

## **Doctoral Degree Programmes**

### AREAS OF STUDY

- Civil Engineering
- Computer Science
- Electrical and Computer Engineering
- Electromechanical Engineering
- Mathematics

## FACULTY OF SCIENCE AND TECHNOLOGY

# Doctoral Degree Programmes

## Doctor of Philosophy

### • Civil Engineering

Compulsory Courses	Credits
<b>Faculty-wide Compulsory Courses:</b>	
STGC8002 Research Writing	1
STGC8003 Research Methods and Ethics	3
<b>Department-wide Compulsory Courses:</b>	
CIVL8001 Advanced Topics in Civil Engineering	3
CIVL8999 Doctoral Thesis	18
<b>Total:</b>	<b>25</b>

Other Courses	Credits
<b>For students admitted without a relevant Master's degree:</b>	
5 Required Electives selected from existing compulsory and elective courses of Master's degree programmes in Civil Engineering	15
<b>Grand Total:</b>	<b>40</b>

## Doctoral Degree Programmes

### Doctor of Philosophy

- **Computer Science**

Compulsory Courses		Credits
<b>Faculty-wide Compulsory Courses:</b>		
STGC8002	Research Writing	1
STGC8003	Research Methods and Ethics	3
<b>Department-wide Compulsory Courses:</b>		
CISC8001	Advanced Topics in Computer Science	3
CISC8999	Doctoral Thesis	18
<b>Total:</b>		<b>25</b>

Other Courses		Credits
<b>For students admitted without a relevant Master's degree:</b>		
5 Required Electives from the List of Required Electives in Master's degree programme in Computer Science or E-commerce Technology		15
<b>Grand Total:</b>		<b>40</b>

FACULTY OF SCIENCE AND TECHNOLOGY

# Doctoral Degree Programmes

## Doctor of Philosophy

- **Electrical and Computer Engineering**

Compulsory Courses		Credits
<b>Faculty-wide Compulsory Courses:</b>		
STGC8002	Research Writing	1
STGC8003	Research Methods and Ethics	3
<b>Department-wide Compulsory Courses:</b>		
ECEN8001	Advanced Topics in Electrical and Computer Engineering	3
ECEN8999	Doctoral Thesis	18
<b>Total:</b>		<b>25</b>
<b>Other Courses</b>		<b>Credits</b>
<b>For students admitted without a relevant Master's degree:</b>		
5 Required Electives from the List of Required Electives in Master's degree programme in Electrical and Computer Engineering		15
<b>Grand Total:</b>		<b>40</b>

## Doctoral Degree Programmes

### Doctor of Philosophy

- **Electromechanical Engineering**

Compulsory Courses		Credits
<b>Faculty-wide Compulsory Courses:</b>		
STGC8002	Research Writing	1
STGC8003	Research Methods and Ethics	3
<b>Department-wide Compulsory Courses:</b>		
EMEN8001	Advanced Topics in Electromechanical Engineering	3
EMEN8999	Doctoral Thesis	18
<b>Total:</b>		<b>25</b>
<b>Other Courses</b>		<b>Credits</b>
<b>For students admitted without a relevant Master's degree:</b>		
5 Required Electives from the List of Required Electives in Master's degree programme in Electromechanical Engineering		15
<b>Grand Total:</b>		<b>40</b>

FACULTY OF SCIENCE AND TECHNOLOGY

# Doctoral Degree Programmes

## Doctor of Philosophy

- **Mathematics**

Compulsory Courses		Credits
<b>Faculty-wide Compulsory Courses:</b>		
STGC8002	Research Writing	1
STGC8003	Research Methods and Ethics	3
<b>Department-wide Compulsory Courses:</b>		
MATH8001	Advanced Topics in Mathematics	3
MATH8999	Doctoral Thesis	18
<b>Total:</b>		<b>25</b>
<b>Other Courses</b>		<b>Credits</b>
<b>For students admitted without a relevant Master's degree:</b>		
5 Required Electives from the List of Required Electives in Master's degree programme in Mathematics		15
<b>Grand Total:</b>		<b>40</b>

# Master's Degree Programmes

## Master of Science

### • Artificial Intelligence

	<b>Credits</b>
<b>Compulsory Courses:</b>	
CISC7026    Introduction to Deep Learning	3
CISC7401    Advanced Machine Learning	3
CISC7402    Mathematics for Artificial Intelligence	3
CISC7498    Project Report	6
<b>Required Electives:</b>	
5 Required Electives from Table I	15
<b>Grand Total:</b>	<b>30</b>

#### **Table I: List of Required Electives**

CISC7403    Cloud and Distributed Systems	3
CISC7404    Special Topics in Artificial Intelligence	3
CISC7013    Principles of Artificial Intelligence	3
CISC7018    Computer Vision and Pattern Recognition	3
CISC7019    Web Mining	3
CISC7021    Applied Natural Language Processing	3
EMEN7101    Introduction to Mobile Robotics	3

## FACULTY OF SCIENCE AND TECHNOLOGY

# Master's Degree Programmes

## Master of Science

### • Civil Engineering

	Credits
<b>Compulsory Courses:</b>	
CIVL7998 Project Report	6
<b>Required Electives:</b>	
2 Required Electives chosen from Table I	6
6 Required Electives chosen from Table I and II*	18
<b>Grand Total:</b>	<b>30</b>
OR	
<b>Compulsory Courses:</b>	
CIVL7997 Internship and Report	3
<b>Required Electives:</b>	
2 Required Electives chosen from Table I	6
7 Required Electives chosen from Table I and II*	21
<b>Grand Total:</b>	<b>30</b>

\* The 2 chosen Required Electives from Table I stated in the first requirement cannot count towards the 6 / 7 Required Electives stated in the second requirement.

#### List of Required Electives (Table I)

CIVL7001	Advanced Mathematics	3
CIVL7002	Theory of Elasticity and Plasticity	3
CIVL7003	Finite Element Method	3
CIVL7029	Hydrodynamics and Floods	3

#### List of Required Electives (Table II)

CIVL7004	Advanced Soil Mechanics	3
CIVL7005	Subsurface Investigation and Soil Testing	3
CIVL7006	Advanced Foundation Engineering	3
CIVL7007	Soil Dynamics	3
CIVL7008	Structural Design of Foundations	3
CIVL7009	Special Topics in Geotechnical Engineering II	3
CIVL7010	Structural Vibrations	3
CIVL7011	Plates and Shells	3
CIVL7012	Structural Analysis and Finite Elements	3
CIVL7013	Special Topics in Structural Engineering III	3



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CIVL7014	Numerical Modeling in Geomechanics	3
CIVL7015	Random Vibrations of Structures	3
CIVL7016	Behavior and Design of Steel Members	3
CIVL7017	Ground Improvement Techniques	3
CIVL7018	Slope Stability and Earth Retaining Structures	3
CIVL7019	Special Topics in Geotechnical Engineering I	3
CIVL7020	Special Topics in Structural Engineering I	3
CIVL7021	Special Topics in Structural Engineering II	3
CIVL7022	Advanced Computational Methods: Principles and Applications	3
CIVL7023	Construction Financial Management	3
CIVL7024	Fracture Mechanics and Fatigue	3
CIVL7025	Reliability Analysis in Civil Engineering	3
CIVL7026	Instrumentation Systems in Civil Engineering	3
CIVL7027	Constitutive Modeling in Soil Mechanics	3
CIVL7028	Analysis and Design of Reinforced Concrete Members	3
CIVL7030	Coastal Fluid Mechanics and Storm Surge	3
CIVL7031	Sediment Transport and Erosion	3
CIVL7032	Municipal Solid Waste Management	3
CIVL7033	Environmental Chemistry	3
CIVL7034	Coastal Water Treatment: Principles and Processes	3
CIVL7035	Water Pollution Control: Physical and Chemical Modeling	3
CIVL7036	Environmental Assessment and Planning: Computer Modeling	3
CIVL7037	Air Pollution Control	3
CIVL7038	Special Topics in Environmental Engineering IV	3
CIVL7039	Air Pollution Meteorology and Chemistry	3
CIVL7040	Special Topics in Environmental Engineering I	3
CIVL7041	Special Topics in Environmental Engineering II	3
CIVL7042	Special Topics in Environmental Engineering III	3
CIVL7043	Quantitative Methods for Construction Decision Making	3
CIVL7044	Quality and Safety Management in Construction	3

## FACULTY OF SCIENCE AND TECHNOLOGY

# Master's Degree Programmes

## Master of Science

- **Civil Engineering with Specialization in Hydraulics and Environmental Engineering**

	Credits
<b>Compulsory Courses:</b>	
CIVL7001 Advanced Mathematics	3
CIVL7029 Hydrodynamics	3
CIVL7999 Academic Thesis*	6
<b>Required Electives:</b>	
6 Required Electives chosen from the List of Required Electives	18
<b>Grand Total:</b>	<b>30</b>

OR

<b>Compulsory Courses:</b>	
CIVL7001 Advanced Mathematics	3
CIVL7029 Hydrodynamics and Floods	3
CIVL7996 Applied Thesis*	3
<b>Required Electives:</b>	
7 Required Electives chosen from the List of Required Electives	21
<b>Grand Total:</b>	<b>30</b>

\*Academic thesis based programme targets all MSc students, while applied thesis based programme targets all MSc students except for studentship/assistantship holders.

### List of Required Electives for MSc in Civil Engineering (Hydraulics and Environmental Engineering)

CIVL7003	Finite Element Method	3
CIVL7023	Construction Financial Management	3
CIVL7030	Coastal Fluid Mechanics and Storm Surge	3
CIVL7031	Sediment Transport and Erosion	3
CIVL7032	Municipal Solid Waste Management	3
CIVL7033	Environmental Chemistry	3
CIVL7034	Coastal Water Treatment: Principles and Processes	3
CIVL7035	Water Pollution Control: Physical and Chemical Modeling	3
CIVL7036	Environmental Assessment and Planning: Computer Modeling	3
CIVL7037	Air Pollution Control	3
CIVL7038	Special Topics in Environmental Engineering IV	3

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CIVL7039	Air Pollution Meteorology and Chemistry	3
CIVL7040	Special Topics in Environmental Engineering I	3
CIVL7041	Special Topics in Environmental Engineering II	3
CIVL7042	Special Topics in Environmental Engineering III	3
CIVL7043	Quantitative Methods for Construction Decision Making	3
CIVL7044	Quality and Safety Management in Construction	3

FACULTY OF SCIENCE AND TECHNOLOGY

# Master's Degree Programmes

## Master of Science

- **Coastal Environment and Safety**

	<b>Credits</b>
<b>Compulsory Courses:</b>	
CIVL7101 Introduction to Oceanography	3
CIVL7029 Hydrodynamics and Floods	3
CIVL7034 Coastal Water Treatment Principles and Processes	3
CIVL7198 Project Report	6
<b>Required Electives:</b>	
5 Required Electives chosen from the List of Required Electives	15
<b>Grand Total:</b>	<b>30</b>

OR

<b>Compulsory Courses:</b>	
CIVL7101 Introduction to Oceanography	3
CIVL7029 Hydrodynamics and Floods	3
CIVL7034 Coastal Water and Wastewater Treatment Principles and Processes	3
CIVL7197 Internship and Report	3
<b>Required Electives:</b>	
6 Required Electives chosen from the List of Required Electives	18
<b>Grand Total:</b>	<b>30</b>

### List of Required Electives for MSc in Coastal Environment and Safety

CIVL7102 Marine Ecology	3
CIVL7103 Aquatic Chemistry	3
CIVL7104 Atmospheric Chemistry	3
CIVL7105 Coastal Pollution: Sources, Fate and Effects of Pollutants	3
CIVL7106 Special Topics in Hazard Alleviation	3
CIVL7107 Special Topics in Coastal Environment	3
CIVL7018 Landslides Mechanisms, Mitigation and Risk Assessment	3
CIVL7022 Advanced Computational Methods: Principles and Applications	3
CIVL7030 Coastal Fluid Mechanics and Storm Surge	3
CIVL7031 Sediment Transport and Erosion	3

# Master's Degree Programmes

## Master of Science

### • Computer Science

		Credits
<b>Compulsory Courses:</b>		
CISC7005	Computer Science Seminar	3
CISC7999	Academic Thesis*	6
<b>Required Electives:</b>		
7 Required Electives chosen from the List of Required Electives except CISC7005		21
<b>Grand Total:</b>		<b>30</b>

OR

<b>Compulsory Courses:</b>		
CISC7001	Fundamentals of Software Engineering	3
CISC7996	Applied Thesis*	3
<b>Required Electives:</b>		
8 Required Electives chosen from the List of Required Electives except CISC7001		24
<b>Grand Total:</b>		<b>30</b>

\*Academic thesis based programme targets all MSc students, while applied thesis based programme targets all MSc students except for studentship/assistantship holders.

### List of Required Electives for MSc in Computer Science

CISC7001	Fundamentals of Software Engineering	3
CISC7002	Computer Communications and Networks	3
CISC7004	Current Development in Database	3
CISC7005	Computer Science Seminar	3
CISC7006	Compiler Construction	3
CISC7007	Design and Analysis of Algorithms	3
CISC7008	Complexity Theory	3
CISC7009	Formal Methods in Software Engineering	3
CISC7010	Discrete System Simulation	3
CISC7011	Computer System Performance Modeling	3
CISC7012	Computer Graphics - Principles and Systems	3
CISC7013	Principles of Applications of Artificial Intelligence	3
CISC7014	Advanced Topics in Computer Science	3
CISC7015	Advanced Topics in Computer Science I	3
CISC7016	Advanced Topics in Computer Science II	3
CISC7017	Principles and Applications of Concurrent Programming	3

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CISC7018	Computer Vision and Pattern Recognition	3
CISC7019	Web Mining	3
CISC7020	Distributed Computer	3
CISC7021	Applied Natural Language Processing	3
CISC7022	Big Data Processing and Analysis	3
CISC7023	Introduction to Business Process Management	3

# Master's Degree Programmes

## Master of Science

### • Construction Project Management

	<b>Credits</b>
<b>Compulsory Courses:</b>	
CIVL7201 Construction Project Management Theory and Practice	3
CIVL7202 Contract Management	3
CIVL7203 Advanced Construction Planning and Scheduling	3
CIVL7204 Building Information Modeling (BIM): Development and Application	3
CIVL7298 Project Report	6
<b>Required Electives:</b>	
4 Required Electives chosen from the List of Required Electives	12
<b>Grand Total:</b>	<b>30</b>

OR

<b>Compulsory Courses:</b>	
CIVL7201 Construction Project Management Theory and Practice	3
CIVL7202 Contract Management	3
CIVL7203 Advanced Construction Planning and Scheduling	3
CIVL7204 Building Information Modeling (BIM): Development and Application	3
CIVL7297 Internship and Report	3
<b>Required Electives:</b>	
5 Required Electives chosen from the List of Required Electives	15
<b>Grand Total:</b>	<b>30</b>

### List of Required Electives for MSc in Construction Project Management

CIVL7205 Construction Cost Management	3
CIVL7206 Innovative Methods and Applications of Information Technology in Construction	3
CIVL7207 Sustainability in Construction	3
CIVL7208 Special Topics in Construction Project Management	3
CIVL7023 Construction Financial Management	3
CIVL7043 Quantitative Methods for Construction Decision Making	3
CIVL7044 Quality and Safety Management in Construction	3

## FACULTY OF SCIENCE AND TECHNOLOGY

# Master's Degree Programmes

## Master of Science

### • Electrical and Computer Engineering

	Credits
<b>Compulsory Courses:</b>	
ECEN7002 Advanced Mathematics	3
ECEN7998 Project Report	6
<b>Required Electives:</b>	
7 Required Electives chosen from the List of Required Electives	21
<b>Grand Total:</b>	<b>30</b>
OR	
<b>Compulsory Courses:</b>	
ECEN7002 Advanced Mathematics	3
ECEN7997 Internship and Report*	3
<b>Required Electives:</b>	
8 Required Electives chosen from the List of Required Electives	24
<b>Grand Total:</b>	<b>30</b>

\*\*The number of hours for Internship is 720.

### List of Required Electives for MSc in Electrical and Computer Engineering

ECEN7003	Microelectronic Circuit Design	3
ECEN7004	Digital Signal Processing	3
ECEN7005	Active Network Theory	3
ECEN7006	Advanced Topics in Control Systems	3
ECEN7007	Advanced Topics in Simulation	3
ECEN7008	Expert Systems	3
ECEN7009	Microelectronics for Telecommunication and Signal Processing	3
ECEN7010	Laser and Semiconductor Physics	3
ECEN7011	Advanced Topics in Telecommunications	3
ECEN7018	Flexible Alternative Current Transmission System	3
ECEN7019	Embedded System	3
ECEN7020	Advanced Topics in Analog and Mixed-Signal Integrated Circuits	3
ECEN7021	Biomedical Transducers and Instruments	3
ECEN7022	Electrochemical Energy Conversion and Storage	3
ECEN7023	Special Topics in Biomedical Engineering	3
ECEN7024	Medical Imaging Systems	3
ECEN7025	Modeling and Theoretical Analysis for Communication Systems	3



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CISC7002	Computer Communications and Networks	3
CISC7102	Computer Networks and Internet	3
CISC7109	Internet Security and Cryptography	3
CISC7110	Electronic Payment Systems	3
CISC7111	Smart Card Technology & Applications	3

**Remarks:**

In order to obtain a total of 30 credits to complete the programme, students must take:

- 1 compulsory course from Table 1 to obtain 3 credits, 7 required electives from Table 2 to obtain 21 credits, and "Project Report" from Table 3 to obtain 6 credits, OR
- 1 compulsory course from Table 1 to obtain 3 credits, 8 required elective from Table 2 to obtain 24 credits, and "Internship and Report" from Table 3 to obtain 3 credits.

## FACULTY OF SCIENCE AND TECHNOLOGY

# Master's Degree Programmes

## Master of Science

### • Electromechanical Engineering

	Credits
<b>Compulsory Courses:</b>	
EMEN7037 Advanced Mathematics for Electromechanical Engineering	3
EMEN7998 Project Report	6
<b>Required Electives:</b>	
7 Required Electives chosen from the List of Required Electives	21
<b>Grand Total:</b>	<b>30</b>

OR

<b>Compulsory Courses:</b>	
EMEN7037 Advanced Mathematics for Electromechanical Engineering	3
EMEN7997 Internship and Report	3
<b>Required Electives:</b>	
8 Required Electives chosen from the List of Required Electives	24
<b>Grand Total:</b>	<b>30</b>

### List of Required Electives for MSc in Electromechanical Engineering

EMEN7002	Physics of Materials	3
EMEN7003	Variational Principles and the Application	3
EMEN7006	Mechatronics	3
EMEN7007	Process Heat Transfer	3
EMEN7008	Convective Heat Transfer	3
EMEN7009	Computational Method for Thermo-Fluid System	3
EMEN7010	Energy Conversion and Utilization	3
EMEN7011	Advanced Robotics and Control	3
EMEN7014	Fluid Power Engineering	3
EMEN7017	Special Topics in Manufacturing I	3
EMEN7018	Special Topics in Manufacturing II	3
EMEN7019	Special Topics in Thermal Engineering I	3
EMEN7020	Special Topics in Thermal Engineering II	3
EMEN7021	Automotive Engineering	3
EMEN7022	Failure Analysis in Mechanical Engineering	3
EMEN7023	Advanced Electrical Services	3
EMEN7024	Advanced Electromechanical Energy Conversion	3
EMEN7025	Human Factors Engineering	3
EMEN7027	Engineering Acoustics	3
EMEN7028	Advanced Electric Vehicles	3
EMEN7029	Special Topic in Electromechanical Engineering I	3

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EMEN7030	Special Topic in Electromechanical Engineering II	3
EMEN7031	Micromechatronics and Applications	3
EMEN7032	Intelligent Theory and Engineering Applications	3
EMEN7033	Industrial Engineering and Engineering Management	3
EMEN7034	Theories and Practice of CAD/CAM/CAE	3
EMEN7035	Product Design and Management	3
EMEN7036	Modeling and Analysis of Production Systems	3
EMEN7038	Mechanical Processing of Materials	3
EMEN7039	Prognostics and Health Management of Engineering Systems	3

## FACULTY OF SCIENCE AND TECHNOLOGY

# Master's Degree Programmes

## Master of Science

### • Financial Technology

	Credits
<b>Compulsory Courses:</b>	
CISC7107 Data Mining and Decision Support System	3
CISC7110 Electronic Payment Systems	3
CISC7301 Introduction to Financial Technologies (FinTech)	3
CISC7398 Project Report	6
<b>Required Electives:</b>	
2 Required Electives from Table I	6
3 Required Electives from Table II	9
<b>Grand Total:</b>	<b>30</b>

OR

<b>Compulsory Courses:</b>	
CISC7107 Data Mining and Decision Support Systems	3
CISC7110 Electronic Payment Systems	3
CISC7310 Introduction to Financial Technologies (FinTech)	3
CISC7397 Internship and Report	3
<b>Required Electives:</b>	
2 Required Electives from Table I	6
4 Required Electives from Table II	12
<b>Grand Total:</b>	<b>30</b>

#### Table I: Required Electives from Financial, Economics, Accounting

BECO7010 Statistics and Financial Economics	3
CISC7112 Legal Issues of IT and E-Commerce	3
FINC7010 Corporate Finance	3
FINC7024 Investments and Portfolio Management	3
FINC7035 Financial Risk Management	3

#### Table II: Required Electives from Information Technologies

CISC7004 Current Development in Database	3
CISC7013 Principles of Artificial Intelligence	3
CISC7021 Applied Natural Language Processing	3
CISC7022 Big Data Processing and Analysis	3
CISC7101 Information Systems Development Methodologies	3
CISC7106 Data Warehousing	3
CISC7109 Internet Security and Cryptography	3
CISC7111 Smart Card Technology and Applications	3

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CISC7116	Fundamentals of Business Process Management	3
CISC7302	Algo Trading and High Frequency Trading	3
CISC7303	Cloud Computing	3

## FACULTY OF SCIENCE AND TECHNOLOGY

# Master's Degree Programmes

## Master of Science

### • Internet of Things

	Credits
<b>Compulsory Courses:</b>	
ECEN7101 Introduction to Internet of Things	3
ECEN7102 Advanced Topics in Applied Probability and Statistics	3
ECEN7198 Project Report	6
<b>Required Electives:</b>	
6 Required Electives chosen from the List of Required Electives	18
<b>Grand Total:</b>	<b>30</b>

OR

<b>Compulsory Courses:</b>	
ECEN7101 Introduction to Internet of Things	3
ECEN7102 Advanced Topics in Applied Probability and Statistics	3
ECEN7197 Internship and Report*	3
<b>Required Electives:</b>	
7 Required Electives chosen from the List of Required Electives	21
<b>Grand Total:</b>	<b>30</b>

\*The number of hours for Internship is 720.

### List of Required Electives for MSc in Internet of Things

#### Group 1:

ECEN7103	RFID Principle and Applications	3
ECEN7104	Advanced Integrated Circuit Design for Internet of Things	3
ECEN7105	Embedded Systems for Internet of Things Applications	3

#### Group 2:

CISC7102	Computer Networks and Internet	3
ECEN7011	Advanced Topics in Telecommunications	3
ECEN7025	Modeling and Theoretical Analysis for Communications Systems	3
ECEN7108	Advanced Topics in Internet of Things	3

#### Group 3:

CISC7013	Principles of Artificial Intelligence	3
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CISC7022	Big Data Processing and Analysis	3
CISC7107	Data Mining and Decision Support Systems	3
CISC7109	Internet Security and Cryptography	3
CISC7303	Cloud Computing	3
ECEN7106	Convex Optimization for Internet of Things Applications	3
ECEN7107	Data Analysis for Internet of Things	3

Remarks:

- ^ Students who take Project Report are required to take 6 Required Electives to obtain 18 credits. And students are required to choose at least one course from each of the Group 1, 2 and 3, OR
- ^ Students who take Internship and Report are required to take 7 Required Electives to obtain 21 credits. And students are required to choose at least one course from each of the Group 1, 2 and 3.

## FACULTY OF SCIENCE AND TECHNOLOGY

# Master's Degree Programmes

## Master of Science

### • Mathematics

	Credits
<b>Compulsory Courses:</b>	
MATH7001 Functional Analysis	3
MATH7002 Real Analysis	3
MATH7998 Project Report	6
<b>Required Electives:</b>	
6 Required Electives chosen from the List of Required Electives	18
<b>Grand Total:</b>	<b>30</b>

### List of Required Electives for MSc in Mathematics

MATH7003	Advanced Numerical Linear Algebra	3
MATH7004	Advanced Probability and Statistics	3
MATH7005	Clifford Analysis	3
MATH7006	Geometry and its Applications	3
MATH7007	Mathematical Theory of Computational Intelligence	3
MATH7008	Matrix Analysis	3
MATH7009	Numerical Methods for Differential Equations	3
MATH7010	Partial Differential Equations	3
MATH7011	Reading Course I	3
MATH7012	Reading Course II	3
MATH7013	Stochastic Differential Equations	3
MATH7014	Stochastic Processes	3
MATH7015	Time Series Analysis	3
MATH7016	Topics in Analysis	3
MATH7017	Topics in Geometry	3
MATH7018	Topics in Matrix Analysis	3
MATH7019	Topics in Partial Differential Equations	3
MATH7020	Topics in Probability and Statistics	3
MATH7021	Financial Mathematics	3



# Master's Degree Programmes

## Master of Science

### • Robotics and Autonomous Systems

	<b>Credits</b>
<b>Compulsory Courses:</b>	
EMEN7101 Introduction to Mobile Robotics	3
EMEN7102 Introduction to Sensors and Actuators	3
EMEN7198 Project Report	6
<b>Required Electives:</b>	
4 Required Electives chosen from Group 1 in the List of Required Electives	12
2 Required Electives chosen from Group 2 in the List of Required Electives	6
<b>Grand Total:</b>	<b>30</b>

### List of Required Electives for MSc in Robotics and Autonomous Systems

#### **Group 1:**

ECEN7019	Embedded System	3
EMEN7011	Advanced Robotics and Control	3
EMEN7032	Intelligent Theory and Engineering Applications	3
EMEN7103	Aerial Robotics	3
EMEN7104	Special Topics in Robotics	3
EMEN7105	Special Topics in Autonomous Systems	3

#### **Group 2:**

CISC7201	Introduction to Data Science Programming	3
CISC7202	Tools for Machine Learning	3
ECEN7101	Introduction to Internet of Things	3
EMEN7039	Prognostics and Health Management of Engineering Systems	3

FACULTY OF SCIENCE AND TECHNOLOGY

# Master's Degree Programmes

## Master of Science

- **Smart Ocean Technology**

	<b>Credits</b>
<b>Compulsory Courses:</b>	
CISC7203 Database and Data Mining Technologies	3
CIVL7101 Introduction to Oceanography	3
OCES7001 Ocean Remote Sensing	3
OCES7002 Physical Oceanography	3
OCES7198 Project Report	6
<b>Required Electives:</b>	
4 Required Electives chosen from the List of Required Electives	12
<b>Grand Total:</b>	<b>30</b>

OR

<b>Compulsory Courses:</b>	
CISC7203 Database and Data Mining Technologies	3
CIVL7101 Introduction to Oceanography	3
OCES7001 Ocean Remote Sensing	3
OCES7002 Physical Oceanography	3
OCES7197 Internship and Report	3
<b>Required Electives:</b>	
5 Required Electives chosen from the List of Required Electives	15
<b>Grand Total:</b>	<b>30</b>

### List of Required Electives for MSc in Smart Ocean Technology

CISC7303 Cloud Computing	3
OCES7003 Ocean Acoustics	3
OCES7004 Ocean Sensors	3
OCES7005 Marine Robotics and Application	3
OCES7006 Special Topics in Ocean Observation and Modeling	3
OCES7007 Special Topics in Underwater Communication and Networks	3
OCES7008 Machine Learning and Applications in Ocean Science	3

# Bachelor's Degree Programmes

## Bachelor of Science

### • Applied Physics and Chemistry

<b>Year I</b>	<b>Credits</b>
APAC1000 Advanced Mathematics I	3
APAC1001 College Physics	3
APAC1002 Electromagnetism and Physical Optics	3
APAC1003 Introduction to College Chemistry	3
APAC2000 Advanced Mathematics II	3
Community and Peer Education Courses	2
Languages and Skills Courses	9
General Education Courses:	
GELH1000 Chinese Language and Culture	3
GEST1004 Quantitative Reasoning for Science and Technology	3
1 course from area of Science and Technology	3
<b>Total Credits:</b>	<b>35</b>

<b>Year II</b>	<b>Credits</b>
APAC2001 Analytical and Environmental Chemistry	3
APAC2002 Modern Physics	3
APAC2003 Inorganic Chemistry	3
APAC2004 Quantum Physics	3
APAC2006 Organic Chemistry: Foundations of Chemical Reactivity and Synthesis	3
APAC4004 Mathematical Methods in Physics	3
CISC1001 Programming Science	3
1 Required Elective	3
Community and Peer Education Courses	1
Languages and Skills Courses	6
General Education Courses:	
GEA1000 Macao and Chinese Civilization	3
GESB1000 Ethics, Values, Law and Society	3
1 Free Elective	3
<b>Total Credits:</b>	<b>40</b>

<b>Year III</b>		<b>Credits</b>
APAC3000	Materials Physics and Chemistry	3
APAC3001	Solid State Physics	3
APAC3002	Thermodynamics and Statistical Physics	3
APAC3003	Materials Characterization	3
APAC3004	Optoelectronics	3
APAC3005	Physical Chemistry	3
APAC3006	Semiconductor Physics	3
General Education Courses:		
2 General Education Courses		6
1 Free Elective		3
<b>Total Credits:</b>		<b>30</b>

<b>Year IV</b>		<b>Credits</b>
APAC4000	Research Project	6
4 Required Electives		12
General Education Courses:		
1 General Education Course		3
1 Free Elective		3
<b>Total Credits:</b>		<b>24</b>

		<b>Credits</b>
<b>Grand Total:</b>		<b>129</b>

#### **List of Required Electives**

APAC3007	Low-Dimensional Physics	3
APAC3008	Nanochemistry	3
APAC3009	Polymer Chemistry	3
APAC3010	Thin Film Physics	3
APAC4001	Electrochemistry	3
APAC4002	Electrodynamics	3
APAC4003	Magnetic Properties of Materials	3
APAC4005	Micro-/Nano-Systems	3
APAC4007	Semiconductor Materials and Devices	3
APAC4008	Supramolecular Chemistry	3
APAC4009	Theory and Modeling of Materials Properties	3
APAC4010	Topics in Emerging Materials	3
CISC1006	Probability and Statistics	3

