Advanced Diploma in Structural Engineering

Syllabus

30 August 2018

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1 Programme Structure and Rules of Combination

1.1 Rationale

Certificate in Structural Engineering
The level 4 Certificate in Structural Engineering is designed for Engineers and Assistant Engineers working in the construction sector who are progressing into a civil engineering or structural engineering role. This qualification develops the learner's knowledge and skills to design and develop projects, liaise with stakeholders and oversee small to medium construction projects safely and efficiently.

Advanced Diploma in Structural Engineering
The Level 5 Advanced Diploma in Structural Engineering is designed for Engineers working in the construction sector who are progressing into managing larger and more complex construction projects. The qualification develops the learner's knowledge and skills to design and develop projects, liaise with stakeholders and oversee large or complex construction projects safely and efficiently. The Level 5 Advanced Diploma in Structural Engineering is also designed for construction professionals who wish to study for a Bachelor Degree (BSc or BEng) in a 2-year top-up course at one of our partner universities.

1.2 Progression to other qualifications

The programme provides the underpinning knowledge and understanding for the Advanced Diploma in Structural Engineering. It also enables students to study towards a university degree, as once they achieve the Level 5 Diploma they can progress to our partner universities and study for a Bachelor Degree.

1.3 Programme Rules of Combination

The programme comprises two qualifications: the Level 4 Certificate in Structural Engineering and the Level 5 Advanced Diploma in Structural Engineering.

The course is of two years' duration, including optional industrial training. Each year long programme contains 6 core units. Students' performance will be assessed by an open book online exam (assignments).

Year 1:

- Fundamentals of Engineering Drawings
- Construction and Civil Engineering Technology
- Structural Fundamentals
- Soils and Foundations
- Fluid Mechanics and Hydraulics
- Engineering Mathematics and Modelling

Year 2:

- Structural Analysis
- Structural Design of Concrete
- Structural Design of Steel
- Advanced Structural Design
- Design and Computing
- Structural Engineering Design Project

To achieve the Level 4 Certificate, candidates are required to undertake:

- All six units from Year 1.

To achieve the Level 5 Diploma, candidates are required to undertake:

- All 12 units – 6 units from Year 1 & Year 2

1.4 Entry Requirements

- Minimum 18 years old **and** one of the following:
- Minimum Grade C in GCSE in Mathematics and English (or Equivalent) **or**
- Level 3 qualification in Engineering/Science including Mathematics **or**
- If you have relevant experience please contact us on enquiries@theccm.co.uk with your updated CV.

1.5 Unit and Assessment Grades

The tutor will award a grade to the achievement of each unit (fail, pass, merit or distinction). Unit grades apply to overall performance in units including assignments, practical exercises and course work.

Indicative marking descriptors for differentiating between levels of achievement when marking assignments are provided below (Section 1.8).

The overall grade for a qualification is calculated using a points system. Each unit grade attracts points as follows:

Fail	0 points
Pass	1 point
Merit	2 points
Distinction	3 points
Unit Exemption	1 point

1.6 Assessment

The assessment process is set by the College of Contract Management, which defines the requirements learners are expected to meet to demonstrate that a learning outcome has been achieved. All learning outcomes must be achieved in order to gain attainment of credit for that unit. Tutor-led assessment should be carried out throughout the course.

All units are assessed by internally-set assignment briefs by the partner universities and chartered institutions. Internally-set assignment briefs must be approved prior to issue to candidates.

All completed assessments are marked internally, internally verified and subject to approval by our partner universities.

The assessment criteria are based on 3 areas:

1. **Task achievement** – This is a measure of how well the candidate answers the task question/questions and the identification of the important aspects of the task.

2. **Technical Content** – This is a measure of how well the candidate identifies, describes and evaluates the technical aspects of the task.

3. **Presentation** – This is a measure of how well the candidate presents the assignment and includes the quality of the structure and paragraphing, the quality and relevance of visual or graphical content and the referencing used for quoted sources.

1.7 Assignment Policies

1. All submission of assignments must include:

   a) a copy of the full brief given by the Programme Coordinator;
   b) all source material must be cited in the text and a full bibliography of source material (including author, title, publisher, edition and page) listed at the end of the submission.

2. All submissions must be submitted into our system as instructed by the Programme Coordinator.

3. All submissions under the student's name must only be the work of that student. All information sources must be acknowledged. There is the **possibility of failing the module if the contents of the assignment are plagiarised** as set out in the rules and regulations of the institution.

