Telecommunications Engineering Course Design

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Abstract: - Telecommunication engineers design, develop, test and maintain telecommunications systems. They are one of the driving forces behind recent, significant growth in areas such as the Internet, mobile telephones and other modern wired and wireless communications systems. This paper explains telecommunication course design approach for under graduate and post graduate levels. Main subjects in telecommunications engineering courses include: Digital systems, Overview of digital communication, Telecommunication system engineering, Telecommunication modeling and simulation, and Mobile and satellite communication systems. This paper also explains core body of telecommunications knowledge, course design and development based on current industry trends and feedback received from professional engineers.

Key-Words: - Telecommunications, Computer Networks, Sydney accord, Washington accord

1 Introduction

Perception of the telecommunications engineering is important in the current economy. By studying telecommunication engineering, students will understand the theory and practice of significant advancements and developments in modern technology. Currently the Australian federal government is developing a National Broadband Network (NBN) with four main areas of focus:

- Transforming the structure of telecommunications.
- Switchover to digital television and enhancing the broadcasting sector.
- Realising the digital economy.
- Enabling a good consumer experience.

We have designed telecommunications courses for undergraduates as Bachelor of Engineering Technology (Telecommunications) - BEngTech(Tel), for post graduates as Graduate Diploma of Engineering (Telecommunications) - GDEng(Tel) and Master of Engineering (Telecommunications) - MEng(Tel).

Section 2 gives background of the course. Section 3 explains coherent body of knowledge. Underlying design and structure of the course is given in the section 4 and section 5 is detailing course mapping to an international standard. Summary of professional engineers survey is given in section 6. Section 7 concludes with the further unit development and laboratory setup needed for telecommunication engineering courses.

2 Background

Engineering is the discipline and profession of capturing and applying mathematical, technical and scientific knowledge to research, plan, design, invent and implement real world cutting edge technology using appropriate materials, devices, procedures and systems to achieve desired objectives efficiently [1][2][3]. Historically engineering has covered four main disciplines: electrical, chemical, mechanical, and civil engineering [4]. The fundamentals of engineering and engineering education have a long history of development [5]. While each of the main engineering disciplines is quite distinct, they share a coherent body of knowledge in the areas of mathematics and engineering practice.

All engineering courses are designed based on the following educational outcomes which are Australian Quality Framework (AQF) requirements:

1. Advanced knowledge of the specialist area of telecommunications engineering, administration and management
2. High order skills in the analysis and evaluation in telecommunication engineering and computer networks
3. High order skills in the application of telecommunications engineering and network administration knowledge to problems within the telecommunications industry
4. Advanced skills in communication, collaboration and independent learning

The methods of delivery will include: lectures, tutorials, laboratory classes, studio based learning,

seminars, online distribution of materials, case studies, computer laboratory exercises and project based leaning. A combination of these modes will be used in each unit of study to ensure students achieve the specified learning outcomes applicable to the body of knowledge for that discipline.

3 Coherent body of knowledge

Each of the main areas of engineering encompasses several other forms of engineering. Electrical engineering is a very diverse field and it is currently undergoing expansion as new applications are found for electronic equipment. Electrical engineering includes electronic, computer systems, telecommunications, control and electrical power engineering [6]. All of these engineering disciplines are concerned with the way electrical energy is generated and employed in homes and industry. Electrical engineers design and build the systems and machines that generate, transmit, measure, control and use electrical energy. Digital systems are relevant to all aspects of electrical engineering.

The transmission of electronic signals forms the basis of communications and information technology. Telecommunication engineering is a branch of electrical engineering, and deals with the theory and practice of the transmission of information electronically [7]. Telecommunication information involves visual signals and audio messages using electrical devices such as telegraph, telephone, television, radio, microwave, fibre optic or satellites. Communication uses either wires or wireless or both as the medium.

Development of unit topics are based on textbooks and journals. The following journals are relevant to core Telecommunications engineering courses:

Telecommunication Journals

International Journal of Electronics and Telecommunications, IEEE transaction on broadcast and television receivers, Broadcast Transmission Systems, IRE Transactions on Broadcasting, IEEE Transactions on Cable Television, IEEE Transactions on Communications, Speech and Vision, IEE Proceedings I, Electronic Computers, Transactions of the I.R.E. Professional Group.