# Bachelor's Degree Programmes

## Bachelor of Science

### • Civil Engineering

Year I		Credits
CIVL1000	Computer Science	3
CIVL1001	Introduction to Civil and Environmental Engineering	2
CIVL1003	Statics	3
CIVL1004	Engineering Geology	3
ECEN1008	Physics I	3
ECEN1010	Physics II	3
MATH1003	Intermediate Calculus	3
Community and Peer Education Courses		2
Languages and Skills Courses		9
General Education Courses:		
GEA1000	Macao and Chinese Civilization	3
GELH1000	Chinese Language and Culture	3
GESB1000	Ethics, Values, Law and Society	3
GEST1004	Quantitative Reasoning for Science and Technology	3
<b>Total Credits:</b>		<b>43</b>

Year II		Credits
CIVL1002	Civil Engineering Drawing	2
CIVL2000	Kinematics and Dynamics	3
CIVL2001	Mechanics of Materials	3
CIVL2002	Surveying	2
CIVL2003	Fluid Mechanics	3
CIVL2004	Mathematics for Civil Engineering	3
CIVL2005	Construction Materials	3
CIVL2006	Structural Analysis	3
CIVL2007	Soil Mechanics	3
MATH2000	Engineering Mathematics I	3
MATH2001	Engineering Mathematics II	3
STGC1001	General Chemistry	3
Community and Peer Education Courses		1
Languages and Skills Courses		3
<b>Total Credits:</b>		<b>38</b>

<b>Year III</b>		<b>Credits</b>
CIVL3000	Steel Design	3
CIVL3001	Construction Management and Practice	3
CIVL3002	Environmental Engineering I	3
CIVL3003	Environmental Engineering II	3
CIVL3004	Reinforced Concrete Design	3
CIVL3005	Foundation Engineering	3
4 Required Electives from the List of Required Electives		12
Languages and Skills Courses		3
General Education Course:		
GEA1000	Macao and Chinese Civilization	3
<b>Total Credits:</b>		<b>36</b>

<b>Year IV</b>		<b>Credits</b>
CIVL4000	Graduation Project I	3
CIVL4001	Graduation Project II	3
CIVL4002	Integrated Project Design	3
STGC3000	Work-Integrated Education	3
3 Required Electives from the List of Required Electives		9
General Education Courses:		
1 course from area of Literature and Humanities		3
1 course from area of Society and Behaviour		3
1 course from area of Global Awareness		3
<b>Total Credits:</b>		<b>30</b>

<b>Grand Total:</b>	<b>Credits</b>
	<b>147</b>

#### **List of Required Electives**

CIVL3006	Civil Engineering Hydraulics	3
CIVL3007	Advanced Topics in Soil Mechanics	3
CIVL3008	Environmental Modeling	3
CIVL4004	Advanced Mechanics of Materials	3
CIVL4005	Advanced Structural Analysis	3
CIVL4006	Structural Vibrations	3
CIVL4007	Advanced Reinforced Concrete Design	3
CIVL4008	Structural Systems and Analysis	3
CIVL4009	Selected Topics in Geotechnical Engineering	3
CIVL4010	Earth Retaining Systems	3
CIVL4011	Application of Numerical Methods in Geotechnical Engineering	3
CIVL4012	Introduction to Soil Improvement	3
CIVL4013	Engineering Economics and Ethics	3
CIVL4014	Construction Planning, Scheduling and Control	3

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CIVL4015	Construction Methods, Procedure and Equipment	3
CIVL4016	Environmental Engineering III	3
CIVL4017	Essentials to Environmental Biotechnology	3
CIVL4018	Wastewater Treatment Engineering	3
CIVL4019	Traffic Engineering	3
CIVL4020	Transportation Planning and Public Transport System	3
CIVL4021	Special Topics in Civil Engineering	3

## FACULTY OF SCIENCE AND TECHNOLOGY

# Bachelor's Degree Programmes

## Bachelor of Science

### • Computer Science

Year I	Credits
CISC1001 Programming Science	3
CISC1004 Introduction to Computer Science	3
CISC1006 Probability and Statistics	3
MATH1003 Intermediate Calculus	3
Community and Peer Education Courses	2
Languages and Skills Courses	12
General Education Courses:	
GELH1000 Chinese Language and Culture	3
GEST1004 Quantitative Reasoning for Science and Technology	3
1 course from area of Science and Technology	3
<b>Total Credits:</b>	<b>35</b>

Year II	Credits
CISC1002 Discrete Structures	3
CISC2001 Computer Organization	3
CISC2002 Numerical Methods and Computation	3
CISC2003 Object Oriented Programming and Data Structures	3
CISC2005 Principles of Operating Systems	3
CISC2006 Algorithm Design and Analysis	3
MATH1001 Linear Algebra I	3
Community and Peer Education Courses	1
Languages and Skills Courses	3
General Education Courses:	
GEGA1000 Macao and Chinese Civilization	3
1 course from area of Science and Technology	3
1 course from area of Literature and Humanities	3
<b>Total Credits:</b>	<b>34</b>



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<b>Year III</b>		<b>Credits</b>
CISC3000	Introduction to Database Systems	3
CISC3001	Computer Networks	3
CISC3026	Software Engineering Principles	3
CISC3002	Mobile Application Programming or	3
CISC3003	Web Programming	

4 Required Electives 12

General Education Courses:

1 course from area of Global Awareness 3

1 course from area of Society and Behaviour 3

1 Free Elective 3

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**Total Credits: 33**

<b>Year IV</b>		<b>Credits</b>
CISC4000	Graduation Project	6
CISC4001	Professionalism and Ethics in Computer Science	3
STGC3000	Work-Integrated Education	3

3 Required Electives 9

2 Free Electives 6

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**Total Credits: 27**

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**Grand Total: Credits 129**

#### **List of Required Electives\***

##### **Stream A: Data Science and Artificial Intelligence**

CISC3005	Advanced Database Systems	3
CISC3012	Artificial Intelligence	3
CISC3014	Information Retrieval and Web Search	3
CISC3018	Cloud Computing and Big Data Systems	3
CISC3023	Machine Learning	3
CISC3024	Pattern Recognition	3
CISC3025	Natural Language Processing	3

##### **Stream B: Multimedia Computing**

CISC3009	Computer Graphics	3
CISC3011	Digital Image Processing	3
CISC3016	Multimedia Computing	3
CISC3021	Multimedia Forensics and Security	3
CISC3024	Pattern Recognition	3
CISC3029	Computer Vision	3

**Stream C: Software Engineering**

CISC2007	Human-Computer Interaction	3
CISC2008	Object-Oriented Analysis and Design Patterns	3
CISC3010	Distributed Computer Systems	3
CISC3020	Formal Software Specification	3
CISC3022	Software Testing	3
CISC4002	Software Project Management	3

**Other Electives:**

CISC2004	Compiler Construction	3
CISC3006	Computer Based Simulation	3
CISC3007	Formal Languages and Automata	3
CISC3015	Data and Information Visualization	3
CISC3017	Bioinformatics	3
CISC3019	Competition Programming and Problem Solving	3
CISC3027	Special Topics in Computer and Information Science	3
CISC3028	Entrepreneurship in Computer Science	3
CISC4003	Information Security	3

Remarks:

- \* Students are required to take 4 courses from one of the Stream A, B or C, and 3 courses from outside that Stream or from Other Electives in the List of Required Electives.

# Bachelor's Degree Programmes

## Bachelor of Science

### • Electrical and Computer Engineering

<b>Year I</b>		<b>Credits</b>
ECEN1001	Introduction to Electrical and Computer Engineering	1
ECEN1003	Information Technology Revolution and Electronics	1
ECEN1004	Embedded Systems	3
ECEN1005	Circuit Analysis	4
ECEN1011	Digital Systems	3
ECEN1012	Computer Programming and Network Fundamentals	4
ECEN1013	Physics for Electrical and Computer Engineering	3
MATH1003	Intermediate Calculus	3
Community and Peer Education Courses		2
Languages and Skills Courses		9
General Education Course:		
GEST1004	Quantitative Reasoning for Science and Technology	3
<b>Total Credits:</b>		<b>36</b>

<b>Year II</b>		<b>Credits</b>
ECEN2001	Measurement and Instrumentation	3
ECEN2002	Electric Machines	3
ECEN2003	Fundamental Electronics	3
ECEN2005	Electromagnetism	3
ECEN2015	Applied Electronics	3
ECEN2017	Signals and Systems	3
ECEN2018	Linear Algebra, Probability and Statistics for Electrical and Computer Engineering	4
ECEN2019	Power System Engineering and Protection	3
MATH2000	Engineering Mathematics I	3
Community and Peer Education Courses		1
Languages and Skills Courses		3
General Education Course:		
1 course from area of Science and Technology		3
<b>Total Credits:</b>		<b>35</b>

<b>Year III</b>		<b>Credits</b>
ECEN3000	Control Systems	3
ECEN3001	Digital Signal Processing	3
ECEN3008	Power Systems Analysis	3
7 Required Electives		21
General Education Courses:		
GEA1000	Macao and Chinese Civilization	3
GESB1000	Ethics, Values, Law and Society	3
<b>Total Credits:</b>		<b>36</b>

<b>Year IV</b>		<b>Credits</b>
ECEN3002	Electrical and Computer Engineering Seminars	1
ECEN4000	Graduation Project I	3
ECEN4001	Graduation Project II	3
STGC3000	Work-Integrated Education	3
3 Required Electives		9
Languages and Skills Courses		3
General Education Courses:		
GELH1000	Chinese Language and Culture	3
1 course from area of Global Awareness		3
1 course from area of Literature and Humanities		3
1 course from area of Society and Behaviour		3
<b>Total Credits:</b>		<b>34</b>

	<b>Credits</b>
<b>Grand Total:</b>	<b>141</b>

### List of Required Electives^

#### **Group A: Biomedical Engineering**

ECEN2009	Biology	3
ECEN3003	Introduction to Biomedical Engineering	3
ECEN3004	Fundamental Bio-Electricity	3
ECEN3005	Biomedical Electronics	3
ECEN3006	Introduction to Biomedical Signal Analysis	3
ECEN4004	Biomedical Measurement and Instrumentation	3
ECEN4005	Introduction to Biomedical Imaging	3

#### **Group B: Electric Power Engineering and its Automation**

ECEN3007	Power Electronics	3
ECEN3009	Power Quality and Energy Saving	3
ECEN3010	Power Electronics Design and Implementation	3
ECEN3011	Electric Drive	3
ECEN4006	Renewable Energy Conversion	3

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ECEN4007	Power System Design and Implementation	3
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**Group C: Microelectronics Discipline**

ECEN3017	Analog Integrated Circuit Design	3
ECEN3018	Introduction to Data Converters	3
ECEN3019	Introduction to Radio-Frequency Circuits and Systems	3
ECEN3020	Advanced Topics in Analog and Mixed-Signal Integrated Circuit Design	3
ECEN3022	Advanced Integrated Circuit Design for Internet of Things Systems	3

**Group D: Wireless Technology Discipline**

ECEN3012	Principles of Communication Systems	3
ECEN3013	Radio Frequency and Microwave Techniques for Wireless Systems	3
ECEN3014	Antenna Theory and Applications in Wireless Communications	3
ECEN3015	Cellular Communication Network Design and Optimization	3
ECEN3016	Introduction to Wireless Technology for Digital Game	3
ECEN4008	Introduction to Wireless Sensing Network	3
ECEN4009	Microwave and Millimeter Wave System Design	3

**Group E: Internet of Thing Engineering and Intelligent Control**

ECEN3023	Intelligent Methods for Electrical and Computer Engineering	3
ECEN3024	Fundamentals of Internet of Things	3
ECEN3025	Internet of Things Workshop	3
ECEN3026	Data Analytics for Electrical and Computer Engineering	3

**Group F: General and Mathematics**

ECEN1006	Engineering and Society	3
ECEN2006	Numerical Method and Computation	3
ECEN2010	Semiconductor Device Physics	3
ECEN2011	Introduction to Electro-Robot Design	3
ECEN3021	Multimedia Technology	3
ECEN4002	Digital Control	3
ECEN4003	Special Topic in Electrical and Computer Engineering	3

Remarks:

^ Students are required to select 10 courses in the above Required Elective Course Groups with the following rubrics:

- 1 course from each of Group A-F 18
- 1 more course from one of the Discipline Group A-E 3
- 3 more courses freely selected from any of the Groups A-F 9

**Total: 30**

## FACULTY OF SCIENCE AND TECHNOLOGY

# Bachelor's Degree Programmes

## Bachelor of Science

### • Electromechanical Engineering

Year I		Credits
ECEN1008	Physics I	3
EMEN1001	Engineering Drawing I	1
EMEN1002	Engineering Drawing II	1
EMEN1003	Engineering Materials	3
EMEN1004	Statics	3
MATH1003	Intermediate Calculus	3
Community and Peer Education Courses		2
Languages and Skills Courses		12
General Education Courses:		
GELH1000	Chinese Language and Culture	3
GEST1004	Quantitative Reasoning for Science and Technology	3
1 course from area of Science and Technology		3
<b>Total Credits:</b>		<b>37</b>

Year II		Credits
EMEN2000	Strength of Materials	3
EMEN2001	Thermodynamics	3
EMEN2002	Manufacturing Technology	3
EMEN2003	Electrical Engineering	3
EMEN2004	Dynamics	3
EMEN2005	Computer-Aided Design	3
EMEN2006	Machine Elements	3
EMEN2007	Mechatronics	3
MATH2000	Engineering Mathematics I	3
MATH2001	Engineering Mathematics II	3
Community and Peer Education Courses		1
Languages and Skills Courses		3
General Education Course:		
GEGA1000	Macao and Chinese Civilization	3
<b>Total Credits:</b>		<b>37</b>

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<b>Year III</b>		<b>Credits</b>
EMEN3000	Production Management	3
EMEN3001	Fluid Mechanics	3
EMEN3002	Control Engineering	3
EMEN3003	Heat Transfer	3
EMEN3004	Computer Engineering	3
EMEN3005	Society and the Engineer	1

4 Required Electives 12

General Education Courses:

GESB1001	Applied Ethics	1
GESB1002	Foundations of Moral Values	1
GESB1003	Law and Society	1
1 course from area of Global Awareness		3

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**Total Credits:** 34

<b>Year IV</b>		<b>Credits</b>
EMEN4000	Graduation Project	6
STGC3000	Work-Integrated Education	3

6 Required Electives 18

General Education Courses:

1 course from area of Literature and Humanities		3
1 course from area of Society and Behaviour		3

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**Total Credits:** 33

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<b>Grand Total:</b>	<b>Credits</b>
	<b>141</b>

#### **List of Required Electives^**

##### **Stream A – Building Services**

EMEN3008	Air Conditioning and Refrigeration	3
EMEN3012	Electrical Services - Wiring and Installations	3
EMEN3018	Intelligent Buildings	3
EMEN3025	Fire Protection Engineering	3
EMEN3030	Special Topics in Electromechanical Engineering I	3
EMEN3036	Extra-low-voltage Electrical Systems in Buildings	3
EMEN3037	Facility Management	3
EMEN3038	Lighting Technology	3

##### **Stream B – Energy, Engineering Design & Control**

EMEN3009	Applications of Vibration and Noise Control	3
EMEN3010	Computer Technology in Engineering	3
EMEN3013	Electromechanical Energy Conversion	3
EMEN3014	Electronics and Instrumentation	3

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EMEN3015	Finite Element Techniques in Engineering	3
EMEN3016	Fundamentals of Automotive Engineering	3
EMEN3019	Internal Combustion Engines	3
EMEN3023	Computational Fluid Dynamics	3
EMEN3026	Robotics	3
EMEN3028	Optimization Techniques and Their Applications in Engineering	3
EMEN3031	Special Topics in Electromechanical Engineering II	3
EMEN3033	Theory of Mechanisms	3
EMEN3035	Electric Vehicles	3
EMEN3040	Nonlinear Dynamics and Chaos	3
EMEN3041	Selection of Materials for Engineering Design	3
EMEN3042	Sensors and Actuators	3
EMEN3045	Thermal Energy Transportation in Porous Media	3

**Stream C – Materials, Manufacturing & Engineering Management**

EMEN3006	Advanced Manufacturing	3
EMEN3007	Advanced Materials for Engineering	3
EMEN3011	Corrosion, Wear and Degradation of Materials	3
EMEN3017	Industrial Data Management	3
EMEN3024	Engineering Management	3
EMEN3027	Mechanical Behaviour of Engineering Materials and Basic Failure Analysis	3
EMEN3029	Production Systems, Planning and Control	3
EMEN3032	Special Topics in Electromechanical Engineering III	3
EMEN3034	Creative Industry	3
EMEN3039	Mechanical Processing of Materials	3
EMEN3043	Statistics and Probability for Engineering	3
EMEN3044	Surface Engineering and Coating Technology	3

**Remarks:**

- ^ Students are required to select at least one Required Elective from each stream and the rest can be from Stream A, B or C.



# Bachelor's Degree Programmes

## Bachelor of Science

### • Mathematics with Specialization in Mathematics and Applications

<b>Year I</b>	<b>Credits</b>
MATH1000 Discrete Mathematics	3
MATH1001 Linear Algebra I	3
MATH1002 Linear Algebra II	3
MATH1003 Intermediate Calculus	3
Community and Peer Education Courses	2
Languages and Skills Courses	12
General Education Course:	
GELH1000 Chinese Language and Culture	3
GEST1004 Quantitative Reasoning for Science and Technology	3
1 Free Elective	3
<b>Total Credits:</b>	<b>35</b>

<b>Year II</b>	<b>Credits</b>
MATH2002 Multivariable Calculus	3
MATH2003 Mathematical Analysis I	3
MATH2004 Mathematical Analysis II	3
MATH2005 Probability	3
MATH2007 Numerical Analysis	3
MATH2008 Operations Research	3
MATH2011 Introduction to Scientific Computing	3
ECEN1008 Physics I	3
Community and Peer Education Courses	1
Languages and Skills Courses	3
General Education Courses:	
GEA1000 Macao and Chinese Civilization	3
GESB1000 Ethics, Values, Law and Society	3
<b>Total Credits:</b>	<b>34</b>

<b>Year III</b>		<b>Credits</b>
MATH3000	Ordinary Differential Equations	3
MATH3001	Complex Analysis	3
MATH3004	Partial Differential Equations	3
MATH3026	Real Analysis	3
MATH3027	Functional Analysis	3
2 Required Electives		6
General Education Courses:		
1 course from area of Literature and Humanities		3
1 course from area of Society and Behaviour		3
1 Free Elective		3
<b>Total Credits:</b>		<b>30</b>

<b>Year IV</b>		<b>Credits</b>
MATH4002	Research in Mathematics	3
MATH4005	Numerical Methods for Differential Equations	3
1 Required Elective		3
General Education Courses:		
1 course from area of Global Awareness		3
1 course from area of Science and Technology		3
2 Free Electives		6
<b>Total Credits:</b>		<b>21</b>

	<b>Credits</b>
<b>Grand Total:</b>	<b>120</b>

**List of Required Electives**

MATH3002	Introduction to Stochastic Process	3
MATH3009	Time Series Analysis	3
MATH3011	Numerical Matrix Analysis	3
MATH3012	Introduction to Computational Intelligence	3
MATH3013	Mathematical Modeling	3
MATH3014	Topics in Applied Mathematics	3
MATH3015	Introduction to Financial Mathematics	3
MATH3028	Numerical Linear Algebra	3
MATH3029	Topics in Applied Analysis	3

# Bachelor's Degree Programmes

## Bachelor of Science

### • Mathematics with Specialization in Statistics and Data Science

<b>Year I</b>		<b>Credits</b>
CISC1001	Programming Science	3
CISC1002	Discrete Structures	3
MATH1001	Linear Algebra I	3
MATH1002	Linear Algebra II	3
MATH1003	Intermediate Calculus	3
Community and Peer Education Courses		2
Languages and Skills Courses		12
General Education Courses:		
GELH1000	Chinese Language and Culture	3
GEST1004	Quantitative Reasoning for Science and Technology	3
<b>Total Credits:</b>		<b>35</b>

<b>Year II</b>		<b>Credits</b>
MATH2002	Multivariable Calculus	3
MATH2003	Mathematical Analysis I	3
MATH2004	Mathematical Analysis II	3
MATH2005	Probability	3
MATH2006	Applied Statistics	3
Community and Peer Education Courses		1
Languages and Skills Courses		3
General Education Courses:		
GEA1000	Macao and Chinese Civilization	3
GESB1000	Ethics, Values, Law and Society	3
2 Free Electives		6
<b>Total Credits:</b>		<b>31</b>

<b>Year III</b>		<b>Credits</b>
CISC3000	Introduction to Database Systems	3
MATH2009	Linear Statistical Analysis	3
MATH3000	Ordinary Differential Equations	3
MATH3002	Introduction to Stochastic Process	3
MATH3017	Data-Driven Sampling Methods	3
MATH3018	Multivariate Data Analysis	3
3 Required Electives		9
General Education Courses:		
1 course from area of Literature and Humanities		3
1 course from area of Society and Behaviour		3
<b>Total Credits:</b>		<b>33</b>

<b>Year IV</b>		<b>Credits</b>
MATH2010	Computational Statistics	3
MATH4003	Nonparametric Statistics	3
MATH4004	Graduation Project	3
1 Required Elective		3
General Education Courses:		
1 course from area of Global Awareness		3
1 course from area of Science and Technology		3
1 Free Elective		3
<b>Total Credits:</b>		<b>21</b>

	<b>Credits</b>
<b>Grand Total:</b>	<b>120</b>

### **List of Required Electives**

CISC3015	Data and Information Visualization	3
CISC3018	Cloud Computing and Big Data Systems	3
CISC3023	Machine Learning	3
CISC3024	Pattern Recognition	3
CISC3025	Natural Language Processing	3
MATH3008	Introduction to Stochastic Calculus	3
MATH3009	Time Series Analysis	3
MATH3015	Introduction to Financial Mathematics	3
MATH3020	Bayesian Method in Data Analysis	3
MATH3021	Data Mining and Statistical Learning	3
MATH3025	Topics in Statistics and Data Science	3
MATH3030	Topics in Statistical Methods in Data Science	3

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## Course Description

### DOCTORAL DEGREE PROGRAMMES

#### **CIVL8001     ADVANCED TOPICS IN CIVIL ENGINEERING**

Any specialized topics in Civil Engineering chosen by staff members who have experience in that particular field, but the topics are not covered by other postgraduate courses.

Pre-requisite: None

#### **CIVL8999     DOCTORAL THESIS**

An independent investigation under the supervision of a faculty staff member.

Pre-requisite: None

#### **CISC8001     ADVANCED TOPICS IN COMPUTER SCIENCE**

Any specialized topic in Computer Science chosen by staff member who has experience in that particular field, but the topic is not covered by the other postgraduate courses.

Pre-requisite: None

#### **CISC8999     DOCTORAL THESIS**

An independent investigation under the supervision of a faculty staff member.

Pre-requisite: None

#### **ECEN8001     ADVANCED TOPICS IN ELECTRICAL AND COMPUTER ENGINEERING**

Any specialized topic in Electrical and Computer Engineering chosen by staff member who has experience in that particular field, but the topic is not covered by the other postgraduate courses.

Pre-requisite: None

#### **ECEN8999     DOCTORAL THESIS**

An independent investigation under the supervision of a faculty staff member.

Pre-requisite: None

#### **EMEN8001     ADVANCED TOPICS IN ELECTROMECHANICAL ENGINEERING**

Any specialized topic in Electromechanical Engineering chosen by staff member who has experience in that particular field, but the topic is not covered by the other postgraduate courses.

Pre-requisite: None

#### **EMEN8999     DOCTORAL THESIS**

An independent investigation under the supervision of a faculty staff member.

Pre-requisite: None

#### **MATH8001     ADVANCED TOPICS IN MATHEMATICS**

Any specialized topic in Mathematics chosen by staff member who has experience in that particular field, but the topic is not covered by the other postgraduate courses.

Pre-requisite: None

#### **MATH8999     DOCTORAL THESIS**

An independent investigation under the supervision of a faculty staff member.

Pre-requisite: None

#### **STGC8002     RESEARCH WRITING**

The course focuses on helping students to make academic presentations whether verbally (as in a conference) or in writing (as in a paper). Topics include:

- How to structure a presentation (on paper and in power point)
- Tenses used in various parts of a paper presentation
- How to structure clear logical paragraphs
- How to be concise

- How to avoid ambiguity and different writing styles (for example, conventions for use of numbers, abbreviations, etc.)

Pre-requisite: None

### **STGC8003 RESEARCH METHODS AND ETHICS**

This course aims to provide PhD students with research skills that are essential to become a successful researcher. The need for research ethics and the responsibility of the researcher (the student) and to avoid committing acts of academic dishonesty (such as through using citations and references). The topics of this course will include research methodology, professional ethics and academic integrity, and oral presentation and paper writing techniques. Students will be required to perform a literature survey, to construct a research proposal, and to write a paper summary in the style of formal scientific paper, in one of their familiar research topics.

Pre-requisite: None

## **MASTER'S DEGREE PROGRAMMES**

### **CIVL7001 ADVANCED MATHEMATICS**

This course introduces the methods for numerical analysis in science and engineering. It includes the mathematical modeling and error analysis, methods for the solutions of linear and nonlinear algebraic equations, optimization, numerical differential derivation and integration, curve fitting, numerical solutions of ordinary and partial differential equations.

Pre-requisite: None

### **CIVL7002 THEORY OF ELASTICITY AND PLASTICITY**

This course intends to provide students a comprehensive knowledge on the theory of elasticity and plasticity. The course focuses on the following topics: continuous medium, Cartesian tensors, deformation, displacement and strain tensors, compatibility conditions, external and internal forces, equilibrium, stress tensors, principal stresses, invariants and stress deviators, Mohr's circle, constitutive law, plasticity theory, yield and failure criteria, stability postulates, laws of mechanics, Navier's equations, plane stress and plane strain problems, variational principles, general theory of plane strain for perfectly plastic materials.

Pre-requisite: None

### **CIVL7003 FINITE ELEMENT METHOD**

Basic concepts. Virtual work and energy methods. Weighted residual methods. Rayleigh-Ritz and Galerkin methods. Finite element displacement method. Interpolation functions. Plate stretching and plane strain. Triangular elements. Isoparametric elements. Three dimensional stress analysis. Plate bending. Field problems. Vibrations. Stability. Nonlinear behaviour. Hybrid elements.

Pre-requisite: None

### **CIVL7004 ADVANCED SOIL MECHANICS**

The emphasis of this course is on the practical knowledge of soil behavior required by civil engineers for design and construction of geotechnical projects. Two most important topics of soil mechanics, consolidation and shear strength of soils, will be discussed in detail.

Pre-requisite: None

### **CIVL7005 SUBSURFACE INVESTIGATION AND SOIL TESTING**

The aim of this course is designed to provide postgraduate civil engineering students an advanced knowledge of geotechnical site investigation and soil testing. It includes site investigation procedures, planning and reporting, methods of subsurface investigation; ground or soil exploration includes boring, sampling soils and rocks; description and classification of soils and rocks, determination of stratigraphy and engineering properties by different types of field tests and laboratory tests; estimation of soil properties for foundation design and geophysical methods for site investigation.

Pre-requisite: None

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**CIVL7006      ADVANCED FOUNDATION ENGINEERING**

Shallow foundations. Bearing capacity of foundations on homogeneous soils and layered soils. Estimation of settlements. Measures to minimize damage. Analysis of combined footings and rafts. Pile foundations. Piles subjected to lateral loads. Displacement of pile group under axial and lateral loads. Foundation design for fills. Foundations for transmission towers.

Pre-requisite: None

**CIVL7007      SOIL DYNAMICS**

Dynamics of elastic systems. Single and multi-degree of freedom systems. Wave propagation in soil. Deformation and elastic properties of soils. Types of machine foundations. Mass-spring-dashpot model and elastic half space theory. Foundations for reciprocating machines and hammer foundations. Construction aspects of machine foundations. Foundations for miscellaneous machines. Vibration isolation and dampers.

Pre-requisite: None

**CIVL7008      STRUCTURAL DESIGN OF FOUNDATIONS**

Conventional structural design of continuous footings, individual footings, combined footings and rafts of various types subjected to vertical loads, lateral loads and moments. Design of circular rafts. Soil-structure interaction and design of foundation using flexibility approach. Structural design of piles and pile caps, under-reamed piles piers and caissons. Structural design of retaining structures.

Pre-requisite: None

**CIVL7009      SPECIAL TOPICS IN GEOTECHNICAL ENGINEERING**

This is a course for postgraduate students to understand the principles of geotechnical earthquake engineering. The basic concepts of seismology will be covered. Basic principles of wave propagation and ground response analysis will be presented. Advanced topics including liquefaction and seismic slope stability will also be covered.

Pre-requisite: None

**CIVL7010      STRUCTURAL VIBRATIONS**

This course introduces fundamental concepts of structural dynamics. It serves as an introductory course for graduate students in civil and mechanical engineering. This course starts from fundamental concepts and formulation of structural dynamic problems. Then, analysis in time-domain and frequency-domain will be introduced. Numerical methods will be delivered with consideration in accuracy, efficiency and stability.

Pre-requisite: None

**CIVL7011      PLATES AND SHELLS**

Basic concept of plates and shells will be introduced such as small deflection theory of elastic thin plates, rectangular plates, circular plates, plates on elastic foundation, in plane forces, buckling of plates, large deflections of plates, membrane theory of shells, bending theory of shells, shallow shells, cylindrical shells, buckling of shells.

Pre-requisite: None

**CIVL7012      STRUCTURAL ANALYSIS AND FINITE ELEMENTS**

This course focuses on the following topics: finite element modeling for analysis of tall buildings, frame structure, shear wall structure, wall-frame structure, space structure, core structure, and core wall structure, tube structure, outrigger-braced structure, giant structure, stability and dynamics of structures, the analysis and behavior of various structures.

Pre-requisite: None

**CIVL7013      SPECIAL TOPICS IN STRUCTURAL ENGINEERING**

Members of the staff will arrange special courses on advanced topics for properly qualified graduate students.

Pre-requisite: None

#### **CIVL7014 NUMERICAL MODELING IN GEOMECHANICS**

This course introduces constitutive models of soils and numerical modeling in geotechnical engineering. Soil constitutive models, such as Linear Elastic, Elasto-Plastic, Nonlinear and Cam-Clay models are discussed. Basic background of the finite element (FE) technique is briefly introduced with emphasis on geotechnical applications. A finite element commercial program (PLAXIS or SIGMA/W) is introduced to students to analyze geotechnical problems. The course aims to provide students essential knowledge on soil behavior, numerical modeling, and their applications in geotechnical engineering.

Pre-requisite: None

#### **CIVL7015 RANDOM VIBRATIONS OF STRUCTURES**

This course focuses on the following topics: random variable; random process; correlation function; power spectral density function; properties of linear systems; response of linear SDOF systems to random excitation; responses of linear MDOF systems to random excitation; probability density responses of linear systems; reliability analysis of linear systems; introduction to nonlinear random vibrations.