4. All submissions should be in pdf format and students **must** keep a copy of all submitted work for reference purposes. Receipt will be acknowledged by the College once the work is completed.

5. Whenever a candidate submits work after the approved deadline without an authorised extension, a "Pending" grade will be awarded. The Assessor may comment on the quality of the work for learning purposes.

6. Requests for extensions of submission deadlines must be made in writing **prior** to the submission deadline to the Assessor and must be supported by documentary evidence.

1.8 Level 4 Certificate and Level 5 Diploma in Structural Engineering Indicative Marking Descriptors

Note: Please note that the bands below describe indicative characteristics only. An overall holistic approach is required when assessing a candidate's work and assigning a grade. Please read these grading bands in conjunction with the College of Contract Management Assignment Policy.

Grade	Task Achievement The Relevance of the Response	Inclusion of Relevant Technical Knowledge in Content	Presentation/Coherence
Distinction			
70% +	The work demonstrates a comprehensive understanding of the task. All relevant information is included. The main issues are effectively identified and analysed. There is evaluation and some analysis of solutions to issues relevant to the task. The response shows control of content within the word count.	The work demonstrates a strong understanding of a wide range of technical issues relevant to the task. There is analysis of the advantages/disadvantages of possible choices, risks and potential outcomes.	The work is appropriately structured and the argument is developed coherently. There is a recognised form of source referencing which supports the points in the task. Paragraphing and titling are used effectively to assist the reader. The use of visual/graphical information is clear and effective in assisting the reader. The graphical information is relevant to the task and is accurate.
Merit			
60-69%	The work demonstrates a clear understanding of the main issues relevant to the task. The issues are explained effectively and potential solutions identified. There is some attempt to analyse the merits of the solutions to the task. The task is broadly achieved within the word count, if relevant to assignment.	The work demonstrates an understanding of the key technical issues of the task. There is clear description of relevant technical aspects with some attempt to evaluate the merits of these as appropriate to the task.	Demonstrates an awareness of presentation and an attempt to present the information with clarity and coherence. There is referencing of sources and use of paragraphing and titling to assist the reader. There is use of clear graphical information to support the assignment which has broad relevance to the task. There may be some limited inaccuracies/omissions in these.
Pass			
40-59%	The work demonstrates an understanding of the task. The main points are identified and the task is achieved. There is no attempt to evaluate or analyse the solutions. There may be some inaccuracies, omissions and irrelevant content. There may be lack of control in relation to the word count.	The work demonstrates an understanding of the main technical issues which are identified. This may be limited to description with little evidence of evaluation. There may be some omissions and inaccuracies in the detail. There may be some irrelevant details.	There is an attempt to structure the information. There is evidence of paragraphing and titling which is not always appropriate. Some basic graphical information may be included which is of some assistance to the reader. There may be some omissions or inaccuracies. The work is generally coherent but there may be occasional lapses in coherence and structure.
Fail			
0-39%	The work shows a poor understanding of the task. Frequent inaccuracies. Failure to identify important aspects of the task. Much of the information is irrelevant to the task. There may be evidence of copy and paste from external sources. The response may be limited to lists of words with no attempt to explain the relevance/merits of these to the task. The assignment falls short of the word count.	The work demonstrates a lack of understanding of the technical aspects. There are omissions of important technical information. Errors are evident in the technical content. There is no attempt to explain the relevance of the technical content to the task.	Lacks structure and may be limited to lists of points which are not developed. Disorganised in structure causing difficulty for the reader to understand the points. The response is Illegible or incoherent in places. No referencing of external sources. The graphical illustrations are of poor quality or absent. They may be irrelevant. There may be errors and a lack of clarity causing difficulty for the reader to understand.

1.9 Calculating Overall Qualification Grade

To calculate the overall qualification grade, the individual module grades should be added together and compared to the table below:

1.9.1 Level 4 Certificate in Structural Engineering

Candidates must pass 6 units of the programme, which must include the 3 mandatory units from Year 1, as defined above, and may include any of the remaining 9 units from Year 1 or 2.

Total Points for all 6 Units	Overall Grade
18	**Distinction**
17	
16	
15	
14	
13	**Merit**
12	
11	
10	
9	**Pass**
8	
7	
6	
5 or fewer	**Fail**
Candidates must achieve at least a pass in (or hold exemption from) all 6 units to be awarded the Certificate.	

1.9.2 Level 5 Advanced Diploma in Structural Engineering

Candidates must pass the remaining 6 units of the programme. Units for the Diploma must be different to those undertaken as part of the Certificate.