Mobile Communication Journals

Microwaves, Antennas and Propagation, IEE Proceedings H; Radar, Sonar & Navigation, IET Generation, Transmission & Distribution, IET; Reliability and Quality Control, Transactions of the IRE Professional Group.

Wireless Communication Journals

Wireless Communications, IEEE; Wireless Communications, IEEE Transactions on Component Parts, Transactions of the IRE Professional Group on Evolutionary Computation, IEEE Transactions on Antennas and Propagation Magazine.

Satellite Communication Journals

International Journal of Satellite Communications and Networking; IEEE Transactions on Network and Service Management, IEEE Transactions on Circuits and Systems for Video Technology, IEEE Transactions on Circuits and Systems I: Fundamental Theory and Applications, IEEE Transactions Ultrasonics, Ferroelectrics and Frequency Control.

3.1 Australian government-announced funding on telecommunication projects

Telecommunications play an important role in the world economy and the worldwide telecommunication industry's revenue was estimated to $3.85 trillion in 2008. The service revenue of the global telecommunications industry was estimated to $1.7 trillion in 2008, and is expected to touch $2.7 trillion by 2013 [8].

The following examples illustrate the need of telecommunication technologists and engineers to be part of government proposal [8].

- The Digital Regions Initiative will fund innovative broadband applications to improve education, health and emergency services in regional areas through innovative broadband programs co-funded with all tiers of government.
- The continuation and enhancement of the Satellite Phone Subsidy Scheme for Australians living and working in areas without terrestrial mobile coverage, including the replacement of older handsets for those without coverage and making more handsets available to emergency services and health organisations with a demonstrated need.
- A refocused Indigenous Communications Program to improve basic telecommunications services, basic public internet access and training to remote Indigenous communities.

3.2 Some evidence of the areas in which telecommunication engineers work

Telecommunication engineering is a fast growing, challenging and very rewarding field. It is a major field in electronics and electrical engineering. Broadly, engineering technologists in the telecommunication industry can work for example as a telecommunication engineer/technologist, telecom equipment engineer, or a central office engineer.

- Telecommunication engineering work ranges from circuit design to strategic development and is responsible for designing and installation of equipment and facilities such as basic cabling (copper, co-axial cable, fiber optics, radio), complex electronic switching systems (telco, internet service providers, broadcast, mobile services) and wireless broadcasting. Telecom engineers are expected to provide the best solution possible for the lowest cost.
- A telecom equipment engineer designs networking equipment such as routers, switches, multiplexers, and other specialized computer or electronics equipment designed to be used in the telecommunication network infrastructure.
- A central-office engineer is responsible for designing and overseeing the implementation of telecommunications equipment in a central office. He/she is responsible for integrating new technology into the existing network, assigning the equipment location in the center and monitoring facilities.
- Telecommunication engineers must also consider the factors such as: regulations and safety in installation, removal of hazardous material, and commonly used tools to perform installation and removal of equipment
- Telecommunication technicians develop and provide superior products and services for voice, data and video applications, security requirements, and support.
- A mobile or wireless technologist is a provider of choice for telephony systems, data networks, video, converged networks, cable and wire infrastructure, and wireless telecommunications products and services.
- Telecommunication engineers are also trained in the design and development of software and hardware used for communications, such as wireless telephones and satellites.

4. Underlying design and structure of the course

The telecommunication engineering technology course has been developed, based on the literature survey on theoretical and practical aspects in which telecommunication technologist can use the knowledge to capture, apply and validate concepts of telecommunication in real world. The purpose of the foundation units is to promote knowledge exchange and sharing of ideas within telecommunication field. Advanced level units allow students to think independently and apply their knowledge in a real world cases.

Proposed telecommunications courses / programs enable graduates to be proficient in wired and wireless networks and emerging network technologies. Graduates are equipped with the practical and theoretical skills to gain immediate access to engineering careers or to augment their existing industry skills and become a telecommunication or network specialist.