Pre-requisite: None

#### **CIVL7016 BEHAVIOR AND DESIGN OF STEEL MEMBERS**

This course is designed to introduce the behaviour and design of steel structural members according to the limit states design concept. The behaviour and design of the following topics will be discussed: (1) Steelmaking, Steel Properties, Design Philosophy, (2) Torsion of beam (St. Venant torsion, warping torsion of W-shapes, solution of torsion problem), (3) Beam (Beam classifications - Bending moment and shear capacity. Lateral torsional buckling), (4) Plate Girders (Local buckling, plastic action and moment redistribution, lateral buckling under uniform moment and special loading cases, inelastic effects, elastic and inelastic shear behaviour of plate girder), (5) Axially Loaded Members (Elastic and inelastic buckling theories, effect of residual stresses and initial curvature, local buckling), (6) Beam-Columns (In-plane behaviour, ultimate strength, out-of-plane behaviour, elastic and inelastic stability, local buckling). Students are expected to obtain advance knowledge about the design and failure mode of steel structural members after finished this course.

Pre-requisite: None

#### **CIVL7017 GROUND IMPROVEMENT TECHNIQUES**

Soil densification, Compaction Control Tests, Preloading and use of vertical sand drains, In-situ reinforcement- stone columns, soil nailing, micropiles, ground anchors, rock bolts, Flexible Geosynthetic sheet reinforcement.

Pre-requisite: None

#### **CIVL7018 LANDSLIDES MECHANISMS, MITIGATION AND RISK ASSESSMENT**

Under the influence of climate change and urban development, landslides are becoming one of the most common natural hazards in China and around the world. In this course, landslide (debris flow) disasters will be the major focus. Mechanisms, process, mitigation measures and risk assessment will be discussed. The course will arise the students' awareness and prepare necessary background knowledge for them to manage coastal safety targeting landslide disasters.

Pre-requisite: None

#### **CIVL7019 SPECIAL TOPICS IN GEOTECHNICAL ENGINEERING I**

This course explores current special topics in geotechnical engineering, such as site characterization, instrumentation, ground improvement and remediation. Topics vary with each offering and are disseminated before registration.

Pre-requisite: None

#### **CIVL7020 SPECIAL TOPICS IN STRUCTURAL ENGINEERING I**

Members of the staff will arrange special courses on advanced topics for properly qualified graduate students.

Pre-requisite: None



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**CIVL7021 SPECIAL TOPICS IN STRUCTURAL ENGINEERING II**

Members of the staff will arrange special courses on advanced topics for properly qualified graduate students.

Pre-requisite: None

**CIVL7022 ADVANCED COMPUTATIONAL METHODS: PRINCIPLES AND APPLICATIONS**

This is an introductory course on advanced computational methods for civil and coastal dynamical system analysis. The methods are potentially applied to coastal city vulnerability and resilience analysis, system modeling and updating, dynamical system identification, structural reliability and control, statistical analysis and uncertainty quantification, and more. Students will learn foundational knowledge and principles of advanced computational methods. Also, the students will be equipped with exploring state-of-the-art computational tools and methods to enter the corresponding research fields.

Pre-requisite: None

**CIVL7023 ECONOMIC ANALYSIS AND FINANCIAL MANAGEMENT IN ENGINEERING**

The course is to cover the fundamental principles needed by construction managers to successfully manage the finances of construction companies. These principles include accounting for financial resources, managing costs and profits, managing cash flows and analyzing financial alternatives.

Pre-requisite: None

**CIVL7024 FRACTURE MECHANICS AND FATIGUE**

Linear elastic fracture mechanics, Concept of Stress intensity factor, Correction factors of stress intensity factor, Numerical methods for stress intensity factor determination, Introduction to the elastic plastic fracture mechanics. Assessment of residual life of structural members.

Pre-requisite: None

**CIVL7025 RELIABILITY ANALYSIS IN CIVIL ENGINEERING**

This course focuses on the following topics: development of design code in civil engineering, randomness in civil engineering, limit state design and performance function, reliability analysis, reliability-based design criteria and factors in design codes, system reliability, further development and research topics on reliability analysis in civil engineering.

Pre-requisite: None

**CIVL7026 INSTRUMENTATION SYSTEMS IN CIVIL ENGINEERING**

This course is designed to introduce the concept and application of instrumentation system in Civil Engineering. The following topics will be discussed in the class: (1) Instrumentation systems, Signals and Errors, (2) Characteristics of instruments – Transducers, Noise and Nonlinearity, Static characteristics, Dynamic characteristics, (3) Signal conditioning – Introduction, Operating amplifier, Applications of Op-amps, filtering, (4) Data acquisition – Analog devices, Digital Devices, Sampling Theorem, Nyquist frequency, Quantization error, (5) Noise Reduction – Interference, Shielding, Grounding, Noise mode, Noise elimination or reduction, (6) Instruments and Sensors – Strain gauge, LVDT, Pressure transducer, Load cell (7) Signal Processing – Sampling Theorem, Laplace-transform and Z-transform. Students are expected to obtain knowledge about the background theory and application of different type of instruments used in Civil Engineering.

Pre-requisite: None

**CIVL7027 CONSTITUTIVE MODELING IN SOIL MECHANICS**

Constitutive modelling is an important subject in continuum mechanics. This course focuses on the physical and mathematical principles of constitutive modelling with emphasis on soil mechanics. Elasticity and plasticity frameworks for isotropic and anisotropic soil modelling are discussed. Critical state hardening models such as the original Cam clay and modified Cam clay are elaborated in details. The concept of bounding surface and more advanced state-dependent

dilatancy models are introduced. The course aims at providing students a fundamental understanding of the constitutive modelling techniques in soil mechanics.

Pre-requisite: None

### **CIVL7028 ANALYSIS AND DESIGN OF REINFORCED CONCRETE MEMBERS**

This course intends to provide students the knowledge on both analytical and design aspects of reinforced concrete and prestressed concrete members. The course focuses on the following topics: the analysis and design of both statically determinate and indeterminate prestressed concrete members, the analysis and design of prestressed concrete composite sections, the limit analysis of reinforced concrete slabs, and the strut-and-tie method.

Pre-requisite: None

### **CIVL7029 HYDRODYNAMICS AND FLOODS**

In the context of coastal environment and urban safety, this course introduces the fundamentals and topics of fluid mechanics. In addition, analytical and numerical methods for predicting flood hazards will be introduced.

Pre-requisite: None

### **CIVL7030 COASTAL FLUID MECHANICS AND STORM SURGE**

This course provides understanding on the physical processes in the coastal regions, where between the continental slope of marginal sea and land. The course starts with basic principle of the current and mass transport, then towards their applications in coastal marine system, which including the features of estuary circulation, shelf Ekman current, tide, geostrophic effect and the underlying forcing mechanisms. The formation of storm surge and the disaster prevention in the coastal regions will be introduced.

Pre-requisite: None

### **CIVL7031 SEDIMENT TRANSPORT AND EROSION**

This course aims to introduce fundamental mechanics of sediment transport in oceans, coastal areas, and rivers, and practical tools for sediment-related problems. It talks about sediment dynamics and coastal sediment-related problems, especially coastal erosions. Edge-cutting studies on related topics and tools for solving sediment problems are introduced.

Pre-requisite: None

### **CIVL7032 MUNICIPAL SOLID WASTE MANAGEMENT**

Integrated Solid Waste Management: Throughout this course, the management of our society's waste will be covered in a manner that meets public health and environmental concerns and the public's desire to reduce, reuse, and recycle waste materials. The engineering principles, the data, the engineering and scientific formulas, and examples of the day-to-day issues associated with the management of municipal solid waste (MSW) will be discussed. Starting from the introductory materials in integrated MSW, materials recovery, processing, and waste transformation, and integrated MSW policy issues will also be covered. Eventually the reflective and logical way of thinking regarding the problems and solutions in solid waste engineering will be nourished.

Pre-requisite: None

### **CIVL7033 ENVIRONMENTAL CHEMISTRY**

Many aspects of environmental engineering involve the treatment of water for human consumption and the treatment of wastes prior to their release into the environment. In addition, an understanding of the chemical fate of pollutants in the environment is important. Water chemistry and chemical reactions are therefore important in both engineered treatment processes and in natural systems in which wastes may be attenuated.

Pre-requisite: None

### **CIVL7034 COASTAL WATER TREATMENT PRINCIPLES AND PROCESSES**

This course focuses on the fundamental principles in the design and operation of key technologies in coastal water and wastewater treatment. The principles of physics, chemistry, and biology are

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covered, as well as the processes of treatment and the issues that arise from their application. Moreover, through the case study, the current state of this field, as well as relevant research topics, will be introduced.

Pre-requisite: None

#### **CIVL7035 WATER POLLUTION CONTROL: PHYSICAL AND CHEMICAL MODELING**

Carbonate buffering systems of natural waters: acid and base equilibrium; Inorganic species in natural waters: solid dissolution and precipitation equilibrium; Metal behavior in natural waters: metal-ligand complex formation; Redox reactions in natural waters: equilibrium and kinetics; Particulate matters in natural waters: aqueous surface chemistry.

Pre-requisite: None

#### **CIVL7036 ENVIRONMENTAL ASSESSMENT AND PLANNING: COMPUTER MODELING**

General methods for environmental assessment and planning: pollution monitoring, pollution source and pathways, impacts on environment, pollution control; Linear and non-linear multi-objectives programming; Regional planning of air and water pollution control; Urban development vs. environmental planning.

Pre-requisite: None

#### **CIVL7037 AIR POLLUTION CONTROL**

Air quality and meteorological conditions; Air pollution index and indicators; Air pollution control: strategies and technologies; Aerosols; Vehicular emission pollution; Toxic organic air pollution; Global environmental issues: acid rain; global warming; ozone depletion.

Pre-requisite: None

#### **CIVL7038 SPECIAL TOPICS IN ENVIRONMENTAL ENGINEERING**

(Subtitle: Biological Wastewater Treatment)

Principles of microbiological, biochemical, and biophysical processes used in environmental waste treatment and remediation processes, with particular emphasis on water quality control processes.

Pre-requisite: None

#### **CIVL7039 AIR POLLUTION METEOROLOGY AND CHEMISTRY**

It is designed to provide a rigorous, comprehensive treatment of the chemistry of air pollutants in the ambient air, the meteorology of air pollution, and the transport, diffusion and removal of the pollution species in the atmosphere. In this course, students will learn the methods and models, which would allow to predict the concentration profile that would result from any specified set of pollution emissions for any specific meteorological conditions at any location for any period.

Pre-requisite: None

#### **CIVL7040 SPECIAL TOPICS IN ENVIRONMENTAL ENGINEERING I**

(Subtitle: Remediation of Contaminated Soil and Groundwater)

This course will nourish students with their capabilities of selecting and/or developing remediation technologies appropriate for the causes and characteristics of contamination of the subsurface environment, soil and groundwater. This course will especially be focused on studying the causes of contamination of soil and groundwater, the characteristics and behaviors of contaminants, and the physical / chemical / biological / thermal remediation technologies.

Pre-requisite: None

#### **CIVL7041 SPECIAL TOPICS IN ENVIRONMENTAL ENGINEERING II**

(Subtitle: Physical and Chemical Water Treatment)

Physical-chemical treatment processes for the treatment of water, including sedimentation, flotation, filtration, coagulation, oxidation, disinfection, precipitation, adsorption, and membrane treatment processes. Current issues in drinking water quality and treatment are discussed.

Pre-requisite: None

### **CIVL7042 SPECIAL TOPICS IN ENVIRONMENTAL ENGINEERING III**

(Subtitle: Environmental Biotechnology)

This course reflects the most current and exciting fields of environmental science engineering, as a combination of ET (Environmental Technology) and BT (Bio-Technology) and would enable students first to connect two different facets of environmental biotechnology, principles of environmental microbiology and environmental engineering. They can develop the basic concepts and quantitative tools in the principles part and then can apply those in the applications part. They will be able to, in the long run, exploit microbiological processes to improve environmental quality, such as preventing the discharge of pollutants into the environment, cleaning up contaminated environments, and recovering valuable resources for human society. For students not already having a solid background in environmental microbiology, this course will also provide fundamentals in taxonomy, metabolism, genetics, and microbial ecology, by addressing the microbiology concepts that are most essential for understanding the principles and applications of environmental biotechnology.

Pre-requisite: None

### **CIVL7043 QUANTITATIVE METHODS FOR CONSTRUCTION DECISION MAKING**

This course aims to provide sound and comprehensive coverage of the concepts of quantitative methods for construction decision making. Major topics include: (1) analytic hierarchy process (AHP), (2) decision tree analysis, (3) inventory analysis, (4) simulation techniques, (5) linear, mixed-integer and goal programming, (6) dynamic programming.

Pre-requisite: None

### **CIVL7044 QUALITY AND SAFETY MANAGEMENT IN CONSTRUCTION**

This course aims to provide sound and comprehensive coverage of the concepts of quality management and safety management for the construction industry of Macau, as compared to their international practices. Major topics include: (1) quality management system based on ISO9000, (2) QA/QC in construction, (3) quality indicators and quality costs, (4) safety management systems, (5) construction accidents, (6) safety schemes.

Pre-requisite: None

### **CIVL7101 INTRODUCTION TO OCEANOGRAPHY**

This course is designed to introduce students to important concepts and fundamental principles in the study of the oceans and basic oceanographic research. Topics cover chemical, geological, physical and biological oceanography, as well as basic concepts in marine resource and marine environmental management.

Pre-requisite: None

### **CIVL7102 MARINE ECOLOGY**

This course presents the fundamental principles and advanced topics on the ecology of marine biodiversity and ecosystems. It focuses on processes and patterns that are specific to the marine environment, including the dynamics of estuarine and coastal ecosystem, the drivers of primary and secondary productivity, dynamics of coral reef ecosystem.

Pre-requisite: None

### **CIVL7103 AQUATIC CHEMISTRY**

Many aspects of coastal environmental process involve in-depth understanding of aquatic chemistry principles. In addition, aquatic chemistry knowledge is of vital importance to pollution control and remediation in coastal areas. Water chemistry and chemical reactions are therefore important in both engineered treatment processes and in natural systems in which wastes may be attenuated.

Pre-requisite: None

### **CIVL7104 ATMOSPHERIC CHEMISTRY**

This course is designed to provide some fundamentals of meteorological phenomena and chemical processes that affect urban air quality and global climate, with a focus on coastal

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environment where anthropogenic emissions and marine air masses interact substantially. It deals with the horizontal and vertical dynamics of air in a global to regional scale, as well as the chemistry occurring during transport of air pollutants. Specifically, the basics of atmospheric radiation and subsequent dynamics for air motion in general and in typical coastal regions will be introduced, as related to air pollution dispersion and the air pollution issues in recent decades.

Pre-requisite: None

#### **CIVL7105 COASTAL POLLUTION: SOURCES, FATE AND EFFECTS OF POLLUTANTS**

This course discusses the current state of coastal pollution, focusing on the impact of major pollutants (nutrients, microplastics, and antibiotics, etc.). Meanwhile, it also presents the removal strategies of the major pollutants found in seawater. The objective of this course is to equip graduate students with an understanding of the fundamental concepts and solutions relating to coastal pollution to lay a solid scientific foundation for their future research and work.

Pre-requisite: None

#### **CIVL7106 SPECIAL TOPICS IN HAZARD ALLEVIATION**

Members of the staff will arrange special courses on advanced topics on hazard prevention and mitigation in coastal cities to introduce principles and techniques of hazard alleviation to improve urban safety for properly qualified graduate students.

Pre-requisite: None

#### **CIVL7107 SPECIAL TOPICS IN COASTAL ENVIRONMENT**

Members of the staff will arrange special courses on advanced topics on coastal environment to introduce research and development in coastal environmental protection and remediation for properly qualified graduate students. It allows students to integrate multiple disciplinary knowledge to analyse scientific and technological problems related to coastal environmental protection and remediation.

Pre-requisite: None

#### **CIVL7197 INTERNSHIP AND REPORT**

An independent project in cooperation with industry carried out under the supervision of a faculty staff member and co-supervised by an industrial supervisor.

Pre-requisite: None

#### **CIVL7198 PROJECT REPORT**

Project Report focuses on combining existing academic theories or advanced technologies with an evaluation of a case study or academic project. Students will learn systematic problem-solving process skills, professional research and development practices, and project management skills. The goal of this option is to facilitate the integration of practice with academic research.

Pre-requisite: None

#### **CIVL7201 CONSTRUCTION PROJECT MANAGEMENT THEORY AND PRACTICE**

The aim of this course is to provide students with an overview of the theoretical and practical tools needed to successfully manage construction projects through feasibility study, design management, tendering, contract administration, time management, cost management, quality management, health and safety management, material and plant management, as well as customer relationship management.

Pre-requisite: None

#### **CIVL7202 CONTRACT MANAGEMENT**

This course will introduce to students the knowledge that is required to effectively utilize the contract as a tool to manage a construction project. The focus of the course will be understanding key contract terms and how to apply them when managing an active construction project.

Pre-requisite: None

**CIVL7203 ADVANCED CONSTRUCTION PLANNING AND SCHEDULING**

This course will introduce to students the principles, methods and tools required for the development and implementation of scheduling in the construction industry. This course will also introduce to students various programming and scheduling techniques suitable for planning of long, medium and short-term projects. Coursework is integrated with hands-on utilization of scheduling software commonly used in the industry and students will develop skills to create a schedule of tasks and activities related to the construction of a building or other structures, to allocate appropriate resources to such construction activities, and to develop schedules of construction activities within the most optimum time and cost. Guest lecturers may be featured for certain topics.

Pre-requisite: None

**CIVL7204 BUILDING INFORMATION MODELING (BIM): DEVELOPMENT AND APPLICATION**

This course covers topics about the development and application of Building Information Modeling (BIM) in building and construction management. The detailed contents may change depending on current developments and teacher specialization.

Pre-requisite: None

**CIVL7205 CONSTRUCTION COST MANAGEMENT**

This course covers the study of managing construction project cost in both the pre-contract and post-contract stages. It also covers key tools and techniques used such as value management, risk management and life cycle costing. It provides an introduction to construction cost information and databases; construction cost practices; and total cost control practices for construction projects.

Pre-requisite: None

**CIVL7206 INNOVATIVE METHODS AND APPLICATIONS OF INFORMATION TECHNOLOGY IN CONSTRUCTION**

This course introduces innovative technologies in the construction industry. It covers the advanced developments in construction management strategies, commercial software and digital tools, industrialization techniques, infrastructural systems and facilities, and novel construction methods and materials.

This course also covers the applications of information technology for construction management. Topics include introduction to both well-established information technology solutions and emerging trends. The course employs a combination of lecture and outside reading, and it depends on demonstrations of various software products in each category.

Moreover, speakers from various construction companies are invited to discuss the latest implementations in representative construction projects.

Pre-requisite: None

**CIVL7207 SUSTAINABILITY IN CONSTRUCTION**

This course covers the concepts of sustainable development and introduces the sustainable practices used in construction operations. It also covers environmental impact assessment and life-cycle environmental cost analysis when making sustainability decisions. It also covers sustainable construction materials and equipment, traditional and alternative construction processes.

Pre-requisite: None

**CIVL7208 SPECIAL TOPICS IN CONSTRUCTION PROJECT MANAGEMENT**

Members of the staff will arrange special courses on advanced topics on construction project management to introduce principles, tools and techniques applicable to the management of an active construction project at various phases.

Pre-requisite: None

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**CIVL7297     INTERNSHIP AND REPORT**

An independent project in cooperation with industry carried out under the supervision of a faculty staff member and co-supervised by an industrial supervisor.

Pre-requisite: None

**CIVL7298     PROJECT REPORT**

Project Report focuses on combining existing academic theories or advanced technologies with an evaluation of a case study or academic project. Students will learn systematic problem-solving process skills, professional research and development practices, and project management skills. The goal of this option is to facilitate the integration of practice with academic research.

Pre-requisite: None

**CIVL7996     APPLIED THESIS**

An independent project under the supervision of a faculty staff member. The goal of this thesis work is to facilitate the integration of practice with existing academic research or advanced technologies. The project must relate to the subject matter and be agreed by the department.

Pre-requisite: None

**CIVL7998     PROJECT REPORT**

An independent project carried out under the supervision of a faculty staff member.

Pre-requisite: None

**CIVL7997     INTERNSHIP AND REPORT**

An independent project in cooperation with industry carried out under the supervision of a faculty staff member and co-supervised by an industrial supervisor.

Pre-requisite: None

**CIVL7999     ACADEMIC THESIS**

An independent and original research study under the supervision of a faculty staff member. The topic of research must be in line with the stream taken by the student. In general, the study could result in a technical publication or a presentation at a professional meeting.

Pre-requisite: None

**CISC7001     FUNDAMENTALS OF SOFTWARE ENGINEERING**

The course discusses the theories, methods and tools of software engineering for developing large and complex software systems. The main contents are requirement, specification, system analysis and modeling, software design, architectural design, object-oriented design, functional-oriented design, verification and validation. Unified Development Process based on Modeling Language (UML) as well as its CASE tool are used to software system analysis and design combining with the course projects.

Pre-requisite: None

**CISC7002     COMPUTER COMMUNICATIONS AND NETWORKS**

Introduction to computer network high level protocols, internetworking techniques, client server architecture, API for Networking programming, High speed networks and ATM technology, Network management, Mobile and Wireless communication technology. The Important protocols for Internet in TCP/IP suit protocols will be discussed in detail.

Pre-requisite: None

**CISC7004     CURRENT DEVELOPMENT IN DATABASE**

The course introduces Distributed DBMS architecture, distributed database design, semantic data control, distributed query processing, distributed transaction management, distributed concurrency control, distributed DBMS reliability, database interoperability, e-commerce application development and deployment with HTML, Web server, Java applet, CORBA, JavaBean, and DB server technologies.

Pre-requisite: None

### **CISC7005 COMPUTER SCIENCE SEMINAR**

Under the supervision of academic staff, students will search the literature for a topic in computing that is of interest to them, and give a presentation on the state of the art technology. Visiting researchers and staff members may also present their research work.

Pre-requisite: None

### **CISC7006 COMPILER CONSTRUCTION**

Design of compilers for block-structured general-purpose programming languages. Automatic generation of lexical analyzers and parsers. Error detection and correction. Code optimization.

Pre-requisite: None

### **CISC7007 DESIGN AND ANALYSIS OF ALGORITHMS**

Principles of design of efficient algorithms: recursion, divide and conquer, balancing, dynamic programming, greedy method, data structure selection. Correctness and analysis of algorithms. Examples drawn from problems in sorting, searching, set manipulation, pattern matching, graphs, matrices, polynomials, and integers.

Pre-requisite: None

### **CISC7008 COMPLEXITY THEORY**

Models of computation, such as Turing machines and random access machines; nondeterminism and alternation. Computable and noncomputable functions. Time and space complexity, complexity hierarchies, NP-completeness, and provably difficult problems. Proof techniques, such as simulation, diagonalization, and reducibility.

Pre-requisite: None

### **CISC7009 FORMAL METHODS IN SOFTWARE ENGINEERING**

Formal models and methods and their application in all phases of software engineering process; operational, algebraic, model-based and property-based specification methods; verification of consistency and completeness of specifications; verification of properties of software; specification construction and verification using method-based tools.

Pre-requisite: None

### **CISC7010 DISCRETE SYSTEM SIMULATION**

Principles of simulation of discrete, event-oriented systems. Model construction, simulation and validation; relationship to other techniques for system analysis and design.

Pre-requisite: None

### **CISC7011 COMPUTER SYSTEM PERFORMANCE MODELING**

Use of queuing network models as tools to evaluate the performance of centralized and distributed computer systems.

Pre-requisite: None

### **CISC7012 COMPUTER GRAPHICS - PRINCIPLES AND SYSTEMS**

This course introduces the generation of graphics by computers with or without human interaction. The contents include hardware and software of computer graphics, graphics modeling, graphical transformations, realistic image synthesis and illumination techniques, interactive methods and user interface, graphics programming languages and systems.

Pre-requisite: None

### **CISC7013 PRINCIPLES OF ARTIFICIAL INTELLIGENCE**

Overview of Artificial Intelligence Application Areas, Languages and Programming Techniques for Artificial Intelligence, Problem Solving, Knowledge-based Systems, Knowledge Representation, Planning, Machine Learning, Natural Language Processing, Genetic Algorithms.

Pre-requisite: None



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**CISC7014    ADVANCED TOPICS IN COMPUTER SCIENCE**

This course introduces students to advanced topics in Computer Science. The detailed contents may change from year to year depending on current developments and teacher specialization.

Pre-requisite: None

**CISC7015    ADVANCED TOPICS IN COMPUTER SCIENCE I**

To introduce the most advanced technologies in the field of Computer Science.

Pre-requisite: None

**CISC7016    ADVANCED TOPICS IN COMPUTER SCIENCE II**

To introduce the most advanced technologies in the field of Computer Science.

Pre-requisite: None

**CISC7017    PRINCIPLES AND APPLICATIONS OF CONCURRENT PROGRAMMING**

The aim of the course is to introduce the principles of concurrency and concurrent programming languages. The main contents are processes, concurrency, synchronous and asynchronous communication, non-determinism, shared variables and resources, deadlock, safety and liveness, event-driven multithreads, real-time distributed and concurrent systems, concurrent programming languages (Java, CSP).

Pre-requisite: None

**CISC7018    COMPUTER VISION AND PATTERN RECOGNITION**

This course introduces the fundamentals and advanced topics of computer vision and pattern recognition for postgraduate students. It emphasizes both theory and applications of pattern recognition. Topics include overviews of general computer vision and pattern recognition techniques, statistical decision theory, linear discriminant functions, multilayer neural and deep networks, supervised learning, unsupervised learning and clustering, and applications of computer vision and pattern recognition.

Pre-requisite: None

**CISC7019    WEB MINING**

The course will cover the fundamental concepts, principles and algorithms in the area of Web Mining. It will firstly give an introduction to the concepts of the traditional information retrieval systems and the principles of web search engines, then, the course will extensively discuss techniques and algorithms of web mining, including Link-Base analysis, web page classifications, web advertisement, recommendation algorithms, web information extractions, web image indexing. The course also requires each student to complete a related course project

Pre-requisite: None

**CISC7021    APPLIED NATURAL LANGUAGE PROCESSING**

This course covers both the fundamental and advanced topics in Natural Language Processing (NLP), which deals with the application of computational models to text data. In this course, the core tasks in natural language processing will be examined, including minimum edit distance, language modelling, Naive Bayes, Maximum Entropy, text classification, sequence labelling, POS tagging, syntax parsing and computational lexical semantics. Modern NLP applications will be explored such as information retrieval, and statistical machine translation. Students will learn how to formulate and investigate research questions on related topics

Pre-requisite: None

**CISC7022    BIG DATA PROCESSING AND ANALYSIS**

This course introduces the latest development of data engineering techniques, including data query processing (e.g., multi-dimensional data, sequence data, and spatial-temporal data) in cloud computing and HPC environments. Students will learn study and learn how to formulate and investigate the state-of-the-art problems and solutions on related topics.

Pre-requisite: None

### **CISC7023 INTRODUCTION TO BUSINESS PROCESS MANAGEMENT**

The course introduces students to the principles and methods of business process management. Topics include business process modeling foundation, process orchestrations, managing process flows, and process discovery techniques.

Pre-requisite: None

### **CISC7996 APPLIED THESIS**

An independent project under the supervision of a faculty staff member. An applied thesis focuses on combining existing academic theories or advanced technologies with an evaluation of a case study or industrial project. The goal of this option is to facilitate the integration of practice with academic research.

Pre-requisite: None

### **CISC7999 ACADEMIC THESIS**

An independent and original research study under the supervision of a faculty staff member. An academic thesis is a scholarly written document of a piece of original research on a particular topic in consistent with every detail of research methodology. In general, the study could result in a technical publication or a presentation at a professional meeting.

Pre-requisite: None

### **CISC7201 INTRODUCTION TO DATA SCIENCE PROGRAMMING**

This course is designed for students who are new to the world of data science. After the introduction of some basic arithmetic, variables, and data structures in Python, students will start to learn how to collect and extract data from real datasets. Some data analytical skills using the control flows and Python packages (e.g., NumPy, SciPy, Pandas, etc.) will be introduced. To address the needs of big data processing, some distributed computing frameworks (e.g., Spark) and visualization tools with Python will be discussed. Students may apply some basic learning algorithms with Python packages (e.g., scikit-learn) to extract knowledge from data.

Pre-requisite: None

### **CISC7202 TOOLS FOR MACHINE LEARNING**

The course will start from the very beginning of the ML basis. First, the basic concepts such as linear algebra; probability and information theory, and numerical methods will be introduced. Next machine learning overview, inductive learning, and representation learning will be introduced. Basic deep learning processes are designed as artificial neural network; Bayesian Networks and learning; Deep learning and deep neural networks; convolution neural network. Throughout the course, practical methodology of using tools such as Tensorflow or Karas etc. will be emphasized.

Pre-requisite: CISC7201

### **CISC7203 DATABASE AND DATA MINING TECHNOLOGIES**

This course is designed to enable students to learn the database and data mining concepts and techniques for big data analytics and development in different domains. The course concentrates on the practical issues of database and data mining for solving big data problems. The content includes data modeling in database and data warehouse, SQL, Python programming for database, Python programming and R programming for data mining applications. Students will learn the skills of database modeling, querying, and programming, as well as the programming techniques for data mining.

Pre-requisite: None

### **CISC7204 DATA SCIENCE AND DATA VISUALIZATION**

This course is designed to enable students to learn the significance of data visualization in data science and big data analytics, and develop knowledge and skills to present quantitative data using data visualization tools. This course emphasizes on the practical aspects of data science with a focus on using R or Python programming language to process data, produce visualizations, and interpret these visualizations. Students will learn the practice of data cleaning, reshaping of data, basic tabulations, aggregations and visual representation in order to increase the

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understanding of complex data and models.

Pre-requisite: None

## ***Specialization A: Artificial Intelligence Applications***

### **CISC7013 PRINCIPLES OF ARTIFICIAL INTELLIGENCE**

Overview of Artificial Intelligence Application Areas, Languages and Programming Techniques for Artificial Intelligence, Problem Solving, Knowledge-based Systems, Knowledge Representation, Planning, Machine Learning, Natural Language Processing, Genetic Algorithms.

Pre-requisite: None

### **CISC7018 COMPUTER VISION AND PATTERN RECOGNITION**

This course introduces the fundamentals and advanced topics of computer vision and pattern recognition for postgraduate students. It emphasizes both theory and applications of pattern recognition. Topics include overviews of general computer vision and pattern recognition techniques, statistical decision theory, linear discriminant functions, multilayer neural and deep networks, supervised learning, unsupervised learning and clustering, and applications of computer vision and pattern recognition.

Pre-requisite: None

### **CISC7019 WEB MINING**

The course will cover the fundamental concepts, principles and algorithms in the area of Web Mining. It will firstly give an introduction to the concepts of the traditional information retrieval systems and the principles of web search engines, then, the course will extensively discuss techniques and algorithms of web mining, including Link-Base analysis, web page classifications, web advertisement, recommendation algorithms, web information extractions, web image indexing. The course also requires each student to complete a related course project.