Total Points for all 6 Units	Overall Grade
18	**Distinction**
17	
16	
15	
14	
13	**Merit**
12	
11	
10	
9	**Pass**
8	
7	
6	
5 or fewer	**Fail**
Candidates must achieve at least a pass in (or hold exemption from) all 6 units to be awarded the Certificate.	

1.9.3 Level 5 Advanced Diploma in Structural Engineering – entire qualification

Candidates must pass all 12 units of the programme

Total Points for all 12 Units	Overall Grade
36	**Distinction**
35	
34	
33	
32	
31	
30	
29	
28	**Merit**
27	
26	
25	
24	
23	
22	
21	
20	
19	**Pass**
18	
17	
16	
15	
14	
13	
12	
11 or fewer	**Fail**
Candidates must achieve at least a pass in (or hold exemption from) all 12 units to be awarded the Diploma.	

Subject	Fundamental of Engineering Drawings
Subject Code	SE401

Summary

Year	1
Unit	1
Status	core
Learning Hours	100 hrs including Lectures and Group Exercises
Credits	10
Period of Study	2 months

Summary of Learning Outcomes

Learning outcomes are results of learning that students will have achieved on successfully completing a course. The following reference points were used in designing the learning outcomes;

- QAA Subject Benchmark Statements to ensure: that appropriate and effective teaching, support, assessment and learning resources are provided for students; that the learning opportunities provided are monitored; and that the provider considers how to improve them; and

- The professional competencies required by ICE.

Learning outcomes are expressed under three broad headings of achievement in both threshold and typical standards:

U: Understanding (a general awareness of the activity)
K: Knowledge (a more detailed level of understanding of the activity)
S: Skills (to be able, without supervision, to perform relevant functions)

Learning outcomes: **The learner will:**	**Assessment criteria:** **The Learner can:**
1. Have a sound understanding in engineering language and fundamental drawings and design principle [K, U].	1.1 Understand the types of sectional views, Cutting plane or sectional plane. 1.2 Understand the layout of drawing sheet, margin, border lines, title block, list of parts, scales, uses of scale, sizes of scale, dimensioning.
2. Understand various civil engineering design options and able to apply dimensions on engineering drawings [S].	2.1 Understand the purpose of construction drawing, drawing lines and shapes, views and dimensions. 2.2 Understand the representation of materials, doors, windows, and first and third angle projection.
3. Be able to apply the features and functions of typical CAD systems for producing CAD drawings [S].	3.1 Understand the plans, elevations, structural elements, elevations, component drawings and engineering drawings. 3.2 Able to read symbols indicating materials and drawings for trade information. 3.3 Able to prepare detailed structural and service drawings. 3.4 Able to create 2D drawings using Auto CAD.
4. Understanding BIM Tools [U].	4.1 Introduction of BIM Tools. 4.2 Understand Quantification using the BIM process.
Additional information about the unit	
Units aim(s)	

Recommended Reading

1. Keith Styles and Andrew Bichard, Working Drawings Handbook, 4th edition
2. Mark W. Huth, Understanding Construction Drawings, 5th edition
3. W. Otie Kilmer, Rosemary Kilmer, Construction Drawings and Details for interiors: Basic Skills, 2003

Unit Title	**Construction and Civil Engineering Technology**
Unit Code	SE402

Summary

Year	1
Unit	2
Status	core
Learning Hours	100hrs including Lectures and Group Exercises
Credits Value	10
Period of Study	2 months

Summary of Learning Outcomes

Learning outcomes are results of learning that students will have achieved on successfully completing a course. The following reference points were used in designing the learning outcomes;

- QAA Subject Benchmark Statements to ensure: that appropriate and effective teaching, support, assessment and learning resources are provided for students; that the learning opportunities provided are monitored; and that the provider considers how to improve them; and

- The professional competencies required by ICE.