The Bachelor of Engineering Technology (Telecommunications) and Master of Engineering (Telecommunications) courses have been designed based on the following broad principles:

1. Understanding the basic concepts of the theory and practice of telecommunications
2. An in-depth understanding of the technologies involved in modern telecommunication systems
3. Application of theory and practice to the current telecommunication industry.

4.1 Understanding the basic concepts of the theory and practice of telecommunications

Basic concepts of the theory and practice covered in first year units: Introduction to Digital Systems, Overview of Networking, Overview of Digital Communication.

Example: Overview of Digital Communication unit gives an introduction to the theory and practice behind many of today's communications systems. Unit covers the following topics: Communication System Model, Message sources and source coding, Channel Coding, Digital baseband transmission, Bandpass signalling, Digital modulation and demodulation, and Digital transmission on channels. To assess students' understanding of the principles of digital communication, assessment tasks are developed as follows:

Assessment of understanding of the practical components of the unit is based on the fundamental characteristics and configuration of telecommunication devices such as antennae, routers, switches etc. Assessment of the theoretical aspects of the unit include an assignment directed toward a student's understanding of the literature with theoretical and practical concepts assessed against at a final invigilated examination as shown in table 1.

Table 1: Assessments of Digital Communication unit

Practical lab test	Week 6	10%
Individual assignments	Weeks 5 and 12	30%
Laboratory exercises	Weeks 2 - 12	10%
Examination (2 hours)	Week 14	50%

4.2 An in-depth understanding of the technologies involved in modern telecommunication systems

This topic is included in second and third year units such as Telecommunication System Engineering , Telecommunication Modeling and simulation, Mobile and Satellite Communication Systems.

Example: Unit description of Telecommunication Modeling and simulation

Telecommunications systems are complex and large, which contain many different components interacting in complex interrelationships. The analysis of such systems can become extremely difficult in real world. Computer modeling, simulation and analysis should be implemented that could predict the operation of telecommunication networks. Modeling techniques can be used to analyse each telecommunication component. Simulation is an approach which can be used to model large, for forecasting or performance measurement purposes. Telecommunication system modeling and simulation has four steps:

- Modeling the system
- Generation of the realizations of the model
- Measurement of Simulation data
- Analysis of output data

Two simulation applications Network simulator 2 (NS-2) and RF Signal Propagation Loss And Terrain analysis tool (SPLAT) will be used in this unit to model and simulate various telecommunication networks and systems.

NS-2 is to model discrete event simulator targeted at various networking research. This application provide efficient TCP, UDP, routing, ad-hoc networks, sensor networks and multicast protocols over wired and wireless (local and satellite) networks simulation environment [9].

SPLAT is a powerful terrestrial RF propagation and terrain analysis tool covering the spectrum between 20 MHz and 20 GHz. The application is used for the visualization, design, and link budget analysis of wireless Wide Area Networks (WANs), commercial and amateur radio communication systems above 20 MHz, microwave links, frequency coordination and interference studies, and the determination of analog and digital terrestrial radio and television contour regions [10].

Theory and practice of the unit Telecommunication Modeling and simulation covers key knowledge and skills students would be expected to attain by successfully completing this unit:

Capabilities

a. In depth knowledge of high speed communication technologies
b. Model and simulate networks with IP phone, IPTV, NGN
c. The ability to analyse complex problems in new telecommunication networks

Competencies

d. Able to understand access technologies such as xDSL, FTTH, WiFi, WiMAX, third generation (3G), long term evolution (LTE)
e. Able to understand and explain NGN's services, management technologies, operating support systems (OSS), cable services, IP multimedia systems
f. Able to understand and explain common and emerging techniques and technologies used in telecommunications
g. Able to understand and explain common and emerging services and management
h. Able to specify, build, and manage a telecommunication network

Professional Skills

i. To be able to understand the fundamental properties of heterogeneous information networks.
j. Opportunity to use tools to model, analyse and simulate telecommunication networks

This unit covers the following topics:

- Theoretical and parameter requirements of telecommunication technologies and services.
- Topological modelling of telecommunication networks.
- Analysis of performance factors such as Reliability, Availability and Serviceability (RAS), Signal to Noise Ratio (SNR), sensitivity and link budget calculations, micro and macro diversity to combat fading, calculation of radio coverage for cellular networks.
- Evaluation of alternatives in capacity planning and design, packet loss, delay and buffer size.
- Analysis of content and data delivery: supply and demand in telecommunication networks.
- Planning, designing, modelling and simulation for performance and consideration of service level agreements.
- Cost optimisation with flow considerations.
- Application of evolutionary computing in telecommunication network design and optimisation.

- Evaluation of multi-technology systems and services, quality of service and class of service (core network).
- Modelling and simulation of telecommunication business case studies to be able to design, plan and implement telecommunication infrastructure.

Assessment of understanding of the practical components of the unit is based on the fundamental characteristics and configuration of telecommunication devices such as digital TV, cable telephony etc. The assessment of the theoretical aspects of the unit includes an assignment directed toward a student's understanding of the literature with theoretical and practical concepts assessed again at a final invigilated examination as shown in table 2.

Table 2: Assessments of Telecommunication Modeling and simulation unit

Assessment Type	**When assessed**	**Weighting**	**Learning Outcomes Assessed**
Individual Assignment	Week 4	20%	a-j
Group project	Week 10	15%	d-j
Mid Term Test	Week 6	15%	a-c
Final Examination	Week 14	50%	a-j

4.3 Application of theory and practice to the current telecommunication industry

This topic is covered in second and third year units such as Project 1 , Project 2, Mobile and satellite communications.

Example: Unit description of Mobile and satellite communications

This unit provides a basic concepts and technologies associated with mobile and satellite communications.

Mobile communication system can be classified as:

- Wireless telephony
- Trunking system
- Cellular telephony
- Satellite communication system

Wireless telecommunications can be divided into two broad categories: mobile communications and fixed wireless communications. Mobile communications technology must be able to allow roaming and ability to provide service to a mobile phone users. The fixed wireless user does not need mobility. Wireless is an alternative means of providing service through satellite when the customer are in a remote location.

Mobile Communications Protocols includes Radio Frequency (RF) Protocols: Interim Standard 136 (IS-136) is a specific Time Division Multiple Access (TDMA) based radio frequency (RF) standard. IS-95 is a specific Code Division Multiple Access (CDMA) based radio frequency (RF) standard. TDMA and CDMA are digital RF protocols. Mobile Networking Protocols: Global System for Mobility (GSM) is a global standard based on TDMA. GSM utilizes the GSM Mobile Application Part (MAP) as a mobile networking protocol.

Third generation network Universal Mobile Telecommunications System (UMTS) is a global coverage and seamless services with enormous variety of applications and interactive services. UMTS involves a satellite segment which complements the terrestrial one to offer a global mobile communication service.

Long Term Evolution, LTE, is a standard for wireless communication of high-speed data for mobile phones and data terminals. It is based on the GSM/EDGE and UMTS/HSPA network technologies, increasing the capacity and speed using new modulation techniques.

Theory and practice of the unit Wireless Networks and Security covers key knowledge and skills students would be expected to attain by successfully completing this unit:

Capabilities

a) Capacity to explain the theoretical principles of mobile and wireless networks.
b) Ability to judge the suitability of the various services and standards for mobile communication.
c) Ability to select and recommend the appropriate technology for a given situation.
d) Ability to analyse a case study, investigate alternatives, and formulate and justify the chosen solution.

Competencies

e) Able to evaluate and describe main mobile protocols, such as IS-136, IS-95 and GSM.
f) Able to review and report on cellular systems: OFMD, MIMO, GSM, EDGE, WiMAX.
g) Able to compare and contrast aspects of mobility, such as hands-off and roaming.
h) Able to evaluate and discuss advantages and drawbacks of the wireless application protocols (WAP) and MAP.
i) Able to investigate and report on the different types of satellites: orbits, services and systems.

j) Able to critically analyse and rate satellite technologies, their design and operation.
k) Able to identify, and debate the benefits and drawbacks of satellite antennas and earth stations.

