UNIVERSITI SAINS MALAYSIA
PUSAT PENGAJIAN KEJURUTERAAN AWAM
SCHOOL OF CIVIL ENGINEERING

Graduate Prospectus

MASTER OF SCIENCE (MIXED-MODE) PROGRAMME

Master of Science (Environmental Engineering)
Master of Science (Structural Engineering)

1.0 GRADUATE STUDY AT USM

Universiti Sains Malaysia (USM) was established in June 1969 as the second university in the country. Over the past thirty years the university has undergone tremendous transformation in terms of infrastructural development, academic program and R&D facilities. As one of the five research universities in Malaysia, USM envisions itself to be a world-class university by embarking on world class research programmes via strategic planning and implementation of its R&D agenda. USM has gained reputation for providing excellent graduate programmes since its inception in 1969. Students are enrolled in masters or doctorate degree programs in over 26 Schools and 34 research centres in the areas of Medicine, Science and Technology, Engineering and Arts. Graduate students have been attracted to the excellent state-of-the-art facilities for research and the highly qualified academic staffs who are active researchers supported by well-funded research programmes.

2.0 SCHOOL OF CIVIL ENGINEERING

The School of Civil Engineering, Universiti Sains Malaysia, was established in the early 1989 and first started its operation at Perak Branch Campus at Seri Iskandar, Perak by the end of 1989. In May 2001, Perak Branch Campus was moved to Seri Ampangan, Nibong Tebal, Penang and renamed as Engineering Campus.The School of Civil Engineering is a well-established school with multi-disciplinary departments. It has a long tradition of providing high quality postgraduate research programmes in a very wide range of topics across the spectrum of civil engineering field. The School regularly attracts research students from industries, private institutions and government institutions. Academic staffs at the School are actively involved in both basic and applied research studies. Much of the research studies are funded by government agencies and some portions are carried out in collaboration with industries. The academic staffs are generally professionals with appropriate higher academic degrees who have years of sound professional, research, teaching and industrial experiences. All areas of research in the School are supported by well-equipped laboratories and handled by highly trained technical personnel.

3.0 OBJECTIVES & ORGANISATION STRUCTURE

The main objective of the postgraduate program at School of Civil Engineering is to produce research scholars who are capable of advancing knowledge and educating future scholars for the benefit of mankind.

The School of Civil Engineering is headed by a Dean with the support of three (3) Deputy Deans, three (3) Program Chairmen and 38 lecturers from various disciplines of civil engineering. The supporting staff comprises one Senior Assistant Registrar and one Assistant Registrar, 23 technical staffs 10 administrative staffs, and 5 Research Officer. Details of academic, technical and administrative staffs are given in Appendix B and accessible through http://civil.eng.usm.my.

4.0 GRADUATE PROGRAMMES

The School of Civil Engineering offers the following two modes of graduate programmes:
(a) Research Mode
(b) Mixed-Mode

4.1 MASTER OF SCIENCE AND DOCTOR OF PHILOSOPHY BY RESEARCH

4.1.1 Mode of study

Students are required to carry out research study on topics of their choice. They will be under the supervision of a main supervisor and co-supervisor/supervisors (if necessary).

Field supervisors are sometimes appointed by the School wherever necessary. Students are not required to take any courses. In some cases, students may be required to take prerequisite courses (if necessary) concurrently or before undertaking the research activities. At the end of the research study, a student has to submit a thesis to be examined by a panel of examiners in a viva-voce session. Applications and registration for research mode programmes are open throughout the year. The research study can be undertaken either on full-time or part-time basis.

4.1.2 Period of Candidature & Residency for Research Programme

The periods of candidature for the Masters and Doctor of Philosophy Degree Programmes for both part-time and full-time candidates are shown in Table 1.

Table 1: Period of candidature (MSc and PhD by research mode)

Mode	Master's Degree		Doctor of Philosophy	
	Min	Max	Min	Max
Full Time	12 months	36 months	24 months	60 months
Part Time	24 months	72 months	36 months	90 months
Residential Requirement	Full-time (12 months/year) Part-time (15 days/year)		Full-time (12 months/year) Part-time (15 days/year)	

4.1.3 Area of Research

Specific areas of studies for the Master of Science and Doctor of Philosophy Degree Program by Research are as follows:

Environmental Engineering

Landfill Technology, Composting, Water and Wastewater Treatment, Industrial Wastewater Treatment, Solid Waste Management, Environment Impact Assessment (EIA) and Environmental Management Plan (EMP), Air Quality and Water Quality Studies, Sludge Management, Noise Pollution Control and Management, Geo-environment, Water Quality Modeling.

Geotechnical Engineering

Slope stabilization (soil/rock), Ground Improvement, Reinforced Soil, Landslide Risk Management and Application of Geosynthetics, Rock Mechanics, Blasting and Vibrations, Foundation Engineering, Land Reclamation and Rehabilitation, Spatial Analysis, Probabilistic Methods in Geotechnical Engineering, Geostatistics, Shear

Strength of Soft Clay, Collapsing Soil, Risk Assessment in Geotechnical Engineering, Geotechnical Assessment, Piling Vibrations.

Water Resources Engineering
Water Supply, Urban Storm Water Management, Hydrological Modeling, Flood Forecasting, River Engineering, GIS Applications in Water Resources, Irrigation and Drainage, Urban Hydrology, Modeling of Pumping Station, Land Use Hydrology, Urban Hydrology, Sediment Transport, Ecohydrology.

Highway and Transportation Engineering
Pavement Engineering, Asphalt Technology, Traffic Engineering, Road Safety, Intelligent Transport Systems, Public Transport Study, Highway Capacity Studies, Travel Behavior Studies, GIS Applications in Transportation, Sustainable Transport.

Structural Engineering
Concrete Technology, Sustainable Concrete Materials and Practices, Structural Health Monitoring, Masonry Engineering, Construction Management, Concrete Repair Materials and Techniques, Structural Retrofitting and Strengthening, Wind Engineering, Earthquake Engineering, Timber Engineering, Shell and Spatial Structures, Computational Mechanics, Steel Structures, Advanced Structural Analysis.

Geomatic Engineering and Management
Monitoring Systems, Geo-Information System (GIS), Measurement Sciences, Monitoring System, Global Positioning Systems (GPS), Spatial Decision Support Systems, Digital Mapping and Imaging, Engineering Survey, Spatial Statistics, Stress Management, Emotional Intelligence, Engineering Entrepreneurship

4.2 MASTER OF SCIENCE BY MIXED-MODE

4.2.1 Mode of study

The mixed-mode program is a structured programme which combines coursework and research. Mixed-mode program is only offered at master's level. The mixed-mode program aims to provide engineers with expertise and advanced knowledge in the respective field of specialization. At the same time, the program also aims at providing postgraduate education to engineers who pelan to pursue their studies at PhD level. Under mixed-mode programs, students are required to attend lectures, sit for examinations and submit a dissertation. The programme is run based on semester system and offered in full-time basis. Minimum duration is 1 year and maximum is 2 years. For the award of the Master degree, a candidate has to accumulate a total of 40 units (including dissertation).

4.2.2 Structure of Programme

The programme structure for Master Degree by Mixed-Mode consists of three (3) components:-

i. Core Courses (16 units)
ii. Elective Courses (4 units)
iii. Dissertation (20 units)

The overall programme structure is shown in Table 2. For the purpose of graduation, a student has to accumulate 40 units out of which 16 units should come core courses (4 courses with 4 units each), 4 units from elective course (1 course with 4 units) and 20 units from dissertation.

Table 2: Programme Structure of MSc by Mixed-Mode

SEMESTER 1	SEMESTER 2	SEMESTER KSCP
Core Courses (4)	Dissertation Project*	Submission of Dissertation and Evaluation
Elective (1)	-	-

**Registration in Semester 2 but research activities can begin from Semester 1.*

4.2.3 Core Courses

Core Courses are advanced courses for the respective field of specialization. These courses are selected to provide the student with advanced knowledge in the specific area. All four courses under the core category (4 units each) are compulsory.

4.2.4 Elective Courses

Elective Courses are additional advanced courses which are offered to provide students with additional advanced knowledge in related fields.
Each elective course carries **FOUR (4)** units. Students are required to choose **ONE (1)** from **TWO (2**) courses offered as elective courses.

4.2.5 Dissertation

Under the course Dissertation, students are required to conduct a piece of research study on a specific topic of their choice. Total units for this course which is compulsory is **TWENTY (20)**. Students are required to carry out research, analyze results, write and present the results in the form of a dissertation.

The dissertation will be subjected to examination by a panel of examiners in a viva-voce session. Dissertation will be graded PASS or FAIL.

4.2.6 Language

All courses will be conducted in English. Dissertation must also be written in English.

4.2.7 Assessment

Core and elective courses are assessed based on coursework and final examination. The component coursework constitutes about 40 to 50% of the total mark which includes test, assignment, laboratory report, mini project and seminar presentation. On the other hand, final examination constitutes about 50 to 60% of the total mark. It is assessed through a three hour examination during end of semester examination week.

In order to graduate, students MUST:

(i) Pass All The Courses(Core and Elective) with Minimum Grade C+ Based on Grading Scheme Given in Table 3.

(ii) Pass the Dissertation Examination

(iii) Achieve a Cumulative Grade Point Average (CGPA) > 2.5.