Pre-requisite: None

### **CISC7021 APPLIED NATURAL LANGUAGE PROCESSING**

This course covers both the fundamental and advanced topics in Natural Language Processing (NLP), which deals with the application of computational models to text data. In this course, the core tasks in natural language processing will be examined, including minimum edit distance, language modelling, Naive Bayes, Maximum Entropy, text classification, sequence labelling, POS tagging, syntax parsing and computational lexical semantics. Modern NLP applications will be explored such as information retrieval, and statistical machine translation. Students will learn how to formulate and investigate research questions on related topics.

Pre-requisite: None

### **CISC7022 BIG DATA PROCESSING AND ANALYSIS**

This course introduces the latest development of data engineering techniques, including data query processing (e.g., multi-dimensional data, sequence data, and spatial-temporal data) in cloud computing and HPC environments. Students will learn study and learn how to formulate and investigate the state-of-the-art problems and solutions on related topics.

Pre-requisite: None

### **CISC7998 PROJECT REPORT**

An independent project under the supervision of a faculty staff member. A Project Report focuses on combining existing academic theories or advanced technologies with an evaluation of a case study or industrial project. The goal of this Project Report is to facilitate the integration of practice with academic research.

Pre-requisite: None

### **CISC7301 INTRODUCTION TO FINANCIAL TECHNOLOGIES**

The world of global tourism and entertainment, banking and financial services, as well as logistics

and supply chain are changing rapidly with the emergence of start-up financial technologies, commonly referred to as FinTech, that are not only empowering or disrupting the status quo, but are shaping almost all the services industries. This course will discuss the scope of FinTech that defined by WeBank (ABCD) or by AntFinance (BASIC) as well as how they changed the way people live, how companies operate, and how government regulate. This course will provide students with the latest empowering and practical knowledge on FinTech enabling them to understand some FinTech changes taking place currently and the trends that will impact different industries in the future.

Pre-requisite: None

### **CISC7302 ALGO TRADING AND HIGH FREQUENCY TRADING**

Program trading and high frequency trading (HFT) have become important to the financial industry that it generated over sixty percent of trading volume at Nasdaq and NYSE. There are wide range of activities that AI and big data can support in such trading process, which include opportunities identification, cost/friction estimation, market impact estimation, trading strategies selection, trade scheduling, capital and liquidity management, as well as risk management. In this course, we will discuss both traditional financial engineering models and modern AI, especially the machine learning and deep learning, that can be used in supporting Algo Trading. Modern topics like RoboAdvisor, AlphaGo Zero, and social media based market sentiment analysis will also be discussed.

Pre-requisite: None

### **CISC7303 CLOUD COMPUTING**

This course will introduce Cloud Computing and relevant technologies in designing and implementing large-scale and composite business web applications on Cloud Computing platform. Topics covered include Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS), Infrastructure-as-a-Service (IaaS), Data-as-a-Service (DaaS), and Cloud Computing Ecosystem. This course will cover scalable computing services in a pay-as-you-go model and Cloud Computing approaches for development and deployment of web services and information systems. This course will also introduce computer network high level protocols, internetworking techniques, client server architecture, API for Networking programming, High speed networks and ATM technology, Network management, Mobile and Wireless communication technology. The Important protocols for Internet in TCP/IP suit protocols will be discussed in detail. Students will study state-of-the-art solutions for cloud computing developed by Google, Amazon, Microsoft, Tencent Cloud, and Aliyun (Ali Cloud), etc.

Pre-requisite: None

### **CISC7998 PROJECT REPORT**

Project Report focuses on combining existing academic theories or advanced technologies with an evaluation of a case study or academic project. Students will learn systematic problem-solving process skills, professional research and development practices, and project management skills. The goal of this option is to facilitate the integration of practice with academic research.

Pre-requisite: None

### **CISC7401 ADVANCED MACHINE LEARNING**

This course introduces advanced Machine Learning theories, methodologies, algorithms, application tools, and programming tools.

Pre-requisite: None

### **CISC7402 MATHEMATICS FOR ARTIFICIAL INTELLIGENCE**

This course gives an introduction of mathematical background related to Artificial Intelligence to the students. The detailed contents may change from year to year depending on current developments and teacher specialization.

Pre-requisite: None

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### **CISC7403 CLOUD AND DISTRIBUTED SYSTEMS**

This graduate-level course introduces distributed systems and cloud computing areas focusing on system design and performance analysis. This course will also introduce state-of-the-art cloud solutions implemented in real systems.

Pre-requisite: None

### **CISC7404 SPECIAL TOPICS IN ARTIFICIAL INTELLIGENCE**

This course introduces special topics and advanced technologies in Artificial Intelligence. The detailed contents may change from year to year depending on current developments and teacher specialization.

Pre-requisite: None

### **CISC7498 PROJECT REPORT**

Project Report focuses on combining existing academic theories or advanced technologies with an evaluation of a case study or academic project. Students will learn systematic problem-solving process skills, professional research and development practices, and project management skills. The goal of this option is to facilitate the integration of practice with academic research.

Pre-requisite: None

### **ECEN7001 INTRODUCTION TO RESEARCH**

This is one of the fundamental courses in the Electrical and Electronics Engineering Master of Science Programme and is intended that it will provide the student with the basic knowledge about what is the research of one specific topic in the specialized areas of Power, Control or Electronics leading the student to make a survey on that topic and afterwards to write a report about it. This report will serve as an important basis for the future Thesis research work (that is the reason why it is mandatory). The responsibility of supervising this course is given to the student's Supervisor.

Pre-requisite: None

### **ECEN7002 ADVANCED MATHEMATICS**

Laplace Transform. Transforms of Derivatives and Integrals. s-Shifting, t-Shifting, Unit Step Function, Dirac's Delta Function, Differentiation and Integration of Transforms, Convolution, The Heaviside Expansion Theorem, Periodic Functions. Fourier Series, Half-Range Expansion, Complex Fourier Series. Fourier Integrals. Fourier Transform. Series Solution of Differential Equations, Legendre Polynomial, Bessel Functions. Sturm-Liouville Problem, Eigenfunction Expansions. Partial Differential Equations. Separation Variables, Use of Fourier-Bessel Series, Use of Fourier-Legendre Series. Solution by Laplace Transforms, solution by Fourier Transforms.

Pre-requisite: None

### **ECEN7003 MICROELECTRONIC CIRCUIT DESIGN**

The primary goal of this course is to introduce basic electronic principles needed by the integrated circuit designer and to discuss engineering tradeoffs and practical considerations that are necessary for the student to make the transition from the classroom to industry as an integrated circuit designer. After the introduction of these principles, some basic circuitry either digital or analog are presented together with one real advanced VLSI CMOS process. The evaluation is composed by several assignment works of simulation and layout design of basic circuits in the beginning of the semester and after mid-term the students will make a real IC design that will be implemented in a Multi-Project Chip.

Pre-requisite: None

### **ECEN7004 DIGITAL SIGNAL PROCESSING**

Orthogonal expansions, z-transformation and its properties. Band limited signals and sampling theorem. Discrete-time systems. The design and realisation of digital filters. Non-recursive and recursive digital filtering. Multi-rate sampling. Auto-correlation and cross-correlation techniques. Matching filtering. Power frequency spectrum. Adaptive signal processing - random gradient method. The concept of Parametric Model and its applications for random signal power spectrum modern estimation, extraction and pattern recognition. Multi-channel signal processing by using

Singular Value Decomposition (SVD). The introduction of Artificial Neural Networks.

Pre-requisite: None

### **ECEN7005 ACTIVE NETWORK THEORY**

Network Theory investigates the universal laws and the calculations of networks. Its contents, methods and style are always changed by the influence of era. Network analysis and synthesis has been transformed drastically, due to the emergence of digital computer and optimum method. And there are close and deep connections between network theory and system theory. Therefore, the basic achievements of the latter were introduced into the former, such as states, state equations and matrix algebra descriptions.

Pre-requisite: None

### **ECEN7006 ADVANCED TOPICS IN CONTROL SYSTEMS**

The course introduces the digital control system and intelligent control system. The topics discussed include modern design techniques for digital control system and fuzzy logic and control.

Pre-requisite: None

### **ECEN7007 ADVANCED TOPICS IN SIMULATION**

Simulation of electronic circuits with SPICE has replaced bread boarding as a powerful means of analyzing the performance of complex circuits (including IC circuits) and systems. Because of the huge number of devices contained in today's electronic circuits and systems, device model level has to be raised to a higher level, macro model in simulation. So macro modeling is a very powerful tool in simulation.

Pre-requisite: None

### **ECEN7008 EXPERT SYSTEMS**

In the past ten years research in the field of artificial intelligence has many important successes. One of the most significant has been the development of powerful expert or knowledge-based systems. In many world famous universities, the subject has already been treated as one of their core courses. We should of course attach importance to the subject in the making of our master training programme.

Artificial intelligence background (including intelligent supports of decision making, CIM and CA technologies). Problem analysis and selection. Knowledge acquisition. Knowledge representation. Reasoning under uncertainty. Selecting a development tool. Constructing the knowledge base. Knowledge-based technology. Verification, validation, and integration. Implementation and management strategies. Survey of electromechanical engineering and manufacturing applications. Case studies: samples of expert system development.

Pre-requisite: None

### **ECEN7009 MICROELECTRONICS FOR TELECOMMUNICATION AND SIGNAL PROCESSING**

The primary goal of this course is to present the most important functions that can be encountered in most of the applications in Telecommunications and Signal Processing. These functions that include, namely: Sampling, Discrete-Time and Digital Filtering and A/D and D/A Conversion, are presented both in theory and practice. The theory includes the basic fundamentals associated with each function and the practice comprises the presentation of different architectures for implementation, using for example Switched-Capacitor and Digital Techniques. The evaluation is composed by 4 laboratory works of simulation and electronic testing that will include the design of filters, A/D and D/A converters. The Software used for simulation includes the SWITCAP II programme (for functional SC-simulation) and the HSPICE programme (for electronic simulation at the transistor level). The Hardware used for electronic design and testing includes the MF10 (Integrated Switched-Capacitor Filter) and the Digital Signal Processor - Texas TMS 320C25.

Pre-requisite: None

### **ECEN7010 LASER AND SEMICONDUCTOR PHYSICS**

The course includes two parts. Part one introduces concepts and characteristics of laser principles,

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theories, operations and optic fiber. Other technologies for laser cavity and laser beam are covered. For part two, the objective is for engineering students to understand and to apply the knowledge of quantum physics to the semiconductor applications. Student learns elementary properties of semiconductor, energy bands structure, carrier properties, devices properties and various semiconductor fabrication techniques.

Pre-requisite: None

#### **ECEN7011 ADVANCED TOPICS IN TELECOMMUNICATIONS**

This course is designed to introduce the key techniques in digital communications systems and wireless networks including source coding, channel coding, modulation, communication channels, performance evaluation, wireless cellular networks, WiFi, and IoT networks; Channel coding schemes including block codes and convolutional codes, basic modulation schemes including PSK, ASK, FSK, QAM and TCM, advanced communication techniques including MIMO, OFDM and edge computing are particularly introduced.

Pre-requisite: None

#### **ECEN7018 FLEXIBLE ALTERNATIVE CURRENT TRANSMISSION SYSTEM**

The Flexible Alternative Current Transmission System and Distribution Flexible AC Transmission System (FACTS/DFACTS) are a new converging technology based on the Power Electronics, Control Theory and Power System for revolution of ever more efficient control and better utilization of power and energy in the existing systems. The FACTS offers an opportunity to enhance controllability, stability and power transfer capability of AC transmission systems with fastest control speed. DFACTS is the extended modern technique of FACTS to focus on the Custom issues or power line conditioning in the distribution site as well as the Information Technology's Electricity Issues. During the last decade, a number of control devices under the term FACTS/DFACTS technology have been proposed and implemented. This course provides a comprehensive guide to FACTS, covering all the major aspects in research and development of FACTS technologies. Various applications are also included to demonstrate the issues and benefits of applying FACTS. This course involved in the operation and control of modern power systems by FACTS technology.

Pre-requisite: None

#### **ECEN7019 EMBEDDED SYSTEM**

This is a project oriented course of Embedded System for postgraduate students. It emphasizes general concepts and design techniques of embedded system. Topics include overview of embedded system, real-time system, hardware and software co-design, and components selection.

Pre-requisite: None

#### **ECEN7020 ADVANCED TOPICS IN ANALOG AND MIXED-SIGNAL INTEGRATED CIRCUITS**

This course will provide a detailed discussion to the various types of analog and mixed-signal integrated circuits, e.g. data conversion and RF communication ICs, which are the key components in electronic systems. The performance characterization of data converters and RF circuits will be presented, and various types of data converters (including analog-to-digital and digital-to-analog) and RF building block (low-noise amplifier and mixer) will be discussed. The students are expected to complete several design and simulation projects with the implementation of the whole data converters and RF building blocks and the projects are expected to lead to chip fabrications for experimental verification.

Pre-requisite: None

#### **ECEN7021 BIOMEDICAL TRANSDUCERS AND INSTRUMENTS**

This essentially interdisciplinary course aims to introduce students the basic principles & techniques for biomedical transducers and instrumentations. This course covers sensing and measurement for qualitative description and quantitative analysis in biomedical engineering field mainly on noninvasive techniques.

Pre-requisite: None

### **ECEN7022 ELECTROCHEMICAL ENERGY CONVERSION AND STORAGE**

This course introduces principles, mathematical models and implementation of electrochemical energy conversion and storage. The principle of electrochemistry is introduced, including components of an electrolytic cell, Nernst's equation, thermodynamics and electrokinetics. The basic of power conversion is also introduced, including power electronics switches, converters and their control. The applications to batteries, solar cells, fuel cells and other emerging energy generation technologies are explored.

Pre-requisite: None

### **ECEN7023 SPECIAL TOPICS IN BIOMEDICAL ENGINEERING**

The course will introduce a selected special topic in the Biomedical Engineering (BME) area, includes any specialized topic in BME chosen by the staff member who has experienced in that particular field, but the topic is not covered by other postgraduate courses. Students may register for this course multiple times as long as the topic is different.

Pre-requisite: None

### **ECEN7024 MEDICAL IMAGING SYSTEMS**

The course aims to introduce the physics and principles of operation behind the major medical imaging systems including X-ray radiography, computed tomography (CT), magnetic resonance imaging (MRI), ultrasound (US) and nuclear medicine imaging (SPECT and PET). Image quality such as impulse response, signal-to-noise, resolution and its tradeoffs with system design for different imaging modalities will also be discussed.

Pre-requisite: None

### **ECEN7025 MODELLING AND THEORETICAL ANALYSIS FOR COMMUNICATION SYSTEMS**

This course is designed to introduce fundamental knowledge on the several theoretic methods and how to use them to model and analyze different issues in communication systems such as resource allocation in mobile computing, routing in the networking, and protocol design in wireless communication systems. For instance, the strategic making decision can be used to analyze the task and resource allocation in mobile computing. The VCG auction can be used to analyze the shortest path routing problem in communication networks. Reverse auction can be used to design incentive mechanism in the mobile intelligent sensing network. Coalitional activity can be used to analyze the cooperative relay networks. By learning this course, students should have deep understanding on these theoretic analysis methods and have the capability of using these methods to mathematically model and analyze various interactive problems in communication systems. All of these are assessed in assignments, presentations and projects.

Pre-requisite: None

### **ECEN7101 INTRODUCTION TO INTERNET OF THINGS**

This course introduces students to advanced topics in Internet of Things. The detailed contents may change from year to year depending on current developments and teacher specialization

Pre-requisite: None

### **ECEN7102 ADVANCED TOPICS IN APPLIED PROBABILITY AND STATISTICS**

This course prepares students with the fundamental principles and methods in probabilities and statistics for machine learning and data sciences. It covers from first a review of basic concepts such as common distributions, conditional and joint distributions, covariance and correlation, central limit theorem, sampling, to classical theory in estimation, hypothesis testing and Bayesian inference, and some advanced topics for regression, clustering, classification and learning.

Pre-requisite: None

### **ECEN7103 RFID PRINCIPLE AND APPLICATIONS**

This course provides students about radio frequency identification (RFID) information systems from hardware architecture, communication protocols to applications. Students will learn various types of RFID (e.g. HF, UHF RFID) technologies and different types of tags (i.e., active, passive,



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antenna polarizations, etc.), and their operating principles in hardware. The communication protocol for anti-collision and security enhancement will also be introduced. This course brings out various examples of both prevalent and emerging applications, to allow the students to obtain an idea of the potential applications in IoT such as item tracking and tracing, inventory monitoring and control, asset monitoring and management, anti-theft, electronic payment, access control, anti-counterfeit, smart tags.

Pre-requisite: None

#### **ECEN7104 ADVANCED INTEGRATED CIRCUIT DESIGN FOR INTERNET OF THINGS**

This course targets to provide an overview of the enabling integrated circuit design techniques for the development of energy constrained Internet of Things (IoT) systems. The fundamental building blocks in an IoT system will be systematically introduced, including the analog interface, power management circuits, energy harvesting modules, analog-to-digital converters, short-range radios, digital architecture, non-volatile memory, hardware security and battery/packaging. Advanced circuit design techniques targeting for ultra-low power consumption to fulfill the application level requirements will also be introduced.

Pre-requisite: None

#### **ECEN7105 EMBEDDED SYSTEMS FOR INTERNET OF THINGS APPLICATIONS**

This is a project oriented course for IoT related smart applications, especially the sensors for collecting data/information. It emphasizes the multi-tasking and time-driven programming for real-time applications. Topics include overview of embedded systems, time-driven multi-tasking programming, hardware and software co-design, and sensors interfaces.

Pre-requisite: None

#### **ECEN7106 CONVEX OPTIMIZATION FOR INTERNET OF THINGS APPLICATIONS**

This course focuses on convex optimization with applications to wireless communication systems, information theory, signal processing, control systems and machine learning. The first part will be on the theory of convex optimization—recognizing convex sets, convex functions, convex optimization problems and duality. The second part of the course will be on algorithms for solving convex optimization problems. This course is crucial to students and researchers in the above fields of engineering.

Pre-requisite: None

#### **ECEN7107 DATA ANALYSIS FOR INTERNET OF THINGS**

This course is an introductory course on data analytics and its application in IoT. It covers three major topics: 1) Primary data analytics theory including classification, regression, principal component analysis, etc.; 2) Hands on data analytics experiences with NumPy, Pandas, Matplotlib, & Scikit-learn packages; and 3) Applications in IOT (with a special example on buildings energy systems), in which comprehensive experiments with real data will be included.

In this course, students will learn systematic knowledge on data analytics and Python. They will also gain solid hands-on experiences in using Python to analyze IOT data.

Pre-requisite: None

#### **ECEN7108 ADVANCED TOPICS IN INTERNET OF THINGS**

This course introduces students to advanced topics in Internet of Things. The detailed contents may change from year to year depending on current developments and teacher specialization.

Pre-requisite: None

#### **ECEN7197 INTERNSHIP AND REPORT**

An independent project in cooperation with industry carried out under the supervision of a faculty staff member and co-supervised by an industrial supervisor.

Pre-requisite: None

#### **ECEN7198 PROJECT REPORT**

Project Report is distinguished from the Academic Thesis by its focus on combining existing

academic theories or advanced technologies with an evaluation of a case study or academic project. Project Report focuses on combining existing academic theories or advanced technologies with an evaluation of a case study or academic project. The goal of this option is to facilitate the integration of practice with academic research.

Pre-requisite: None

### **ECEN7996 APPLIED THESIS**

An independent project under the supervision of a faculty staff member. An applied thesis focuses on combining existing academic theories or advanced technologies with an evaluation of a case study or industrial project. The goal of this option is to facilitate the integration of practice with academic research.

Pre-requisite: None

### **ECEN7998 PROJECT REPORT**

Project Report is distinguished from the Academic Thesis by its focus on combining existing academic theories or advanced technologies with an evaluation of a case study or academic project. Project Report focuses on combining existing academic theories or advanced technologies with an evaluation of a case study or academic project. The goal of this option is to facilitate the integration of practice with academic research.

Pre-requisite: None

### **ECEN7997 INTERNSHIP AND REPORT**

An independent project in cooperation with industry carried out under the supervision of a faculty staff member and co-supervised by an industrial supervisor

Pre-requisite: None

### **EMEN7002 PHYSICS OF MATERIALS**

Atomic Theory: Hydrogen atom, Angular momentum and Pauli Exclusion Principle, Energy levels of atom, Energy bands, Fermi energy. Defects of materials. Dislocation: Edge dislocation, Screw dislocation, Burgers vector, Dislocation density, Elastic property of dislocation, Force on dislocation, Stress field and strain energy of dislocation, Dislocation motion and interaction, Dislocations in real crystal, Dislocations observation. Atomic structures and properties of some new materials.

Pre-requisite: None

### **EMEN7003 VARIATIONAL PRINCIPLES AND THE APPLICATION**

Principle of minimum potential energy; Principle of minimum complementary energy; Ritz method; Galerkin method; Kantonowitch method; Trefftz method; Hellinger-Reissner principle; Hu-washizu principle; Lagrange multiplier; High order Lagrange multiplier; Variational principle of non-linear elasticity; Methods for establishing generalized variational principle; Variational principle and the relating theorems in limit analysis; Applications for FEM, for limit analysis, for to find solutions and for to derive formulas; Developments in research work.

Pre-requisite: None

### **EMEN7006 MECHATRONICS**

Mechanical system interfacing; Combinational digital logic; Synchronous sequential logic; Asynchronous sequential logic; Register transfer logic; Embedded control computers; Analog digital conversion; Position and velocity measurement; Operational amplifiers for analog signal processing; Power amplifiers.

Pre-requisite: None

### **EMEN7007 PROCESS HEAT TRANSFER**

Application of fundamental principles of single- and two-phase fluid dynamics and heat transfer to the design and analysis of different types of heat exchangers, such as double pipe heat exchangers, shell and tube heat exchangers, fin-plate heat exchangers, cross flow heat exchangers.

Pre-requisite: None

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**EMEN7008 CONVECTIVE HEAT TRANSFER**

Convective heat transfer occurs in almost all branches of engineering applications. This course will cover the followings. The equation of convective heat transfer, the differential equation for the boundary layer, the integral equation of the boundary layer, momentum and heat transfer for the laminar internal and external flow, the momentum and heat transfer for the turbulent internal and external flow, natural and mixed convections.

Pre-requisite: None

**EMEN7009 COMPUTATIONAL METHOD FOR THERMO-FLUID SYSTEM**

The purpose of this course is to use computational method to investigate heat transfer and fluid flow and other related processes that occur in engineering equipment. This course will cover: Discretization method. Explicit and implicit methods for heat conduction. Upwind, exponential, hybrid and power-law schemes for convection. Calculation of flow field use various algorithms.

Pre-requisite: None

**EMEN7010 ENERGY CONVERSION AND UTILIZATION**

Renewable energy resources. Solar energy, wind power, wave and tidal power, geothermal energy, hydroelectric power. Environmental assessment of alternative energy resources.

Conventional energy resources, fossil fuel in solids, liquid and gaseous states. Nuclear energy. Energy analysis, energy economics, energy and society. Energy and the third world, energy conservation and energy policies.

Pre-requisite: None

**EMEN7011 ADVANCED ROBOTICS AND CONTROL**

Analyzes kinematic characteristics of planar and spatial manipulators. Differential kinematics and statics. Dynamics. Trajectory planning. Introduction to feedback control of physical system behavior. State-space and functional descriptions of linear and nonlinear systems. Feedback, stability, and robustness. Design of PID controllers and compensators. Interaction control. Actuators and sensors. Robot control architecture.

Pre-requisite: None

**EMEN7014 FLUID POWER ENGINEERING**

Basics of fluid flow and hydro-mechanics. Advanced pneumatic power systems. Advanced hydraulic power systems. Fluidics. Fluid logic control circuits. Modelling of fluid power systems. Fluid power system control. Dynamic analysis and simulation of fluid power systems. Fluid power plumbing and maintenance.

Pre-requisite: None

**EMEN7017 SPECIAL TOPICS IN MANUFACTURING I**

Laser physics, types of lasers and laser radiation for material processing, laser hazards & safety, laser optics and beam delivery systems, laser beam interaction with materials, laser materials processing: laser surface engineering, laser cutting, laser welding, laser drilling, laser marking, laser selective sintering.

Pre-requisite: None

**EMEN7018 SPECIAL TOPICS IN MANUFACTURING II**

In industry, material degradation of components and equipment arises from one or more of the three modes: wear, corrosion and fracture. The lifetime of the component is determined by the interaction among materials properties, component design, and the application conditions. This course intends to give a comprehensive knowledge on materials degradation and preventive methods by surface engineering. In addition, the fabrication of microelectronic devices will also be introduced in this course. This course focuses on the following topics: Surfaces: Their Nature, Roughness & Characterization; Corrosion; Tribology; Friction, Wear & Lubrication; Surface Treatment & Coating Technology.

Pre-requisite: None

### **EMEN7019 SPECIAL TOPICS IN THERMAL ENGINEERING I**

To introduce the most advanced technologies in the field of thermal engineering according to recent literatures/ publications in indoor air quality, ventilation and energy saving and advanced HVAC systems.

Pre-requisite: None

### **EMEN7020 SPECIAL TOPICS IN THERMAL ENGINEERING II**

To introduce the most advanced technologies in the field of thermal engineering according to recent literatures/ publications in single and multi-phase heat transfer and its applications.

Pre-requisite: None

### **EMEN7021 AUTOMOTIVE ENGINEERING**

Introduction to road vehicles. Modern internal combustion (IC) engine construction. Fuels and combustion. Thermodynamic analysis of IC engines. Advances in IC engines. Electronic fuel injection. Variable valve actuation. Turbocharging and supercharging. Advanced electronic control technology. Emission control. Engine characteristics and performance measurement. Engine trouble-diagnosis. Advanced automotive drive trains, braking, steering and suspension systems. Safety devices. Racing technology. Vehicle aerodynamics. Chassis engineering. Automobile mechanics.

Pre-requisite: None

### **EMEN7022 FAILURE ANALYSIS IN MECHANICAL ENGINEERING**

This course presents theories for preventing/mitigating the failure modes that are most frequently encountered in mechanical engineering. These include fatigue, stress concentration, fracture, creep, impact, buckling, wear, residual stresses, etc. This course shall cover such important design tools as: linear fracture mechanics, the various widely-used rules for predicting fatigue strength, models for predicting crack growth, the most important criteria for yield failure, and so forth. Case studies (such as the effects of residual stresses on the failure of railway rails) that involved the various failure modes shall be discussed, with an eye to reinforcing the students' ability in applying the various theories.

Pre-requisite: None

### **EMEN7023 ADVANCED ELECTRICAL SERVICES**

- To introduce the most advanced technologies in the field of electrical services engineering according to recent literatures and publications.
- To introduce the fundamentals in design of vertical transportation, security, lighting and energy storage systems.
- To enable students to understand the major design features, operating characteristics and functions of facilities used in electrical building services.

Pre-requisite: None

### **EMEN7024 ADVANCED ELECTROMECHANICAL ENERGY CONVERSION**

- To provide students understanding of various advanced electromechanical energy conversion systems, including the operating principles, performance characteristics and applications.
- To provide students knowledge in the selection, operation and control of electric machines.
- To ensure the students to develop an understanding of various variable speed drive systems and their applications

Pre-requisite: None

### **EMEN7025 HUMAN FACTORS ENGINEERING**

Students will gain an understanding of the basic theoretical concepts, principles and techniques of ergonomics as well as an introduction to fundamental ergonomic measurement tools for assessment of physical workload, posture, occupational exposure, and stress. The topics include systems design and task analysis, muscle use and anthropometry, workspace design, activity-related soft tissue disorders, back injuries, shiftwork, organizational and psychosocial aspects of

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work, skilled work and mental activity and regulations in ergonomics. The professional software such as "HumanCAD" is introduced for supporting ergonomic systems design and task analysis. The students are required to complete a related course project.

Pre-requisite: None

### **EMEN7027 ENGINEERING ACOUSTICS**

This course is to develop students' understanding of fundamentals of acoustics and its applications. Through this course students should be capable of modeling and analyzing engineering acoustics problems. Topics include: Fundamentals of vibrations. Vibration of continuous bodies (string, bar, plate). Acoustics wave equation. Acoustics impedance, power, and intensity. Spectral descriptions of acoustics. Transmission and reflection of sound. Acoustic radiation. Room acoustics. Introduction of acoustics and vibration measurements. Introduction of boundary element method.

Pre-requisite: None

### **EMEN7028 ADVANCED ELECTRIC VEHICLES**

This course will introduce the electrical and mechanical aspects of EVs, including the fundamentals, design, control, modeling, battery and other energy storage, electric propulsion systems. It will cover vehicle dynamics, energy sources, electric propulsion systems, regenerative braking, parallel and series hybrid electric vehicle (HEV) design, EV charging and infrastructure, impacts to environment and economy, and practical design considerations.

Pre-requisite: None

### **EMEN7029 SPECIAL TOPIC IN ELECTROMECHANICAL ENGINEERING I**

Any specialized topic in Electromechanical Engineering chosen by staff member who has experience in that particular field, but the topic is not covered by the other postgraduate courses in the MSc. programme.

Pre-requisite: None

### **EMEN7030 SPECIAL TOPIC IN ELECTROMECHANICAL ENGINEERING II**

Any specialized topic in Electromechanical Engineering chosen by staff member who has experience in that particular field, but the topic is not covered by the other postgraduate courses in the MSc. programme.

Pre-requisite: None

### **EMEN7031 MICROMECHATRONICS AND APPLICATIONS**

Micro/nanotechnology has become very important in creating innovative technologies in the fields of ultrahigh precision mechatronics, bio-medical engineering and energy/environmental technology. This course introduces fundamental aspects of micromechatronics. It involves scaling laws at the micro/nano-scales, electrostatics, piezoelectrics, electromagnetism, measurement tools, materials and fabrication methods, diverse micromechatronic systems and their applications.

Pre-requisite: None

### **EMEN7032 INTELLIGENT THEORY AND ENGINEERING APPLICATIONS**

This course introduces the fundamentals of intelligent system technologies and their engineering applications. It will present the principles of knowledge-based systems, fuzzy logic and artificial neural networks and explore how manufacturing and automation could benefit from application of these technologies. It will also discuss the representation of knowledge, knowledge acquisition, decision making mechanism, learning and machine learning, as well as its applications in various engineering domains.

Pre-requisite: None

### **EMEN7033 INDUSTRIAL ENGINEERING AND ENGINEERING MANAGEMENT**

This course is intended to introduce to the concepts of supervision and management in an engineering environment. Design of Work Systems, Facilities design and planning, Operation

Management, Knowledge Management, Supply Chain Management, Materials and Inventory Management, Logistical Management, Enterprise Resource Planning, and Decision Making System are studied as part of the course. Skills on analytical problem solving, statistical thinking and creativity are essential. The course project is required to apply Industrial Engineering (IE) and Engineering Management (EM) technology in solving the critical problems for the industries.