Professional Skills

l) Able to identify and critically analyse the structure and key features of mobile networks and satellite communication systems.
m) Ability to investigate the research and professional literature to solve, and report on, complex mobile communication problems.
n) Ability to develop models of practical applications and rigorously evaluate their performance.

This unit covers the following topics:

Mobile communication theory:

- Introduction to mobile and wireless communications, multi-carrier transmission, advanced single-carrier transmission, advanced receivers, advanced radio resource management and protocols, and different radio network architectures.
- Frequency division, orthogonal frequency division, time division and code division multiple access. Frequency division duplexing and time division duplexing
- The cellular concept, frequency reuse, channel allocation schemes, handoff, call control, interference
- Tele-traffic models for cellular mobile networks, GSM, EDGE, HSPA, CDMA, WiMAX, NBN
- CDMA system principals & spread spectrum for 3G wireless systems
- Cellular broadband wireless systems (3G+ and 4G).

Satellite: design, operation and evaluation of:

- Orbits (LEO, MEO, GEO, etc.), services, systems
- Satellite technology and operation
  - Spacecraft
- Earth stations, antennas (for satellites such as fixed, broadcast satellite, mobile, store and forward, tracking, telemetry)
- Investigation of future trends of satellite communication:
  - Emerging trends in mobile satellite services.

Integration of existing and new global telecommunications. Assessment components for this unit is as shown in the table 3.

Table 3: Assessments of Telecommunication Modeling and simulation unit

Assessment Type	**When assessed**	**Weighting**	**Learning Outcomes Assessed**
Test	Week 6	10%	a-c
Group assignments	Weeks 5 and 12	40%	k-n
Laboratory exercises	Weeks 2 - 12	10%	d-f
Examination (2 hours)	Week 14	40%	a-m

5. International Standards mapping

Sydney accord and Washington accord are international standard organisations [11]. Both accord agreement has been established and signed by the leading Engineers associations of all the countries involved, and graduates of the signatories are recognised as Engineering professionals by the corresponding associations. The accord provides for the mutual recognition of technology programs. The accord has been signed by a number of countries—including Australia—in which similar Engineering programs are delivered, and therefore covers the academic aspects that are part of the Engineering professional licensing and regulation requirements in all those countries.

The aim of the Bachelor of Engineering Technology (Telecommunications) – BEngTech (Tel), Graduate Diploma of Engineering (Telecommunications)– GDEng (Tel) and Master of Engineering (Telecommunications) – MEng (Tel) is to enable students to develop and demonstrate an understanding of a broad knowledge of the fundamentals of Telecommunication Engineering. Students develop skills in industry relevant technologies, and they develop professional skills in independent learning, interpersonal communication, time management, and teamwork. Graduates of the GDEng and MEng (Tel) will be internationally recognised as Professional Engineers and BEngTech(Tel) will be recognised as Engineering Technologists.

A graduate of a Washington Accord program in Engineering is able to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to defined and applied engineering procedures, processes, systems or methodologies. Washington accord specified three profiles: Knowledge, Graduate attributes and

Professional Competencies. These profiles attributes are mapped onto proposed engineering units.

6. Survey of Engineering degrees

One of the important aspect of course design is to align topics with current industry trends. Therefore, I took survey of proposed course structure and content. All participants are professional engineers as follows:

Australian professional engineers = 11
International professional engineers = 3
Industry professional engineers = 9
Academic professional engineers = 5

Survey includes 3 sections: Personal details, survey of BEngTech(Tel) course and survey of MEng (Tel) course. We did not take survey on GDEng (Tel) as engineering accord/organisation do not accreditate graduate diploma courses.

6.1 Summary of Personal Details Survey

Survey format is given in section 6.1 and summary of the survey in section 6.2.