Table 3: Grading Scheme

GRADE	GPA	RANGE	CATEGORY
A	4.00	80.100	PASS
A-	3.67	70-79	
B+	3.33	64-69	
B	3.00	58-63	
B-	2.67	52-57	
C+	2.33	46-51	
F	0	0-45	FAIL

A student who fails to achieve minimum grade of C+ in any course is required to repeat the corresponding course in the following academic session provided that the candidature period is still valid. Courses will not be offered in Semester KSCP.

4.2.8 Course Programme:

The following TWO (2) programmes are offered:

Master of Science (Structural Engineering)
Master of Science (Environmental Engineering)

Details of the courses offered in each program are given in Appendix A1, A2 and A3.

4.2.9 Mode of Offering

Programmes are offered on full time basis only.

5.0 TECHNICAL FACILITIES

The School has laboratories which are fully equipped with basic as well as sophisticated equipment and instrumentation. Most of the sophisticated equipment is computer-assisted with fully automatic data logging for high accuracy testing. The available laboratories include:

- Structures and Strength of Materials Laboratory
- Concrete Laboratory
- Heavy Structures Laboratory
- Environmental Engineering Laboratory
- Geomatic Engineering Laboratory
- Hydraulics Laboratory
- Hydrology Laboratory
- Geotechnical Engineering Laboratory
- Highway Engineering Laboratory
- Traffic Engineering Laboratory

6.0 ADMISSION REQUIREMENTS

MSc Degree (Mixed Mode and Research)

Applicants should possess a Bachelor degree in Civil Engineering or related areas from a recognized university, with CGPA of at least 2.75 or equivalent. A candidate with lower CGPA could be considered for admission based on relevant research and job experiences in related area.

7.0 ADMISSION PROCEDURE

Application is accepted online. Procedures for application are available at http://www.ips.usm.my. Registration for graduate studies by research is open throughout the year. Application for MSc (Mixed-Mode) program is open only once in any academic year. Registration for mixed-mode program follows the normal academic calendar of USM.

8.0 TUITION FEES

As fees may change at time of application, students are adviced to check the latest information on fees at the office of Institute of Graduate Studies, USM or at - **http://www.ips.usm.my**. For the MSc(Mixed-Mode) programme, total fees payable for each semester will be based on the registered credit hours per semester. Total credit hours for Semester I and II are 20 units, respectively.

9.0 FINANCIAL ASSISTANCE

There is no financial assistance for MSc(Mixed Mode) programme.

10.0 ACCOMMODATION

The University has a limited number of student hostels/housing. Students are advised to contact the Student Affairs Department upon receiving the offer letter.

11.0 MAINTENANCE AND LIVING EXPENSES IN MALAYSIA

Living costs will depend on the type of accommodation. It is generally recommended that international students allocate between *USD2,500 and *USD3,000 a year for living (food, clothing, books, transport and entertainment) and accommodation costs.

12.0 VISA

Foreign students who are offered admission into USM are advised to contact Institute of Graduate Studies, the International Office, USM and Malaysian Embassy for further details pertaining to their visas before their departure for Malaysia.

13.0 ENQUIRES

For further information regarding postgraduate program at School of Civil Engineering, please contact:

Dean
School of Civil Engineering, Engineering Campus
Universiti Sains Malaysia
Seri Ampangan, Seberang Perai Selatan
14300 Nibong Tebal, Penang, MALAYSIA
Tel. No: +6 (04) 5996201/6204/6205/6209
Fax No: +6 (04) 5941009
Email: dean_civ@usm.my
Website: http://www.civil.eng.usm.my

For details on general matters related to postgraduate studies at USM, please contact:

Dean
Institute of Graduate Studies
Universiti Sains Malaysia
11800 USM, Penang, MALAYSIA
Tel. No: 604-6533888 (Ext. 2943) Fax No : 604-6532931
Email: **dean_ips@usm.my** Website: http**://www.ips.usm.my**

Application forms and details of the admission can be downloaded from http://www.ips.usm.my - Institute of Graduate Studies, Universiti Sains Malaysia, 11800 USM, Penang, Malaysia.

* The above information is correct at time of printing.

APPENDIX A: COURSE DESCRIPTION

A.1 MASTER OF SCIENCE (STRUCTURAL ENGINEERING)

EAS 661/4 – ADVANCED STRUCTURAL MECHANICS

1.0 SYNOPSIS OF COURSE

Theory of Elasticity; Principle of Energy; Finite Element Method; Application of Finite Element Analysis in Structural Engineering Problems

2.0 COURSE COMPONENT:

Unit : 4
Coursework : 40% [Tests (10%), Assignments (20%), Mini projects (10%)]
Final Exam : 60%

3.0 TOPICS TO BE COVERED :

TOPIC	SYLLABUS
1	**Review on the Basic Equations in Structural Mechanics** Equilibrium relationship; stress-strain relation (constitutive) and compatibility relation
2	**Theory of Elasticity** Theories of Stress and Strain; Stress components – Governing equations for equilibrium; Deformation and strain - compatibility condition; Stress-strain relationship – Hooke's Law ; Specialization of 3D elasticity to plane stress, plane strain, axis-symmetrical and plate-bending problems
3	**Principle of Energy** Principle of Virtual Work; Formulation of equilibrium equations; Strain energy, strain energy density, principle of minimum potential energy and its application to solution of structural problems; Introduction to variational principle
4	**Finite Element Method** Discretization process, Formulation of finite element equation, Assemblage, Application of loads and boundary conditions; Aspect ratio of element, Consistent and lumped mass; Displacement function, Characteristic and Basic Requirement, Polynomial displacement function; Truss, beam and column–beam elements; Plane stress and plane strain elements: Triangular and rectangular element; Introduction to numerical method for solution of finite element equation.
5	**Application of Finite Element Analysis in Structural Engineering Problems** Modeling and analysis using finite element software; Verification of finite element analysis results

4.0 COURSEWORK COMPONENTS:-

4.1 Assignment/mini project/seminar/laboratory

A total of 2 written assignments and 1 mini project will need to be submitted.

4.2 Tests

A total of 2 tests will be conducted.

Details will be given in teaching plan to be distributed to students.

5.0 FINAL EXAMINATION:-

Students are required to sit for a three hour final examination.

6.0 REFERENCES:-

1. Dawe, D. J., 'Matrix and Finite Element Displacement Analysis of Structures, Glarendon Press, Oxford, 1984.
2. Rockey, K.C., Evans, H.R., 'Griffiths, D.W. and Nothercot, D.A., 'The Finite Element Method - A Basic Introduction for Engineers, 2nd. Edition, Granda, 1983.
3. Stasa, F.L., 'Applied Finite Element Analysis for Engineers', CBS Publishing Japan Ltd. 1985.
4. Singh, S. 'Theory of Elasticity', 2nd. Edition, Delhi, 1988.
5. Cook, R.D., Malkus, David S., Plesha, Michael E. and Witt, Robert J., 'Concepts and Application of Finite Element Analysis – 4th Edition', John Wiley and Sons, 2002.
6. Timoshenko, S.P. & Goodier, J.N. 'Theory of Elasticity', McGraw-Hill Book Company. 3rd Edition,1970.
7. Bathe, K.J. , 'Finite Element Procedures', Prentice Hall, 1996.
8. Shames, I.H., 'Introduction to Solid Mechanics', 2nd edition, Prentice Hall. 1996.
9. Przemieniecki, J.S., 'Theory of Matrix Structural Analysis', Dover Publications, 1985.
10. Zienkiewicz, O.C. and Taylor, R.L., ' The Finite Element Method : Vol.1 and 2 .4th Edition', McGraw-Hill, 1991.
11. Beer, G. and Watson, J.O., 'Introduction to Finite and Boundary Element Methods for Engineers', John Wiley and Sons, 1992.
12. Buchanan, G. R., 'Theory and Problems of Finite Element Analysis', McGraw-Hill, 1995.
13. Ross, C.T.F, ' Finite Element Methods in Structural Mechanics', John Wiley & Sons, 1985.
14. Hjelmstad, K.D., "Fundamental of Structural mechanics', Prentice Hall, 1997.
15. Bittnar, Z & Sejnoha, J., 'Numerical Methods on Structural Mechanics', T. Telford, London, 1996.
16. Morgan, W., Durka, F. & Williams, D.T., 'Structural Mechanics', 5th. Edition, Longman Group, 1996.