Pre-requisite: None

#### **EMEN7034 THEORIES AND PRACTICE OF CAD/CAM/CAE**

This course studies modern design and manufacturing techniques in the computer-based environment. It is designed to address the key issues in product development with the goal of providing the future engineers with a thorough understanding of the concepts and technologies in CAD/CAM/CAE. The major focus of the course will be computer graphics, geometric modeling, design reuse, feature recognition, process planning, NC path planning, rapid prototyping, engineering optimization, and computer integrated manufacturing.

Pre-requisite: None

#### **EMEN7035 PRODUCT DESIGN AND MANAGEMENT**

Innovation management and new product development are critical for improving the competitiveness of economies and firms. This course presents and utilizes multi-disciplinary approaches to cover different aspects of product design innovation and development management. The topics include innovation management, product design and optimization, design principle and process (design for manufacturability/environment/usability/X, axiomatic design, robust design, etc), product portfolio management, product life cycle management and design collaboration, etc.

Pre-requisite: None

#### **EMEN7036 MODELING AND ANALYSIS OF PRODUCTION SYSTEMS**

The complexity of the design and control problems encountered in the modern production system is increasing. This course introduces modeling and analysis methods for linking decision and performance throughout the production system. The methods could be used to support analysis of alternative manufacturing material/service strategies. The fundamental production operation issues will be discussed, ranging from serial systems, mass customization, quality control, group technology, cellular manufacturing, facility management, layout planning and material handling systems, etc.

Pre-requisite: None

#### **EMEN7037 ADVANCED MATHEMATICS FOR ELECTROMECHANICAL ENGINEERING**

First-order Ordinary Differential Equation; Second-order Ordinary Differential Equation; Fourier Series, Integrals, and Transforms; Analytical Solution of Partial Differential Equations: Heat Equation, Wave Equation, Circular Membrane, Laplace's Equation, Poisson's Equation; Complex Analytic Functions; Complex Integration; Power Series; Taylor Series; Laurent Series; Residue Integration Method; Numerical methods in Linear algebra with Matlab; Numerical Methods for Differential Equations with Matlab.

Pre-requisite: None

#### **EMEN7038 MECHANICAL PROCESSING OF MATERIALS**

Mechanical processing technologies are amongst the eldest manufacturing processes used by mankind. These processes are multi-discipline activities that require knowledge from different engineering areas. The methods for analysing these processes seek to integrate this multi-disciplinary aspect to obtain analytical or numerical solutions for the distribution of main field variables in the interior of the parts and the tool-part contact surfaces, resulting in a group of essential elements for design, project and optimization of parts and tools, aiding future engineers to cultivate a critical spirit on analysing the results and purpose alternative manufacturing solutions.

Pre-requisite: None

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**EMEN7039 PROGNOSTICS AND HEALTH MANAGEMENT OF ENGINEERING SYSTEMS**

This course provides the concepts and methods of prognostics and health management (PHM) of engineering system, which describes PHM techniques and their applications in engineering systems. A variety of tools and techniques for developing health management and monitoring of components and systems will be discussed. Topics related to sensor signal acquisition, data pre-processing techniques, various signals processing methods for feature extraction, machine learning methods and data driven prognostics models. After successfully completing this course, students will have a good understanding of system health monitoring, optimum sensor placement for health assessment, and current challenges and opportunities in the PHM field.

Pre-requisite: None

**EMEN7101 INTRODUCTION TO MOBILE ROBOTICS**

This course aims at teaching students basic knowledges and more recent advances on mobile robotics, such as robot sensing, localization, mapping, and motion planning.

Pre-requisite: None

**EMEN7102 INTRODUCTION TO SENSORS AND ACTUATORS**

Introduction to sensors and actuators, especially flexible devices. These sensors and actuators have wide applications in wearable electronics, Internet of Things, robotics, and mobile health, etc. This course prepares students to work professionally in academic researching or companies focusing on advanced technology.

Pre-requisite: None

**EMEN7103 AERIAL ROBOTICS**

This course aims to introduce students to the fundamental concepts involved in the design and operation of aerial robots, visiting the topics of rotorcraft modelling, navigation guidance and control, as well as motion planning. In particular we will derive dynamic models of robotic quadrotors, discuss the available sensors to be installed onboard and sensor fusion techniques rooted on the concepts of Kalman Filtering for linear and nonlinear systems, present methods for aerial robot control with stability analysis, and basic algorithms for efficient robot motion in unstructured environments. Finally, some applications are presented and future uses of aerial robots are discussed.

Pre-requisite: None

**EMEN7104 SPECIAL TOPICS IN ROBOTICS**

Any specialized topic in Robotics chosen by staff member who has experience in that particular field, but the topic is not covered by the other postgraduate courses in the MSc. programme.

Pre-requisite: None

**EMEN7105 SPECIAL TOPICS IN AUTONOMOUS SYSTEMS**

This course will give students an in-depth perspective on the most advanced techniques and algorithms currently used in wheeled mobile, aerial, space, and ocean autonomous robots, working in unstructured environments. These techniques will include recent results from machine vision, robotic image and video processing, sensor-based control for autonomous robots, sensor fusion for robot pose estimation, advanced nonlinear motion estimation and control, simultaneous localization and mapping, learning and deep neural networks, perception and compliance of human behaviour, and advanced robotic trajectory tracking and path planning. Case studies of successful algorithms employed in single and multiple autonomous robots will be presented and discussed.

Pre-requisite: None

**EMEN7198 PROJECT REPORT**

Project Report is a task of the capstone project focusing on combining existing academic theories or advanced technologies with an evaluation of a case study or academic project. Students will be asked to select a topic, or an engineering problem that arouses their interests, conduct literature review and research on the topic, design the experimental or testing methodology,

acquire a portfolio of findings or results, create a final product or a written report demonstrating their learning acquisition or conclusions and finally give an oral presentation on the capstone project to a panel who collectively evaluate the quality of the task.

Pre-requisite: None

### **EMEN7997 INTERNSHIP AND REPORT**

An independent project in cooperation with industry carried out under the supervision of a faculty staff member and co-supervised by an industrial supervisor.

Pre-requisite: None

### **EMEN7998 PROJECT REPORT**

Project Report is distinguished from the Academic Thesis by its focus on combining existing academic theories or advanced technologies with an evaluation of a case study or academic project. Project Report focuses on combining existing academic theories or advanced technologies with an evaluation of a case study or academic project. The goal of this option is to facilitate the integration of practice with academic research.

Pre-requisite: None

### **MATH7001 FUNCTIONAL ANALYSIS**

The first level of abstract analysis is about operators and, in particular, functionals, in linear normed and Banach spaces, and in Hilbert spaces. Besides the basic concepts the course will finally rest on the three corner stone theorems, viz., the Hohn-Banach theorem of Extension of bounded linear functional in linear normed spaces, the resonance theorem (Banach-Steinhaus Theorem) and the open mapping theorems (the closed range theorem).

Pre-requisite: None

### **MATH7002 REAL ANALYSIS**

Based on the concept completeness of the real number system this course systematically extends the length concept for intervals to general measurable sets. Based on the concept measurable sets and their measures the course introduces measurable functions and its subclass integrable functions and their integration. In such way completeness of Lebesgue integrable functions extending Riemann integration is established. This develop analysis is indispensable.

Pre-requisite: None

### **MATH7003 ADVANCED NUMERICAL LINEAR ALGEBRA**

Direct methods for solving linear systems. Iterative methods for solving linear systems. Sparse matrix computations. Eigenvalue problems. Least squares problems. Toeplitz solvers.

Pre-requisite: None

### **MATH7004 ADVANCED PROBABILITY AND STATISTICS**

This course studies advanced theory such as law of large number, central limit theorem and Poisson limit theorem with their applications in Statistics.

Pre-requisite: None

### **MATH7005 CLIFFORD ANALYSIS**

Clifford algebras, spinors, elementary geometric algebra, Dirac differential operators, monogenic (Clifford analytic) functions, Taylor and Laurent series for monogenic functions, CK extensions of real analytic functions, Cauchy integrals, generalized exponential functions and Hardy spaces, singular Cauchy integrals and Plemelj formulas.

Pre-requisite: None

### **MATH7006 GEOMETRY AND ITS APPLICATIONS**

This is a research oriented course related to one of the following 3 areas in geometry: algebraic geometry, differential geometry, or even computational geometry. The topics can be different from year to year, depending on the instructors' interest. The instructor can also discuss the materials from some current topics, or some topics in his or her research area. The instructor can develop



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the theory toward the geometric application as well.

Pre-requisite: None

### **MATH7007 MATHEMATICAL THEORY OF COMPUTATIONAL INTELLIGENCE**

Mathematical model of neurons and neural networks, learning of ANN, optimization methods for error function, Backpropagation learning methods, Approximation theory of ANN and applications. Evolutionary algorithms and their convergence theorem.

Pre-requisite: None

### **MATH7008 MATRIX ANALYSIS**

Similarities and canonical forms of matrices. Normal, Hermitian and positive definite matrices. Matrix norms. Inequalities of eigenvalues and singular values.

Pre-requisite: None

### **MATH7009 NUMERICAL METHODS FOR DIFFERENTIAL EQUATIONS**

In this course, we focus on the numerical methods for solving the ordinary and partial differential equations. The main contents include single and multi-step methods for ordinary differential equations; finite difference method, finite element method, spectral method for partial differential equations; the related numerical analysis; quality programming for the numerical algorithm.

Pre-requisite: None

### **MATH7010 PARTIAL DIFFERENTIAL EQUATIONS**

This course provides some knowledge on partial differential equations. It includes the study of Fourier transformation and translation invariant operators. Characteristic theory of linear equations will be given. Various boundary value problems for homogeneous wave equations, Laplace equations and parabolic equations will also be studied.

Pre-requisite: None

### **MATH7011 READING COURSE I**

For individual students or a group of students. Self-study of specific topics under the guidance of a supervisor.

Pre-requisite: None

### **MATH7012 READING COURSE II**

For individual students or a group of students. Self-study of specific topics under the guidance of a supervisor.

Pre-requisite: None

### **MATH7013 STOCHASTIC DIFFERENTIAL EQUATIONS**

This course starts from reviewing the basic probability theory and stochastic processes such as Markov chains, Poisson processes and so on, and then studies Brownian motions, Ito formula, Ornstein-Uhlenbeck process, growth models, Black-Scholes equations and some applications of stochastic differential equations in Finance and biology.

Pre-requisite: None

### **MATH7014 STOCHASTIC PROCESSES**

Gaussian processes, stationary processes, Markov chain and Markov processes. Stochastic processes with independent increments, Brownian motions, martingales and semi-martingales.

Pre-requisite: None

### **MATH7015 TIME SERIES ANALYSIS**

This module introduces methods for analyzing the time series data. Topics include: Stationary random processes, Autocovariance and autocorrelation functions, Discrete parameter models, Purely random processes, Autoregressive processes (first order, second order, general orders), Moving average processes, ARMA processes, General linear processes, Harmonic processes, Stochastic limiting operations and standard continuous parameter models, etc. This module is

targeted at students who are interested in time series and are able to meet the prerequisite.

Pre-requisite: None

### **MATH7016 TOPICS IN ANALYSIS**

Selected topics in analysis. The content may vary from year to year.

Pre-requisite: None

### **MATH7017 TOPICS IN GEOMETRY**

Selected topics in geometry. The content may vary from year to year.

Pre-requisite: None

### **MATH7018 TOPICS IN MATRIX ANALYSIS**

Selected topics in matrix analysis. The content may vary from year to year.

Pre-requisite: None

### **MATH7019 TOPICS IN PARTIAL DIFFERENTIAL EQUATIONS**

Selected topics in partial differential equations. The content may vary from year to year.

Pre-requisite: None

### **MATH7020 TOPICS IN PROBABILITY AND STATISTICS**

Selected topics in probability and statistics. The content may vary from year to year.

Pre-requisite: None

### **MATH7021 FINANCIAL MATHEMATICS**

Introduction to option pricing and the Black-Scholes model. Introduction to martingale theory and stochastic calculus, the Cox-Ross-Rubinstein model, and the martingale method in option pricing. Backward stochastic differential equations and option pricing. Consumption-investment strategies, and maximization problems of utilities in financial markets. Other updated topics in financial mathematics.

Pre-requisite: None

### **MATH7998 PROJECT REPORT**

An independent project under the supervision of a faculty staff member. A Project Report focuses on combining existing academic theories or advanced technologies with an evaluation of a case study or industrial project. The goal of Project Report is to facilitate the integration of practice with academic theory.

Pre-requisite: None

### **OCES7001 OCEAN REMOTE SENSING**

This course is designed to introduce students to important concepts and fundamental principles in remote sensing and applications in oceans and coastal environments. Topics cover sensors, microwaves, image analysis and applications of remote sensing in oceans and coastal area.

Pre-requisite: None

### **OCES7002 Physical Oceanography**

This course will introduce the physical oceanographic objectives, concepts, and processes in the ocean to students with a broad background in mathematics and physics. It starts from learning properties of seawater and the basic oceanographic phenomena, then developing the basic equations which describe the principles upon which physical oceanography is based. The principles will help to understand the waves, tides, effect of earth rotation, Ekman dynamics and the large-scale circulation. The student will learn the fundamental concepts for describing and modelling currents, waves, and understand their role in the climate system.

Pre-requisite: None

### **OCES7003 Ocean Acoustics**

This course is designed to introduce students to important concepts and fundamental principles

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in oceans acoustics. Topics cover acoustic wave propagation, reflection and transmission in fluid media, ray tracing and normal modes methods for solving wave equation, central basic methods and problems relevant for the use of sound in marine environments, as well as the principle of designing underwater acoustic systems.

Pre-requisite: None

#### **OCES7004 Ocean Sensors**

This course is designed to introduce students to functional principle of different types of sensors, mathematical-scientific and informatics-based measuring methods as well as data acquisition systems and models. Topics cover introduction to ocean sensors, fundamental principles of sensor operation, design and construction of ocean sensors and application in ocean environments, challenges and innovations.

Pre-requisite: None

#### **OCES7005 Marine Robotics and Application**

This course introduces the broad spectrum of marine vehicles and their application in oceans, the fundamental principles of maritime robotics such as autonomous underwater and surface vehicle, as well as theoretical and practical design of robotics.

Pre-requisite: None

#### **OCES7006 Special Topics in Ocean Observation and Modeling**

This course is designed to introduce students to tools, technologies, and data that covers all major aspects of measurements of physical, chemical and biological parameters in oceans, as well as ocean models.

Pre-requisite: None

#### **OCES7007 Special Topics in Underwater Communication and Networks**

This course is designed to introduce students to communication technologies of underwater wireless communication, such as acoustic communication, optical communication, and magneto-inductive communication. Topics cover basics fundamentals, advantages and disadvantages, and applications of underwater communication technologies.

Pre-requisite: None

#### **OCES7008 Machine Learning and Applications in Ocean Science**

This course covers the fundamental tools and techniques for machine learning and their applications in ocean science. Students will learn how to analyze large amounts of data to identify patterns and trends, and understand the implications of these findings in ocean science.

Pre-requisite: None

#### **OCES7197 Internship and Report**

An independent project in cooperation with industry carried out under the supervision of a faculty staff member and co-supervised by an industrial supervisor.

Pre-requisite: None

#### **OCES7198 Project Report**

Project Report focuses on combining existing academic theories or advanced technologies with an evaluation of a case study or academic project. Students will learn systematic problem-solving process skills, professional research and development practices, and project management skills. The goal of this option is to facilitate the integration of practice with academic research.

Pre-requisite: None

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**BACHELOR'S DEGREE PROGRAMMES****APAC1000    ADVANCED MATHEMATICS I**

The course aims at providing mathematical concepts and methods to students in the study of classical mechanics, electromagnetism, quantum mechanics as well as statistical mechanics. The topics will cover linear algebra, vector calculus, special functions, complex numbers and hyperbolic functions.

Pre-requisite: None

**APAC1001    COLLEGE PHYSICS**

In this part, mechanics included rotation, gravitation, elasticity, oscillation, waves, sound waves, fluid, gas theory and laws of thermodynamics will be introduced.

Pre-requisite: None

**APAC1002    ELECTROMAGNETISM AND PHYSICAL OPTICS**

In this part, Electromagnetism will be introduced in terms of forces, fields, potential, laws, current, circuits, induction, circuit components, electromagnetic waves, light, geometric optics, interference and diffraction.

Pre-requisite: None

**APAC1003    INTRODUCTION TO COLLEGE CHEMISTRY**

This course addresses the basic concepts of chemistry through lectures and laboratory experiments. Topics include: atoms and molecules, periodic table, electronic structure, chemical bonding, chemical reactions, electrochemistry, and organic chemistry.

Pre-requisite: None

**APAC2000    ADVANCED MATHEMATICS II**

The course is the extension of Advanced Mathematics I. The course aims at providing mathematical concepts and methods to students in the study of classical mechanics, electromagnetism, quantum mechanics as well as statistical mechanics. The topics will cover infinite series, Fourier series and transformation, ordinary differential equations, probability.

Pre-requisite: APAC1000

**APAC2001    ANALYTICAL AND ENVIRONMENTAL CHEMISTRY**

Introduction of analytical chemistry, including the concept of analytical chemistry, sample preparation, analysis methods, quality control, as well as analytic techniques for environmental science. Related experiments will also be arranged in this course.

Pre-requisite: APAC1003

**APAC2002    MODERN PHYSICS**

This course is intended to develop basic theoretical tools needed to understand fundamental atomic processes. It will introduce you to modern quantum physics starting with the special theory of relativity and the foundations of quantum mechanics. Then it presents the basic concepts and principles of atomic physics. Topics may include the hydrogen and helium atoms, spin-orbit coupling schemes, hyperfine interaction, Lamb shift, atoms in magnetic fields, multi-electron atoms, Pauli exclusion principle, Hund's rules, diatomic molecules, Born-Oppenheimer approximation, electronic, vibrational, rotational and rotational-vibrational spectra.

Pre-requisite: None

**APAC2003    INORGANIC CHEMISTRY**

Introduction of inorganic chemistry, including general principles of chemistry, periodic properties of elements, acid-base theory, structure of compounds, s, p, d-block elements, etc. Some related experiments will be included.

Pre-requisite: APAC1003

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**APAC2004 QUANTUM PHYSICS**

Introduction to quantum mechanics. It may cover the following topics: Wavefunction and Schrodinger equation, observables, eigenfunctions, one-dimensional steady state problem, Mechanical quantities expressed by operators and representation transformation, the evolution of mechanical quantities over time and symmetry, the Schrodinger equation in spherical coordinates, spin and orbital angular momentum, Quantum transitions, hydrogen atom and addition of angular momenta.

Pre-requisite: APAC2000

**APAC2006 ORGANIC CHEMISTRY: FOUNDATIONS OF CHEMICAL REACTIVITY AND SYNTHESIS**

Introduction of the structures, properties, preparation, and reactions of a vast array of molecules that we call organic compounds. Introduction of concepts that structure determines properties leading to exploration of the subject in a systematic manner through understanding of classes and functionalities and reaction mechanism. Materials learnt in earlier chapter will serve as building blocks for the topics in the later chapter. Stereo- and regio-controlled chemical reaction types are introduced.

Pre-requisite: APAC1003

**APAC3000 MATERIALS PHYSICS AND CHEMISTRY**

The course will introduce the general synthesis methodologies in material science based on Physics and Chemistry principles. Exploration and applications of novel and functional materials, especially in modern technology, will also be covered in the course.

Pre-requisite: None

**APAC3001 SOLID STATE PHYSICS**

In this course, the behavior of atoms and shared electrons in solids will be described by classical physics and quantum mechanics. The discussion of solid with crystalline structure will be one of the emphases. Some properties of crystal such as defects, disorder and thermal vibration will be studied. Then, band theory and motion of electron will be investigated.

Pre-requisite: None

**APAC3002 THERMODYNAMIC AND STATISTICAL PHYSICS**

This course introduces the foundations of statistical mechanics to students with a strong mathematics and physics background, who are contemplating a major in Physics or interested in a rigorous treatment of physics. The main contents include the zeroth, first, second and third laws, thermodynamical potentials and Legendre transformation, phase coexistence and phase transition, thermodynamical stability, statistical distribution of almost independent systems, and others.

Pre-requisite: None

**APAC3003 MATERIALS CHARACTERIZATION**

Introduction of commonly used materials characterization methods (XPS, SEM, AFM, XRD, Raman, XPS), including their theory of operation and hands-on experience. Includes a discussion of the measurement process and instrumental analysis of samples.

Pre-requisite: None

**APAC3004 OPTOELECTRONICS**

This course covers the fundamental principles of wave and geometric optics, photonics and optoelectronics, with an emphasis on applications. Topics may include light propagation and basic properties, polarization, waveguide and optical fibre, optical properties of crystals and semiconductors, semiconductor light emitting diodes, lasers, photodetectors, photovoltaic devices and displays. The course also includes substantial laboratory and project work.

Pre-requisite: None

**APAC3005 PHYSICAL CHEMISTRY**

This course provides a theoretical and mathematical description of the physical behavior of chemical systems. Introduce and interpret observations on the physical and chemical properties of matter. Physical chemistry is also essential for developing and interpreting the modern techniques used to determine the structure and properties of matter, such as new synthetic materials. Related experiments will also be arranged in this course.

Pre-requisite: APAC1003 or HSC11000

**APAC3006 SEMICONDUCTOR PHYSICS**

Brief introduction of solid-state physics and crystallography, followed by a major focus on the knowledge of semiconductor physics with topics including electronic states in semiconductors, defects in semiconductors, the carrier transportation in semiconductors, unbalanced carriers in semiconductors and semiconductor junctions, via both classroom teaching and lab exercises.

Pre-requisite: None

**APAC3007 LOW-DIMENSIONAL PHYSICS**

The course aims at an introduction to basic principles of nanophysics allowing working in research and development in nanotechnology. Students will learn basic principle of physics of nanometer-size systems with a focus on basic physical phenomena.

Pre-requisite: None

**APAC3008 NANO CHEMISTRY**

Introduction of nanomaterials and nanochemistry, including the concept of nanoscale, the band structure and the corresponding characters of nanomaterials, the fabrication, modification and application of nanosystem.

Pre-requisite: None

**APAC3009 POLYMER CHEMISTRY**

Introduction of various classes of organic and polymer compounds, emphasizing organic and polymer chemical reactions and mechanisms of major functionalities and their importance in the area of chemistry. Topics covered include: structure and bonding; regio-, geometric, and stereoisomerism; substitution and elimination reactions; synthesis and reactions of alcohols and epoxides; structure and properties of polymer; free radical polymerization; condensation polymerization; crystallization and crosslinking of polymer chains; characterization and application of organic and polymer compounds. Related experiments will also be arranged in this course.

Pre-requisite: APAC1003

**APAC3010 THIN FILM PHYSICS**

Thin films are used in many aspects in modern technologies. This course mainly focuses on introducing the working principles of various thin film fabrication techniques, such as, thermal evaporation, sputtering, chemical vapor depositions. Physics in obtaining vacuum and/or plasma conditions as well as the applications of thin films in modern society are also going to be covered.

Pre-requisite: None

**APAC4000 RESEARCH PROJECT**

The course is designed for the students to carry out projects at year 4. The projects should be focused on the scope of Applied Physics and Chemistry.

Pre-requisite: None

**APAC4001 ELECTROCHEMISTRY**

Introduction to fundamental principles of electrochemistry and electrochemical methods of analysis. The course will cover topics in physical as well as electroanalytical chemistry including thermodynamics, electrode potentials, galvanic and electrolytic cells, electrode kinetics, dynamic electrochemistry, mass transport by migration, diffusion and convection, diffusion layers, and electrochemical instrumentation and techniques. The student will learn about the theoretical and practical aspects of electrochemical measurements whether they be used for determining some

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physical property a system. Using a combination of problem-based learning approaches and traditional lectures, the student will develop critical thinking skills in the areas of electrochemical method and data interpretation.

Pre-requisite: None

#### **APAC4002 ELECTRODYNAMICS**

Electrodynamics is aimed at exploring the properties of electromagnetic fields, law of motion, and its interaction with charged matter. The main focus of this course is to explain the theory of macroscopic electromagnetic field.

Pre-requisite: None

#### **APAC4003 MAGNETIC PROPERTIES OF MATERIALS**

Introduction of electric and magnetic properties of materials, including interesting macroscopic phenomena such as superconductor, multiferroics, frustration, etc., and related macroscopic origins, based on frontier researches and emerging new materials.

Pre-requisite: None

#### **APAC4004 MATHEMATICAL METHODS IN PHYSICS**

The course focuses on the partial differential equations in physics, their mathematical structures, as well as related numerical methods. The main topics will cover the introduction of elliptic, parabolic, and hyperbolic equations, their key theoretical results, and numerical methods for solving these equations.

Pre-requisite: GEST1004

#### **APAC4005 MICRO-/NANO-SYSTEMS**

This course provides an overall introduction to miniaturization and microelectromechanical systems (MEMS) with basic theoretical principles of the scaling in micro/nano-devices. Key fabrication methodology, material, and structural design of MEMS will be introduced. The state-of-the-art applications of MEMS in interdisciplinary fields will also be covered.

Pre-requisite: None

#### **APAC4007 SEMICONDUCTOR MATERIALS AND DEVICES**

Introduction of semiconductor and device physics. Brief introduction of semiconductor growth and the device fabrication processes, including crystal growth, floating zone refining, defects control, doping and lithography. Main focus will be on the properties of semiconductor devices, such as p-n junction, metal-semiconductor contact, MIS and transistor. Also, applications of semiconductor devices will be introduced.

Pre-requisite: APAC3006 or APAC3001

#### **APAC4008 SUPRAMOLECULAR CHEMISTRY**

Supramolecular chemistry is “chemistry beyond the molecule”. It is an interdisciplinary field that covers the physical, chemical and biological properties of complex chemical species held together mainly by non-covalent interactions. This course provides an introduction to the field, and discusses the intermolecular forces that dictate the formation of supermolecules and supramolecular assemblies and their properties. Main topics include basics of molecular recognition, host-guest chemistry, self-assembly, supramolecular materials and function, as well as supramolecular medicine.

Pre-requisite: None

#### **APAC4009 THEORY AND MODELING OF MATERIALS PROPERTIES**

This course uses the theory and application of atomistic computer simulations to model, understand, and predict the properties of real materials.

Pre-requisite: None

#### **APAC4010 TOPICS IN EMERGING MATERIALS**

Materials are fundamental to economic, social and industrial development. They form the basis

for the functionality of the built environment, products and technologies that are vital to modern society. This course will discuss the recent discovery of emerging materials that they can be the key innovative trigger in the development of many new products and technologies.

Pre-requisite: None

### **CIVL1000 COMPUTER SCIENCE**

This course introduces computer science with basic logic and fundamental programming techniques. Fundamental of programming include primitive data types, expressions, control statements, functions, and arrays. Both theoretical concepts and practical skills are involved; students can experience problem solving by formulating programmatic solutions for real problems and translate them into programs with the programming languages: C++ and Fortran.

Pre-requisite: None

### **CIVL1001 INTRODUCTION TO CIVIL AND ENVIRONMENTAL ENGINEERING**

Introduction to the study and practice of civil engineering; subfields in the discipline, such as structural, geotechnical, environmental, water resources, ocean & coastal, transportation, and construction engineering; professionalism and professional registration; engineering ethics and safety. Independent study on various topics will be assigned to students.

Pre-requisite: None

### **CIVL1002 CIVIL ENGINEERING DRAWING**

This course is designed to provide civil engineering undergraduates with basic understanding of the theory and practice of engineering drawings and computer-aided design for civil engineering applications. Students will learn to read and construct blueprints and working drawings by means of lectures, discussion of drawing examples related to existing buildings or projects, CAD practice. Topics will include basic fundamentals of graphics and drafting principles, Auto-Cad fundamentals, architectural drawings, structural floor plan of building, detailing for typical reinforced concrete structural and steel members.

Pre-requisite: None

### **CIVL1003 STATICS**

It is a beginning level course for the preparation of other intermediate courses in solid and fluid mechanics. It introduces the basic concepts, tools and methods for rigid bodies, such as forces, moments, free body diagram, equilibrium, supports, reactions, internal forces and moments, truss, frame, shear force and bending moment diagram, etc.

Pre-requisite: None

### **CIVL1004 ENGINEERING GEOLOGY**

The first part includes the major principles of physical geology covering the structure of the Earth, plate tectonics, volcanism and other mountain building processes, the surface erosion process, and the formation and properties of minerals and rocks. The second part concerns with the application of geological knowledge to civil engineering problems such as landslide, subsidence and earthquake etc. The third part includes the engineering classification of soils.

Pre-requisite: None

### **CIVL2000 KINEMATICS AND DYNAMICS**

This course covers the following topics: kinematics of particles, kinetics of particles; Newton's second law and energy and momentum methods, systems of particles, kinematics of rigid bodies, plane motion of rigid bodies: forces and accelerations and energy and momentum methods, kinetics of rigid bodies in three dimensions, mechanical vibrations.

Pre-requisite: ECEN1008; CIVL1003

### **CIVL2001 MECHANICS OF MATERIALS**

This course introduces fundamental concepts of deformable bodies. It serves as a bridge between mechanics of rigid bodies and structural analysis. It introduces the behavior of structural members, both qualitatively and quantitatively, under different types of external loadings.



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Pre-requisite: CIVL1003

### **CIVL2002 SURVEYING**

This course covers the following topics: distance measurement, leveling, angle measurement, surveying errors and adjustments, field operations, traverse, construction surveying, curve measurement, measurement of area and volume, topography.

Pre-requisite: None

### **CIVL2003 FLUID MECHANICS**

Properties of fluids; Fluid statics; Fluid in motion and the conservation of mass; Pressure variation in flows; Momentum and energy principles; Dimensional analysis and similitude; Application in civil engineering: pipe flow, pipe networks, and open channel analysis.

Pre-requisite: GEST1004 and ECEN1008

### **CIVL2004 MATHEMATICS FOR CIVIL ENGINEERING**

There are two parts of this course:

1. linear algebra;
2. probability.

It aims at providing civil engineering students necessary mathematics tools in their study of core courses. Examples will be designed with civil engineering-related problems.

Pre-requisite: MATH1003

### **CIVL2005 CONSTRUCTION MATERIALS**

This course is designed to provide undergraduate civil engineering students fundamental principles of the behavior, physical and engineering properties of various common civil engineering materials, including natural stones, sands, aggregates, cement, concrete, steel, timber and bituminous materials. Selection and design of materials based on their intended use in design and construction are emphasized. The laboratory sessions are designed to provide students a hand-on experience on various material testing concepts and procedures. Written reports and oral presentation of experimental results will be required.

Pre-requisite: None

### **CIVL2006 STRUCTURAL ANALYSIS**

This first course in structures introduces structural design concept and process, analysis of statically determinate structures, analysis of indeterminate structures by flexibility method and stiffness method.