6.1.1 Personal Details Survey Format

1. Title
○ Mr ○ Ms ○ Mrs ○ Miss ○ Dr
○ A/Professor ○ Professor ○ Other
Other (please specify)
2. Given Name:
3. Family Name:
4. Position:
5. Company Name and address
Company Name: Suburb: State
6. Email:
7. Phone number:
8. Qualifications:
Bachelor degree and specialisation:
Master Degree and specialisation:
PhD and Specialisation:
9. Are you member of Engineers Australia?
○ Yes ○ No
10. If Yes, level of Engineers Australia membership
○ Graduate Member ○ Member
○ Chartered Professional Engineer ○ Other

6.1.2 Summary of Personal Details Survey

Table 4 gives summary of title and qualifications only. This table indicates that participants are knowledgeable in engineering area, specifically in telecommunications major to criticise the course structure and content. There is a good balance of post graduates and undergraduates among participants.

Table 4: Summary of personal details responses

1. Title	Response Percent	Response Count
Mr	50.0%	6
Mrs	8.3%	1
Dr	33.3%	4
Other	8.3%	1
Other (please specify)		1

8. Qualifications	Response Percent	Response Count
Bachelor degree and specialisation	83.3%	10
Master Degree and specialisation	91.7%	11
PhD and Specialisation	50.0%	6

6.2 Summary of BEngTech(Tel) and MEng (Tel) course surveys

Section 6.2.1 gives survey format for both courses, summary of BEngTech(Tel) survey in section 6.2.2, summary of MEng(Tel) survey in section 6.2.3 and comments received from participants are given in section 6.2.4 and 6.2.5. Course structure is given in section 6.2.6.

6.2.1 BEngTech and MEng Survey Form

All 10 questions specified below have 5 options and comment space as follows:

Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree
Comment:

There are 10 questions in each course survey as:
1. Full Name:
2. Is course well structured from Year 1 to Year 3?
3. Are core units appropriate to Telecommunication Engineering?
4. Are specialisation units appropriate to Telecommunication Engineering course?
5. Does Telecommunication Engineering course cover 'Core Knowledge'?
6. Does course cover 'Professional & Interpersonal Skills'?
7. Does course cover 'Life Long Learning'?
8. Does course cover hands on practical work?
9. Does course cover industry relevant material?
10. Does course cover industry based projects?

6.2.2 Summary of BEngTech(Tel) surveys

From table 5 below, summary indicates:

1. No one indicated 'Strongly Disagree'. That means all participants are happy with the proposed course.
2. On average more than 80% of the participants agreed that course covers professional body requirement and as well as current industry trends.

Table 5: Summary of BEngTech(Tel) surveys

	Strongly Agree	Agree	Neutral	Disagree
Is course well structured from Year 1 to Year 3?	15.4%	61.5%	15.4%	7.7%
Are core units appropriate to Telecommunication Engineering?	7.7%	76.9%	15.4%	
Are specialisation units appropriate to Telecommunication Engineering course?	30.8%	46.2%	23.1%	
Does Telecommunication Engineering course cover 'Core Knowledge'?	33.3%	50.0%	16.7%	
Does course cover 'Professional & Interpersonal Skills'?	15.4%	76.9%	7.7%	
Does course cover 'Life Long Learning'?	15.4%	46.2%	30.8%	7.7%
Does course cover hands on practical work?		76.9%	23.1%	
Does course cover industry relevant material?	7.7%	76.9%	15.4%	
Does course cover industry based projects?	7.7%	76.9%	15.4%	

6.2.3 Summary of MEng(Tel) surveys

From table 6 below, summary indicates similar to BEngTech (Tel):

1. No one indicated 'Strongly Disagree'. That means all participants are happy with the proposed course.
2. On average more than 75% of the participants agreed that course covers professional body requirement and as well as current industry trends.
3. However there are concern in 3 areas, which have more than 35% as Neutral.
   a. Are core units appropriate to Telecommunication Engineering?
   b. Does course cover 'Life Long Learning'?
   c. Does course cover hands on practical work?
   d. Does course cover industry relevant material?

We will invigate these further.