EAS 662/4 – STRUCTURAL RETROFITTING TECHNOLOGY

1.0 SYNOPSIS OF COURSE

Durability and deterioration of concrete; Structural Appraisal ; Repair Materials; Retrofitting Techniques; Electrochemical techniques; Laboratory work and demonstration

2.0 COURSE COMPONENT:

Unit : 4
Coursework : 40% [Tests (15%), Assignments (10%), Project (15%)]
Final Exam : 60%

3.0 TOPICS TO BE COVERED :

TOPIC	SYLLABUS
1	**Durability and Deterioration of Concrete** Factors affecting durability of concrete, mineral and chemical admixtures and their roles in enhancing durability of concrete, deterioration of concrete, classification of cracks and defects, mechanisms of cracking, physical and chemical causes of deterioration, mechanisms of deterioration, sulphate attack, alkali-silica reaction, carbonation, chloride attack, corrosion of reinforcement, factors affecting rate and extent of deterioration, preventive measures, performance based specifications and testing.
2	**Structural appraisal** Process of appraisal, visual inspection and preliminary investigation, details investigation, diagnosis, methods of assessing in-situ concrete quality and strength, testing techniques, non-destructive and semi-destructive tests, assessment of concrete structures affected by reinforcement corrosion, appraisal report.
3	**Repair Materials** Important properties of repair materials, material compatibility, cements, admixtures, concrete, mortar and slurry, bonding aids, fillers and sealants, surface treatments, mechanisms of protection, polymers, epoxy, testing and assessment of effectiveness of surface treatments, fiber reinforced composites (FRP).
4	**Retrofitting Techniques** Steps in repair of concrete structures, crack repair methods, patch repair, pressure grouting, guiniting and shotcreting, repair of common structural elements, examples of repair work, strengthening techniques, plate bonding, jacketing, external prestressing.
5	**Electrochemical Techniques** The use of electrochemical techniques in arresting reinforcement corrosion, cathodic protection (CP) systems, sacrificial anodes and impressed current CP systems, desalination, chloride extraction, working principles, advantages and limitations.
6	**Mini Project** Assessment of strength, shrinkage, porosity and permeability of repair mortars/concrete. Demonstration on the use of non-destructive and semi-destructive tests.

4.0 COURSEWORK COMPONENTS:-

4.1 Assignment/mini project or lab report

A total of 2 written assignments and 1 mini project or lab report will need to be submitted.

4.2 Tests

A total of 2 tests will be conducted.

Details will be given in teaching plan to be distributed to students.

5.0 FINAL EXAMINATION:-

Students are required to sit for a three hour final examination.

6.0 REFERENCES:-

1. ACI Committee 440, "Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures", American Concrete Institute, 2002.
2. ACI Committee 546, "Concrete Repair Guide", American Concrete Institute, 1996.
3. ACI, BRE, CONCRETE SOCIETY, ICRI, "Concrete Repair Manual", 2nd Edition, American Concrete Institute, 2003.
4. Allen R.T.L., Edwards S.C. and Shaw J.D.N., "The Repair of Concrete Structures", Blackie Academic & Professoinal, Chapman & Hall, 1993.
5. British Cement Association, "The Diagnosis of Alkali-Silica Reaction", British Cement Assocoation Publication, 1988.
6. Bungey J.H., "The Testing of Concrete in Structures", Surrey University Press, Glasgow, UK, 1989.
7. Cambell-Allen D. and Ropper H., "Concrete Structures – Materials, Maintenance and Repair", Longman Scientific & Technical, 1990.
8. Concrete Society, "Non-structural Cracks in Concrete", Technical Report No. 22, 3rd ed., 1992.
9. Currie R.J. and Robery P.C., "Repair and Maintenance of Reinforced Concrete", Building Research Establishment Report, 1994.
10. Emmons P.H., "Concrete Repair and Maintenance Illustrated", American Concrete Institute, 1993.
11. Perkins P.H., "Repair, Protection and Waterproofing of Concrete Structures", Elsevier Applied Science Publisher, London and N.Y., 1986.
12. Pullar-Strecker P., "Corrosion Damaged Concrete – Assessment and Repair", CIRIA, Butterworths, 1988.
13. Raina V.K., "Concrete Bridges – Inspection, Repair, Strengthening and Load Capacity Evaluation", Tata McGraw Hill, 1994.

EAS 663/4 – DYNAMICS AND STABILITY OF STRUCTURES

1.0 SYNOPSIS OF COURSE

Stability of structures; Beam-column member; Determination of buckling load as an eigenvalue problem; Stiffness criteria in stability of structures; Approximate buckling load using energy method; Design of beam-column; Dynamic analysis of single degree of freedom systems; Dynamic analysis of multiple degree of freedom systems.

2.0 COURSE COMPONENT:

Unit : 4
Coursework : 40% [Tests (10%), Assignments (20%) and Mini projects (10%)]
Final Exam : 60%

3.0 TOPICS TO BE COVERED:

TOPIC	SYLLABUS
1	**Stability of Structures** Concepts of stable, neutral and unstable equilibrium; bifurcation and maximum load; Behaviour of imperfect columns
2	**Beam-Column** Governing equations; solution and boundary conditions; principle of superposition
3	**Determination of Buckling Load as Eigenvalue Problems** Buckling criteria; Elastic buckling of prismatic columns; Concepts of effective length; Perry-Robertson's Formula; Eigenvalue problem in buckling.
4	**Stiffness Criteria in Stability of Structures** Slope-deflection equation for column-beam member; Stability of frames; Matrix method
5	**Approximate Buckling Load Using Energy Method** Stationary potential energy ; Rayleigh-Ritz's method
6	**Design of beam-column** Consideration of stability in the design of beam-column; Provision in different code of practice/design recommendation for stability in the design of beam-column
7	**Dynamic analysis of single degree freedom (SDOF) system** Introduction to dynamics of structures; Formulation of equation of motions for undamped and damped systems; response under free vibration ; response under forced vibration – harmonic, impulsive, step and ramp loading as well as general dynamic loading ; Duhamel's integral.
8	**Dynamic analysis of multiple degree freedom (MDOF) system** Formulation of equation of motions; analysis of vibration frequency and the corresponding mode; orthogonality conditions; normalized coordinates; uncoupled equations of motion; dynamic response under general dynamic loading with the method of mode superposition; Eigenvalue problem in vibration.

4.0 COURSEWORK COMPONENTS

4.1 Assignment/mini project/seminar/laboratory

A total of 2 assignments and 1 mini project will need to be submitted.

4.2 Tests

A total of 2 tests will be conducted.

Details will be given in teaching plan to be distributed to students.

5.0 FINAL EXAMINATION

Students are required to sit for a three hour final examination.

6.0 REFERENCES

1. Clough R.W. and Penzien J., Dynamics of Structures. McGraw-Hill, 2nd. Edition, 1993.
2. Craig, R.R., Structural Dynamics - An Introduction to Computer Methods, John Wiley & Sons, 1981
3. Mario Paz, Structural Dynamics – Theory and Computation. 3rd ed., Van Nostrand Reinhold, 1991
4. Chopra, Anil K., Dynamics of Structures : Theory and Application to Earthquake Engineering(2nd edition), Prentice-Hall, 2000
5. Hart, G.W. and Wong, Kevin, Structural Dynamics for Structural Engineers, John-Wiley & Sons, 2000
6. Bathe K.J., Finite Element Procedures, Prentice Hall, 1996
7. Timoshenko S.P. and Gere J.M. Theory of Elastic Stability. International Student Edition, 2nd ed., McGraw-Hill Book Company, 1961
8. Chajes A. Principles of Structural Stability Theory. Prentice Hall, Englewood Cliffs, 1974
9. Brush D.O. and Almroth B.O., Buckling of Bars, Plates and Shells. International Student Edition, McGraw-Hill, Inc., 1975
10. El Naschie, M.S., Stress, Stability and Chaos in Structural Engineering : An Energy Approach, McGraw-Hill International Editions, 1992
11. Bazant, Zdenek P. and Cedolin, Luigi, Stability of Structures : Elastic, Inelastic, Fracture, and Damage Theories, Dover Publication, 2003
12. Dym, Clive L., Stability Theory and Its Applications to Structural Mechanics, Dover Publication, 2003
13. Bachman, Hugo, Ammann, Walter J. and Deischl, Florian, Vibration Problems in Structures: Practical Guidelines, Springer-Verlag, 1995

EAS 664/4 – PRINCIPLE OF STRUCTURAL DESIGN

1.0 SYNOPSIS OF COURSE

Slab Design; Masonry Design; Design for Special Structures; Advanced Design Project

2.0 COURSE COMPONENT :

Unit : 4
Coursework : 40% [Test (20%), Assignment (20%)]
Final Exam : 60%

3.0 TOPICS TO BE COVERED:

TOPIC	SYLLABUS
1	**Slab Design** Hillerberg method, upper bound/lower bound theory, yield criteria/condition
2	**High Rise Building** Design criteria; structural form; modeling and analysis
3	**Design of Structures under Wind Loading** Design criteria; wind load estimation based on MS 1553 (2002)
4	**Design of Structures under Earthquake Loading** Design criteria; earthquake load estimation based on static and dynamic procedures; design of Intermediate Moment Resisting Frame structures
5	**Design of Structures under Tsunami Loading** Design criteria; tsunami load estimation; design of tsunami evacuation buildings
6	**Masonry Design** Introduction to masonry; masonry unit; masonry structure; masonry design based on BS 5628 (2005) and ACEM.
7	**Advanced Design Project** Design of special structures.

4.0 COURSEWORK COMPONENTS :-

Assignment/Design report/Presentation

A total of 2 assignments and 1 design report will need to be submitted. Design project will need to be presented.

Details will be given in teaching plan to be distributed to students.

5.0 FINAL EXAMINATION :-

Students are required to sit for a three hour final examination.

