BACHELOR OF ELECTRICAL/ELECTRONIC ENGINEERING PROPOSAL

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Engineering Stakeholders' Meeting
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USP
THE UNIVERSITY OF THE SOUTH PACIFIC

Agenda

- Role of Professional Engineers.
- Design Project & Analysis.
- Specialization.
- First Engineering Degree Programs.
- Degree Programs Accreditation.
- Engineering Programs Requirements.
- Demand for Professional Engineers.
- Electrical/Electronic Engineering Curriculum.

ROLE AND EXPERTISE OF PROFESSIONAL ENGINEERS

- Professional practitioners of engineering.
- Apply:
  - scientific knowledge,
  - mathematics/physics,
  - ideas to solve practical problems/meet challenges.
- Develop solutions for technical problems.
- Design materials, machines, and systems.
- Consider the limitations imposed by:
  - practicality,
  - safety,
  - cost.

DESIGN PROJECT AND ANALYSIS

- Design:
  Develop new technological solutions.
  - Defining problems (specifications, requirements),
  - Conducting research (about 56% of the total design process),
  - Analyzing criteria,
  - Finding solutions (that best match the requirements),
  - Making decisions (implementation, prototyping).

- Analysis:
  Apply engineering analysis techniques in:
  - manufacturing,
  - testing,
  - maintenance.

  Estimate the Time/Cost required to complete projects.

SPECIALIZATION

- Specialize in one or more engineering disciplines:
  - Electrical,
  - Electronics,
  - Mechanical, …
- Specialize in one industry or technology:
  - Motor vehicles,
  - Turbines,
  - Electric power distribution systems, …
- Specialties are recognized by professional societies:
  - IEEE Vehicular Technology Society,
  - IEEE Power and energy Society, …

FIRST PROFESSIONAL ENGINEERING DEGREE CURRICULUM

- Most engineering programs involve:
  - Pure science courses:
    - Mathematics,
    - Physics, ...
  - General engineering courses.
    - Engineering graphics,
    - Engineering law, ...
  - Specialized engineering courses.
  - Course design project is part of the curriculum of most engineering programs.
  - General courses not directly related to engineering:
    - Social sciences,
    - Humanities, …
  - Industrial attachment.

ENGINEERING DEGREE PROGRAMS GRADUATE EXIT REQUIREMENTS?

- Management Skills:
  - Business Planning.
  - Ethical Practices.
  - Engineering Law.
- Communications Skills:
  - Oral/Written.
  - Technical Presentations.
  - Technical Reports.
- Project Development Skills:
  - Design/Development.
  - Verification.
  - Team Building.

ACCREDITATION

- Process by which engineering program are evaluated by an external body to determine if applicable standards are met.
- THE WASHINGTON ACCORD serves as an international accreditation agreement for academic engineering degrees.
- Degree programs in engineering are accredited by:
  - The Institution of Professional Engineers (IPENZ) in New Zealand.
  - The Accreditation Board for Engineering and Technology (ABET) in the United States.
  - Engineers Australia (EA) in Australia.
  - The Institution of Engineering and Technology (IET) in the United Kingdom.
  - The Canadian Engineering Accreditation Board (CEAB) in Canada.

ENGINEERING PROFESSIONAL DEGREE PROGRAMS REQUIREMENTS

- Electrical & Electronic Engineering Degree Programs require:
  - Specialized Laboratories.
  - Specialized Academic Staff Members.
  - Industry-University Partnerships are Essential.

DO WE NEED PROFESSIONAL ENGINEERS?

- Demand for Engineering graduates by:
  - Local and regional industry.
- USP has responded by using:
  - Real market data analysis.
  - Local and regional demand.
  - Students career perceptions.
- USP is in the process of developing and implementing new four-year specialized professional engineering degree programs:
  - Bachelor Degree in Electrical/Electronic Engineering (BEng).
  - Bachelor Degree in Mechanical Engineering (BEng).
- Proposed BEng in Electrical/Electronic curriculum is in line with international engineering degree standards:
  - The Institute of Electrical and Electronics Engineers (IEEE).
  - The Association for Computing Machinery (ACM).

