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MODULE DIRECTORY

LEVEL 6 – Electronics Pathways

SCHOOL OF APPLIED COMPUTING

FACULTY OF ARCHITECTURE COMPUTING AND ENGINEERING

2018-2019

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INTRODUCTION

This Module Directory includes all the modules for Level 6 Electronics within the School of Applied Computing in the academic year 2018-2019.

This directory accompanies the Programme of Study Handbook, which will provide you with details of which modules you will be studying for your programme this year in the 'Programme of Study' section. This directory may include modules that are running on other programmes of study within your School/Faculty. If you require assistance in identifying the modules for your programme of study, please contact the Programme Director (whose name and contact details are provided in the accompanying Programme of Study Handbook), or the relevant Faculty Office.

The University has made every effort to make the information as full and as accurate as possible, but you should note that minor changes in the organisation of modules between the planning stage and the actual teaching are inevitable. We shall try to keep any such changes to a minimum, and you will receive plenty of advance warning in the event of any alteration. We would also be grateful if you would let us know about any changes that you think might be helpful if introduced into future handbooks.

MODULES

MODULE CODE: M3X8527
TITLE: Digital Systems Synthesis
DATED: 03/06/2014

LEVEL: 6
CREDITS: 20

JACS CODE: H610

AIM(S)

- To develop an advanced appreciation of the structure and design of digital systems and finite state machines in particular.

LEARNING OUTCOMES

Upon the successful completion of this module, the student should be able to demonstrate the ability to:

1. Synthesis and critically evaluate of innovative VHDL designs through the use of state of the art simulation and synthesis software.
2. Implement advanced digital designs including multi-input systems controllers.

INDICATIVE CONTENT

- Review of combinational and sequential circuit design including finite state machines.
- System controller design: system synchronisation, handshaking, state assignment, next state decoder, output decoder.
- PLDs and FPGAs.
- VHDL: model development, behavioural modelling, the VHDL language, program design, modelling FSMs.
- Schematic capture, synthesis and simulation tools for PLD and FPGA design (e.g. Mentor Graphics, Altera and Xilinx).

LEARNING AND TEACHING STRATEGY

The theoretical content is introduced primarily via lectures. The module is intended to be practical in nature and to develop skills in designing digital circuits. Appropriate case studies will be a preliminary to students undertaking the design of combinatorial and sequential circuits in the laboratory. The designs will be implemented utilising programmable logic devices or FPGAs using the VHDL language.

The allocation of teaching to deliver the module is:

Activity type	Hours	Percentage
Scheduled learning	60	30%
Independent learning	140	70%
Placement learning	0	
TOTAL	200	100%

ASSESSMENT

Description of each assessment component and its weighting, together with an example for new forms of assessment:

Assessment Component 1 – Coursework - 40%

Use advanced synthesis tools such as Xilinx or Mentor to design, simulate and synthesise advanced digital designs. A formal laboratory report will be required for the assessment.

Exemplar: Synthesise an 8 bit by 8 bit signed number multiplier utilising appropriate synthesis tools.

Assessment Component 2 – Written - 60%

The exam will test theoretical understanding and application of concepts. Students will be required to solve fundamental digital design problems including finite state machines and multi-input systems controllers.

Assessment Summary

Activity type	Percentage
Written	60%
Coursework	40%
Practical	0%
TOTAL	100%

BIBLIOGRAPHY

Essential

Ashenden, P (2007) *Digital Design (VHDL): An Embedded Systems Approach Using VHDL*, Morgan Kaufman

Brown, S and Vranesic (2008), *Fundamentals of Digital Logic with VHDL Design*, McGraw Hill

Background

Botros, N M (2014) *HDL with digital design: VHDL and Verilog (Engineering Series)*, Mercury Learning and Information

Hamblen, JO, Hall, TS, and Furman, MD., *Rapid Prototyping of Digital Systems*, Springer Verlag (2007)

Lala, PK., *Principles of Modern Digital Design*, Wiley (2007)

Pedroni, V A (2014) *Finite State Machines in Hardware: Theory and Design (with VHDL and SystemVerilog)*

Reese, R and Davis, J. (2007) *Finite State Machine-datapath: Design, Optimization, and Implementation (Synthesis Lectures on Digital Circuits and Systems)* Morgan Claypool