6.0 REFERENCES :-

1. Thomas T.C. Hsu, Unified Theory of Reinforced Concrete, CRS Press, 1993
2. M.P. Nielson, Limit Analysis and Concrete Plasticity, Prentice-Hall, 1984
3. CH. Massonnet, W. Olszak, A. Philips, Plasticity in Structural Engineering Fundamentals and Applications, Springer-Verlag, 1979
4. Ghali, A. Concrete Structures: Stresses and deformation, 2nd Edition, E & EN Spon, 1994
5. MacGinley, T.J. and Choo, B.S., Reinforced Concrete Design Theory and Examples, E & FN Spon, 1995

6. Westbrook, R., 'Structural engineering Design in Practice, Longman Scientific & Technical. 1988.
7. Hillerborg, A., Strip Method Design handbook, E & FN Spon, 1995
8. McCormac, J.C.,Design of Reinforced Concrete, John Wiley & Sons, Inc., 2001
9. British Standard, BS 8110 (1997), British Standard Institute
10. British Standard, BS 5950 (1997), British Standard Institute
11. Westbrook, R. & Walker, D. (1996), 'Structural engineering design in practice: project design examples', Longman.

EAS 665/4 – BRIDGE ENGINEERING

1.0 SYNOPSIS OF COURSE

Introduction of bridge structures, types, trends, economics, aesthetic, and alternative design; Introduction of Arches in Bridge Structures and Limit States Design; Legal loads, Highway design loads and load factors; Loads and Load combinations; Bridge Deck; Deck Analysis; Diaphragms and Cross Frames; Application of Codes of Practice and JKR practices.

2.0 COURSE COMPONENT:

Unit : 4
Coursework : 40% [Tests (10%), Assignment (30%)]
Final Exam : 60%

3.0 TOPICS TO BE COVERED :

TOPIC	SYLLABUS
1	**Introduction of Bridge Structures, Types, Trends, Economics, Aesthetic and Alternative Design** Fundamental concept of bridge, types of bridge structures i.e. concrete, steel and composite; Aspect of trends, economics, aesthetic and alternative design; Comparison of all types of bridge structures and hydrology calculation.
2	**Introduction of Arches in Bridge Structures and Limit States Design** Introduction to the concept of arch in bridge structures; Concept of Limit State Design and principles of design.
3	**Legal loads, Highway Design Loads and Load Factors** Design loads vs. legal loads, highway design loads vehicle categories and limitations.
4	**Loads and Load Combinations** Loads and load combinations; influence line theory, notional lane, primary loads: HA and HB loads, pedestrians loads, secondary loads, centrifugal loads, longitudinal loads, etc.
5	**Bridge Decks** Introduction of basic types of bridge decks, load distribution, reinforcement, serviceability and fatigue limit state, stability and method of analysis.
6	**Deck Analysis** Types of beams, I, T , M. Deck analysis; yield line theory, Westergaard theory, influence line, grillage analogy, orthotropic plate theory, folded plate method and finite element and finite strip method.
7	**Diaphragms and Cross Frames** Diaphragms and Cross frames, types, definition and functions, composite reactions etc.
8	**Application of Codes of Practice and JKR Practices** Use of Codes of Practices, BS 5400 and JKR practices in the design of bridge.
9	**Mini Project** Report on bridge design including explanation of design procedure, determination of data, design calculation and drawing

4.0 COURSEWORK COMPONENTS :-

4.1 Assignment/mini project/seminar/laboratory

A total of 3 written assignments and 1 mini projects will need to be submitted. Details will be discussed in class.

4.2 Tests

A total of 2 tests will be conducted.

Details will be given in teaching plan to be distributed to students.

5.0 FINAL EXAMINATION:-

Students are required to sit for a three hour final examination.

6.0 REFERENCES :-

1. BS 5400 Pt.1,2,3,4,5,6,7,8,9,10 Steel, concrete and composite bridges.
2. Heins, C.P., Design of Modern Steel Highway Bridges.
3. Fritz Leonhardt, Bridges, Aesthetics and Design.
4. Fences, Gates, and Bridges : A Practical Manual by George A. Martin (Editor), Castle, Jr. Freeman; Amazon ; 2001
5. Studies in composite design of steel beam and concrete bridge decks; B& W REPRINT; National Research Council Highway Research Board ; Washington ; 1958.
6. Bridge Engineering: Design, Rehabilitation, and Maintenance of Modern Highway Bridges ; Mc Grawhill Professional Publishing ; 2001
7. William T. Segui ; LRFD Steel Design; Thomson Brooks/Cole; 2003
8. Rick Best and Gerard De Valence ; Design and Construction; Butterworth and Heinemann; 2003.
9. R. Hulse and W.H.Mosley; Prestressed Concrete Design by Computer ; Macmillan ; Basingstoke; 1987.
10. David J. Lee; The Theory and Practice of Bearings and Expansion Joints For Bridges; Cement and Concrete Association ; 2002

EUP 501/4 – ENGINEERING MANAGEMENT

1.0 COURSE SYNOPSIS

Action-based Research in Competitive Environment; Sustainable development; System Approaches in Engineering Management; Resources Planning, Optimization and Evaluation; Strategic Management; Basics of Management; Risk Management; The Process of Procurement; Decision-Making; Change Management; Re-engineering

2.0 COURSE COMPONENT:

Units : 4
Coursework : 40% [Test (10%), Assignments (20%), Report (10)]
Final Exam : 60%

3.0 TOPICS TO BE COVERED :

TOPIC	SYLLABUS
1	**Action-based Research in Competitive Environment -** Introduction to organizational values; perception; implementation; engineers and their specialization; marketing intelligence; technological change forecasting; Sustainable development - Engineering Principles' and Ethics; System Approaches in Engineering Management; Resources Planning, Optimization and Evaluation
2	**Strategic Management** Importance of strategic management; the strategic management process; types of organizational strategies (the hierarchy of strategy: corporate-level strategy, business-level strategy, functional-level strategy); strategic management model.
3	**Basics of Management**; **Risk Management -** Risk and uncertainty in projects, types of risk, risk management project ; The Process of Procurement; Decision-Making
4	**Change Management** What is change; forces for change; change process; managing change; contemporary issues in managing change; dealing with resistance to change; stimulating innovation
5	**Re-engineering** Basis for re-engineering; steps of re-engineering; re-engineering models; re-engineering methodologies.

4.0 COURSEWORK :

A total of 4 written assignments will need to be submitted.

Details will be given in teaching plan to be distributed to students.

5.0 FINAL EXAMINATION :-

Students are required to sit for a three hour final examination.

6.0 REFERENCES :-

1. Organizational Development: Science Interventions For Organization Improvement - French W.L., Prentice Hall, 1999.

2. Integrated Strategic Change: How Organizational Development Builds Competitive Advantage – Worley C.G. et. Al., Prentice Hall, 1996.
3. Gaining and Sustaining Competitive Advantage – Barney J.B., Prentice Hall, 2001.
4. Exploring Corporate Strategy: Text and Cases – G. Johnson & K. Scholes, Prentice Hall, 4th ed., 1997.
5. Management in Malaysia: Malaysian Institute of Management, 2nd. ed, 2001.
6. Management: V. Gabriel, Longman, 3rd. ed., 2003.
7. Management: S.P. Robbins and M. Coulter, Prentice Hall, 7th ed. 2001.

A.2 MASTER OF SCIENCE (ENVIRONMENTAL ENGINEERING)

EAP 581/4 – WATER SUPPLY ENGINEERING

1.0 SYNOPSIS OF COURSE

Water quality – Introduction to physical, chemical and biological characteristics.

Water demand – Studying of water demand from various sectors and making prediction on population, industrial and services growth rate.

Water treatment process – Learning about the water treatment process involved in water supply industry and advance water treatment for special purposes.

Legislation – Introduction to by-laws and acts involved in water supply in Malaysia and selected country including study on the existing legislation and its effect on the contamination of water resources.

Water distribution system – Studying on various components involved in the distribution of water from its source to the consumer.

Water quality modeling – Introduction to water quality modeling for river, estuaries, lakes and ground water.

Laboratory – Introduction to water quality tests based on water source pollution and water supply for public consumption.

2.0 COURSE COMPONENT :

Unit : 4
Semester : 1
Coursework : 40% [10% Test (10), Assignment (20%), Reports (10%)]
Final Exam : 60%

3.0 TOPICS TO BE COVERED :

TOPICS	SYLLABUS
1	**Water quality** Sources, uses, physical characteristics, organic and inorganic, chemical and biological characteristics, water pollution, standards, and health aspects of water supply.
2	**Water demand evaluation** Demand estimating and variations, population and consumption rates, population growth, industrial and development of services growth rates.
3	**Laboratory** Alkalinity and pH, solid and hardness, break point chlorination, atomic absorption spectrophotometer, jar test, most probable number and standard plate count.
4	**Water treatment technologies** Pre-treatment and treatment without chemical, coagulation and flocculation, sedimentation, dissolved air flotation, filtration and disinfection.
5	**Advanced water treatment process** Water for industrial process, distillation, reverse osmosis, electro dialysis, removal of nutrients and phosphorus.

6	**Distribution system** Service reservoir, pumps, design of water reticulation system, pipes, valves, specials and fittings, non-revenue water.
7	**Water quality modelling** Introduction, programming, river, estuary, lake, stochastic and ground water modelling and optimisation.
8	**Legislation** Introduction, by-laws and acts on water supply and pollution in Malaysia and for selected countries.

4.0 COURSE WORKS :-

4.1 Assignment/ /seminar/laboratory

A total of 3 written assignments/seminar will need to be prepared and submitted. Students are also required to attend laboratory sessions and to prepare six reports.

4.2 Tests

A total of 2 tests will be given.

Details will be given in teaching plan to be distributed to students.