Table 6: Summary of MEng(Tel) surveys

	Strongly Agree	Agree	Neutral	Disagree
Is course well structured from Year 1 to Year 2?	7.1%	71.4%	14.3%	7.1%
Are core units appropriate to Telecommunication Engineering?	7.1%	50.0%	42.9%	
Are specialisation units appropriate to Telecommunication Engineering course?	7.1%	64.3%	28.6%	
Does Telecommunication Engineering course cover 'Core Knowledge'?	14.3%	71.4%	14.3%	
Does course cover 'Professional & Interpersonal Skills'?	14.3%	64.3%	14.3%	7.1%
Does course cover 'Life Long Learning'?	14.3%	42.9%	35.7%	7.1%
Does course cover hands on practical work?		38.5%	61.5%	
Does course cover industry relevant material?	7.1%	57.1%	35.7%	
Does course cover industry based projects?	14.3%	71.4%	14.3%	

6.2.4 Comments received for BEngTech(Tel)

2. Is course well structured from Year 1 to Year 3?

- Overall, I think subjects should be delivered in order like OSI layer; that is, from physical layer to application layer. For instance, BN102 Web Systems should be delivered after BN106 Networking Fundamentals. However, this logic totally depends on the contents/topics of each subject, not just its title. I said this because when I saw BN108 Programming for Networking I thought students should be taught a programming fundamental subject prior to taking BN108. However, looking at the topics of BN108, the subject itself looks more like a programming fundamental.

- SSL related(symmetrical key, Public, Private keys, Message Digests etc.) Network Management related(SNMP protocol, Agent development, MIB definitions and SNMP tools Web Services. Firewalls, Proxy Servers, DHCP (listed as DCHP!). ATM Technology being covered?
- From Industrial point of view, I think Unit BN203 needs Unix C, Unit BN201 needs Matlab/Scilab's signal processing toolbox to introduce; BN 108, 301 --> Network Simulator / OPNET initiated

4. Are specialisation units appropriate to Telecommunication Engineering course?

Would be nice to include case studies from MEF (Metro Ethernet Forum) and TMForum since many of the telecom service providers are building there systems based on this suggestions and guidelines.

5. Does Telecommunication Engineering course cover 'Core Knowledge'?

Practical NS2 & Matlab, Unix C applications should be included in major courses.

7. Does course cover 'Life Long Learning'?

I think subjects like BN301 Project 1 and BN304 Project 2 would make students learn. People learn well when they have to find ways to solve their problems. Success or not, they learn.

8. Does course cover hands on practical work?

Unit titled as Prog for Networking seems to have Object Oriented Coding, Is TCP/IP socket communication covered in here?

9. Does course cover industry relevant material?

- NBN will be the next big thing for Australian telecommunication industry. A practical demonstration of what would be the role of NBN and what would be the role of service providers like Telstra or Optus will show more light to students. They will be able to figure out where they should apply the course skills. Also it would assist a focused student to stream line his carrier.
- When the practical NS2 & Matlab, Unix C applications should be included in major courses.

10. Does course cover industry based projects?

Some visit and information analysis based studies may help in this regard.

6.2.5 Comments received for MEng(Tel)

2. Is course well structured from Year 1 to Year 2?

- Is it possible that we replace the phrase "Overview of" with the phrase "Introduction to"? Or even remove it for example "Overview of Digital Communication", we could change to "Digital Communication Systems".
- May be the term overview can be removed from unit names. Can introduce more project work.
- Perhaps the course is designed for students with background in any disciplines, and that is why there are quite a number of introductory/overview subjects. At master level, I am looking for advanced/challenging subjects.

3. Are core units appropriate to Telecommunication Engineering?

- May be ME502 and ME503 be part of the core as this is a masters in Telecom.
- My experience with the study of telecommunication engineering is that in telecommunication systems, there are three areas that students wish/need to study. They include "Medium access control systems/methods/protocols (e.g. TDMA, FDMA, CDMA)", "Transmission systems including switching systems (e.g. SONET, PBXs)", "Signaling system including controlling system e.g. SS7". Nowadays, computer systems seem to replace hard-switching devices with soft-switching software.
- Unit 502,503, 504 needs signal processing tooolbox induced (from MATLAB/SCILAB); Unit 504,504,601,602 must implement Network Simulator 2/3 or OMNET++ -- which are industrially used -- to make the courses appropriate.