Journals

ACM Transactions on Database Systems

ACM Transactions on Information Systems

MODULE CODE: M3X8529
TITLE: Embedded Microcontrollers
DATED: 03/06/2014

LEVEL: 6
CREDITS: 20

JACS CODE: H130

AIM(S)

- To extend the student's knowledge of microprocessor systems into common real-time and embedded control applications

LEARNING OUTCOMES

Upon the successful completion of this module, the student should be able to demonstrate the ability to:

1. Analyse real time systems.
2. Recognise and explain the design and operation of a range of embedded control systems.
3. Design, test and commission small embedded control systems based on a microprocessor or microcontroller.

INDICATIVE CONTENT

- Operating systems for real time applications. Real time kernels. Concurrency.
- Hardware architectures (microprocessor-based and microcontroller). Microcontroller review.
- Case studies of typical embedded control configurations (e.g. PC-based - mouse, network control, keyboard).
- Development system support (compiler, assembler, linker, simulator, in-circuit emulator, and programmer).

LEARNING AND TEACHING STRATEGY

Material is introduced in conjunction with practical work and is supported by examples classes and tutorials within a laboratory environment. Case studies of a wide variety of applications are analysed. One particular family of microcontrollers is examined in detail. Laboratory work involves a full development cycle for the design, test and implementation of an embedded control system (e.g. alarm clock, industrial controller, communications link controller).

The allocation of teaching to deliver the module is:

Activity type	Hours	Percentage
Scheduled learning	60	30%
Independent learning	140	70%
Placement learning	0	
TOTAL	200	100%

ASSESSMENT

Description of each assessment component and its weighting, together with an example for new forms of assessment:

Assessment Component 1 – Written – 60%

Analyse the characteristics and constraints of real time systems.

Assessment Component 2 – Coursework – 40%

Using computer-based development software, classify hardware and software systems for real-time applications.

- apply appropriate software design approaches;
- design and analyse suitable hardware configurations with supporting interfacing circuitry.
- design and implement a microcontroller system to satisfy a real-time application.
- demonstrate, document and justify all aspects of the design including the choice of microcontroller.
- a formal laboratory report will be required for the assessment

Exemplar: Design a digital clock utilising a RISC based processor.

Assessment Summary

Activity type	Percentage
Written	60%
Coursework	40%
Practical	0%
TOTAL	100%

BIBLIOGRAPHY

Essential

Gomaa, Hassan (2011) *Software Modeling and Design: UML, Use Cases, Patterns, and Software Architectures*, Addison-Wesley

Gomaa, Hassan (2013), *Designing Concurrent, Distributed, and Real-Time Applications with UML*, Addison-Wesley

Background

Laplante P A and Ovaska, S J (2011) [*Real-Time Systems Design and Analysis: Tools for the Practitioner*](#), Wiley

Gomaa, Hassan (2002) *Microchip PIC 16/17 Microcontroller Data Book*, Microchip

Gomaa, Hassan (2000), *Embedded Control Handbook*, Microchip

MODULE CODE: M6X00373
TITLE: Electrical Machines
DATED: 2013/14

LEVEL: 6
CREDITS: 20

JACS CODE: H600

AIM(S)

- To familiarise students with the construction and principles involved in electrical machines and electric power systems.

LEARNING OUTCOMES

Upon the successful completion of this module, the student should be able to demonstrate the ability to:

1. Demonstrate an in depth understanding of the principles of operation and design of electrical machines.
2. Demonstrate an in depth understanding of the principles involved in electric power systems engineering.

INDICATIVE CONTENT

- Transformers: single and three phase.
- Introduction to rotating machines.
 - o Underlying concepts of rotating machines; fundamental torque equation; rotating field principle; 3-phase windings; winding factors.
- The underlying concepts, theories and principles of operation, analysis and construction of:-
 - o Synchronous machines.;
 - o Polyphase induction motors;
 - o Direct current machine;
 - o Single-phase ac motors.
- A.C. Transmission and Distribution
 - o The grid system, analysis of short and medium length transmission line systems, analysis
- Stability
 - o Definition, types, stability, effects of faults on stability, loading and maintaining stability.
- Protection
 - o Purpose and function of protection system; types of protection systems and their analysis; design criteria;
- Earthing of Power Systems
- Overhead Lines and transmission line parameters
- Underground cables: types, laying, components, properties and ratings.
- High Voltage Direct Current Transmission (HVDC)

- o Advantages and disadvantages; history, types of HVDC links; operation, analysis and design.
- Flexible AC Transmission Systems (FACTS)

LEARNING AND TEACHING STRATEGY

This module will be taught using a range of teaching and learning strategies which may include formal lectures with use of presentations, simulations, worked examples, worksheet exercises and group work where appropriate. Practical session may include the use of suitable equipment for experiment and analysis of results. The smaller nature of the groups can facilitate a tutorial type approach but delivered in a laboratory situation.