5.0 FINAL EXAMINATION :-

Students are required to sit for a three hour final examination.

6.0 REFERENCES :-

1. MWH (2005) *Water Treatment: Principles and Design*, John Wiley & Sons, New Jersey.
2. American Water Works Association and American Society of Civil Engineers (2005) *Water Treatment Plant Design,* 4th Edition, McGraw Hill, New York.
3. American Water Works Association (2011) *Water Quality & Treatment: A Handbook on Drinking Water*, 6th Edition, McGraw Hill, New York.
4. The Malaysian Water Association and Ministry of Energy, Water and Communications Malaysia (2008) *Malaysia Water Industry Guide 2007*, published by MWA and Ministry of Energy, Water and Communications Malaysia.
5. APHA, AWWA & WPCF (2005) *Standard Methods for the Examination of Water and Wastewater,* 21st Edition.
6. Twort, A.C., Ratnayaka, D.D. and Brandt, M.J (2000) *Water Supply,* 5th Edition, Edward Arnold. Reprinted 2006 by Butterworth-Heinemann
7. Davis, M.L. and Cornwell, D.A. (1998) *Introduction to Environ Engineering,* 3rd Edition, McGraw Hill.
8. MDC Sdn Bhd (1997) *Environmental Quality Act 1974 and Regulation.*
9. Dewan Bahasa dan Pustaka (1995) *Glosari Alam Sekitar.*
10. Hammer, M.J. dan Hammer, J.M.Jr. (1996) *Water and Wastewater Technology,* 3rd Edition, Prentice Hall.
11. Chapra, S.C. (1997) *Surface Water Quality Modeling,* McGraw Hill.
12. James, A. (1993) *An Introduction to Water Quality Modeling.* 2nd Edition, Wiley.
13. Montgomery, J.M. (1985) *Water Treatment Principles and Design,* John Wiley.
14. Barnes, D., Bliss, P.J., Gould, B.W. and Vallentine, H.R. (1981) *Water and Wastewater Engineering Systems,* Pitman, London.
15. Hutton, L.G. (1983) *Testing of Water in Developing Countries,* Water Research Centre, UK.

EAP 582/4 – WASTEWATER ENGINEERING

1.0 SYNOPSIS OF COURSE

Sources, characteristic and classification of wastewater; Wastewater quantity ; Sewerage system; Treatment plant principle and design; Treatment and disposal of non-hazardous industrial waste; Low cost treatment system for hot climate; Sludge treatment and disposal; Geotechnology of waste management; Pollution, laboratory analyses; Legislation.

2.0 COURSE COMPONENT:

Unit : 4
Coursework : 40% [3-4 Tests (10%), 3-4 Assignments (10%), Presentation (10%) and Laboratory (10%)]
Final Exam : 60%

3.0 TOPICS TO BE COVERED :

TOPIC	TOPICS
1	**Legislation** Effluent standard in Malaysia and overseas; regulations related to wastewater disposal in Malaysia; MS - ISO 14000.
2	**Wastewater quantity and characteristics** Importance of wastewater quantity; physical, chemical and biological characteristics; wastewater classification; Dry Weather Flow; storm water; factors affecting quantity of wastewater; Population Equivalent; wastewater quality.
3	**Laboratory** TDS, SS, VSS, BOD, COD, TOC, N, P, SO_4, metals, sludge volume index.
4	**Treatment plant principles and design** Wastewater treatment objective; plant classification - aerobic and anaerobic, fixed media and suspended cultures, primary, secondary and tertiary; management aspect; biological oxidation; kinetic of BOD; design of physical and chemical plant - screen, comminutor, grit removal, skimming and equalization tanks, primary sedimentation tank, coagulation and flocculation; design of biological plant - activated sludge, RBC, anaerobic digester; advanced wastewater treatment; wastewater reclamation and reuse; nutrient removal.
5	**Treatment and disposal of non-hazardous industrial waste** Type of waste – quantity and characteristics; physical, chemical and biological treatment; waste minimization, reuse, recycle; case study.
6	**Low cost treatment system for hot climate** Design of waste stabilization ponds - facultative, maturation, anaerobic and high rate; aerated lagoon; oxidation ditch; land treatment; high rate biofilter; septic and Imhoff tanks.

7	**Sewerage system** Definition - sewer, sewage and sewerage; sewerage systems - combined, separate and partially separate system; sewers classification; sewer installation and sewerage appurtenances; sewer design; pumping station principles and design.
8	**Sludge treatment and disposal** Sources; characteristics; quantity; treatment objective; thickening - gravity, floatation, centrifuge, elutriation; stabilization - anaerobic digester, aerobic and anaerobic lagoons, thermal treatment; dewatering - drying bed, filter press, vacuum filtration; disposal methods - pyrolysis, wet air oxidation and incineration; ultimate disposal - landfilling, sea disposal.
9	**Geotechnology of Waste Management** Form of waste, index properties; clay mineral, Compressibility and settlement; site investigation and selection; liners, leachate generation and collection, caps; and gas management.

4.0 COURSEWORK:-

4.1 Assignment/mini project/seminar/laboratory

A total of 3-4 written assignments/mini projects/seminar will need to be prepared. Students are also required to attend laboratory sessions and to prepare 6 reports.

4.2 Tests

A total of 2-5 tests will be given.

Details will be given in teaching plan to be distributed to students.

5.0 FINAL EXAMINATION :-

Students are required to sit for a three hour final examination.

6.0 REFERENCES:-

1. Guidelines for Developers Volume 4: Sewage Treatment Plants, Second Edition, Ministry of Housing and Local Government, Sewerage Services Department.
2. Guidelines for Developers Volume 3: Sewer Networks and Pump Stations, Second Edition, Ministry of Housing and Local Government, Sewerage Services Department.
3. Metcalf and Eddy, 'Wastewater Engineering – Treatment and Reuse', 4th Edition, McGraw-Hill International Editions, 2003.
4. APHA, AWWA & WPCF, 'Standard Methods for The examination of Water and Wastewater', 18th. edition, 1992.
5. Sawyer, C. N., McCarty, P. L. and Parkin, G. F., 'Chemistry for Environmental Engineering', 4th Edition, McGraw-Hill International Editions, 1994.
6. Davis, M.L. and Cornwell, D.A., 'Introduction to Environmental Engineering', 3rd. Editions, McGraw-Hill International Editions, 1998.
7. Peavy, H. S., Rowe, D. R. and Tchobanoglous, G., 'Environmental Engineering', McGraw-Hill International Editions, 1985.
8. Environmental Quality Act 1974 and Regulations, MDC Sdn. Bhd., 1997.
9. Fuaad Nik Abllah, Nik, 'Bekalan Air, Pembetungan dan Pengairan', USM, 1990.
10. Glosari Alam Sekitar, Dewan Bahasa dan Pustaka, 1995.
11. Hammer, M.J., and Hammer, J.M.Jr., 'Water and Wastewater Technology', 3rd. edition, Prentice Hall International Editions, 1996..
12. Jackson, M.H., Morris, G.P., Smith, P.G. and Crawford, J.F., 'Environmental Health Reference Book', Butterworth-heinemann, 1990.
13. Mara, D. 'Sewage Treatment in Hot Climates', John Wiley & Sons, 1980.

14. McLoughlin, J. and Bellinger, E.G., 'Environmental Pollution Control, An Introduction to Principles and Practice of Administration', Graham and Trotman/Maritines Nijhoff, 1993.
15. Nathanson, J.A. , 'Basic Environmental Technology, 2nd. Editions', Prentice Hall, 1997.
16. Nicoll, E.H., 'Small Water Pollution Control Works: Design and Practice', Ellis Horwood Ltd., 1988.
17. Ray, B.T., 'Environmental Engineering', PWS Publishing Co, 1995.
18. Sedlak, R., 'Phosporos and Nitrogen Removal from Municipal Wastewater, Principles and Practice', Lewis Publication, 1991.
19. Sincero, A.P., and Sincero, G.A., 'Environmental Engineering - A Design Approach', Prentice Hall, 1996.
20. Tebbutt, T.H.Y., 'Prinsip Pengawalan Kualiti Air', 4th. edition, Biroteks, ITM, 1992.
21. Vesilind, P.A., 'Treatment and Disposal of Wastewater Sludges', Revised Edition, Ann Arbor Science, 1979.
22. Geotechnology of Waste Management

EAP 583/4 – AIR AND NOISE POLLUTION CONTROL

1.0 SYNOPSIS OF COURSE

Air Pollution – Sources and effects of air pollution; Meteorological aspects and natural purification process; Estimation and measurement of ambient air and source emissions; Control devices for air pollutant; Dispersion models; Legislation

Noise Pollution – Characteristics of sound- sound wave and etc; Sources, effect and regulation of noise pollution; Measurement and analyses of noise; Noise control principle-reduction at source, absorbance and etc; legislation.