Pre-requisite: CIVL2001

### **CIVL2007 SOIL MECHANICS**

This course covers the following topics: the index properties, plasticity and structure of soil, engineering classification of soil, soil compaction, permeability, seepage, effective stress, stresses in a soil mass, consolidation behavior and strength of soils. The first part of the course introduces fundamental engineering properties and the second part covers the concept of time dependent deformation behavior and the strength of soil.

Pre-requisite: CIVL1003

### **CIVL3000 STEEL DESIGN**

This course covers the following topics: This course is designed to introduce the behaviour and design of steel structural members according to the limit states design concept. The behaviour and design of tension members, compression members, laterally restrained and unrestrained beams, beam-columns and design of connections will be discussed. Students are expected to obtain basic knowledge about the design and failure mode of steel structural members after finishing this course.

Pre-requisite: CIVL2006

### **CIVL3001 CONSTRUCTION MANAGEMENT AND PRACTICE**

This course addresses various aspects of managing construction projects. Topics include: Organizational structure of construction companies; Project delivery systems: traditional, construction management, design-build, BOT; Project estimating and tendering; Project scheduling and tracking; Construction services during design and site administration; Safety considerations and quality control.

Pre-requisite: None

### **CIVL3002 ENVIRONMENTAL ENGINEERING I**

This course is organized with the following chapters: introduction of environmental engineering; chemistry; biology; ecosystems; materials and energy balances; risk perception, assessment and management; hydrology; water characteristics involving physical, chemical and biological aspects; water quality analysis including principles and methods involved in natural water quality process; physical and chemical modelling for water environmental processes involving chemical equilibrium, reaction kinetics, and reactor principles.

Pre-requisite: STGC1001

### **CIVL3003 ENVIRONMENTAL ENGINEERING II**

This course is organized with the following chapters: water quality control in rivers; water and wastewater treatments: physical, chemical and biological processes; design principles for water and wastewater treatment facilities; water treatment processes and unit operations including coagulation and flocculation, sedimentation and flotation, filtration and clarification; reactor principles and wastewater treatments including bio-chemical treatments, secondary sedimentation operation, activated sludge treatment process, bio-film treatment process.

Pre-requisite: CIVL3002

### **CIVL3004 REINFORCED CONCRETE DESIGN**

This course covers the following topics: reinforced concrete material properties; limit state design concepts; introduction to European design standards (i.e. Eurocodes 1 and 2); analysis of frames and shear wall structures; analysis of sections in bending and/or axial loads; yield line and strip methods for slabs; behavior and design of reinforced concrete beams, one-way slabs and two-way slabs considering flexure, shear, anchorage, curtailment and serviceability requirements; behavior and design of short and slender columns under combined bending and axial loads.

Pre-requisite: CIVL2006

### **CIVL3005 FOUNDATION ENGINEERING**

The course introduces civil engineering students the fundamental concepts of foundation analysis and design. This course covers the following topics: Review of Soil Mechanics; Subsurface Exploration; Shallow Foundations; Pile Foundations, and selected topics of foundation engineering.

Pre-requisite: CIVL2007

### **CIVL3006 CIVIL ENGINEERING HYDRAULICS**

Application of the basic laws of fluid mechanics to hydraulic problems. Analysis of simple and multiple steady pipe flows: branching pipes, pipes in series and parallel, and pipe network; flow measurement in pipe. Unsteady flow in pressure conduits: establishment of steady flow and water hammer. Analysis of pumps and turbines. Pump and system characteristics. Steady open channel flow: energy and momentum principles; critical and uniform flow development and their computation; best hydraulic section; gradually varied flow and its profile computation; flow measurement in open channel. Introduction to Hydrology.

Pre-requisite: CIVL2003

### **CIVL3007 ADVANCED TOPICS IN SOIL MECHANICS**

This course is focused on the practical knowledge of soil behavior required by civil engineers for design and construction of geotechnical projects. Two most important topics of soil mechanics, consolidation and shear strength of soils, will be discussed in detail. In addition, other practical

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topics including soil compaction, slope stability will be covered.

Pre-requisite: None

### **CIVL3008 ENVIRONMENTAL MODELING**

This course is organized with the following chapters: Key Tool Skills; Mass Balance and Kinetics; Atmospheric Process; Carbon Dioxide Equilibria; Pesticides, Mercury, and Lead; Fates of Organic Compounds; PCBs, Dioxins, and Flame Retardants.

Pre-requisite: None

### **CIVL4000 GRADUATION PROJECT I**

The graduation project (GP) for Civil Engineering Programme is a one-year independent study under the supervision of faculty member(s), which includes either analytical, experimental, computational, or case-study type work. A final report must be submitted near the end of the second semester accompanied with an A3 size poster. The GP will be assessed through continuous work, report writing and oral presentation. The mark will be given as a single unit for both the courses 'CIVL4000 GRADUATION PROJECT I' and 'CIVL4001 GRADUATION PROJECT II', with a total of 6 credits.

Pre-requisite: Final year level

### **CIVL4001 GRADUATION PROJECT II**

The graduation project (GP) for Civil Engineering Programme is a one-year independent study under the supervision of faculty member(s), which includes either analytical, experimental, computational, or case-study type work. A final report must be submitted near the end of the second semester accompanied with an A3 size poster. The GP will be assessed through continuous work, report writing and oral presentation. The mark will be given as a single unit for both the courses 'CIVL4000 GRADUATION PROJECT I' and 'CIVL4001 GRADUATION PROJECT II', with a total of 6 credits.

Pre-requisite: CIVL4000

### **CIVL4002 INTEGRATED PROJECT DESIGN**

The course focuses to provide design skills required to carry out real case projects from inception, feasibility, engineering, procurement, and implementation. Emphases will be placed on presentation of design project in the form of technical descriptive writings, verbal communications, calculations, and drawings. Professional ethic training will be provided by experienced engineer/professor. Before the end of this course, students need to finish and pass the assessment of engineering safety training which is provided either by the Macau Direcção dos Serviços para os Assuntos Laborais 澳門勞工事務局 (for local students) or by the department (for non-local students).

Pre-requisite: None

### **CIVL4004 ADVANCED MECHANICS OF MATERIALS**

This course covers the following topics: plastic deformation of axially loaded member, plastic bending of beams, bending of beams with asymmetric cross sections, shear stress and shear center of thin-walled cross section, strain energy and energy method, calculation of beam deflection with moment diagram.

Pre-requisite: CIVL2001

### **CIVL4005 ADVANCED STRUCTURAL ANALYSIS**

This course is the second course in structural analysis and covers the general stiffness method, the matrix stiffness method, influence lines for determinate and indeterminate structures, virtual work method, plastic analysis of beams and frames.

Pre-requisite: CIVL2006

### **CIVL4006 STRUCTURAL VIBRATIONS**

This course introduces dynamic behaviour of structures and methods to obtain structural response under dynamic load and base excitation.

Pre-requisite: CIVL2006

### **CIVL4007 ADVANCED REINFORCED CONCRETE DESIGN**

This course covers the following topics: Introduction to Macao codes for loadings (including vertical loads, wind loads, and seismic loads) on structures and the reinforced concrete structural design; behavior and design of flat slabs and stair slabs; behavior and design of structural walls, foundations and earth retaining structures; prestressed concrete.

Pre-requisite: CIVL3004

### **CIVL4008 STRUCTURAL SYSTEMS AND ANALYSIS**

This course covers the following topics: structures and the behavior of various types of buildings; structures and the behavior of various forms of bridges; structures and the behavior of catenary cable systems; suitability of a structural type under given conditions.

Pre-requisite: CIVL2006

### **CIVL4009 SELECTED TOPICS IN GEOTECHNICAL ENGINEERING**

Any specialized topic in Geotechnical Engineering chosen by the staff member who has experience in that particular field. The topic will include new theories, design concepts and procedures.

Pre-requisite: CIVL2007

### **CIVL4010 EARTH RETAINING SYSTEMS**

Earth retaining systems form an important component of many civil engineering projects. In particular, it is a necessary element for deep excavations, which are commonly performed in modern cities to obtain underground space. This course will provide extensive discussions for the design and analysis of retaining systems including gravity walls, sheet-pile walls, and diaphragm walls. Students will learn to use computer software to analyze a retaining wall for deep excavation. The course will cover the following topics: lateral earth pressure, retaining wall types, analysis of backfilled walls and in-situ walls, stability of wall and base, settlements due to excavation, strut and anchor systems, diaphragm walls: slurry control, concrete technology, instrumentation for deep excavation.

Pre-requisite: CIVL2007

### **CIVL4011 APPLICATION OF NUMERICAL METHODS IN GEOTECHNICAL ENGINEERING**

This course introduces students the application of numerical methods in geotechnical engineering. Basic background of the finite element (FE) and finite difference (FD) methods are briefly introduced with emphasis on geotechnical applications. A finite element commercial programme (GeoStudio) is introduced to students to analyze geotechnical problems, especially using Sigma/W for stress and displacement modeling and Seep/W for seepage analysis. The course includes the following topics: Geotechnical analysis; Finite Element Theory for Linear Materials; Modeling of Shallow Foundations; Geotechnical Considerations; Finite Difference Method, Modeling of Construction and Excavations; Modeling of Seepage.

Pre-requisite: CIVL2007

### **CIVL4012 INTRODUCTION TO SOIL IMPROVEMENT**

This is the introductory course of ground improvement techniques for marginal and problematic soil. The content includes the basics of laboratory and in situ tests for geotechnical projects. Then, surface compaction, admixture stabilization and deep densification are covered. Ground modification by consolidation and vertical drains are then covered. Various types of in situ reinforcement techniques such as stone columns, soil soils are introduced.

Pre-requisite: CIVL2007

### **CIVL4013 ENGINEERING ECONOMICS AND ETHICS**

This course aims to provide sound and comprehensive coverage of the concepts of engineering economics and ethics. Topics include: role of engineers in business, time value of money, major analysis methods, codes of ethics, rights and responsibilities of engineers and ethical issues in engineering practice.

Pre-requisite: None

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**CIVL4014 CONSTRUCTION PLANNING, SCHEDULING AND CONTROL**

This course applies modern management methods to planning and scheduling for construction projects. Topics include: presentation of planning information, developing a network model, precedence/arrow diagrams, critical path method, time-cost trade-offs, resource allocation and leveling, PERT & Monte Carlo techniques, project monitoring, control and update, linear scheduling and computer scheduling.

Pre-requisite: None

**CIVL4015 CONSTRUCTION METHODS, PROCEDURE AND EQUIPMENT**

This course addresses various aspects of contemporary construction methods and equipment. Topics include: equipment economics, engineering fundamentals of moving earth, excavating, loading & hauling equipment, foundation and basement construction, concrete construction practices and formwork design.

Pre-requisite: None

**CIVL4016 ENVIRONMENTAL ENGINEERING III**

This course is organized with the following chapters: Conservation Laws and Continua; Low-Concentration Particle Suspensions and Flows; Interactions of Small Charged Particles; Adsorption, Partitioning, and Interfaces; Diffusive Mass Transport; Filtration and Mass Transport in Porous Media; Reaction Kinetics.

Pre-requisite: CIVL3003

**CIVL4017 ESSENTIALS TO ENVIRONMENTAL BIOTECHNOLOGY**

This course reflects the most current and exciting fields of environmental science engineering, as a combination of ET (Environmental Technology) and BT (Bio-Technology).

Pre-requisite: None

**CIVL4018 WASTEWATER TREATMENT ENGINEERING**

This course nourishes students with engineering knowledge of the comprehensive management for the collection and transport, and the treatment and disposal of sewage/wastewater.

Pre-requisite: None

**CIVL4019 TRAFFIC ENGINEERING**

This course deals with fundamental introduction of traffic engineering, such as human factor design, geometric design and section design, traffic flow theory analysis, capacity analysis, traffic count methods, signalized intersection analysis; introduction of ITS

Pre-requisite: None

**CIVL4020 TRANSPORTATION PLANNING AND PUBLIC TRANSPORT SYSTEM**

In the first part of the course, it deals with introduction of urban transportation planning system such as data collection, trip generation, trip distribution, mode choice and trip assignment. In the second part, it familiarizes the students with important issues of public transport system such as system, technology and quality of service. Various kinds of public transportation system like bus, bus rapid transit, light rapid transit, railway rapid transit will be discussed.

Pre-requisite: CIVL4019

**CIVL4021 SPECIAL TOPICS IN CIVIL ENGINEERING**

Members of the staff will arrange special courses on updated topics for properly qualified students.

Pre-requisite: None

**CISC1001 PROGRAMMING SCIENCE**

This course introduces the notion of algorithms and teaches principles of problem solving. It also introduces fundamental concepts of programming, such as scalar data types, variables, functions, choice, iteration, recursion, arrays, strings, enumerations, record types, and file processing. These concepts are introduced through the C programming language.

Pre-requisite: None

### **CISC1002 DISCRETE STRUCTURES**

This course introduces the fundamental ideas of discrete mathematics used in many basic computer-related concepts. These include Set Theory, Logic, Counting, Relations, and Graph Theory. Throughout the course, students will also be trained in developing skills in mathematics, such as Modeling, Abstraction and Proof Methods.

Pre-requisite: None

### **CISC1006 PROBABILITY AND STATISTICS**

Sample space and events, axioms of probability; Conditional probability, independence and the Bayes Rule; Random variables, discrete probability distribution, continuous probability distribution, joint probability distribution; Mean, variance, covariance and correlation; Some discrete probability distributions: uniform, binomial, hyper geometric, geometric, negative binomial and Poisson; Some continuous probability distributions: normal, exponential, gamma, chi-Squared, lognormal and Weibull; Sampling distributions; Confidence intervals; Hypotheses Testing; Regression and correlation analysis.

Pre-requisite: GEST004

### **CISC1000 INFORMATION TECHNOLOGY FUNDAMENTALS AND PRACTICES**

This foundational course introduces and explores the impact of information technology (IT) in our modern society. The course is designed to provide the fundamentals and practices for an effective use of IT in our daily lives. The course is divided in three modules:

- Module I introduces the fundamentals of IT, the Internet and the Web, connectivity and mobility, and important issues in computer privacy, security and ethics.
- Module II focuses on application software for computers and mobile devices.
- Module III explores computer hardware and computer software, mobile devices and apps, communication and networking.

Pre-requisite: None

### **CISC1004 INTRODUCTION TO COMPUTER SCIENCE**

This is an introductory course on Computer Science (CS) for first year students. The course is designed to give an overview of CS, and its use in various applications, such that students will be more aware and engaged in their major. Details pertaining to the theoretical aspects of CS will be covered in other classes. This course is first divided into topics covering the fundamentals of CS, before shifting to its applications in the real world. Upon completion of this course, students will have a better understand of CS, and be more motivated to study its other aspects.

Pre-requisite: None

### **CISC2001 COMPUTER ORGANIZATION**

Introduction is given to the architecture and organization of a computer system, with a contemporary chip as a sample for introducing machine language, assembly language and Central Processing Unit (CPU). The contents include various parts of computers: CPU, Memory, Input/Output. The primary features and working principles in each part will be introduced in detail, including interrupts, direct memory access, virtual memory and memory management, algorithms and hardware implementation of integer and floating-point number operations.

Pre-requisite: None

### **CISC2002 NUMERICAL METHODS AND COMPUTATION**

Introduction to data representations and computer arithmetic; Basic techniques in MATLAB programming; Numerical solution of nonlinear algebraic equations; Approximating functions; Numerical differentiation and integration; Numerical solution of ordinary differential equations.

Pre-requisite: GEST004

### **CISC2003 OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES**

This course aims to introduce basic features of objected oriented programming and data structures.

Pre-requisite: CISC1001

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**CISC2004     COMPILER CONSTRUCTION**

Modern compiler design, use of automatic tools, compilation techniques and programme intermediate representations; scanner, recursive descent parser, bottom-up parser, code generation and optimization; semantic analysis and attribute grammars, transformational attribute grammars.

Pre-requisite: CISC1002

**CISC3000     INTRODUCTION TO DATABASE SYSTEMS**

The course provides an overview of database management, database system architecture, and an in-depth study of relational database systems, including both the theoretical aspects of the relational model as related to relational data objects, relational data integrity, and relational data manipulation (using the relational algebra and relational calculus); and the practical aspects of relational implementations, using the SQL language and views. The course also includes a study of a commercially available database system and database application programming.

Pre-requisite: None

**CISC2005     PRINCIPLES OF OPERATING SYSTEMS**

This course is devoted to the study of the design principles and implementation issues of contemporary computer operating systems. The main topics include a detailed analysis of processes, multithreading, concurrency, memory, input/output, and file management.

Pre-requisite: CISC2001

**CISC2006     ALGORITHM DESIGN AND ANALYSIS**

This course aims to introduce basic features of objected oriented programming and data structures.

Pre-requisite: CISC1002, CISC2003

**CISC2007     HUMAN-COMPUTER INTERACTION**

This course provides an introductory level of human-computer interaction (HCI). The success in the development of highly usable interactive computing systems lies in the understanding of human factors in the process of design. To this aim, this course covers three different perspectives: human – the cognitive aspects, human perceptions and limitations, errors; computer – the current technology for presenting interactive information; and the interaction – from user requirement analysis, interface design, to interface evaluation. This course illustrates the fundamental concepts of human-computer interaction and user-centered design thinking. Specifically, the user-centered design process will be introduced in the lectures and practiced by students through a term-based group project. In addition, trendy HCI research topics will be assigned to individuals to read, research, and share in the class through formal presentations.

Pre-requisite: None

**CISC2008     OBJECT- ORIENTED ANALYSIS AND DESIGN PATTERNS**

The course discusses object-oriented analysis and design using Unified Modeling Language (UML). The main contents are using case diagram, class diagram, sequence diagram, state diagram, activity diagram, and component diagram of UML. And several design patterns are also introduced. UML and its CASE tool are used to analyze and design the course project systems.

Pre-requisite: None

**CISC3001     COMPUTER NETWORKS**

This course covers data communication techniques, data transmission, switching techniques, layered network architectures, data link layer protocols, medium access control sublayer and local area networks.

Pre-requisite: CISC2005

**CISC3002     MOBILE APPLICATION PROGRAMMING**

The growth of mobile devices especially smart phones has led to the high demand of mobile programmers. This course will introduce mobile programming by hands-on experience on mobile

application development for Android based mobile devices. Topics will include Android application development environment, user interface design, intents and services, data persistence, networking and messaging, sensors, and graphics. Students are expected to master basic knowledge to develop a working application on Android platform and demonstrate the capability to analysis, evaluate, and utilize different Android APIs to finish the task at hand.

Pre-requisite: CISC1001

### **CISC3003 WEB PROGRAMMING**

This course teaches students the skills necessary for creating web applications, including programming for both the client and the server side. Given the fast pace of change in this highly dynamic field, the specific technologies taught will change over time. At present this will include popular technologies such as HTML5, CSS, JavaScript, several popular JavaScript libraries and frameworks, as well as server-side technologies such as PHP and Node.js. The course will focus heavily on developing standards-compliant, accessible web sites using cross-platform open technology.

Pre-requisite: CISC1001

### **CISC3005 ADVANCED DATABASE SYSTEMS**

This course provides an in-depth study of: query optimization; transaction management; concurrency control; database recovery; database integrity; database security; distributed database systems and data normalization. In which, information retrieval and web search engines are also briefly introduced and discussed.

Pre-requisite: CISC3000

### **CISC3006 COMPUTER BASED SIMULATION**

Application of modeling techniques to understanding the operation and design of complex systems such as manufacturing systems, data processing systems, transportation systems, and organizational systems. Coverage includes problem definition, system identification, and performance evaluation. Traditional discrete events simulation is essential to study the transient phenomena, through suitable analysis and prediction models. Software modeling of selected systems in terms of specific knowledge and action models should serve as the course project to be collaborated by students working in self-directed work teams. Pedagogy: project-based learning with students cooperatively working in professional research groups, whose group-based and individual profiles, should track the results for evaluation purpose.

Pre-requisite: None

### **CISC3007 FORMAL LANGUAGES AND AUTOMATA**

This course introduces the fundamental concepts of formal languages and automata. It emphasizes the general principles of formal languages, grammars and automata theory. Topics include finite automata, regular expressions, regular languages and their properties, context-free grammars, languages and their properties, pushdown automata, Turing machines and undecidability.

Pre-requisite: CISC1002

### **CISC3009 COMPUTER GRAPHICS**

This course is designed to provide students with a comprehensive introduction to 2D and 3D computer graphics techniques. Topics covered include graphics systems, input and interactive techniques, modeling and representation, shading and illumination, rendering and texturing. To be more practical, the knowledge will be learnt by using an industrial standard in computer graphics, called OpenGL.

Pre-requisite: MATH1003

### **CISC3010 DISTRIBUTED COMPUTER SYSTEMS**

This course is a senior-level elective course on Distributed Systems for Computer and Information Science. The key principles about distributed systems include: architecture, processes, communication, naming, consistency and replication, and security.

Pre-requisite: CISC3001



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**CISC3011     DIGITAL IMAGE PROCESSING**

This course introduces the fundamentals of digital image processing for senior undergraduate students. It emphasizes the general principles and techniques of image processing. Topics include digital image fundamentals, intensity transformations and spatial filtering, filtering in the frequency domain, image restoration, color image processing, image compression, morphological image processing, image segmentation.

Pre-requisite: MATH1001

**CISC3012     ARTIFICIAL INTELLIGENCE**

Introduction to AI, definition of AI, disciplines of AI; the concept of agent in AI; problem solving agent, building search tree, local search; logical agent, knowledge base representation, logical reasoning. Application programming in PROLOG.

Pre-requisite: CISC2006

**CISC3014     INFORMATION RETRIEVAL AND WEB SEARCH**

This course covers basic and advanced techniques for text-based information systems: efficient text indexing, Boolean and vector space retrieval models, evaluation, web search techniques (crawling, link-based algorithms, web document clustering/classification, text mining, and recommendation).

Pre-requisite: None

**CISC3015     DATA AND INFORMATION VISUALIZATION**

This course is to provide students with a comprehensive introduction to data visualization techniques. These techniques are taught in theoretical and technical learning. At the same time the students are learning the algorithms and methods, they have to make practice to learn how to visualize various kinds of data types, by using available software tools and/or programming.

Pre-requisite: None

**CISC3016     MULTIMEDIA COMPUTING**

This course will introduce general principles and techniques in multimedia programming. The main topics will cover multimedia data fundamentals and representation, digital image and drawing creation and modification, audio manipulation and modern music synthesis, animation and video processing. The programming language used in this course will be Java. The goal is to improve the students' insight in multimedia technology and skills on the multimedia programming, which will enable students to develop new and creative ways of using multimedia in the future.

Pre-requisite: CISC1001

**CISC3017     BIOINFORMATICS**

Bioinformatics is the study of biological information through computer modeling or analysis. Its goal is to reveal relationships between sequences, structures, and functions of molecules. In this course, we intend to give an in-depth introduction of the algorithmic techniques used in bioinformatics. Topics which will be covered include sequence similarity analysis, suffix tree, genome analysis, biological database search, phylogenetic analysis, protein structure manipulation and modeling. This course is designed for undergraduate CS students and assumes no prior knowledge of molecular biology beyond the high school level. Basic concepts of molecular biology will be given in the first lecture, as well as in subsequent lectures before the computational problems are defined. The ultimate goal of this course is to prepare students with the knowledge and skills to conduct research in the area of bioinformatics.

Pre-requisite: CISC2006

**CISC3018     CLOUD COMPUTING AND BIG DATA SYSTEMS**

This course aims at providing students with a solid foundation of cloud computing technologies. The topics include cloud computing applications, cloud services, cloud computing platforms, and big data processing engines.

Pre-requisite: None

### **CISC3019 COMPETITION PROGRAMMING AND PROBLEM SOLVING**

This course aims at providing students with creative problem solving and competitive programming skills. International programming competition-type problems will be used to motivate the study of algorithms, programming, and other topics in computer science. Enrollment in the course requires approval of the course instructor.

Pre-requisite: CISC2003

### **CISC3020 FORMAL SOFTWARE SPECIFICATION**

This course aims to introduce formal software specification. The main contents include formal specification language, requirements specification, pre and post conditions, formal software design modeling, formal verification and model checking tools with some practical case studies.

Pre-requisite: None

### **CISC3021 MULTIMEDIA FORENSICS AND SECURITY**

The digital revolution has made a profound impact on our society and has changed the way we work and live. An increasing amount of information can now be acquired, processed, archived, and shared in electronic forms. A major hurdle holding back the wider deployment of services to make multimedia information broadly available to everyone in our society is the lack of security and forensic technologies to assure that content is used for its intended purpose and by its intended recipients. This graduate advanced-topic course focuses on the research and development on the forensic and security technologies for multimedia information.

Pre-requisite: CISC3011

### **CISC3022 SOFTWARE TESTING**

This course aims to introduce software testing concepts and techniques, including software errors, failure, requirements specification, test case design, black box testing, white box testing, unit testing, integrated testing, system testing, automated testing, regression testing, and testing tools. Students will apply their learned testing concepts and techniques to testing some software case studies.

Pre-requisite: None

### **CISC3023 MACHINE LEARNING**

This course introduces key machine learning techniques and their applications. The topics include overview of supervised learning, linear models, kernel methods, decision trees, neural networks, nearest neighbours, ensemble models, and unsupervised learning. Upon completion of this course, students should be able to apply various machine learning techniques in develop intelligent data analysis systems.

Pre-requisite: None

### **CISC3024 PATTERN RECOGNITION**

This course introduces the fundamentals of pattern recognition for senior undergraduate students. It emphasizes the general principles and techniques of pattern recognition. Topics include classifiers based on Bayes decision theory, linear classifiers, nonlinear classifiers, feature selection, feature generation, unsupervised learning and clustering algorithms.

Prerequisite: CISC1006

### **CISC3025 NATURAL LANGUAGE PROCESSING**

This course introduces fundamental concepts and skills associated with the design and implementation of different natural language processing systems covered from morphology, syntax and semantics. The main topics include regular expressions, (weighted) minimum edit distance, language modelling, N vie Bayes (generative model), maximum entropy (discriminative model), text classification, sequence labelling, POS tagging, syntax parsing and computational lexical semantics. The course also includes an overview of practical natural language processing applications.

Pre-requisite: None

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**CISC3026 SOFTWARE ENGINEERING PRINCIPLES**

The course discusses the theories, methods and tools of software engineering for developing large and complex software systems. The main contents are requirement specification, system modeling, architectural design, object-oriented analysis and design, verification and validation. The Unified Modeling Language (UML) and its CASE tool are used to analyze and design the course project systems.

Pre-requisite: None

**CISC3027 SPECIAL TOPICS IN COMPUTER AND INFORMATION SCIENCE**

Aim to introduce different advanced topics in computer science", the topic may change from year to year.

Pre-requisite: None

**CISC3028 ENTREPRENEURSHIP IN COMPUTER SCIENCE**

The course aims to provide entrepreneurship skills to our computer science students. The course contrasts entrepreneurs with managers, contrasts the different kinds of entrepreneurship and discusses the several steps of the entrepreneurial process including starting, growing, managing, leading and exiting.

Pre-requisite: None

**CISC3029 COMPUTER VISION**

This course introduces to students the basic concepts, fundamental principles and algorithms, and major applications in practice in computer vision area. It covers Digital Image Representation, Binary Image Analysis, Gray Level Image Segmentation, Edge detection Techniques, Digital Morphology, Color Image Processing Fundamentals, and Motion estimation, etc.

Pre-requisite: None

**CISC4000 GRADUATION PROJECT**

An independent study under the supervision of a faculty member.

Pre-requisite: None

**CISC4001 PROFESSIONALISM AND ETHICS IN COMPUTER SCIENCE**

This course aims to introduce professionalism and ethics for computer science. The common issues encountered by computer scientists and IT professionals are discussed, including intellectual property, privacy, reliability and security in IT, health and safety in IT, the major normative ethical theories that are applicable to computer science. The code of conduct in computer science including case studies is addressed.

Pre-requisite: None

**CISC4002 SOFTWARE PROJECT MANAGEMENT**

This course introduces project management as it relates to the software life cycle. Different software life cycle models, and the project management activities in each phase of the life cycle, are examined. Project planning activities are introduced, including activity planning, resource estimation and the use of software metrics, risk analysis, resource allocation and project scheduling. This course concludes with a study of project monitoring and control, and project team organization.

Pre-requisite: None

**CISC4003 INFORMATION SECURITY**

The course introduces students to the fundamental issues concerning information security and applied cryptography. The areas covered are protecting information using symmetric and public key cryptography, cryptographic hash functions and standards, key exchange, authentication, digital signatures, digital certificates, secure electronic transactions, non-malicious programme errors, viruses and other malicious code, and firewalls.

Pre-requisite: CISC3000, CISC2005 and CISC3001

### **ECEEN1001 INTRODUCTION TO ELECTRICAL AND COMPUTER ENGINEERING**

Overview of Electrical and Computer Engineering; Basic concepts of ECE; Introduction to situation of ECE around the area; Basic knowledge used in the laboratory.

Pre-requisite: None

### **ECEEN1003 INFORMATION TECHNOLOGY REVOLUTION AND ELECTRONICS**

The main objective of this course is to provide students with a broad vision about the evolution of technology, in the modern age, since its early beginnings, by describing the significance of the 3 Industrial Revolutions throughout time, since the 1<sup>st</sup> initiated with the Steam Engine (James Watt-1763), followed by the 2<sup>nd</sup> started with the inventions of Electrical Power Generation (Michael Faraday-1831) and the Combustion Engine (Siegfried Marcus-1864), until the 3<sup>rd</sup> kicked-off with the discovery of the Transistor (John Bardeen, Walter Brattain and William Shockley-1947) that really marked the commencement of what is now known as the Information Technology Revolution, led by continuous and fast developments in Electronics, Computing and Telecommunications. Current state-of-the-art and well-known information technology platforms and gadgets will be briefly introduced at the system-level related with their human interfaces, in particular the internet, the mobile phone, the computer, the video game console, the media player, the global positioning system (GPS), and as a motivation for showing what is underlying inside such systems in terms of Electronics. Then, an evolution of silicon semiconductors from the original transistor until the present microchips and fiber-optics networks will be described with projections into the future in terms of unlimited circuit integration (processing capability related with the number of transistors on a chip) and bandwidth availability (speed of communications).

Pre-requisite: None

### **ECEEN1004 EMBEDDED SYSTEMS**

The goal of this course is to develop a comprehensive understanding of the technologies behind the embedded systems, particularly, those using computing elements (such as processor, DSP, or FPGA) and the supported software technology (OS, data structure, multi-tasking, etc.). The students develop an application of the technology capabilities and limitations of the hardware and software components for building embedded systems, and methods to evaluate design tradeoffs between different technology choices. Students are required to finish a design project.