ELECTRICAL/ELECTRONIC ENGINEERING CURRICULUM

YEAR 1

Semester 1	Semester 2
PH102 Classical Physics	EE102 Electrical & Electronics Tech
MM101 Engineering Graphics & Design	MM103 Engineering Mechanics
UU114 English for Academic Purposes	CS102 Computing for Science & Tech.
MA111 Calculus I & Linear Algebra I	MA112 Calculus II

The first year courses are a mix of basic mathematics and physics courses as well as introductory courses in Mechanical Engineering and Electrical & Electronics Engineering. There is an English course aimed at improving their written and oral communication skills.

BLUE - New Courses
GREEN – Revised Courses
BLACK - Existing Courses

ELECTRICAL/ELECTRONIC ENGINEERING CURRICULUM

YEAR 2	Semester 1	Semester 2
EE222 Digital Electronics		EE224 Signals & Systems
EE212 Analog Electronics I		EE211 Electrical Machines
MA211 Advanced Calculus		EE225 Analog Electronics II
CS211 Computer Organisation		MA272 Engineering Mathematics IV
		EE200 Industrial Attachment

BLUE - New Courses
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Brief Course Descriptions

- EE222 Digital Electronics:
  - Prerequisite: EE102 or MA111
  - Digital electronic devices and equipment are widely used not only in industry, but also in offices and homes. It is important that technologists and engineers not only understand the principles of digital circuits, but also be able to design digital circuits. The focus of this course is on the design of combinational and sequential logic circuits based on MSI and LSI devices.
- EE212 Analog Electronics I:
  - Prerequisite: EE102
  - This course provides an introduction to the study of Analog Electronics. The first section of the course is essentially devoted to Fundamentals of Analog Devices and Circuits. The next section primarily covers operational amplifiers and their applications which are thoroughly covered. Topics to be covered include: Diode Applications and Special Purpose Diodes, Bipolar Junction Transistors, BJT Bias Circuits and Amplifiers, Field-Effect Transistors, FET Amplifiers and Switching Circuits, Introduction to Op-Amp Circuits, Introduction to Filters, Introduction to Oscillators, CAD, Electronic System Maintenance.

Brief Course Descriptions

- MA211 Advanced Calculus:
  - Prerequisite: MA112
  - This course builds on MA111 and MA112 by further studying mathematical tools for analyzing change. The calculus of functions of several variables is studied with applications to computing arc lengths, surface integrals and volume integrals, and computing extreme values of functions subject to certain constraints. Computing maximum and minimum values of functions of several variables has wide applications in mathematics, computing, economics, engineering and the physical sciences.

- CS211 Computer Organisation:
  - Prerequisite: CS112
  - This course provides an overview of computer systems, representation of data, digital logic, micro-programming level, instruction set processor level, operating system level, and assembly language level.

Brief Course Descriptions

- EE224 Signals & Systems:
  - Prerequisite: EE102 and MA211
  - This subject deals with continuous-time signals and systems. It provides a bridge between the usual circuit subjects and advanced 3rd and 4th year subjects. This subject covers the basic concepts and theories in the field of signals and systems. It covers fundamental topics in signal and systems such as continuous-time signals, continuous-time systems, discrete-time signals, Fourier transform, Laplace transform, Z-transform and introduction to filters. The laboratory component in this course is based on the MATLAB software.

- EE211 Electrical Machines:
  - Prerequisite: EE102
  - This is an introductory course in electrical engineering that deals with electrical to mechanical energy conversion and vise-versa. Electrical machines covered in this course are transformers, electric motors (Induction, Synchronous and DC) and synchronous generators. A new genre of machines, the variable reluctance machines (or stepping motors) will also be studied. An introduction to motor controllers will also be made in this course.