The allocation of teaching to deliver the module is:

Activity type	Hours	Percentage
Scheduled learning	60	30%
Independent learning	140	70%
Placement learning	0	
TOTAL	200	100%

ASSESSMENT

The student would typically be required to complete 2 assignments worth 20% each and sit one exam worth 60% together these cover all the learning outcomes.

Assessment Component 1 – Written (Exam) - 60%

Typically, the student would be required to answer 3 questions out of 4 in 2 hours.

Assessment Component 2 – Coursework – 40%

Typically, the student may be required to carry out laboratory work and investigative research into one or more areas from the indicative content such as DC and AC machines, transformers or transmission lines.

Assessment Summary

Activity type	Percentage
Written	60%
Coursework	40%
Practical	0%
TOTAL	100%

BIBLIOGRAPHY

Essential

Vukosavic S. *Electrical Machines (Power Electronics and Power Systems)* Springer (2013)

Stephen J Chapman, *Electrical Machinery and Power System Fundamentals*. McGraw-Hill Higher Education. (2001)

Hughes A. *Electric Motors and Drives: Fundamentals, Types and Applications, 3rd Edition*. Newnes ISBN: 0750647183. (2005)

Background

Hughes E, Hiley J, Brown K, McKenzie-Smith I. *Hughes Electrical Technology, 10th Edition*. Prentice Hall. ISBN: 978-0132060110. (2008)

Shepherd J, Morton A H, Spence L F. *Higher Electrical Engineering*. Longman. ISBN: 0582988888. (1986)

Bird J. *Electrical Circuit Theory and Technology, 4th Edition*. Newnes. ISBN 978-1-85617-770-2 (2010)

Wildi T. *Electrical Machines, Drives and Power Systems*. Prentice Hall. ISBN: 0131969188. (2005)

MODULE CODE: M6X00374
TITLE: PLCs and Control
DATED: 03/06/2014

LEVEL: 6
CREDITS: 20

JACS CODE: H660

AIM(S)

- To develop an advanced, systematic understanding of analytical methods for predicting the behaviour of a feedback control system and the requirements for safety in the design of industrial computer control.

LEARNING OUTCOMES

Upon the successful completion of this module, the student should be able to demonstrate the ability to:

1. Produce a detailed specification for complex feedback control systems.
2. Synthesize a solution to a control application: write software code and document appropriately.
3. Critically appraise, design and document the hardware and software required for fault diagnostics, operator controls, and safe operation.

INDICATIVE CONTENT

- PLC architectures and concepts
- IEC 61131-3 programming standard: Sequence function charts, timing diagrams, ladder and instruction mode programming
- System Representation: Transfer functions, block diagrams and signal flow diagrams. State-space representation, phase-variable diagrams.
- Time domain analysis: transient performance, root locus, Routh stability.
- Frequency domain analysis: Bode diagrams, Nyquist, Nichols chart.
- Fault diagnosis: Fault trees, Bayesian probability, top down fault finding.

LEARNING AND TEACHING STRATEGY

The implementation of this module will focus on practical activity. This will include programming for the actuator operation of a small-scale automation system. Also there will be a requirement to develop simulation software to test control theories and predict the behaviour of a system using Matlab simulation tools.

The allocation of teaching to deliver the module is:

Activity type	Hours	Percentage
Scheduled learning	60	30%
Independent learning	140	70%
Placement learning	0	
TOTAL	200	100%

ASSESSMENT

Description of each assessment component and its weighting, together with an example for new forms of assessment:

Assessment Component 1 – Coursework - 100%

Students will be required to use design tools to determine parameters of systems for a given specification. They will be required to systematically implement IEC 61131-3 recommendations to a professional level in writing software code, and its documentation.