Learning outcomes are expressed under three broad headings of achievement in both threshold and typical standards:

U: Understanding (a general awareness of the activity)
K: Knowledge (a more detailed level of understanding of the activity)
S: Skills (to be able, without supervision, to perform relevant functions)

Learning outcomes: **The learner will:**	**Assessment criteria:** **The Learner can:**
1. Able to manage and mitigate health, safety and environmental (HSE) risks [K, S]	1.1 Risk assessment. 1.2 Management plan for safe working practices 1.3 Manage and mitigate HSE risks at pre-and post contract stages. 1.4 Quantitative and qualitative risk techniques.
2. Understanding health, safety and environmental law and obligations in construction and the application of current Construction Design and Management (CDM) regulations [K, S]	2.1 HSE hazards in construction. 2.2 Emergency management procedures in accident preventions and investigations. 2.3 Identify and apply the legislation, standards and best practice to prevent accidents. 2.4Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR). 2.5 Obligations of all parties involved in construction according to the HSE law.
3. Understanding foundations and substructure and able to design and operate with suitable technology [K, S]	3.1 Types of foundation (e.g. reinforced strip, piles, raft foundations). 3.2 Basement construction. 3.3 Excavations and ground works.
4. Understanding the superstructure in building construction and able to design and operate with suitable technology [S]	4.1 Type of frames in multi storey buildings construction. 4.2 Sustainable technologies in multi storey buildings construction. 4.3 Exterior envelope of multi storey buildings 4.4 Building materials and selection.
5. Understanding the technology in design process of the built environment [K, U]	5.1 Architectural innovations. 5.2 Environmental legislations. 5.3 Planning and Building Regulations. 5.4 Other impacts in construction design.
6. Able to select and operate building services and systems in a multi stories building [K, S]	6.1 Heating and ventilation. 6.2 Fire safety and building security requirements. 6.3 Energy efficient buildings and select suitable technology in installation of services such power, gas, telecommunications, water, drainage, wastewater, etc.
Additional information about the unit	
Units aim(s)	

Text Book

1. Mike Riley & Alison Cotgrave, *Construction Technology 2 - Industrial and Commercial Building*, 3rd Edition

Recommended Reading

1. Hughes, P. (2015) *Introduction to Health and Safety in Construction*, 5th edition; Abingdon: Taylor and Francis

Subject	**Structural Fundamentals**
Subject Code	SE 403

Summary

Year	1
Status	core
Learning Hours	100 Guided Learning Hours
Credits	10
Period of Study	2 months

Summary of Learning Outcomes

Learning outcomes are results of learning that students will have achieved on successfully completing a course. The following reference points were used in designing the learning outcomes;

- QAA Subject Benchmark Statements to ensure: that appropriate and effective teaching, support, assessment and learning resources are provided for students; that the learning opportunities provided are monitored; and that the provider considers how to improve them; and
-
- The professional competencies required by ICE

Learning outcomes are expressed under three broad headings of achievement in both threshold and typical standards:

U: Understanding (a general awareness of the activity)
K: Knowledge (a more detailed level of understanding of the activity)
S: Skills (to be able, without supervision, to perform relevant functions)

Learning outcomes: **The learner will:**	**Assessment criteria:** **The Learner can:**
1. Understanding and Knowledge of structures, structural materials and structural systems. [K, U]	1.1 Types of structures and structural components. 1.2 Design criteria and philosophy. 1.3 Structural materials and the properties of structural materials. 1.4 Structural Systems and idealisation.
2. Understanding and Knowledge of core structural engineering principles. [K, U]	2.1 Critical concerns of structural engineering. 2.2 Types of loads and load distribution in structures. 2.3 Basic analytical tools of structural analysis (equilibrium, determinacy). 2.4 Internal forces of structural members.
3. Understanding the basis of structural design and able to apply structural engineering knowledge for various structural elements. [K, S]	3.1 Types of Truss structures. 3.2 Analysis of two-dimensional trusses. 3.3 Structural actions on cables and arches. 3.4 Computation of deflections.
4. Able to contribute to the construction design process. [S]	4.1 Beams and other bending members. 4.2 Stability and determinacy of beams. 4.3 Displacement and deformation of beams.
Additional information about the unit	
Units aim(s)	

Text Book

Jerome J. Connor and Susan Faraji, *Fundamentals of Structural Engineering, Springer*; 1st ed. 2013

Unit Title	Soils and Foundations
Unit Code	SE404

Summary

Year	1
Unit	4
Status	core
Learning Hours	100 hrs including Lectures and Group Exercises
Credits Value	10
Period of Study	2 months

Summary of Learning Outcomes

Learning outcomes are results of learning that students will have achieved on successfully completing a course. The following reference points were used in designing the learning outcomes;

- QAA Subject Benchmark Statements to ensure: that appropriate and effective teaching, support, assessment and learning resources are provided for students; that the learning opportunities provided are monitored; and that the provider considers how to improve them; and

- The professional competencies required by ICE.