Brief Course Descriptions

- ~~EE225 Analog Electronics II:~~
  - Prerequisites: EE212
  - This course considers Advanced Analog Circuit Analysis and Design techniques. It builds upon basic knowledge of Analog Electronics taught in the pre-requisite course, taking the student through to a reasonable level of Analysis and Design proficiency. Topics to be covered include: Operational Amplifier and Data-Converter Circuits, Building Blocks of Integrated-Circuit Amplifiers, Differential and Multistage Amplifiers, Frequency Response, Feedback, Output Stages and Power Amplifiers, Filters and Tuned Amplifiers, Signal Generators and Waveform-Shaping Circuits.

- MA272 Engineering Mathematics IV:
  - Prerequisites: MA112 and CS102
  - This provides students with an introduction to mathematical and statistical software and its application to engineering and related problems. Topics to be covered include: probability distributions and densities, expectation and moments, uncorrelatedness and independence, multi-variate Gaussian density, stochastic processes, optimization methods, matrix algebra and analysis, Laplace, Fourier, and Z transform, and R-K methods.

Brief Course Descriptions

- EE200 and MM200 Industrial Attachment:
  - Prerequisites: MM101, MM103 & EE102
  - Workshop practice provides an avenue for engineers to hone skills inside the workshop to support practical work in courses as well as in the industry. Students are expected to have attained adequate general skills to safely and efficiently operate machinery to complete tasks on time. In addition, students are expected to become proficient in first aid and occupational health and safety before advancing to Industrial Attachment. The Industrial Attachment (IA) consists of 800hours of work in an engineering firm or engineering section of a company under the supervision of engineers and workshop supervisors. It is expected that the students completed IA during the summer vacation of the second & third year of study. Here the students must complete and log 800 hours of hands on experience in technical work in the industry and must identify a small industry project and solve the engineering problems using resources available within the industry and the school and in continuous consultations with the faculty member appointed to supervise the project.

ELECTRICAL/ELECTRONIC ENGINEERING CURRICULUM

YEAR 3 **Semester 1** **Semester 2**

EE321 Power Systems Analysis
EE312 Control System Engineering
EE313 Microprocessor Applications
EE301 Energy Supplies

EE323 Digital Control Systems
EE314 Electrical Systems Design
EE325 Power Electronics
EE326 Embedded Systems
EE200 Industrial Attachment

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Brief Course Descriptions

- EE321 Power Systems Analysis:
  - Prerequisite: EE224 or EE211
  - This course will develop the ability of the graduates to solve various power system problems, e.g. Load flow analysis, Z- bus formulation, Fault analysis, power system control, stability analysis.

- EE312 Control System Engineering:
  - Prerequisites: EE224 or MA211
  - This course provides an understanding of the components used in process control, the fundamental principles of process dynamics, and classical feedback control. The course is structured as a first course in control systems. It will take the student through topics such as: transducers (sensors), actuators, processes and plants, transfer functions, system specifications, stability of feedback control systems, and the design of controllers and compensators using root locus, Bode plot and Nyquist plot techniques.

Brief Course Descriptions

- EE313 Microprocessor Applications:
  - Prerequisites: EE222
  - This course builds on the foundation provided by the course EE222 Digital Electronics and provides the student with the knowledge of the internal organisation of microprocessors and computer buses. The principles of operation of digital computers and the interfacing techniques needed to use microprocessors in engineering applications involving data acquisition are covered.

- EE301 Energy Supplies:
  - Prerequisites: None
  - The course considers the resources and distribution of energy in the world as a whole and the region in particular. The main energy conversion processes, chemical to thermal, thermal to mechanical and mechanical to electrical are studied. Particular emphasis is placed on a detailed analysis of the physical problems involved in harnessing renewable and locally available energy sources such as solar radiation, wind, hydro-power, biomass, wave power, and ocean thermal energy. Laboratory work on small scale devices and experiments to harness these sources form a significant part of the course.