2.0 COURSE COMPONENT :

This is a 4 units course, 2 units for air pollution and 2 units for noise pollution:

Unit : 4
Coursework : 40% [15% Tests, 15% Assignments, 10% Mini Project]
Final Exam : 60%

3.0 TOPICS TO BE COVERED :

3.1 AIR POLLUTION AND CONTROL (2 UNITS)

TOPIC	SYLLABUS
1	**Sources and Effects of Air Pollution** Air Composition and structure, definition and general classification of air pollutant, sources, and effects to human health, vegetation and environment.
2	**Meteorological aspects and natural purification process** Characteristics of elements in the atmosphere, Scale of motion, heat, pressure, wind, moisture, relative humidity, , influence of meteorological phenomena on air quality, lapse rates and dispersion, pressure systems and dispersion, winds and dispersion, moisture and dispersion
3	**Estimation and measurement of ambient air and source emissions** Sampling, equipment, methodology, gas velocity and volume flow rate, meteorological equipment, continuous monitoring and equipment.
4	**Control devices for air pollutant** Elimination of particulates, settling chambers, cyclon, fabric filters, electrostatic precipitators, wet scrubbers, elimination of gases, adsorption, absorption, condensation and combustion.
5	**Dispersion models** Simple Gaussion model, coefficient of dispersion, plume rise, reflection of plume, maximum concentration at ground level, calculation of effective stack height
6	**Legislation** Legislation in Malaysia and other countries, criteria of air quality, ambient air standards and emission standards, air quality index

3.2 NOISE POLLUTION AND CONTROL (2 UNITS)

TOPIC	SYLLABUS
1	**Characteristics of sound** Introduction to noise pollution; how sound is generated; characteristics of sound waves; measurement of sound waves; scale in decibel, dB.
2	**Characteristics of sound (cont'd)** Sound intensity; sound power; sound pressure; relationship between power, intensity and pressure; addition of harmonic sound-formula, table, chart; averaged sound level.
3	**Sources, effect and regulation of noise pollution** Introduction; sources-industries, construction, aircraft, traffic and train, others. Noise dose and exposure-allowable dos limit, daily dos. Impact of noise-sleeping disturbances, stresses, damage to ears; temporary and permanent damage; impact on productivity; public reactions to noise pollution. Regulation on noise-regulation in Malaysia and overseas; vehicle emission regulation; occupational regulation; Machinery and Factory Act; Environmental Quality Act; Occupational and Safety Act.
4	**Measurement and Analyses of noise** Introduction; types of equipment including recorder and data logger; procedure of sampling; Analyses of sound-Phon, Octave bands, weighted average. Noise category-Equivalent Sound Pressure Level (Leq), Percentage of noise (Ln), Day and Night sound Pressure Level (Ldn)
5	**Measurement and Analyses of noise** Measurement for different sources-traffic, airport, construction; factors influencing noise propagation in open areas-distance, atmospheric absorption, wind, ground absorption, barrier; factors influencing noise propagation in closed areas-direct and reflected noise, air and structural borne noise, noise propagation through walls.
6	**Noise Control** Introduction; principles of noise control; control at source-reduction on impact, reduction in speed and pressure, friction, propagation area, leaking area. Noise control at pathways-separation, absorption by materials, insulation, barrier-reduction by wall and calculation of delivery loss. Control at receiver-scheduling of working hours, types of ear protection-ear muffs and ear plugs.

4.0 COURSEWORK:-

4.1 Assignment/mini project/seminar.

4.2 Tests

A total of 3 tests will be given.

Details will be given in teaching plan to be distributed to students.

5.0 FINAL EXAMINATION:-

Students are required to sit for a three hour final examination.

6.0 REFERENCES:

1. Baranek, L.L. and Ver, L.L. (Editor), 'Noise and Vibration Control Engineering, Principles and Applications', John Wiley & Sons, 1992.

2. Chow, W. and Connor, K.K. (Editor), 'Managing hazardous air pollutants - States Publisher's, 1993.
3. Couling, S.(Editor), 'Measurement of Airborne Pollutants', Butterworth-Heinemann, 1993.
4. Davis, M.L., and Cornwell, D.A., 'Introduction to Environmental Engineering', 3rd. Editions, McGraw-Hill International Editions, 1998.
5. 'Environmental Quality Act 1974 and Regulations', MDC Sdn. Bhd., 1997.
6. 'Glosari Alam Sekitar', Dewan Bahasa dan Pustaka, 1995.
7. Hewitt, C.N. and Sturger, W.T. (Editor), 'Global Atmospheric Chemical Change', Applied Science, 1993.
8. Jackson, M.H., Morris, G.P., Smith, P.G. and Crawford, J.F., 'Environmental Health Reference Book', Butterworth-heinemann, 1990.
9. lewis H.Bell and Douglas H.Bell, 'Industrial Noise Control, Fundamental and Application', 2nd. Edition, Marcel Dekker, Inc., 1994.
10. McLoughlin, J. and Belllinger, E.G. 'Environmental Pollution Control, AN Introduction to Principles and Practice of Administration', Graham and Trotman/Maritines Nijhoff, 1993.
11. NaHanson, J.A., 'Basic Environmental Technology, 2nd. Edition', Prentice Hall, 1997.
12. Norton, M.P., 'Fundamentals of Noise & Vibration Analyses for Engineers' Cambridge University Press, 1989.
13. Sincero, A.P., and Sincero, G.A., 'Environmental Engineering - A Design Approach', Prentice Hall, 1996.
14. Thuman, A. and Miller, R.K., 'Fundamentals of Noise Control Engineering', The Fairmont Press, Georgia, 1998.

EAP 584/4 – ENVIRONMENTAL IMPACT ASSESSMENT

1.0 SYNOPSIS OF COURSE

EIA theory-definition, benefit, history; EIA procedure – screening, scoping, original data investigation, effect and estimation, economy and social impact assessment, analyses and modeling, cost benefit analyses, risk assessment; Matrices; Mitigation; Report; Sustainable Engineering; Environmental management plan – pre-audit; Field audit; Post-audit; EIA case study; Legislation involving EIA, impact predictions.

2.0 COURSE COMPONENT :

Unit : 4
Semester : 1
Coursework : 40% [10% Tests, 10% Assignments, 20% Project]
Final Exam : 60%

3.0 TOPICS TO BE COVERED

TOPIC	SYLLABUS
1	**Introduction to EIA:** Definition, improvement of EIA; feature and benefit; objective; issues regarding EIA; analysis and cost benefit.
2	**EIA Procedure:** Elements in the procedure; activities – identify, screening, scoping, data gathering, evaluate effects on the environment, economy and social, analysis and modeling, risk assessment, identify mitigation steps, assess and consider the alternative, report preparation; monitoring and environmental audit – pre-audit, field audit, post-audit; EIA methods – ad-hoc, checklist and matrices.
3	**Management and EIA method in Malaysia:** Environmental management in Malaysia; procedures in Malaysia; Initial EIA and Specific EIA; legislation regarding EIA; improvement of EIA in Malaysia including macro EIA. Sustainable engineering.
4	Impact Prediction – Remote Sensing in EIA
5	Impact Predictions – GIS and Landscape
6	Impact Predictions – Geotechnical
7	Impact Predictions - Landslide and Landcover
8	Impact Predictions - Traffic Impact and Accident Risk Assessment
9	Environmental Management Pelan

4.0 COURSEWORK :-

Prediction Project, EIA Project, Literature Review

Details will be given in teaching plan to be distributed to students.

5.0 FINAL EXAMINATION :-

Students are required to sit for a three hour final examination.

6.0 REFERENCES :

1. 'A Handbook of Environmental Impact Assessment', ENSEARCH, Kuala Lumpur, 1990.
2. Bis Was A.K., and Agarwal S.B.C. 'EIA for Developing Countries', Butterworth-Heineman, 1990.
3. 'Environmental Quality Act 1974 and Regulations', MDC Sdn. Bhd., 1997.
4. Canter, L.W., 'Environmental Impact Assessment, 2nd edition', McGraw Hill, Inc., 1996.
5. 'Glosari Alam Sekitar', Dewan Bahasa dan Pustaka, 1995.
6. Jain, et. A1., 'Environmental Assessment', McGraw Hill, 2001
7. Abdullah Mohd. Said, 'Penilaian Kesan-Kesan Alam Sekitar', Biroteks, ITM, Shah Alam, 1992.
8. Environmental Impact Statement, Eccleston CH. John Wiley and Sons Publ. (2000)
9. Introduction to Environmental Analysis. Reeve R. John Wiley and Sons Publ. (2002)
10. Practical Environmental Analysis. Radojevic and Bashkin. RSC Publ. (2006)
11. Environmental Assessment. Singleton R. Thomas Telford Publ. (1999)
12. Environmental Impact Assessment. Lawrence D.P. John Wiley and Sons (2003)
13. Comparative Environmental Risk Assessment. Cothern C.R. Lewis Publ. (1999)
14. Cleaner Technology. Clayton A. Earthscan Publ. (1999)
15. Construction and Natural Environment. Lowton R.M. Butterworth. Heinamann. (1997)

EAP 585/4 – SOLID AND HAZARDOUS WASTE MANAGEMENT

1.0 SYNOPSIS OF COURSE

Solid Waste – The role of waste management, waste management regulation, definition and characteristics of wastes; Sources; Generation of wastes; Measurement of quantity; storage and collection of waste; Transportation; Treatment and processing - reduction, recovery, recycle, reuse, separation, baling; Disposal – principles of incineration, pyrolysis, landfilling and others; Technology of landfilling – siting considerations, method of operations, design, rehabilitation of landfill; Management aspects; Laws and regulations.