Assessment Summary

Activity type	Percentage
Written	0%
Coursework	100%
Practical	0%
TOTAL	100%

BIBLIOGRAPHY

Essential

Jack, H. (2010) *Automating Manufacturing Systems with PLCs* Lulu.com ISBN-10: 0557344255 (also available in full online - http://engineeronadisk.com/V2/book_PLC/engineeronadisk.html)

Kuo, B.C. and Golnaraghi, F. (2009) *Automatic Control Systems*, Prentice Hall

Background

Bolton, W. (2009) *Programmable Logic Controllers* Newnes

Bryan, L.A. and Bryan, E.A. (2003) *Programmable Controllers* 2nd Edition, IDC Textbooks

Websites

IEEEExplore digital library

Appropriate websites to module content.

MODULE CODE: M6X00375
TITLE: Power Electronics and Drives
DATED: 2013/14

LEVEL: 6
CREDITS: 20

JACS CODE: H610

AIM(S)

- To develop in the student an in depth understanding of power electronic circuits and systems, their use in power supply and energy storage systems and their use in electrical drive systems.
- To develop the appropriate skills necessary for the analysis and design of power electronic systems including electrical drive systems.

LEARNING OUTCOMES

Upon the successful completion of this module, the student should be able to demonstrate the ability to:

1. Analyse and design power electronic systems employing established and emerging techniques.
2. Analyse electrical drive systems and apply established and emerging techniques to ensure effective operation of these systems.

INDICATIVE CONTENT

- Power Electronic Converters - Power electronic components and circuits. AC to DC, DC to AC, DC to DC, and AC to AC conversion processes.
- Calculation of peak, mean and RMS values of voltage and current associated with each converter. Maximum Power Point Tracking.. Grid synchronization. Calculation of harmonic distortion factors. Switching losses, conversion efficiency (for example in solar PV).Power factor calculations. Protection of devices.
- Switch Mode and Uninterruptible Power Supplies -Design and analysis of switch mode circuits and systems.
- Design and analysis of uninterruptible power supply systems, incorporating energy storage systems. Charge and discharge control algorithms for various battery types.
- DC and AC Motor Drives including an overview and analysis of electrical machine systems - analysis of AC machine and DC machine systems and their representation by equivalent circuits.
- Application of power electronic converters to motors to provide variable speed and variable torque.
- Analysis of electrical drive systems, consisting of DC and AC machines and a broad range of power electronic converters. Analysis and design of speed and torque control techniques for electrical drives, including vector control.

LEARNING AND TEACHING STRATEGY

This module will be taught using a range of teaching and learning strategies which may include formal lectures with use of presentations, practical demonstrations, laboratory exercises, software simulations, worked examples, design exercises and group work where appropriate. The student will be expected to support the learning process by extensive background reading and research investigations into the topics covered.

The allocation of teaching to deliver the module is:

Activity type	Hours	Percentage
Scheduled learning	60	30%
Independent learning	140	70%
Placement learning	0	
TOTAL	200	100%

ASSESSMENT

The student will typically be required to complete two practical laboratory based assignments and one end exam.

Assessment Component 1 – Written (Exam) - 70%

Typically, students would be required to sit a 2 hour exam answering 3 out of 4 questions.:

Assessment Component 2 – Coursework – 30%

Part A: (15%)

Part B: (15%)

Assessment Summary

Activity type	Percentage
Written	70%
Coursework	30%
Practical	0%
TOTAL	100%

BIBLIOGRAPHY

Essential

Rashid M H. *Power Electronics Handbook, Devices, Circuits and Applications*, 3rd Edition. Elsevier. ISBN: 0123820367 (2010)

Wildi T. *Electrical Machines, Drives and Power Systems*. Prentice Hall. ISBN: 0131969188. (2005)

Mohan N. *Power Electronics* Wiley (2011)

Background

Vukosavic S *Electrical Machines (Power Electronics and Power Systems)* Springer (2013)
ISBN-10: 1461403995

Lander C W, *Power Electronics, 3rd Edition*. McGraw-Hill Higher Education. ISBN:
0077077148 (1993)

Krishnan R. *Electric Motor Drives Modelling, Analysis, and Control*. Prentice Hall. ISBN:
0130910147 (2001)