Brief Course Descriptions

- EE323 Digital Control Systems:
  - Prerequisite: EE312
  - This course covers the principles of sampled data systems and the digital implementation of controllers and compensators. Topics to be covered include signal sampling and reconstruction, z-transform analysis of sampled data systems, digital controller and compensator design via classical techniques (transfer functions), state space system analysis, and design of digital controllers and compensators using modern techniques (state space systems).

- EE314 Electrical System Design:
  - Prerequisites: EE211 or EE225
  - This course covers design methodology, use of computers and CAD packages in design, electrical installation design to AS/NZS 3000:2007 standard, lighting design, selection of motors and design of and electromagnetic controllers, preparation of project documentations. Topics to be covered include industrial control system design using feedback/supervisory control and programmable controllers; selection of motors and design of and electromagnetic controllers.

Brief Course Descriptions

- EE325 Power Electronics and Drives:
  - Prerequisite: EE224 and EE225
  - A detailed study of different types of power converters and their application will form the major part of the course. Industry standard analytical techniques will be taught to provide students with the necessary tools assess and develop solutions for a wide range of energy conversion related engineering problems. An introduction and use of the basic topologies of switched mode power converters, steady state modelling and their uses will be addressed. Dynamic modelling analysis using the state-space averaging method will also be covered. Fundamentals of inductor, transformer, and semiconductor switch design.

- EE326 Embedded Systems:
  - Prerequisite: EE313 and CS211
  - This course provides a broad introduction to topics in general and special purpose processors. The course focuses on the techniques of quantitative analysis and evaluation of embedded systems. Topics to be covered include: Memory technologies, bus architecture, I/O structures, and interface design. General and special purpose microprocessors. Introduction to System-on-Chip. Students will also undertake a course design project.

ELECTRICAL/ELECTRONIC ENGINEERING CURRICULUM

YEAR 4 **Semester 1** **Semester 2**

Semester 1
EE498 Engineering Project I
EE412 Professional Engineering
MG411 Project Management
Option-I

Semester 2
EE499 Engineering Project II
EE421 Maintenance& Reliability Engg
EE422 Digital Signal Processing
Option-II

Option-I & Option-II Courses

Electrical & Electronic Engineering
EE401 Special topics in Power Systems
EE403 Advanced Digital Control
EE404 Mechatronics
EE414 Power Electronics for Distributed Generation and Renewable Energy Systems
EE405 VLSI Design Techniques

BLUE - New Courses
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Brief Course Descriptions

- EE498/MM498 Engineering Project I:
  - Prerequisite: Successful Completion of ALL 100, 200 and 300 level Core Engineering Courses
  - The engineering project is an opportunity for students to conduct an independent research in an environment and manner that utilizes their learnt skills and knowledge to develop further their engineering research skills. With the guidance of a staff supervisor, students will define a research question, identify its foundation in our existing knowledge, recognize or develop the skills/tools required to investigate the question, apply scientific methods to explore the problem in a methodical fashion, and analyse and present results in clear, concise and structured reports, posters, and oral presentations.

- EE412 Professional Engineering:
  - Prerequisite: LL114 and (MM200 or EE200)
  - This course equips the students with the knowledge and appreciation of the roles and responsibilities of professional engineers in the society. Topics that will be covered in this course include responsibility, honesty, integrity and reliability in professional practice; safety, risk and liability; role of engineers in addressing ecological concerns, engineering issues in the South Pacific, role of SPEA; rights of engineers; skills of writing complex professional documents and contract law.

Brief Course Descriptions

- MG411 Project Management:
  - Prerequisite: Approval of Head or Nominee
  - The course involves the concepts, tools and techniques of project management from its planning to scheduling to implementation to commissioning and finally to review. Each stage will demonstrate the importance of human resources, finance, materials and equipment etc. to complete a project in due time and within allocated budget. Clashing of time and cost will be part of discussion as time-cost trade-off is a very important issue in project management. Due importance will be given to project management information systems, reporting systems and computerization as they emerge as the latest issues in project management. Features of software packages such as MS Project and Primavera, and how these packages help in controlling and scheduling of complex projects, will be discussed.