Pre-requisite: ECEEN1000

### **ECEEN1005 CIRCUIT ANALYSIS**

Elementary Resistive Circuit Theorems and Analysis Techniques: KCL, KVL, Nodal & Mesh Analysis and their Matrix formulation, Superposition, Source Transformation, Thevenin & Norton Equivalents, Maximum Power Transfer. Ideal OP AMP Model and its Circuit Analysis Methods. Energy Storage Elements, 1st- and 2nd-Order Circuit Analysis: Natural, Forced and Completed Response. Sinusoidal Steady-State Analysis: Phasor, Impedance and Admittance. AC Steady-State Power: Instantaneous and Average Power, Power Factor and RMS Values. Practice includes problem solving, PSPICE and Laboratory Works. Pre-requisite: GEST1004

### **ECEEN1006 ENGINEERING AND SOCIETY**

This course aims to provide comprehensive coverage of the societal responsibilities and challenges for engineers. This course discusses the ethical codes for engineering profession. The influences of technology on society and global development and their interrelationships are explored. Topics including intellectual property rights, legal and business issues will also be discussed.

Pre-requisite: None

### **ECEEN1011 DIGITAL SYSTEMS**

The objective is to provide the students with basic principles of Digital Logic Design. In this course, we study the Algebra of Logical Variables, Logical Functions, Basic Combinational Circuits, Flip-flops, Registers, Counters, Arithmetics Operations, the Memory Architecture, Sequential Circuits, Controllers, Elementary and more sophisticated Computer Architectures, and certain aspects of the I/O Operations. HDL with FPGA implementation will be included in Laboratory works.

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Pre-requisite: None

### **ECEN1012 COMPUTER PROGRAMMING AND NETWORK FUNDAMENTALS**

This course introduces the fundamental concepts and terminologies of computer programming, and covers the skills in developing and writing computer programs to achieve different functions and network protocols. This course also introduces basic knowledge and fundamental architecture of data and computer networks, the principles of protocol design and the analysis of network performance. The topics cover C programming language, arithmetic and logic statements, data types, control structure, socket programming, the layer architecture and protocols of computer networks, packet switching, network layer routing, physical technologies, etc.

Pre-requisite: None

### **ECEN1013 PHYSICS FOR ELECTRICAL AND COMPUTER ENGINEERING**

This is a calculus-based general physics course for ECE students with a laboratory covering classical mechanics and its applications, fluids, oscillations, waves, fundamental optics and its applications.

Pre-requisite: None

### **ECEN2001 MEASUREMENT AND INSTRUMENTATION**

The course commences with a brief review of some basic terminology, systems of units, measurement standards, probability and statistical analysis, traceability and types of error in measurement. The course then covers different electronic and digital measuring instruments, e.g. oscilloscopes, signal generators, signal analysis instruments, etc. Transducers and signal conditioning circuit design are included.

Pre-requisite: GEST1004

### **ECEN2002 ELECTRIC MACHINES**

This course provides fundamental knowledge on electric machines. It includes three phase circuit analysis, principles and static models of transformers and different machines, and relay control.

Pre-requisite: ECEN1005

### **ECEN2003 FUNDAMENTAL ELECTRONICS**

This course mainly introduces basic electronic devices namely operational amplifiers (Op-Amps), diodes, bipolar junction transistors (BJTs) and field effect junction transistors (FETs). In each device, the DC and AC analysis are firstly presented elucidating fundamental parameters of analogue electronic circuitry model like gain, input impedance, output impedance and so forth. An introductory PSpice simulation of these devices and some of their application circuits is included. The experimental validation of the elementary analogue circuitry using analogue and digital testers is also given. The course objective allows the students to acquire the basic engineering technique and ability to design and analyze the circuits of Op-Amps, diodes, BJTs and FETs using modern computing tools as well as measurement and test facilities.

Pre-requisite: ECEN1005

### **ECEN2005 ELECTROMAGNETISM**

The basic relations for static electric fields in free space and material media, Coulomb's law, Gauss' Law; The steady electric current and static magnetic field, Ohm's Law, Joule Law, Kirchhoff's Law, Biot-Savart Law, Ampere's Law; The static magnetic field of ferromagnetic materials; Magnetic materials and hysteresis; comparison of electric and magnetic relations involving polarization and magnetization; Bounded fields and Laplace's equation; Time changing electric and magnetic fields; Faraday's Law. Maxwell's displacement current; Boundary relations for electric and magnetic fields; The relation between field and circuit

Pre-requisite: None

### **ECEN2006 NUMERICAL METHOD AND COMPUTATION**

Introduction to data representations and computer arithmetic; Basic techniques in MATLAB programming; Numerical solution of nonlinear algebraic equations; Approximating functions;

Numerical differentiation and integration; Numerical solution of ordinary differential equations  
Pre-requisite: GEST1004

### **ECEN2009 BIOLOGY**

Basic principles of plant and animal biology, including cell biology, biochemistry, energetics, genetics, evolution, and ecology. Appreciation of scientific method in general and biological methodology. Lab component will emphasize the use of methodologies typical of biological studies.

Pre-requisite: None

### **ECEN2010 SEMICONDUCTOR DEVICE PHYSICS**

The main goal is to provide the students with an understanding of the relation between physical structure and circuit behavior of semiconductor active devices. The emphasis is on simple models of the semiconductor, the discussion of the properties of potential barriers and field effect, with the MOSFET as the centerpiece of the course. Simple one-device circuits are used to introduce non-linear behavior, and make the connection to the device physics. The students will learn the relation between external circuit parameters (as used in SPICE) and the device internal structure. At the end of the course the students will know the basic mechanism of rectification, amplification and switching and their implementation with various types of semiconductor devices.

Pre-requisite: None

### **ECEN2011 INTRODUCTION TO ELECTRO-ROBOT DESIGN**

The course introduces the fundamental knowledge on the design, implementation and evaluation of a robot and its sub-systems. It covers the basic principles of analog and digital circuits as well as robot sensing and control mechanisms. Students have to apply the knowledge and principles learned to design and build a functional robot by the end of the course.

Pre-requisite: None

### **ECEN2015 APPLIED ELECTRONICS**

This course is devoted to the design and analysis of the advanced analogue application circuits with the emphasis on differential and multistage amplifiers, feedback circuits, filters, oscillators and power amplifiers. Throughout the course, the basic parameters of application circuits of audio and video consumer electronic systems; for example frequency response, bandwidth, power conversion efficiency and so forth are studied. Using circuit theory based CAD, both the time- and frequency-domain simulations are also given. In addition, the experimental verification of these application circuitries using time- and frequency-domain testers is offered. The course objective allows the students to acquire the adequate engineering technique and ability to design and analyze the transistor circuits of audio and video applications using modern computing tools as wells as advanced measurement and test facilities.

Pre-requisite: ECEN2003

### **ECEN2017 SIGNALS AND SYSTEMS**

Basic Continuous-Time Signals and its Transformations. Basic System Properties. Linear Time-Invariant System Analysis: Properties, Convolution Sum and Convolution Integral, Impulse and Step Responses. C-T Fourier Analysis: Fourier Series and Fourier Transform. Time and Frequency Characterization of C-T Signals and Systems: Frequency Response, 1st- and 2nd-Order Systems, Bode Plots, Zero-State System Response. Introduction to Filtering, Modulation and Sampling. Laplace Analysis: Bi- and Uni-lateral Laplace Transform, Pole-Zero Plot and Stability, Transfer Function, Application in Circuit Analysis. Practice includes problem solving, MATLAB and Laboratory Works

Pre-requisite: ECEN1005

### **ECEN2018 LINEAR ALGEBRA, PROBABILITY AND STATICS FOR ELECTRICAL AND COMPUTER ENGINEERING**

The first part of this course gives an introductory treatment of linear algebra that is suitable for a first undergraduate course on the topic. Its aim is to present the fundamentals of linear algebra in

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the clearest possible way. Sound pedagogy is the main consideration. The course will focus on Systems of linear equations and matrices, Determinants, Vectors in 2-space and 3-space, Euclidean vector spaces, General vector spaces, Eigenvalues and eigenvectors, and Linear transformations. An introduction to probability theory and statistics, with an emphasis on solving problems in engineering. The second part of the course will focus on Probability and statistics. Topics in probability include discrete and continuous random variables, probability distributions, sums and functions of random variables, the law of large numbers, and the central limit theorem. Topics in statistics include sample mean and variance. Exercises and problems presented in the classes are tailored to help students to understand the key topics and their application to practical engineering problems.

Pre-requisite: None

### **ECEN2019 POWER SYSTEM ENGINEERING AND PROTECTION**

This course introduces the fundamentals of power system engineering and protection including basic principle of transformer and transmission line, protective devices, fault, protective relay and control, as well as protection for distribution circuits and transmission lines. It emphasizes on the basic understanding of protection concept in power system. Topics include introduction to power system components, protective devices, over-current protection and co-ordination, differential protection, distance protection. Protection for low voltage power distribution network.

Pre-requisite: None

### **ECEN3000 CONTROL SYSTEMS**

This course deals with the fundamental principles for analysis and design of control systems. Topics include dynamic modeling, dynamic response, basic properties of feedback, root-locus design method, frequency-response design method, and state-space design.

Pre-requisite: ECEN2000

### **ECEN3001 DIGITAL SIGNAL PROCESSING**

Discrete-time Signals and Systems; Sampling Theorem and Reconstruction; Transform Analysis for LTI Discrete-Time Signals and Systems: Discrete-Time Fourier Transform (DTFT), z-Transform, Discrete Fourier Transform (DFT), Fast Fourier transform (FFT); Fundamental Digital Filter Design Techniques: Infinite Impulse Response (IIR) and Finite Impulse Response (FIR) Filters; Introduction to the Applications of Digital Signal Processing; Practice includes problem solving, MATLAB based Project Works.

Pre-requisite: ECEN2000 and MATH2000

### **ECEN3002 ELECTRICAL AND COMPUTER ENGINEERING SEMINARS**

Students are required to participate in ECE related seminars and conferences so they may have the chances to contact the progress of ECE in different disciplines.

Pre-requisite: None

### **ECEN3003 INTRODUCTION TO BIOMEDICAL ENGINEERING**

This is an introductory course to the fundamentals of Biomedical Engineering from the view point of Electrical and Electronics Engineering for senior undergraduate students. It emphasizes general concepts and techniques of biomedical engineering. Topics include overview of human body, biomedical electrodes, sensors and transducers, biomedical signals and its measurement techniques, biomedical electronics, electrical safety, and embedded system in biomedical equipment.

Pre-requisite: None

### **ECEN3004 FUNDAMENTAL BIO-ELECTRICITY**

This course is designed to prepare senior undergraduate students with fundamental knowledge of the bioelectric phenomena. Topics include general principles of the electric and magnetic fields in the biological environments, and application of these principles to disease diagnosis.

Pre-requisite: ECEN2009 and ECEN3003

### **ECEN3005 BIOMEDICAL ELECTRONICS**

Introduction to biomedical signals; basic circuit analysis for biomedical signals; design of bioamplifier circuits; characteristics of linear and nonlinear circuit elements; design of basic electronic circuits, principles and practice of bioelectronic measurements.

Pre-requisite: ECEN2003 and ECEN3003

### **ECEN3006 INTRODUCTION TO BIOMEDICAL SIGNAL ANALYSIS**

Introduction to stochastic signal analysis methods used in biomedical signal processing and analysis. Fundamental techniques to analyze and process signals that originate from biological sources: ECGs, EMGs, EEGs, blood pressure signals, etc. Analog and digital filtering.

Pre-requisite: ECEN2007 and ECEN3001

### **ECEN3007 POWER ELECTRONICS**

The course includes operating characteristics of power semiconductor devices, such as Bipolar Junction Transistors, IGBTs, MOSFETs and Thyristors, and fundamentals of power converter circuits including dc/dc converters, ac/dc rectifiers, dc/ac inverters and ac/ac converters.

Pre-requisite: ECEN1005

### **ECEN3008 POWER SYSTEMS ANALYSIS**

This course provides fundamental knowledge on power system. It includes calculation on line parameters, line models, admittance matrix calculation, load flow calculation, symmetrical networks, machine model for short circuit calculation, symmetrical and asymmetrical short circuit calculation and state estimation

Pre-requisite: ECEN1005

### **ECEN3009 POWER QUALITY AND ENERGY SAVING**

This course is designed to prepare senior undergraduate students with knowledge and manipulative skills for employment in the electrical industry. It emphasizes the theory and practice of the power quality and energy saving skills. Topics include power quality standards, Power Quality Monitoring, HV/MV/LV Power Quality Compensators, Energy Efficient Standards, Energy Measure and Energy Saving Equipment.

Pre-requisite: None

### **ECEN3010 POWER ELECTRONICS DESIGN AND IMPLEMENTATION**

Fundamentals of power electronics drivers, components and controller are included and reviewed. Design considerations of power electronic rectification, controlled rectification, DC chopper power modulators, and DC-to-AC inverters are discussed. Fourier series analysis of inverter waveforms, power filter design and feedback control of a power electronics system are examined. Design and implementation of a power electronics system is performed.

Pre-requisite: ECEN3007

### **ECEN3011 ELECTRIC DRIVE**

This course will describe the structure of Electric Drive Systems and their role in various applications such as flexible production systems, energy conservation, renewable energy, transportation etc. This course will cover the basic principles of power electronics in drives using switch-mode converters and pulse width modulation to synthesize the voltages in dc and ac motor drives, the operation of dc motor drives to satisfy four-quadrant operation to meet mechanical load requirements, design torque, speed and position controller of motor drives, space vectors control, speed control of induction motor drives in an energy efficient manner using power electronics, the power quality issues in powering electric drives.

Pre-requisite: None

### **ECEN3012 PRINCIPLES OF COMMUNICATION SYSTEMS**

This course is the basic discipline of telecommunication theory and relevant techniques. In addition to an information theory introduction, it includes the study of signal and architecture of communication systems, amplitude and angle modulation, modulation and demodulation



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techniques and so forth. The important concepts like noise, interference, channel distortion, intersymbol interference and entropy are also elucidated with the help of system simulator. Example transmitter and receiver of broadcasting communication systems and cellular communication systems are also highlighted. The course objective allows the students to acquire the basic engineering understanding to the modern communication systems and; the relevant theory and technique.

Pre-requisite: ECEN2000

### **ECEN3013 RADIO FREQUENCY AND MICROWAVE TECHNIQUES FOR WIRELESS SYSTEMS**

This course deals with the basic RF and microwave circuit design techniques for receivers and transmitters used in modern wireless analog and digital communication systems. The distributed circuitry theory is studied including transmission line, impedance transformation, impedance matching, smith chart, S-parameters, filters, couplers, mixers, oscillators, low noise amplifiers and so forth. The study also includes linear and nonlinear microwave circuitry simulation together with the elementary RF/microwave measurement techniques using scalar and vector network analyzers. The course objective allows the students to acquire the basic engineering technique and ability to design and; analyze the RF and microwave circuits using modern high frequency simulation softwares as well as advanced RF and microwave testers.

Pre-requisite: ECEN2005

### **ECEN3014 ANTENNA THEORY AND APPLICATIONS IN WIRELESS COMMUNICATIONS**

This course is devoted to the antenna fundamentals and its wireless applications. The study includes basic concepts of antennas, dipole, arrays, microstrip patch antennas, adaptive antennas, full wave analysis and optimized antenna design by full wave electromagnetic solvers like MoM. Narrowband and wideband antennas for practical wireless communication systems - GSM, WCDMA, WLAN, RFID and UWB are also studied. Throughout the course, the students acquire the basic engineering technique and ability to design and; analyze the antennas together with the relevant simulation and measurement techniques.

Pre-requisite: ECEN2005

### **ECEN3015 CELLULAR COMMUNICATION NETWORK DESIGN AND OPTIMIZATION**

This course brings students fully up to date with the myriad of system developments in latest cellular communication networks namely GSM, WCDMA and so forth. Topics include basic network architecture and design issues, evolution of the wireless industry, characterization of radio propagation, modeling and simulation of narrowband signal characteristics and radio channel characteristics, fading, diversity, spread-spectrum technique, standards of GSM, GPRS, EDGE and WCDMA and so forth. The basic network optimization technique for 2G and 3G cellular networks is also studied. Throughout the course, the students acquire the basic engineering understanding to modern cellular network design issues and optimization.

Pre-requisite: ECEN3012

### **ECEN3016 INTRODUCTION TO WIRELESS TECHNOLOGY FOR DIGITAL GAME**

This course brings students a straightforward introduction of the use of computer interactive game for entertainment, teaching and learning. The new paradigm of integration of wireless technology and motion, vision, acoustic sensors for interactive game is studied. Coverage includes introductory theory of modern digital game, the game characteristics, rationale for digital game in learning and entertainment, technologies for digital games, case studies, operating system platform, short range communication technologies; sensor design, signal conditioning circuits, user interface, application software and so forth. Throughout the course, the students acquire the introductory engineering understanding to emerging multimedia game application using wireless technology.

Pre-requisite: ECEN2015 and ECEN3012

### **ECEN3017 ANALOG INTEGRATED CIRCUIT DESIGN**

This course is designed to introduce analog IC design fundamentals including single/multiple-

transistor amplifiers, current mirrors, current/voltage reference, output stages, frequency response, feedback, stability, and the operational amplifier design. Students will gain the basic understanding of analog IC design and become familiar with circuit analysis, layout designs and simulation tool flow.

Pre-requisite: None

### **ECEN3018 INTRODUCTION TO DATA CONVERTERS**

This course will provide an introduction to the various types of Data Conversion System, which is of the most key components in the electronics system. The performance characterization of Data Converters will be presented, and various types of data converters (including Analog-to-Digital and Digital-to-Analog) will be discussed. This course can be served as the beginning course in the field of Data Conversion and Signal Processing System in the area of Analog IC Design.

Pre-requisite: None

### **ECEN3019 INTRODUCTION TO RADIO-FREQUENCY CIRCUITS AND SYSTEMS**

This course covers the circuit and system design of modern wireless receivers and transmitters. The system performance metrics, circuit performance metrics and figure-of-merits are introduced. Design examples from practical applications such as GSM, WCDMA, WLAN, GPS are included. The course includes design and simulation projects based on Matlab and Cadence with CMOS technologies.

Pre-requisite: None

### **ECEN3020 ADVANCED TOPICS IN ANALOG AND MIXED-SIGNAL INTEGRATED CIRCUIT DESIGN**

The purpose of this course is to investigate advanced analog circuit integrated circuit design. The student will be exposed to analog design at the system level, and learn how design specifications are achieved and design tradeoffs are made in modern analog and mixed-signal integrated circuits.

Pre-requisite: ECEN3017

### **ECEN3021 MULTIMEDIA TECHNOLOGY**

This course aims at providing students with understanding of multimedia technology from both the theoretical and practice perspective. The course covers the multimedia data types such as image, video, audio, and also introduces emerging multimedia applications such as virtual reality and augmented reality. Programming languages and computer tools for multimedia technology will be introduced to the students.

Pre-requisite: ECEN1006 and ECEN3001

### **ECEN3022 ADVANCED INTEGRATED CIRCUIT DESIGN FOR INTERNET OF THINGS SYSTEMS**

This course targets to provide an overview of the enabling integrated circuit design techniques for the development of energy constrained Internet of Things (IoT) systems. The fundamental building blocks in an IoT system will be systematically introduced, including the analog interface, power management circuits, energy harvesting modules, analog-to-digital converters, short-range radios, digital architecture, non-volatile memory, hardware security and battery/packaging. Advanced circuit design techniques targeting for ultra-low power consumption to fulfill the application level requirements will also be introduced.

Pre-requisite: None

### **ECEN3023 INTELLIGENT METHODS FOR ELECTRICAL AND COMPUTER ENGINEERING**

This is an introductory course in machine learning and computational intelligence tailored for ECE students. It covers topics from statistical learning including linear regression and classification, clustering, Bayesian learning, to more recent techniques such as evolutionary computing, support vector machines, convolutional neural network and deep learning, with special attention to hardware aspects and ECE applications. The course aims to offer students a set of modern

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intelligent solutions as well as the basic ideas and intuition behind, with more emphasis on hands-on experience through practical examples such as intelligent hardware system implementation and case studies with MATLAB and Python.

Pre-requisite: ECEN2007

### **ECEN3024 FUNDAMENTALS OF INTERNET OF THINGS**

This course introduces the fundamentals of real time embedded systems. It covers the basic ingredients of complete IoT systems in terms of real time software development based on a practical embedded system utilizing a real time operating system. Embedded hardware systems (e.g. Raspberry Pi, Beagle Bone, TI Sensor Tag etc.) together with in-depth case studies on intelligent sensor based embedded systems will also be introduced. Students will also have the chance to work on lab/tutorials essential for the development of practical real-world IoT systems.

Pre-requisite: None

### **ECEN3025 INTERNET OF THINGS WORKSHOP**

This course introduces the application and essential peripherals (e.g. sensors, actuators, displays etc.) for real time embedded systems. Students should apply their knowledge in IoT systems to design a practical real world IoT implementation using commercial embedded hardware systems (e.g. Raspberry Pi, Beagle Bone, TI Sensor Tag etc.). Students will also attend lab/tutorials, and develop their own practical real-world IoT projects.

Pre-requisite: None

### **ECEN3026 DATA ANALYTICS FOR ELECTRICAL AND COMPUTER ENGINEERING**

This course is an introductory course on data analytics and its application in smart energy systems. It covers three major topics: 1) Primary data analytics theory including classification, regression, principal component analysis, etc.; 2) Hands on data analytics experiences with NumPy, Pandas, Matplotlib, & Scikit-learn packages; and 3) Applications in smart energy systems (with a focus on buildings energy systems), in which comprehensive experiments with real building energy data will be included.

In this course, students will learn systematic knowledge on data analytics and Python. They will also gain solid hands-on experiences in using Python to analyze smart meter data in energy systems.

Pre-requisite: None

### **ECEN4000/ ECEN4001 GRADUATION PROJECT I AND II**

This course aims to give the students experience in solving real engineering problems and the opportunity to apply the knowledge they have gained during their study. Through the project the students will gain experience in project planning, in teamwork and in communication with management and support staff. The project will also develop their design and research skills.

Pre-requisite: Final Year Student

### **ECEN4002 DIGITAL CONTROL**

Digital control systems; open-loop discrete-time systems; closed-loop systems; system time response characteristics; stability analysis techniques; PID controller design; and the control system simulations

Pre-requisite: ECEN3000

### **ECEN4003 SPECIAL TOPIC IN ELECTRICAL AND COMPUTER ENGINEERING**

The course will introduce a selected special topic in the ECE area.

Pre-requisite: Final Year Student

### **ECEN4004 BIOMEDICAL MEASUREMENT AND INSTRUMENTATION**

Design of measurement systems and biomedical instrumentation; architecture of electronic instruments used to measure physiological parameters, analysis of major process functions integrated in these instruments

Pre-requisite: ECEN3003

#### **ECEN4005 INTRODUCTION TO BIOMEDICAL IMAGING**

This course is an introduction to the current methods and applications of biomedical imaging. We focus on major imaging techniques, including Magnetic Resonance, Ultra Sound and Computed Tomography. For each technique, we will study the image acquisition (how images are created), the corresponding image processing (how images are analyzed), and their usage in major biomedical applications (what the image analysis says about cancer, brain, heart, or cells).

Pre-requisite: None

#### **ECEN4006 RENEWABLE ENERGY CONVERSION**

This course introduces the engineering and technical aspects of renewable energy conversion systems utilizing biomass, solar, wind, hydro power and others. It emphasizes basic generation and power conversion technologies of renewable energy generation systems. Topics include different available sources of sustainable energy and power, their applications, their limitations, energy conversion, integration circuits and storage for renewable technologies.

Pre-requisite: ECEN3007

#### **ECEN4007 POWER SYSTEM DESIGN AND IMPLEMENTATION**

This course is designed to prepare senior undergraduate students with knowledge and manipulative skills for employment in the electrical industry. It emphasizes the theory and practice of the basic electrical installation and maintenance skills. Topics include introduction to HV/MV/LV equipments, power consumption in Macau, installation and maintenance of transformer, MV/LV distribution and Un-interruptible Power Supply, batteries & chargers.

Pre-requisite: ECEN1005

#### **ECEN4008 INTRODUCTION TO WIRELESS SENSING NETWORK**

This course is about the study of contemporary issues in wireless sensing networks. Coverage includes short range communications namely WLAN, RFID, Bluetooth, Zigbee and; sensor design, signal conditioning circuits, detection, energy minimization, connectivity, security, storage management in wireless sensor networks, middleware, applications and so forth. Design examples for RFID and WLAN are also provided. Throughout the course, the students acquire the advanced engineering technique and ability to emerging wireless sensing network design issues and applications.

Pre-requisite: ECEN3012

#### **ECEN4009 MICROWAVE AND MILLIMETER WAVE SYSTEM DESIGN**

This course is devoted to the microwave and millimeter wave integrated circuit design from wireless system perspective with focus on broadband applications. Coverage includes OEM system integration, high frequency simulation tools, design of microwave and millimeter wave wireless frontend circuits including low noise amplifier, mixer, oscillator, filter, power amplifier, antenna, characterization and implementation of microwave and millimeter wave integrated systems in CMOS technologies. Throughout the course, the students acquire the advanced engineering technique and ability to emerging broadband systems and applications.

Pre-requisite: ECEN3013

#### **STGC3000 WORK-INTERGRATED EDUCATION**

Work-Integrated Education allows students to gain experience in areas relevant to their fields of study. The student will be encouraged to attend internship training first. If the students cannot attend the internship training due to any reasons, the student should engage in a research project under the supervision of a faculty member assigned by his/her home department.

Pre-requisite: None

#### **EMEN1001 ENGINEERING DRAWING I**

This course aims at preparing undergraduate engineering students to be able to understand and create technical drawings as a basic technique in engineering and scientific communication. The course seeks to develop the students' effective utilization of computer-aided drafting software package for producing engineering drawings according to the international conventions and

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drawing standards.  
Pre-requisite: None

### **EMEN1002 ENGINEERING DRAWING II**

Introduction to auxiliary views, mechanical working drawing, gears, cams, intersection and developments, building services drawings and floor plan design.

Pre-requisite: EMEN1001

### **EMEN1003 ENGINEERING MATERIALS**

Interatomic bonding and crystalline structures, imperfections and diffusion in solids, mechanical properties, strengthening mechanisms, failure of materials, phase diagrams and phase transformations, heat treatment of ferrous and non-ferrous alloys, types of engineering materials: metallic, ceramic, polymeric and composite materials.

Pre-requisite: None

### **EMEN1004 STATICS**

Force systems and equilibrium conditions with emphasis on engineering problems. Statics of particles and rigid bodies. Equivalent system of forces. Centroids and centers of gravity, Analysis of structures. Forces in beams and cables. Friction. Moments of inertia. Method of virtual work.

Pre-requisite: None

### **EMEN2000 STRENGTH OF MATERIALS**

Fundamental concepts of mechanics of deformable solids (static equilibrium, compatibility of deformation, and material constitutive behavior etc.) Stress and strain, uniaxial tension test, statically indeterminate structures, temperature effects and thermal stress, torsion of circular shafts, simple bending of beams, shear stresses in beams of different cross-sectional shapes, shear centre, combined stresses due to bending, torsion, shear and axial loads, transformation of stresses, failure criteria and stability and buckling.

Prerequisite: EMEN1004

### **EMEN2001 THERMODYNAMICS**

Fundamental principles of thermodynamics, foundation in fundamental thermodynamic phenomena including the first and second laws of thermodynamics, thermodynamic properties, equations of state in real and ideal gases. Analysis of engineering systems, such as: gas turbine, compressor, propulsion systems, vapor and gas power cycle, refrigeration cycle, and automobile engines.

Prerequisite: None

### **EMEN2002 MANUFACTURING TECHNOLOGY**

Introduction to manufacturing industry. Manufacturing system, basic machine tool elements, metal cutting, turning, drilling, boring, milling, grinding, welding, hot and cold working, pressworking, thread and gear working, and nontraditional processes.

Prerequisite: None

### **EMEN2003 ELECTRICAL ENGINEERING**

Introduction to electrical engineering. Fundamentals of electric circuits. Analysis of electric networks. Computer-aided circuit analysis. AC power. Residential wiring and distribution of AC power. Introduction to electromechanics. Introduction to electric machines.

Pre-requisite: None

### **EMEN2004 DYNAMICS**

This course will introduce to students the fundamentals and principles of kinematics and kinetics of particles and rigid bodies. The topics covered include kinematics of particles and rigid bodies, kinetics of particles and rigid bodies, energy and momentum methods, systems of particles, plane motion of rigid bodies, and basics of mechanical vibrations.

Pre-requisite: None

### **EMEN2005 COMPUTER-AIDED DESIGN**

Introduction to the fundamentals of computational and numerical geometry for product design. Topics to be covered include design specification, representation and manipulation of curves and surfaces, solid modeling, geometric transformations, graphical visualization, tolerance analysis, and standards for data exchange. The lab practice with prevailing CAD packages enables students to intelligently use them for solving engineering design problems.

Pre-requisite: None

### **EMEN2006 MACHINE ELEMENTS**

Introduction to machine elements. Screws, fasteners and the design of nonpermanent joints. Welding and the design of permanent joints. Mechanical springs. Rolling-contact bearings. Lubrication and journal bearings. Gears. Clutches, brakes and couplings. Shaft design. Flexible mechanical elements. Mechanical design and assembly.

Pre-requisite: None

### **EMEN2007 MECHATRONICS**

Introduction to the knowledge of mechatronics, control and automation in industrial applications. Sensors and transducers. Signal conditioning. Digital signals. Switches, relays and power-control semiconductors. Motors and motor control. Microprocessor-based control. Programmable logic controllers.

Pre-requisite: None

### **EMEN3000 PRODUCTION MANAGEMENT**

Basic management principles. Production and operation management. Production planning. Production control. Project management. Basic quality management and control. Facility planning. Job design. Business angle for product design and TQM concept.

Pre-requisite: None

### **EMEN3001 FLUID MECHANICS**

Introduction to basic fluid laws and their applications, fluid statics, conservation equations, continuity and linear momentum equations for control volumes, dimensional analysis, dynamic similarity, flow of incompressible fluids in pipes; boundary-layer concepts, effects of friction, measurement techniques.

Pre-requisite: EMEN1004

### **EMEN3002 CONTROL ENGINEERING**

Introduction to control system. Dynamic models and dynamic response. Models of industrial control devices and systems. Feedback control, Routh stability. Root locus plots. The Nyquist stability criterion. Matlab simulation for control systems.

Pre-requisite: EMEN2003

### **EMEN3003 HEAT TRANSFER**

Fundamental of heat transfer, including one and two dimensional steady state heat conduction, transient heat conduction, numerical solutions for heat conduction problem, basic convective heat transfer and thermal radiation. Applications of heat transfer in engineering system.

Pre-requisite: EMEN2001

### **EMEN3004 COMPUTER ENGINEERING**

Computer organization, memory systems, input and output systems, buses, interfacing, communication mechanisms, interrupt mechanisms, computer networks, distributed systems, communication in distributed systems, D-A conversion, A-D conversion, computer process controls, building automation systems & controls.