4. Are specialisation units appropriate to Telecommunication Engineering course?

Is it possible that we make "ME503 Telecommunication System Engineering" a core unit. Replacing it with a unit in DSP in audio, image or video? MATLAB or Octave can be used for teaching DSP related units.

5. Does Telecommunication Engineering course cover 'Core Knowledge'?

- Advanced Networking should also include routing technologies like BGP and OSPF. Web services should discuss both synchronous and asynchronous web service calls.

8. Does course cover hands on practical work?

- A case study on NBN would add lot of value to the course. For master students a case study on NBN technologies would add more value. As you might be aware NBN has three modes of service wireless, satellite and wired communication. What is the need of providing different types of services would create a lot of curiosity and interest to the students.
- Need to look at the type of practical work involved and in which courses/units

9. Does course cover industry relevant material?

NBN will be the next big thing for Australian telecommunication industry. A practical demonstration of what would be the role of NBN and what would be the role of service providers like Telstra or Optus will show more light to students. They will be able to figure out where they should apply the course skills. Also it would assist a focused student to stream line his carrier.

10. Does course cover industry based projects?
Industry visit in addition to core software implementation as mentioned above.

6.2.6 Course structure

Based on the surveys, courses have been redesigned a bit and final structure is as follows:

BEngTech(Tel) course structure

Year 1

Semester 1
BN101 Effective Participation at Work
BE101 Engineering Mathematics
BN102 Web Systems
BN103 Platform Technologies
Semester 2
BE103 Engineering Practice
BN106 Networking Fundamentals
BN108 Programming for Networking
BE102 Digital Systems

Year 2

Semester 1
BN203 Network Security 1
BN209 Software Engineering
BN206 System Administration
BE201 Digital Communication
Semester 2
BE202 Local and Wide Area Network Technologies
BN205 Project Management
BN208 Networked Applications
BE203 Telecommunication Systems

Year 3

Semester 1
BN301 Project 1
BN303 Wireless Networks and Security
BE301 Telecommunication Modeling and simulation
BE302 Mobile and Satellite Communication Systems
Semester 2
BN304 Project 2
Elective
Elective
Elective

MEng (Tel)course structure

Year 1

Semester 1
ME502 Overview of Digital Communication
MN503 Overview of Internetworking
ME504 Advanced Networking
Semester 2
MN502 Overview of Network Security
ME503 Telecommunication System Engineering
MN601 Network Project Management

Year 2

Semester 1
ME603 Project 1
ME601 Telecommunication Modeling and simulation
Elective
Semester 2
ME604 Project 2
ME602 Mobile and Satellite Communication Systems
Elective

Proposed telecommunication courses have telecommunication units as core units. Telecommunication area also covers networks and student will get specialisation in networking area. The existing Networking electives have been selected which are important developments in the area of telecommunications. Electives are specialised in Enterprise Networks, Network Security and Software Engineering. They have been developed by specialist lecturers and have received excellent feedback from student reviews.

7. Conclusion

The Bachelor of Engineering Technology (Telecommunications) BEngTech (Tel) enables its graduates to demonstrate an understanding of broad engineering/telecommunications knowledge in engineering mathematics, digital systems, networking, combined with theoretical insights and substantial depth in general management practices.

The Master of Engineering (Telecommunications) MEng (Tel) enables its graduates to demonstrate an understanding of broad engineering/telecommunications knowledge in digital systems, digital communications, networking, security, modelling and simulation, telecommunication system engineering, mobile and wireless modelling, combined with theoretical insights and substantial depth in general professional engineering management practices.

The curriculum involves analysing and planning approaches to technical problems and management issues, where information is used to forecast for planning and research purposes. Specifically the course delivery mode will be based on case study analysis, tests, examination and problem based learning approaches.

Further course development includes unit development [12] and laboratory setup with physical devices and simulators [13] [14].

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