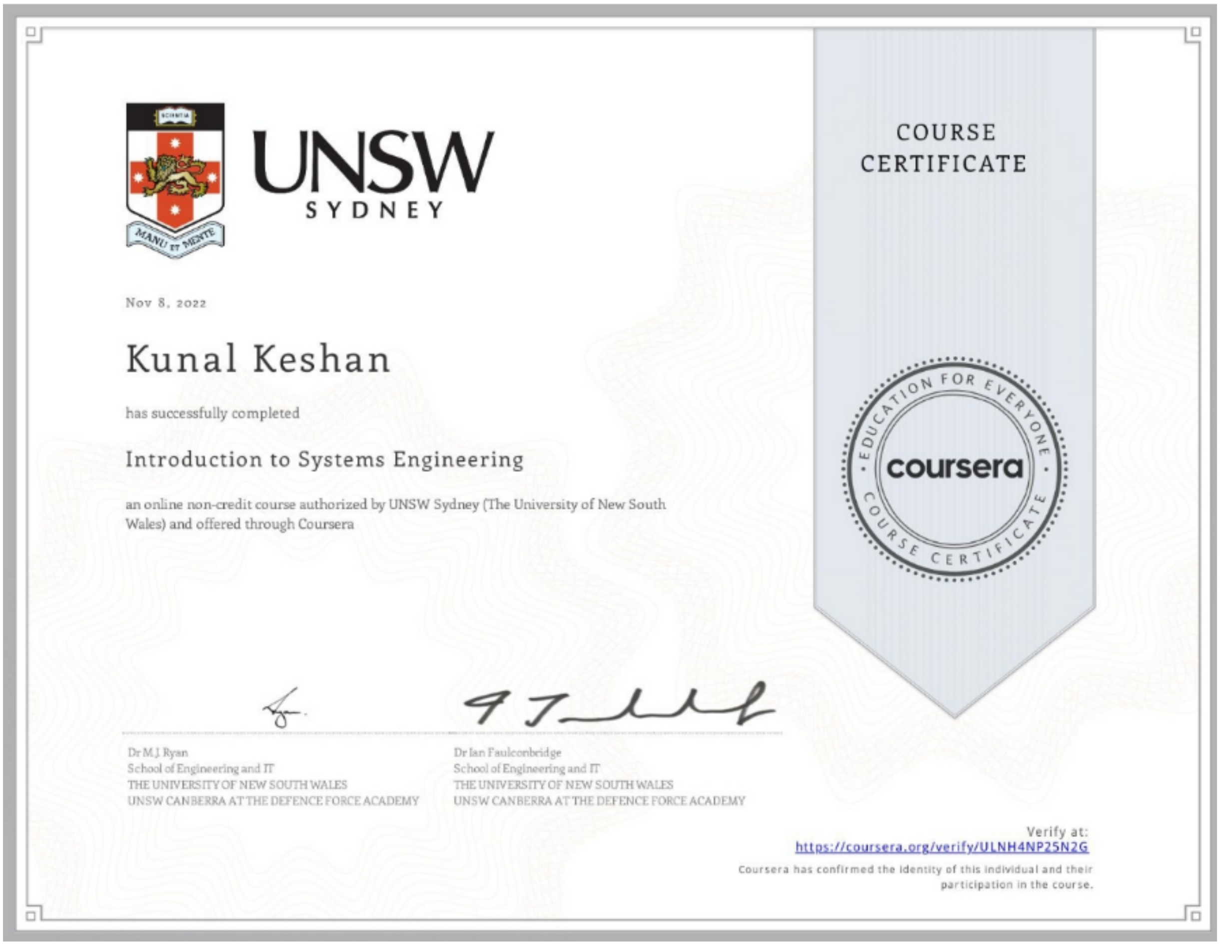
November 8, 2022

4-5 hours/week

Grade Achieved: 93%

Kunal Keshan's account is verified. Coursera certifies their successful completion of Introduction to Systems Engineering

COURSE CERTIFICATE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has successfully completed

Introduction to Systems Engineering

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UNSW CANBERRA AT THE DEFENCE FORCE ACADEMY

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