Mohan N, Undeland T M, Robbins W P. *Power Electronics, Converters, Applications and Design, 3rd Edition*. John Wiley & Sons Inc. 978-0471226932 (2002)

Fitzgerald A E, Kingsley C, Umans S D. *Electric Machinery, 6th Edition*. McGraw-Hill Higher Education. ISBN 978-0071230100. (2002)

Hughes A. *Electric Motors and Drives: Fundamentals, Types and Applications*. Newnes
ISBN: 0750647183 (2005)

MODULE CODE: M6X01095
TITLE: Electronic Systems Design
DATED: 03/06/2014

LEVEL: 6
CREDITS: 20

JACS CODE: H610

AIM(S)

- To produce suitable system designs, using open-ended multi-disciplinary problems with a limited time period, and appreciating practical constraints.

LEARNING OUTCOMES

Upon the successful completion of this module, the student should be able to demonstrate the ability to:

1. Deploy accurately established techniques to produce suitable system designs over a range of technological applications.

INDICATIVE CONTENT

- Appropriate theoretical methods for designing practical systems.
- Case studies of appropriate designs.
- Researching
- Planning
- Self-management
- Estimating
- Design approaches
- Report writing

LEARNING AND TEACHING STRATEGY

Delivery includes elements of Case Study and Design Study. A Case Study is a more passive activity, in which an existing design is studied and the design process examined. A Design Study is a more active process, in which the design process is reworked in order to check the theoretical basis of the design, and to evaluate other possible approaches. Both approaches are educationally valuable and it is possible to cover many more systems by Case Study than Design Study within a fixed time. For this reason the module covers both.

Within each Case Study activity certain sub-systems or aspects of the overall system will be subjected to Design Study. This mixed mode of operation enables a good range of areas to be studied. It facilitates the understanding of which detailed aspects of some systems can interact with the overall system design, and each of the parts of the study help to make the other more interesting by setting a context or by illuminating important aspects more fully. Some of the case studies will address a full theoretical design from concept through specification to final paper design.

Additionally the case studies and design specifications will be applied across a range of disciplines/engineering sectors. This is to encourage cross discipline experience and

involvement. Students will be encouraged to address social, economic, environmental and ergonomic aspects of the designs as is applicable for each design example.

The allocation of teaching to deliver the module is:

Activity type	Hours	Percentage
Scheduled learning	60	30%
Independent learning	140	70%
Placement learning	0	
TOTAL	200	100%

ASSESSMENT

Description of each assessment component and its weighting, together with an example for new forms of assessment:

Assessment Component 1 – Coursework – 50%

A number of written reports will be prepared concerning case/design studies in this subject area which provide evidence of: research and planning of solutions to engineering problems, generation of designs to satisfy a specification, analysis of resource needs and costs, implementation of design solutions.

Exemplar: (appropriate to students' programme of study):

- design of a router (internet device);
- design/upgrade of a Digital Volt Meter (DVM)
- design of a medical patient monitoring system
- design of an data acquisition system (automotive)

Assessment Component 2 – Coursework – 50%

A number of written reports will be prepared concerning case/design studies in this subject area which provide evidence of: research and planning of solutions to engineering problems, generation of designs to satisfy a specification, analysis of resource needs and costs, implementation of design solutions.

Exemplar: (appropriate to students' programme of study):

- design of hardware diagnostic systems for fault-finding on computers;
- design of engine management system;
- design of microprocessor-based three-term controller.
- design of a robot-controlled product picker
- design of autonomous robotic cleaning device with aspects of AI

Assessment Summary

Activity type	Percentage
Written	0%
Coursework	100%
Practical	0%
TOTAL	100%

BIBLIOGRAPHY

Essential

Research material as appropriate for the case studies examined.

Story, N (2013) *Electronics, A Systems Approach 5th Edition*, Prentice Hall/Pearson Education

Background

Creswell, John W (2013) *Research Design: Qualitative, Quantitative, and Mixed Method Approaches, 4th Edition*, Sage Publications

Tilley, Alvin R (2002) *The Measure of Man and Woman: Human Factors in Design. Revised Edition*, John Wiley

Pedroni, V A (2014) *Finite State Machines in Hardware: Theory and Design (with VHDL and SystemVerilog)*