Pre-requisite: None

### **EMEN3005 SOCIETY AND THE ENGINEER**

Industrial health and safety, Washington Accord and the qualification and criteria of professional

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engineers, professional ethics, bribery and corruption, social responsibilities of engineers. Technical writing skills.  
Pre-requisite: None

### **EMEN3006    ADVANCED MANUFACTURING**

Introduction to the fundamental concepts of manufacturing systems, computer-aided process planning, CNC programming, group technology, facility layout, flexible manufacturing system, concurrent engineering, rapid prototyping, and automation, etc. Using of computer-aided manufacturing software and advanced machine tools.

Prerequisite: EMEN1002 and EMEN2005

### **EMEN3007    ADVANCED MATERIALS FOR ENGINEERING**

Specialisation of materials used in industry such as lightweight materials, corrosion and thermal resistance materials, shape memory alloys, conductors, semiconductors and dielectric, magnetic materials, liquid crystals, superconductors, optical fibers, biomaterials, and nano-materials. Electrical, thermal, magnetic, optical and corrosion properties, and case studies.

Pre-requisite: EMEN1003

### **EMEN3008    AIR CONDITIONING AND REFRIGERATION**

Fundamentals of air conditioning and refrigeration. Psychometrics, cooling and heat load calculations, air conditioning systems, duct design, vapor compression and absorption systems, and the principles of cooling towers.

Pre-requisite: EMEN3003 and EMEN3001

### **EMEN3009    APPLICATIONS OF VIBRATION AND NOISE CONTROL**

Introduction to the guidance in the practice of vibration and noise control. Fundamentals of mechanical vibration and sound waves. Industrial noise and vibration control, interaction between sound wave and solid structures, and statistical energy analysis in noise and vibration. Measurements and signal analysis of noise and vibration.

Pre-requisite: None

### **EMEN3010    COMPUTER TECHNOLOGY IN ENGINEERING**

The purpose and role of variables, constants, and procedures in application programming, control programme execution with decision control and looping structures. Concepts of object-oriented programming (OOP).

Prerequisite: None

### **EMEN3011    CORROSION, WEAR AND DEGRADATION AND MATERIALS**

Costs of corrosion and wear, forms of corrosion, electrochemistry, corrosion thermodynamics and kinetics, high temperature oxidation, metallurgical and environmental factors, corrosion protection, coatings and inhibitors, degradation of polymers, friction and lubricants, wear mechanisms, measurement and testing, analysis and correction of corrosion and wear failures, materials selection and safety.

Pre-requisite: EMEN1003

### **EMEN3012    ELECTRICAL SERVICES- WIRING AND INSTALLATIONS**

Overview of electrical services in building, introduction to wiring regulations, fundamental principles and design applications of electrical wiring installations, electricity distribution in buildings, interconnection facilities, protective devices, protection against direct & indirect contacts, cable management, lightning protection, metering, earthing, bonding and reliability of electricity supply.

Pre-requisite: EMEN2003

### **EMEN3013    ELECTROMECHANICAL ENERGY CONVERSION**

AC power, magnetic circuits, principles of electro-magnetism and electro-mechanics, principles of motors and generators, dc machines, synchronous machines, induction machines, dc-dc

converters, dc-ac inverters, electric drive systems, variable voltage variable frequency drive systems.

Pre-requisite: EMEN2003

### **EMEN3014 ELECTRONICS AND INSTRUMENTATION**

Basic principles of electronics components and operations of measuring instruments, transducers and signal conditioning techniques. Voltmeter, ammeter, ohmmeters, multi-meters, oscilloscopes, probes, bridges, diodes, bipolar junction transistors (BJT), operational amplifiers (Op Amp), transducers, noise, and filters.

Pre-requisite: EMEN2003

### **EMEN3015 FINITE ELEMENT TECHNIQUES IN ENGINEERING**

Basics of formulating problems in statics, dynamics and heat transfer into finite-element (FE) models. Data pre-processing and post-processing. Use of commercial FE software (ANSYS). Various types of elements: spring element, bar element, Bernoulli and Timoshenko beam elements, truss element, frame element, 3-noded and 6-noded triangular elements, 4-noded quadrilateral element, axisymmetric element and plate element. Isoparametric transformation. Strengths and weaknesses of the various elements. Derivations of elements will be based on different methods, such as the direct stiffness method and the principle of potential energy. Pre-requisite: EMEN2000 and EMEN2004

### **EMEN3016 FUNDAMENTALS OF AUTOMOTIVE ENGINEERING**

Fundamentals of internal combustion engines. Emission control. Ancillaries. Electronic control units. Transmissions and driveline. Steering systems. Suspensions. Brakes and tires. Engine and vehicle performance tests. Fundamentals of motor vehicle diagnosis and service. Introduction to electric/hybrid vehicles, alternative fuels and fuel-cell technology.

Pre-requisite: None

### **EMEN3017 INDUSTRIAL DATA MANAGEMENT**

Introduction to data management in the modern industry. Designing and specifying information systems, including data modeling techniques and entity-relationship diagrams; Relational database design using the theory of normalization; Building and manipulating databases, including relational algebra, SQL, and graphical user interfaced database manipulations; World wide web based data systems, including an introduction to HTML, web applications, and MySQL.

Pre-requisite: None

### **EMEN3018 INTELLIGENT BUILDINGS**

Principles of sensors, controllers and actuators, building electronics, signal conditioning, networks and communication systems, instrument communication and telemetry, microprocessor based controllers and digital controls; overall systems planning and integration; sustainability and economics; energy conversion technologies, energy use in domestic/non-domestic buildings, design guides, energy management and energy auditing.

Pre-requisite: EMEN2003

### **EMEN3019 INTERNAL COMBUSTION ENGINES**

Engine classification. Engine components. Operating characteristics. Engine cycles. Fuels. Air and fuel induction. Combustion. Modelling of engines. Exhaust flow. Engine cooling. Friction and lubrication. Emissions and air pollution. Engine management systems.

Pre-requisite: EMEN2001

### **EMEN3023 COMPUTATIONAL FLUID DYNAMICS**

Introduction to Computational Fluid Dynamics. Introduction of finite difference method, finite element method, and Lattice Boltzmann method. Macroscopic, microscopic and mesoscopic length scales. Isothermal and Non-Isothermal incompressible fluid flows. Multi-phase and multi-component flows. Computational fluid dynamics for porous media.

Pre-requisite: None



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**EMEN3024 ENGINEERING MANAGEMENT**

Overview of the techniques of applying management principles to professional positions held by engineers and engineering technologists. Management functions of planning, organizing, leading, and controlling and their roles in managing technology.

Pre-requisite: None

**EMEN3025 FIRE PROTECTION ENGINEERING**

Fire Engineering is concerned with the applications of scientific and technical principles to the growth, mitigation, and suppression of fire. This includes the effects of fire on people, on structures, on commodities, and on operations. The identification of fire hazards and their risk, relative to the cost of protection, is an important aspect of fire safety design. The fire engineering course mainly covers the fundamental knowledge of fire dynamics and fire modeling. Moreover, the modern fire protection technology such as fire sprinkler and alarm systems, exit and smoke control systems, and the active and passive protection systems is also included in the course. Besides, the plumbing services for fire suppression systems and buildings are also introduced.

Pre-requisite: None

**EMEN3026 ROBOTICS**

Introduction. Robot terminology. Spatial descriptions and transformations. Manipulator kinematics. Jacobians and static forces. Trajectory generation. Linear and nonlinear control of manipulators. Application of various robots.

Pre-requisite: None

**EMEN3027 MECHANICAL BEHAVIOUR OF ENGINEERING MATERIALS AND BASIC FAILURE ANALYSIS**

Introduction to the most important mechanical properties of materials (principally metals). Stress and strain, elastic and plastic behaviours, hardening behaviour, ductility and fracture, creep, fatigue, residual stress, etc. Interactions among different failure-inducing mechanisms (e.g., between corrosion and fatigue) will also be covered. Real case studies of failures in engineering will be used to consolidate the theories introduced in this course.

Pre-requisite: EMEN1003

**EMEN3028 OPTIMIZATION TECHNIQUES AND THEIR APPLICATIONS IN ENGINEERING**

Modelling of engineering problems and introduction of algorithms/methods for obtaining their optimal solutions. The topics include constrained and unconstrained objective functions, simplex method for linear programming, duality analysis, integer programming, mixed programming, linear and non-linear programming, sensitivity analysis, steepest decent method, conjugate gradient method, conjugate direction method, newton's method, and Lagrange multiplier method. The use of computer software programmes (e.g., LINDO and MathCAD) for solving optimisation problems will be covered in this course also.

Pre-requisite: None

**EMEN3029 PRODUCTION SYSTEMS, PLANNING AND CONTROL**

Elements of production systems. Different types of production systems; Principles and concepts in the design and control of production systems, including organization, production, and advanced quality control, work methods and measurement; Mathematical and computer models for planning and control of facilities, human resources, projects, materials, and information in production systems.

Pre-requisite: None

**EMEN3030 SPECIAL TOPICS IN ELECTROMECHANICAL ENGINEERING I**

Any specialized topic in Electromechanical Engineering chosen by the staff member who has experienced in that particular field, but the topic is not covered by other undergraduate courses in the Electromechanical Engineering Programme.

Pre-requisite: None

### **EMEN3031 SPECIAL TOPICS IN ELECTROMECHANICAL ENGINEERING II**

Any specialized topic in Electromechanical Engineering chosen by the staff member who has experienced in that particular field, but the topic is not covered by other undergraduate courses in the Electromechanical Engineering Programme.

Pre-requisite: None

### **EMEN3032 SPECIAL TOPICS IN ELECTROMECHANICAL ENGINEERING III**

Any specialized topic in Electromechanical Engineering chosen by the staff member who has experienced in that particular field, but the topic is not covered by other undergraduate courses in the Electromechanical Engineering Programme.

Pre-requisite: None

### **EMEN3033 THEORY OF MECHANISMS**

Synthesis of linkage-type mechanisms using graphical and computer methods. Introduction to mechanisms and simple machines. More on machines and mechanisms. Planar and spatial mechanisms. Kinematics and dynamics of mechanisms. Links. Frames and kinematic chains. Skeleton outline. Pairs. Higher pairs. Lower pairs and linkages. Kinematic analysis and synthesis. Basic kinematics of constrained rigid bodies. Planar linkages. Cams. Gears. Other mechanisms.

Pre-requisite: None

### **EMEN3034 CREATIVE INDUSTRY**

The course focuses on creative professional identity, creative career development and entrepreneurship, creative ideation and innovation, project development and management, industry partnerships and networking, and interdisciplinary creative work. Students will explore the advantages and challenges of interdisciplinary study and begin to develop strategies for benefitting the most from their creative industries studies.

Pre-requisite: None

### **EMEN3035 ELECTRIC VEHICLES**

Electric vehicle (EV) is a collective term for battery-powered EV, hybrid EV, plug-in hybrid EV and fuel-cell EV. At present, almost all automobile manufacturers and many electric power utilities have their individual EVs or development programs on EVs. Therefore, the demand for well-trained engineers serving this EV sector has already been significant. With the increasing acceptance of EVs in Macau, this demand will be greatly increased in the coming years. The purposes of the course are:

- To provide students with up-to-date and comprehensive knowledge on various EV technologies
- Provide the necessary skills for students to serve the accelerating EV industry and a good foundation for further research on these technologies
- Understanding the concept of system considerations, system level design and optimization.

Pre-requisite: EMEN2003

### **EMEN3036 EXTRA-LOW-VOLTAGE ELECTRICAL SYSTEMS IN BUILDINGS**

This course focuses on typical extra-low-voltage electrical systems, their applications in buildings and applications in property management.

Pre-requisite: EMEN2003

### **EMEN3037 FACILITY MANAGEMENT**

Facilities management blends the technical demands of building services with managerial responsibilities. The course will build up core competencies that make up the facility management profession, including planning, design, maintenance and sustainability. It ensures the efficient functioning of buildings through integrating people, space, processes and technology. Facility management covers facility location and layout design, intelligent maintenance management, Sustainable facilities management, Service management, quality assessment, and information technology. The students will be trained to gain an understanding of the diverse technologies and decision-making processes in facility management.

Pre-requisite: None

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**EMEN3038 LIGHTING TECHNOLOGY**

This course covers a wide range of lighting systems and their applications in illuminating buildings indoors and outdoors. The subject aims at enabling students to identify, analyze and evaluate basic components and features in lighting systems; and then to apply these components appropriately in building lighting design.

Pre-requisite: EMEN2003

**EMEN3039 MECHANICAL PROCESSING OF MATERIALS**

The course focuses on the fundamentals and analytical analysis methods for mechanical processing of materials. Its application on bulk and sheet metal forming, shearing and metal cutting are also covered.

Pre-requisite: EMEN2002

**EMEN3040 NONLINEAR DYNAMICS AND CHAOS**

Introduction to nonlinear dynamics and chaos. Strange attractors; Discrete and continuous chaotic systems; Bifurcation theory and universality; Sensitivity on initial conditions; Stability analysis of nonlinear systems; Lyapunov exponents; Poincaré maps; Fractal dimensions; Phase space reconstruction; Control and synchronization.

Pre-requisite: MATH2001

**EMEN3041 SELECTION OF MATERIALS FOR ENGINEERING DESIGN**

To make products components that are safe, economical and technically-sound, engineers have to be aware of the importance of materials selection in the design process. Also, to make improvements to and to make failure investigation of existing products, engineers must possess a deep understanding of the material selection process.

This course provides a general overview of the functions/constraints/objectives of the material selection processes (metals, polymers, ceramics, and composites) in design. How processing/manufacturing routes affect material properties and how property/function-based methods are utilised to systematically choose materials for engineering design will also be covered.

Pre-requisite: EMEN1002

**EMEN3042 SENSORS AND ACTUATORS**

The integration of sensing and actuation is one of the key issues in the implementation of mechatronic systems. Sensing enables the measurement of environmental conditions and actuation affects the surrounding environment through a controlled response. In this course, advanced concepts in sensing and actuation for mechatronic systems are introduced, including both traditional sensors and actuators and advanced topics in micro electromechanical system (MEMS) and smart material sensors and actuators.

Pre-requisite: EMEN2007 and EMEN3002

**EMEN3043 STATICS AND PROBABILITY FOR ENGINEERING**

An introduction to probability theory and statistics, with an emphasis on solving problems in engineering. Topics in probability include discrete and continuous random variables, probability distributions, sums and functions of random variables, the law of large numbers, and the central limit theorem. Topics in statistics include sample mean and variance, estimating distributions, correlation, regression, and hypothesis testing and engineering applications.

Pre-requisite: None

**EMEN3044 SURFACE ENGINEERING AND COATING TECHNOLOGY**

Engineers face with a wide variety of choices when selecting a surface treatment for a specific corrosion or wear application. This course provides practical information for the selection of the best possible surface treatment. It focuses on the topics including materials degradation, various surface treatments and their comparison; characterization of coatings, application of control techniques.

Pre-requisite: EMEN1003

### **EMEN3045 THERMAL ENERGY TRANSPORTATION IN POROUS MEDIA**

Thermal energy transportation in porous media is of interest in a number of engineering applications such as water purification and energy storage systems. As an introduction course to the topic of fluid flow and heat transfer in porous media, this course will introduce modeling approaches for heat and fluid flow in porous media. These models are applicable to a wide variety of media, including sand, soil, tube bundle heat exchangers, and open cell metal foams, which have gained attention in recent years as potentially excellent candidates for meeting the high thermal energy dissipation demands in energy storage and electronics industry.

Pre-requisite: EMEN3001 and EMEN3003

### **EMEN4000 GRADUATION PROJECT**

An independent study under the supervision of one or more faculty members. Professional ethics, health, safety and environmental considerations in the engineering project.

Pre-requisite: Final year level

### **STGC3000 WORK-INTERGRATED EDUCATION**

Work-Integrated Education allows students to gain experience in areas relevant to their fields of study. The student will be encouraged to attend internship training first. If the students cannot attend the internship training due to any reasons, the student should engage in a research project under the supervision of a faculty member assigned by his/her home department.

Pre-requisite: None

### **MATH0001 PRE-CALCULUS**

This is an elementary mathematics course for science & engineering students. The goal of this course is to reinforce students' knowledge in elementary mathematics which is needed in calculus. Offered students with their mathematic subject score below a specific score decided by the Faculty are required to take and complete this course in the Summer Term before admission. If a student cannot pass the test, he/she can redo the test during the first semester after admission.

Pre-requisite: None

### **MATH1000 DISCRETE MATHEMATICS**

This course aims at providing students with a solid foundation of basic techniques in discrete mathematics. The topics include elementary set theory, functions, elementary number theory and methods of proof, recursion, counting principle, and graph theory.

Pre-requisite: None

### **MATH1001 LINEAR ALGEBRA I**

Systems of Linear Equations and matrices. Gaussian elimination. Determinants. Cramer's rule. Euclidean Spaces. Addition and scalar multiplication of vectors. Linear transformations. Vector Spaces. Linear independence and linear dependence.

Pre-requisites: None.

### **MATH1002 LINEAR ALGEBRA II**

Vector Spaces. Basis and dimension. Matrices, row spaces, column spaces and null spaces. Rank and nullity. Inner product spaces. Inner products and orthonormal bases. Gram-Schmidt process. Least square problems and orthogonal matrices. Eigenvalues and eigenvectors. Diagonalization, orthogonal diagonalization. Linear transformations. Kernel and range. Inverse linear transformations. Similarity. Additional topics include quadratic forms, unitary, normal, Hermitian matrices, and canonical forms.

Pre-requisites: MATH1001

### **MATH1003 INTERMEDIATE CALCULUS**

Definite integrals. Fundamental theorem of calculus. Applications of definite integrals. Approximations of definite integrals. Sequence and series. Power series and Taylor series.

Pre-requisite: GEST1004

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**MATH1004 GEOMETRY**

Euclidean geometry, Euclidean space, inner product, distance, and angle. Isometries. Vectors in planes and spaces. Lines and planes and surfaces in 3-dimensional space. Linear transformations, projections, orientations and determinants, isomorphisms, and general linear groups. Symmetries and regular polyhedrons. Affine geometry. Affine spaces and affine transformations. Brief discussion on the development of various geometries such as Euclidean and non-Euclidean ones.

Pre-requisite: None

**MATH2000 ENGINEERING MATHEMATICS I**

Functions of two or more variables and their derivatives. Applications of partial derivatives. Multiple integrals. Vector fields and line integrals. Surface integrals. Analytic functions of a complex variable.

Pre-requisite: GEST1004

**MATH2001 ENGINEERING MATHEMATICS II**

Introduction to linear algebra. Linear differential equations. Fourier series and integrals. Laplace transform. Introduction to partial differential equations

Pre-requisite: MATH1003

**MATH2002 MULTIVARIABLE CALCULUS**

Vectors and analytic space geometry. Norms, convergence of vector sequences, open and closed sets, compact sets. Curves, Frenet frames, surfaces. Functions of several variables. Partial derivatives and their applications, linear approximation, differential, Taylor's formula. Method of Lagrange multiplier. Inverse function theorem, implicit function theorem. Multiple integrals. Green's Theorem. Line and surface integrals. Gauss and Stokes' Theorems.

Pre-requisite: GEST1004

**MATH2003 MATHEMATICAL ANALYSIS I**

The axioms for the real number system. Countable and uncountable sets. Sequence of real numbers. Nested intervals theorem. Bolzano-Weierstrass theorem, Cauchy criterion and Heine-Borel Theorem. Limits and continuity of functions. Properties of continuous functions.

Pre-requisite: GEST1004

**MATH2004 MATHEMATICAL ANALYSIS II**

Differentiation. Mean value Theorem. L'Hopital's Rule. Inverse function theorem. Integration. Upper and lower integrals. Riemann integrals. Fundamental theorem of calculus. Elementary functions. Series of numbers. Tests for convergence. Series of functions. Uniform convergence. Power series and Taylor series.

Pre-requisite: MATH2003

**MATH2005 PROBABILITY**

Sample space, random events, and probability. Discrete and continuous random variables. Distributions, densities, joint distribution, and marginal distributions. Conditional probability and independence. Moments, mean, variance, covariance, Chebyshev's inequality, and moment-generation functions. Special probability distributions, densities, and their applications.

Pre-requisite: GEST1004

**MATH2007 NUMERICAL ANALYSIS**

Introduction to algorithm. Error analysis. Interpolation. Remainder of interpolation. Error estimate. Spline function. Numerical integration.

Pre-requisite: MATH1003

**MATH2008 OPERATIONS RESEARCH**

Linear programming and simplex method. Revised simplex method. Duality of linear programming. Sensitivity analysis. Transportation and assignment problems. Network flow problems. Game

theory.

Pre-requisite: MATH1001

### **MATH2009 LINEAR STATISTICAL ANALYSIS**

This course is used to study the way a response variable depending on an unknown, linear combination of explanatory and/or classification variables. This course focuses on the theory of linear models and the topics include: linear regression model, general linear model, prediction problems, sensitivity analysis, analysis of incomplete data, robust regression, multiple comparisons, introduction to generalized linear models.

Pre-requisite: MATH2006

### **MATH2010 COMPUTATIONAL STATISTICS**

Statistical computing is an essential part of modern statistics. Students will learn the core of ideas of programming—functions, objects, data structures, input and output, debugging, logical design and abstraction—through writing code to assist in numerical and graphical statistical analyses. Students will learn how to write maintainable code, as well as debug and test code for correctness. They will learn how to set up and run stochastic simulations, how to fit basic statistical models and assess the results, and how to work with and filter large data sets. Since code is an important form of communication among scientists, students will also learn how to comment and organize code.

Pre-requisite: MATH2006

### **MATH2011 INTRODUCTION TO SCIENTIFIC COMPUTING**

The course is a start for the series courses in Department of Mathematics towards the scientific computing in applied mathematics. The content of the course consists of an introduction to data structures and algorithms, and their applications in mathematical problems.

Pre-requisites: None

### **MATH3000 ORDINARY DIFFERENTIAL EQUATIONS**

First-order differential equations. Second-order linear differential equations. Higher order linear differential equations. Systems of differential equations. Power series solutions of linear differential equations, Sturm-Liouville problems. Laplace transforms. Existence and uniqueness theorem of first-order differential equations. Simple modeling problems.

Pre-requisite: MATH1003

### **MATH3001 COMPLEX ANALYSIS**

Complex numbers. Polar coordinates. Functions of a complex variable. Limits. Derivatives of complex functions. Cauchy-Riemann equations. Harmonic functions, harmonic conjugates. Elementary complex functions, Mobius transformations. Contour integrals. Cauchy-Goursat Theorem. Cauchy integral formula. Liouville's theorem. Maximum moduli of functions. Taylor series. Laurent series. Residue theorems. Evaluation of improper integrals. Rouché's theorem.

Pre-requisite: MATH1003

### **MATH3002 INTRODUCTION TO STOCHASTIC PROCESS**

Conditional expectation, conditional probability, and convergences of random variables. Poisson process and compound Poisson process. Markov chain and Markov processes. Stochastic processes with independent increments, stationary process, and the ergodic theorem. Brownian motion and diffusions.

Pre-requisites: MATH2005

### **MATH3004 PARTIAL DIFFERENTIAL EQUATIONS**

Characteristics, classification of PDE, separation of variables, Fourier transform, and Laplace transform. Well-posedness of the wave and the heat equations. Boundary value problems for the Laplace and Poisson equations. Separation of variables.

Pre-requisites: MATH2002 and MATH3000

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### **MATH3009 TIME SERIES ANALYSIS**

Time series and stationary processes. Autocovariance and partial autocorrelation functions. Tests for stationarity. Linear stationary models, autoregressive models, moving average models, and mixed autoregressive-moving average models. Model identification, estimation and testing. Seasonal models. Applications of times series forecasting.

Pre-requisites: MATH2006

### **MATH3011 NUMERICAL MATRIX ANALYSIS**

Matrix factorizations. Perturbation and error analysis. Operation cost and convergence rate. Direct Methods for linear systems. LU and Cholesky factorizations. Perturbation and error analysis. Vector and matrix norms. Perturbation analysis for linear systems. Error analysis. Classical iterative methods. Jacobi and Gauss-Seidel method. Convergence analysis. SOR method. Krylov subspace methods. Steepest descent method. Conjugate gradient method. Practical CG method and convergence analysis. Preconditioning. GMRES method.

Pre-requisites: MATH1002 and MATH2002

### **MATH3012 INTRODUCTION TO COMPUTATIONAL INTELLIGENCE**

The artificial neuron and its learning. Supervised learning neural networks. Back propagation algorithm. Feedforward multilayer ANN. Approximation theorem of ANN. Genetic algorithms. Travelling salesman problem and applications of computational intelligence methods in finance and engineering.

Pre-requisite: MATH1003

### **MATH3013 MATHEMATICAL MODELING**

Modeling techniques for analysis or decision-making. The detailed content in this course can vary from extending students' training and understanding in applied mathematical knowledge to further study in specific areas in applied mathematics.

Pre-requisite: MATH1003

### **MATH3014 TOPICS IN APPLIED MATHEMATICS**

Content and reading materials are to be determined by the instructor. Students have to give presentations on the reading materials.

Pre-requisite: Final year students only

### **MATH3015 INTRODUCTION TO FINANCIAL MATHEMATICS**

Financial derivatives, vanilla options, and exotic options. Binomial financial model and Cox-Ross-Rubinstein option pricing formula. Black-Scholes financial model and Black-Scholes option pricing formula. No-arbitrage, risk-neutral probability, and the completeness of financial market.

Pre-requisites: MATH3002

### **MATH3017 DATA-DRIVEN SAMPLING METHODS**

The course will deal with sampling methods under various statistical frameworks. The course will present principles in the design and analysis of clinical trials, limitations of observational studies and possible solutions, and principles of sampling from finite populations. The purpose of the course is to introduce sampling methods and data analysis emphasizing key statistical aspects of the experiment design; to present the advantages and limitations of different methods, and to choose an appropriate method to each statistical problem.

Pre-requisite: MATH2006

### **MATH3018 MULTIVARIATE DATA ANALYSIS**

This course focuses on the classical theory and methods of multivariate statistical analysis. Topics include: distribution theory, multivariate normal distribution, Hotelling's T-square and Wishart distributions, inference on the mean and covariance, principal components and canonical correlation, factor analysis, discrimination and classification.

Pre-requisite: MATH2002 and MATH2009

### **MATH3020 BAYESIAN METHOD IN DATA ANALYSIS**

The aim of this course is to introduce students to the Bayesian statistical modelling and inference and to the related computational strategies and algorithms. The course starts with the treatment of simple models, such as those based on normal and binomial distributions. Some advanced models will be treated, including hierarchical models, linear regression models and generalized linear models. Bayesian computational methods (MCMC), including Gibbs sampler and Metropolis-Hastings algorithms, are presented with an emphasis on the issues related to their implementation and monitoring of convergence.

Pre-requisite: MATH2006

### **MATH3021 DATA MINING AND STATISTICAL LEARNING**

The course covers statistical techniques and tools such as kernel methods for estimating the density and regression functions, machine learning, hidden Markov Chain, Expectation-Maximization algorithm, classification, cluster analysis and support vector machines for analysing large data sets and for searching for unexpected relationships in the data. It also covers model selection for searching through a large collection of potential local models that describe some aspects of the data in an easily understandable way.

Pre-requisite: MATH2009

### **MATH3025 TOPICS IN STATISTICS AND DATA SCIENCE**

The course will introduce some other topics besides the contents covered by other courses. The main topics include actuarial statistics, analysis of longitudinal data, categorical data analysis, etc.

Pre-requisite: None

### **MATH3026 REAL ANALYSIS**

The content of differentiation and integration for single variable real functions will be extended to a more general context in this course. The topics of this course include measure theory, theory of Lebesgue integration, differentiation and integration theory for Lebesgue integral, as well as an introduction to Hilbert spaces.

Pre-requisites: MATH2003

### **MATH3027 FUNCTIONAL ANALYSIS**

The course is an undergraduate level course in functional analysis. Classically, functional analysis is the study of infinite dimensional vector spaces of functions and linear operators between them. This class deals with relevant function spaces (normed vector spaces, Banach and Hilbert spaces), spaces for, bounded linear operators on normed vector spaces, fundamental principles of functional analysis (i.e., Han-Banach Theorem, Uniform Boundedness Principle, Open Mapping Theorem and Closed Graph Theorem) and their applications, spectral theory of compact linear operators and spectral theory of compact self-adjoint operators on Hilbert spaces.

Pre-requisites: MATH2003

### **MATH3028 NUMERICAL LINEAR ALGEBRA**

This course is intended as a first introduction to the methods of numerical linear algebra. The content of the course consists of an introduction to numerical methods for solving linear systems, least square problems, and eigenvalue problems.

Pre-requisites: MATH1002 and MATH2004

### **MATH3029 TOPICS IN APPLIED ANALYSIS**

The field of Applied analysis brings together many mathematical topics, such as scientific computing, differential equations, dynamical systems, signal and image analysis, statistical methods, integral transformation, and approximation theory. Applied Analysis focuses on these mathematical disciplines and their application to the real world around us.

Pre-requisites: MATH1001 and MATH2004



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**MATH4005    NUMERICAL METHODS FOR DIFFERENTIAL EQUATIONS**

This course presents mathematical and computational fundamentals of the numerical solution for scientific problems. It covers

- Explicit and implicit methods for ordinary differential equations
- Finite difference methods for partial differential equations (elliptic, parabolic, hyperbolic equations)
- Finite element methods for elliptic equations
- Consistency, convergence, stability of numerical methods
- Solution of linear systems

Pre-requisites: MATH3004, MATH2007 and MATH2011

**MATH4000    ELEMENTARY NUMBER THEORY**

Divisibility theory of the integers, primes, unique factorization, congruence. Fermat's little theorem, Diophantine equations. Quadratic residues and quadratic reciprocity laws, primitive roots. Pell's equations and continued fractions.

Pre-requisite: None

**MATH4002    RESEARCH IN MATHEMATICS**

The students will study selected topics in mathematics under supervision of a faculty member. The student has to submit a report and give a presentation of the study for assessment.

Pre-requisite: Final year students only

**MATH4003    NONPARAMETRIC STATISTICS**

This course focuses on the theory and methods of making statistical inference based on nonparametric techniques. Students will see the analyses of real data from various areas of applications. Topics include properties of order statistics, statistics based on ranks, distribution-free statistics, inference concerning location and scale parameters for one and two samples, Hajek's projection.

Pre-requisites: MATH2006

**MATH4004    GRADUATION PROJECT**

Under the supervision of a faculty member, a student will carry out a focus study of a research topic in statistics or do some case studies based on collected data sets. The students are required to submit a report and give a presentation of the study for assessment.

Pre-requisite: Final year students only

**STGC1001    GENERAL CHEMISTRY**

This course addresses the basic concepts of chemistry and tests theories through experiments. The course covers topics, ranging from basic properties of gases, liquids & solids, chemical kinetics, chemical equilibria, to basic organic molecules, which form a foundation for concepts that will be later developed in Environmental Engineering I & II.

Pre-requisite: None