Hazardous Waste – Hazardous waste management regulation, classification and characteristics; Generation of waste – sources and quantity; Site selection and assessment, handling of waste at site; Storage and collection – protective equipment, safety procedure, risk assessment; Collection and transportation of waste; Treatment and disposal – reduction of waste, recovery of resources, pretreatment, physical treatment, chemical and biological, thermal treatment, secured landfill; Examples of treatments; Site restoration; Laws and regulations.

2.0 COURSE COMPONENT:

Unit : 4
Semester : 1
Coursework : 40% [Tests (10%), Assignments (20%), Presentation (10%)]
Final Exam : 60%

3.0 TOPICS TO BE COVERED:

TOPICS	SYLLABUS
1	**Introduction and regulations:** The role of Solid waste management and solid waste management regulations.
1	**Definitions and characteristics -** sources and types of wastes -domestic, commercial, institution, construction and demolition, municipal (MSW), treatment plant wastes, industrial and agricultural. Physical, chemical and biological properties of MSW.
2	**Generation –** Methods to determine quantity and quality of wastes, rate of generation, factors affecting total amount of wastes generated, collection rates.
3	**Storage –** storage at source, effect to the elements in waste, types of containers and location, public health and aesthetic values.
4	**Collection of Wastes** – Collection services types of collection system, collection routes, transfer station
5	**Site visit –** One day visit to selected transfer stations
6	**Treatment and Processing of Wastes –** 5 R's strategies - reduction, recovery, reuse, recycle, laws and legislation; separation, size reduction, compaction, baling; composting and incineration.
7	**Ultimate Disposal –** soil contamination, types of landfilling, rehabilitation of site, methods of landfilling and operations, site design; generation of gas, leachate, control and monitoring, management – landfill closure and postclosure.

8	**Classification of Hazardous Waste -** definition; classification - solid, liquid and gas; characteristics of waste – ignitable, reactive, flammable, explode, toxic, contagious, radioactive, corrosive, corrode; list of hazardous wastes, hazardous waste in Malaysia.
9	**Generation –** sources of waste, rate of generation from each industry; exponential rate of generation in Malaysia.
10	**Laws and Regulations -** Laws and regulation in Malaysia; comparing laws and regulations with other countries; standard of effluent; standards for the discharge of water and air; laws and regulations concerning exporting of waste; requirement of EIA.
11	**Handling, storage and collection at site –** choice and assessment of site, handling at site, personal protection equipment (ppe); safety procedure; storage – type of containers, labeling, separation of waste; procedure on the standards for storage, management aspects; Collection – type of vehicles, public safety, distribution method.
12	**Treatment and Disposal –** treatment options; pretreatment, recovery of chemicals (regeneration); chemical fixation; encapsulation; chemical/biochemical treatments; design of secured landfill and rehabilitation; basic design of incinerator; specific treatment; examples of treatment based on the type of wastes; latest treatment methods in Malaysia; case study.
13	Site Visit

4.0 COURSEWORK:-

4.1 Assignment/mini project/seminar/laboratory

A total of 3 written assignments/mini projects/seminar will need to be prepared.

4.2 Tests

A total of 2-3 tests will be conducted.

Details will be given in teaching plan to be distributed to students.

5.0 FINAL EXAMINATION :-

Students are required to sit for a three hour final examination.

6.0 REFERENCES :-

1. Basic Hazardous Waste Management, Third Edition Blackman William C. Jr., Jr. Blackman 2001 CRC Press
2. Design of Landfills and Integrated Solid Waste Management (Third Edition) (2004)
3. Electronic Waste Management: Design, Analysis And Application Ronald E. Hester, Roy M. Harrison 2009 Royal Society Of Chemistry.
4. Geotechnical Aspects Of Landfill Design And Construction Xuede Qian, Donald H. Gray, Robert M. Koerner 2001 Prentice Hall
5. Handbook Of Solid Waste Management George Tchobanoglous, Frank Kreith 2002 McGraw-Hill Professional Publishing
6. Handbook Of Solid Waste Management And Waste Minimization Technologies Nicholas P. Cheremisinoff, Dr Nicholas P. Cheremisinoff 2002 Butterworth-heinemann
7. Hazardous Waste Handbook William F. Martin, Martin, John Lippitt 2000 Butterworth-heinemann.
8. Soil And Solid Waste Analysis: A Laboratary Manual P K Behera 2006 Dominant Publishers And Distributors.

9. Solid & Hazardous Waste Management S.C. Bhatia 2007 Atlantic Publishers & Distributors
10. Solid Waste Engineering Vesilind P A Binding: Paperback 2008 Thomson Business Information
11. Textbook Of Solid Wastes Management Khan, Ahsan Binding: Paperback 2007 Cbs

A.3 DISSERTATION

[Common to both MSc. (Structural Engineering) and

MSc. (Environmental Engineering) Programmes]

EAA 605/20 - DISSERTATION

1.0 SYNOPSIS OF COURSE

To conduct research project pertaining to environmental and structural related disciplines (by means of investigation, analysis and reporting in the form of dissertation)

2.0 COURSE COMPONENT:

Unit : 20
Semester : 2
Coursework : Dissertation

3.0 TOPICS TO BE COVERED :

All environmental and structural engineering related topics.

4.0 TENTATIVE TIMETABLE

There is no formal lecture. Students are required to conduct research project under the supervision of a supervisor. Seminar on important aspects of conducting research study will be given. A dissertation is to be submitted according to the following schedule:

WEEK	ACTIVITIES	NOTES
SEM I		
Week 10	Submission of title of dissertation, name of supervisor and draft proposal	To Deputy Dean(Research)
SEM II		
Week 24	Course Registration	All students
Week 24	First Presentation	All students and lecturers
Week 35	Second Presentation	All students and lecturers
SEM III / KSCP		
Week 41	Submission of FOUR copies of dissertation drafts (after amendments and incorporating all comments by supervisors) for evaluation and THREE copies of extended summary #	Submission to office of School of Civil Engineering together notice of submission duly signed by supervisor
Week 41- 42	Evaluation of dissertation by examiners	
Week 43	Submission of reports by internal examiners	
Week 45	Viva-voce Panel of Examiners – decision of PASS/FAIL after each viva-voce.	
Week 50	Submission of TWO copies* of hardbound dissertation and TWO copies of CD##.	Submission to office of School of Civil Engineering

Notes:

The Extended Summary will be used by the internal examiners to evaluate the suitability of research work for publication. It should consist of brief introduction, problem statement, objectives, scope of work, brief methodology, summary of findings and conclusions in a maximum of 10 pages (hard copy)

*Does not include own copy and copy for co-supervisor (if applicable).

1 CD for university library and 1 CD for the School. Students are to submit CD for supervisor directly to supervisor / co – supervisor.

5.0 REFERENCES:

1. A guide to the preparation, submission and examination of thesis, IPS, USM.
2. Allen, G.R. (1976). 'The graduate students, guide to thesis and dissertation: A Practical manual for writing and research', San Fransisco:Josey-Bass.
3. Reynolds, M.M. (1985). 'Guide to thesis and dissertations: An International Bibliography of Bibliographies'. Phoenix, Ariz.: Onyx Press.
4. Watson, G. (1987). 'Writing a thesis: A guide to long essays and dissertations', London: Longman.

APPENDIX B: DETAILS OF ACADEMIC, TECHNICAL, ADMINISTRATIVE STAFF AND RESEARCH OFFICER

B.1 ACADEMIC STAFF

NO.	NAME	SPECIALISATION
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2	Prof. Dr. Badorul Hisham Abu Bakar	Cert. Civil Eng.(PUO), Dip.(UTM), BEng.(USM), MSc., PhD(Leeds) Room Number : 2.20 Email : cebad@usm.my Tel. Number (ext) : 6283 Area of research : *Masonry Structure, Timber Structure*
3	Prof. Dr. Fauziah Ahmad	Dip.(UTM), BSc., PhD(Strath) Room Number: 1.16 Email : cefahmad@usm.my Tel. Number (ext) : 6268 Area of research : *Geotechnical Engineering, Urban Geoinformatic*
4	Prof. Dr. Hamidi Abdul Aziz @ Abdul Rahman	Dip.(UTM), BEng., MSc., PhD(Strath) Room Number : 1.10 Email : cehamidi@usm.my Tel. Number (ext) : 6215 Area of research : *Wastewater, Solid Waste Management,Landfill Technology, Leachate Treatment*
5	Prof. Dr. Ismail Abustan	BSc.(George Washington), MEng., PhD(UNSW) Room Number : 1.15 Email : ceismail@usm.my Tel. Number (ext) : 6251 Area of research : *Water Resources Engineering, Urban Drainage*

6	Prof. Ir. Dr. Md Azlin Md Said	B.Eng., MSc.(Eng)(Liv), PhD(Wales) Room Number : 2.06 Email : azlin@usm.my Tel. Number (ext) : 5834 Area of research : *Remote Sensing, GIS, Satelite System, Application in Water Resources Engineering, Project Management*
7	Prof. Dr. Meor Othman Hamzah	BSc.(Aston), MSc.(Strath), PhD(Leeds) Room Number : 2.03 Email : cemeor@usm.my Tel. Number (ext) : 6210 Area of research : *Highway Engineering, Asphalt Engineering*
8	Prof. Ir. Dr. Mohamad Razip Selamat	BSc., MEng.(Louisville), PhD(Queensland) Room Number : 1.11 Email : cemrs@usm.my Tel. Number (ext) : 6214 Area of research : *Geotechnical Engineering, Rock Engineering*
9	Prof. Ir. Dr. Mohd Nordin Adlan	Dip.(UTM), BSc.(C.N.A.A), MSc.(Loughborough), PhD(N'Castle Upon Tyne) ,F.I.E.M, P.Eng (M) Room Number : 1.05 E-mail : cenordin@usm.my Tel. Number. (ext) : 6252 Area of research : *Dissolved Air Flotation, Water Treatment and Supply*
10	Prof. Dr. Nor Azam Ramli	BApp.Sc.(USM), MSc., MPhil., PhD(Wales) Room Number : 1.23 Email : ceazam@usm.my Tel. Number (ext) : 6227 Area of research : *Environmental Engineering*
11	Prof. Sr. Dr. Wan Muhd Aminuddin Wan Hussin	Dip.LSurv.(UiTM), BSc.(Hons)(UEL), MBA(AUL), PhD (Trent), FISM, CPUL, MSP, MAALS Licensed Land Surveyor Under Act 485 (Revised 1991) Certified Professional Utility Locator Malaysian Speaking Professional.