- EE499/MM499 Engineering Project II:
  - Prerequisite: EE498/MM498
  - The fourth year engineering project is an opportunity for students to conduct a definitive piece of independent research in an environment and manner that utilizes their learnt skills and knowledge to develop further their engineering research skills.

Brief Course Descriptions

- EE421/MM421 Maintenance & Reliability Engineering:
  - Prerequisite: MA272
  - This course is a blend of Maintenance Technology and Maintenance Management, taking into consideration reliability and economics of maintenance strategies. Under the Maintenance Technology, the student will be exposed to condition monitoring techniques, such as vibration, acoustic monitoring and temperature, and in Maintenance Management, they will be exposed to Reliability and Economics of Maintenance, strategies for plant inspection and maintenance, and various other aspects.

- EE422 Digital Signal Processing:
  - Prerequisite: EE224 and MA272 or approval by Course Coordinator/School
  - The subject provides with a sound knowledge of the fundamentals of DSP. It covers A/D and D/A converters, analysis of discrete time signals and systems, design of finite impulse response (FIR) and infinite impulse response (IIR) digital filters. Various methods of implementing digital filters are also discussed. The laboratory concentrates on the fixed-point digital signal processor and Matlab software. Emphasis is on implementing useful DSP systems in real-time using assembly language of the Texas Instruments digital signal processor TMS320C50. Students will also undertake a course design project.

Brief Course Descriptions

- EE401 Special topics in Power Systems:
  - Prerequisite: EE321 and EE325
  - Study of power systems today incorporates modern techniques in power generation and distribution based on dynamics of interconnected systems in deregulated environment. These modern techniques include deterministic study using the power of modern computers and artificial intelligence to meet the power demand. Furthermore, various methodologies are deployed to improve reliability and to sustain the cost effective delivery of power.

- EE403 Advanced Digital Control:
  - Prerequisite: EE323
  - This course presents an advanced theory of digital control systems, sampled-data control systems, analysis and synthesis, as well as practical implementation of the digital control algorithms. Topics covered include a review of digital control system fundamentals and analysis, digital compensator and filter design, discrete linear regulator problems, discrete optimal control design, discrete Kalman filter design, introduction to discrete-time stochastic control systems, discrete Liapunov stability analysis, microprocessor-based control systems and introduction to intelligent and autonomous systems.

Brief Course Descriptions

- EE404 Mechatronics:
  - Prerequisite: EE312 or EE323 or approval by Course Coordinator/School
  - Mechatronics, unlike traditional engineering techniques, is a multi-disciplinary approach to solving engineering problems. In its simplest form it is the intelligent control of an electromechanical system, and as such, practitioners must be skilled in electronics, mechanics, and software. Topics include: intelligent product and processes; design methodology; system modelling; sensors and actuators; microcontrollers; knowledge based control.

- EE414 Power Electronics for Distributed Generation and Renewable Energy Systems:
  - Prerequisite: EE321 and EE325
  - This course introduces concepts on smaller electricity generation systems connected to grid or simply distributed generation systems (DGS). The concept of DGS forms one of the components of the smart grids where electricity generation, storage and consumption are communicated to have better control of power production and flow. The decentralised "feed-in" system has its own technological challenges such as noise to signal ration (SNR) control, load flow control and safety issues. This course explores technological developments and challenges faced in DGS, and well as economical models are explored for scalability of such systems for profit making independent power producers (IPP).

Brief Course Descriptions

- EE405 VLSI Design Techniques:
  - Prerequisite: EE212, EE222, and EE225 or approval by Course Coordinator/School
  - This course provides a broad introduction to topics and techniques used in VLSI design. The course focuses on the techniques of quantitative analysis and performance evaluation of chip design and test. Topics to be covered include: MOS Technologies. Electrical properties of NMOS and CMOS transistors. Subsystem design and layout using simple static, complex static, and dynamic domino CMOS logic circuits. Designs of NMOS and CMOS PLA, finite state machines and memory systems. System designs using gate arrays and Field-Programmable Gate Arrays.

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THANK YOU!