		Room Number : 2.04 Email : cewan@usm.my Tel. Number (ext) : 6211 Area of research : *Geomatic Engineering, Cadastral Surveying, Spatial Data Infrastructure, Underground Utility Mapping, Stress Management*
12	Assoc. Prof. Ahmad Shukri Yahaya	BSc.(Nottingham), MSc.(Aston) Room Number : 1.18 E-mail : shukri@usm.my Tel. Number (ext) : 6270 Area of research : *Statistics, Data Analysis, Environmental Modelling*
13	Assoc. Prof. Dr. Choong Kok Keong	BEng.(UTM), MEng.(Gifu), D.Eng(Tokyo) Room Number : 1.22 Email : cekkc@usm.my Tel. Number. (ext) 6225 Area of research : *Shell and Spatial Structures, Computational Mechanics*
14	Assoc. Prof. Dr. Megat Azmi Megat Johari	BSc.(ONU), MSc., PhD(Leeds) Room Number : 2.07 Email : cemamj@usm.my Tel. Number (ext) : 6208 Area of research : *Concrete Technology, Concrete Repair Materials and Techniques*
15	Assoc. Prof. Sr. Dr. Mohd Sanusi S.Ahamad	Dip., Adv.Dip.(UiTM), MSc., PhD(Nottingham) Room Number : 2.02 Email : cesanusi@usm.my Tel. Number (ext) : 6277 Area of research : *Geomatic Engineering and GIS*
16	Assoc. Prof. Dr. Rozi Abdullah	Dip.(UTM), BSc.(Salf), MSc.(Imperial), PhD(Newcastle) Room Number : 2.31 Email : cerozi@usm.my Tel. Number (ext) : 6281 Area of research : *Hydrology*

17	Assoc. Prof. Dr. Taksiah A. Majid	BSc.(CNAA), MSc., PhD(Liv) Room Number : 2.32 Email : taksiah@usm.my Tel. Number (ext) : 6282 Area of research : *Wind Engineering, Seismic Engineering*
18	Assoc Prof. Ir. Dr. Leong Lee Vien	BEng., MSc., PhD(USM) Room Number : 3.25 Email : celeong@usm.my Tel. Number (ext) : 6286 Area of research : *Traffic and Transportation Engineering*
19	Assoc. Prof. Dr. Mohd Suffian Yusoff	BSc.(UPM), MSc. PhD(USM) Room Number : 3.37 Email : suffian@usm.my Tel. Number (ext) : 6223 Area of research : *Environmental Engineering*
20	Dr. Fadzli Mohamed Nazri	B.Eng., MSc.(USM), PhD(Bristol) Room Number : 3.16 Email : cefmn@usm.my Tel. Number (ext) : 6219 Area of research : *Earthquake Engineering, Seismic hazard, Structural Analysis, Numerical Simulation/Modeling*
21	Dr. Farid Ezanee Mohamed Ghazali	Dip., BEng.(UiTM), MSc., PhD(Leeds) Room Number : 3.31 Email : cefarid@usm.my Tel. Number (ext) : 6222 Area of research : *Construction Management, Project Management*
22	Dr. Fatimah De'nan	Dip. (UTM), BTech.(UTM), MSc.(USM), PhD(UTM) Room Number : 3.07 E-mail : cefatimah@usm.my Tel. Number (ext) : 6271

		Area of research : *Structural Engineering, Steel Structures, Structural Analysis*
23	Dr. Izwan Johari	BEng ., MSc., PhD(USM) Room Number: 3.35 Email : ceizwan@usm.my Tel. Number (ext) : 6292 Area of research : *Masonry Structures*
24	Dr. Lau Tze Liang	BSc., MSc.(USM), PhD(Chula) Room Number : 3.15 Email : celau@usm.my Tel. Number. (ext) : 6284 Area of research : *Structural Engineering*, *Computational Mechanics, Tsunami and Earthquake Engineering*
25	Dr. Mohd Ashraf Mohamad Ismail	BEng.(USM), MSc.(Gadjah Mada), PhD(Kyoto) Room Number : 3.09 Email : ceashraf@usm.my Tel. Number (ext) : 6224 Area of research : *Geotechnical Engineering, Fractured Rock Hydrogeology, Applied Geophysics and Numerical Simulation/Modeling*
25	Dr. Mohd Remy Rozainy Mohd Ariff Zainol	BEng., MSc.(USM), PhD.(Kyoto) Room Number : 3.13 Email : ceremy@usm.my Tel. Number (ext) : 6231 Area of research : *Water Resources Engineering, Experimental Physical Model of Hydraulic, Numerical Simulation/Modeling*
26	Dr. Nastaein Qamaruz Zaman	Dip.(UTM), BEng.(UTM), MEng., PhD(Canterbury) Room Number : 3.08 Email : cenastaein@usm.my Tel. Number (ext) : 6287 Area of research : *Solid Waste Management, Odour Pollution, Anaerobic Digestion*

27	Dr. Noor Faizah Fitri Md Yusof	BEng., MSc., PhD(USM) Room Number : 3.28 Email : noorfaizah@usm.my Tel. Number (ext) : 6269 Area of research : *Environmental Engineering*
28	Dr. Norazura Muhamad Bunnori	BEng.(UKM), MSc.(USM), PhD(Cardiff) Room Number : 3.03 Email : cenorazura@usm.my Tel. Number (ext) : 6259 Area of research : *Structural Health Monitoring*
29	Dr. Nur Sabahiah Abdul Sukor	BEng.(UKM), MEng.(UTM), PhD(Kyoto) Room Number : 3.33 Email : cesabahiah@usm.my Tel. Number (ext) : 6250 Area of research : *Travel Behaviour Analysis, Traffic Psychology, Road Safety*
30	Dr. Puganeshwary A/P Palaniandy	B.Tech., MSc., PhD(USM) Room Number : 3.30 Email : cepuganeshwary@usm.my Tel. Number (ext) : 5883 Area of research : *Water and Wastewater Treatment*
31	Mr. Shaharudin Shah Zaini (*On Study Leave*)	BEng.(UiTM), MSc.(USM) Room Number : 3.02 Email : shaharudin@usm.my Tel. Number (ext) : 6221 Area of research : *Structural Engineering*
32	Mrs. Sharifah Akmam Syed Zakaria	BBA(UKM), MBA(USM) Room Number : 3.19 Email : akmam@usm.my Tel. Number (ext.) : 6253 Area of research : *Engineering Management*

33	Dr. Md Sayuti Ishak	BSc.(UTM), MSc.(USM), PhD(USM) Room Number : 3.17 Email : sayuti@usm.my Tel. Number (ext) : 6216 Area of research : *Construction and Project Management*
34	Dr. Mastura Azmi	BEng., MSc.(UTM), PhD(Kyoto) Room Number : 3.24 Email : cemastura@usm.my Tel. Number (ext) : 6299 Area of research : *Slope Engineering, Earthquake and Seismic Engineering*
35	Mr. Mohamad Fared Murshed	BEng. MSc.(USM) Room Number : 3.18 Email : cefaredmurshed@eng.usm.my Tel. Number (ext) : 6285 Area of research : *Water Treatment and Supply*
36	Dr. Muhd Harris Ramli	BEng., MEng.(UTM), PhD(Kyoto) Room Number : 3.12 Email : cemhr@usm.my Tel. Number (ext) : 6217 Area of research : *Subsurface Contamination, Environmental Geotechnic*
37	Mr. Mustafasanie M Yussof	BEng.(UTM), MSc.(USM) Room Number : 3.32 Email : cemustafa@usm.my Tel. Number (ext) : 6220 Area of research : *Structural Engineering*

B.2 RESEARCH OFFICER

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3	Mr.Mohamad Yusri Abu Bakar	6229
4	Mrs.Nor Habsah Md. Sabiani	6228
5	Mrs.Shafida Azwina Mohd Shafie	6218

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6	Mr.Mad Fadzil Ali	6240
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20	Mr.Shahril Izham Md Noor	6240
21	Mr.Shamsul Ishak	6232
22	Mr.Zulhairi Ariffin	6235
23	Mr.Zulkifly Hashim	6233

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6	Mrs.Norzalia Mat Isa	5760
7	Mrs.Suriani Zainal Abidin	5899
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