Learning outcomes are expressed under three broad headings of achievement in both threshold and typical standards:

U: Understanding (a general awareness of the activity)
K: Knowledge (a more detailed level of understanding of the activity)
S: Skills (to be able, without supervision, to perform relevant functions)

Learning outcomes: **The learner will:**	**Assessment criteria:** **The Learner can:**
1. Gain appreciation of the formation of various kinds of rocks and soils [K, U]	1.1 Identification of rocks and minerals. 1.2 Origin of igneous, sedimentary and metamorphic rocks. 1.3 Weathering of rocks and formation of soils. 1.4 Importance of soils in construction industry.
2. Demonstrate understanding of soil classification and their properties [K, S]	2.1 Site Investigations 2.2 Particle size analysis of soils. 2.3 Earthworks classification, testing and soil properties. 2.4 Fineness, particle shape and plasticity of soils. 2.5 Phase relationships of soils.
3. Understand the effect of water seepage on the engineering properties and behaviour of soils [K, S]	3.1 Bernoulli's Equation and hydraulic conductivity. 3.2 Darcy's law and permeability tests. 3.3 Seepage through embankments. 3.4 Case studies.
4. Understand the factors affecting load carrying capacity of soils and evaluate bearing capacity [K, S]	4.1 Modes of bearing capacity failures of soils. 4.2 Applying bearing capacity equations. 4.3 Effect of water on bearing capacity. 4.4 Plate-Load test as per BS EN1997-2.
5. Understand and apply the methodology for designing shallow foundations [K, S]	5.1 Ground conditions affecting foundation design 5.2 Types of shallow foundations. 5.3 Design of isolated and combined pad foundations. 5.4 Design of mat foundations. 5.5 Case Studies.
6. Gain an appreciation for some of the latest developments in soil stabilisation and foundation engineering [K, U]	6.1 Soil improvement techniques. 6.2 Slope failures and stabilization. 6.3 Deep foundations. 6.4 Case studies.
Additional information about the unit	
Units aim(s)	

Text Book

1. Smith, I. (2017) *Smith's Elements of Soil Mechanics*, 9th Edition. Wiley Blackwell.

Recommended Reading

1. Das, B.M. and Sobhan, K. (2017) *Principles of Geotechnical Engineering*, 9th Edition. Cengage Learning.

2. Knappett, J.A. and Craig, R.F. (2012) *Craig's Soil Mechanics*, 8th Edition. Spon Press.

Unit Title	**Fluid Mechanics and Hydraulics**
Unit Code	SE405

Summary

Year	1
Unit	5
Status	core
Learning Hours	100 hrs including Lectures and Group Exercises
Credits Value	10
Period of Study	2 months

Summary of Learning Outcomes

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- The professional competencies required by ICE.

Learning outcomes are expressed under three broad headings of achievement in both threshold and typical standards:

U: Understanding (a general awareness of the activity)
K: Knowledge (a more detailed level of understanding of the activity)
S: Skills (to be able, without supervision, to perform relevant functions)

Learning outcomes: The learner will:	Assessment criteria: The Learner can:
1. Understand the physical meaning of Vectors and Statics and resolve problems [K, U, S]	1.1 Review of Vector Algebra. 1.2 Resolution of Forces. 1.3 Moments, Couples and Torsion. 1.4 Analysis of Stresses and Strains including hoop, longitudinal and radial
2. Develop an understanding of the properties of fluids and solve mathematical problems [K, U, S]	2.1 Types of fluids. 2.2 Properties- density, specific gravity, and surface tension. 2.3 Viscosity – kinematic and dynamics. 2.4 Fluid pressure- atmospheric, gauge
3. Understand and apply the methodology for evaluating forces on submerged surfaces [U, S]	3.1 Introduction to Hydrostatics. 3.2 Pressure and total force on submerged plane surfaces. 3.3 Pressure and total force on submerged curved surfaces 3.4 Importance of hydrostatics- case studies.
4. Understand and apply the methodology for analysing fluids in motion [U, S]	4.1 Laminar and Turbulent flow. 4.2 Evaluation of discharge and velocity. 4.3 Conservation of mass, momentum and energy 4.4 Bernouli's equation 4.5 Flow through pipes
5. Experimental analysis in Fluid Mechanics and Hydraulics [U, S]	5.1 Measurement of fluid pressure. 5.2 Measurement of velocity and discharge in open channel flow 5.3 Preparation of technical reports.
6. Develop an appreciation for civil engineering works that involve principles of hydraulics [K, U]	6.1 Introduction to Dam engineering 6.2 Hydropower, pumps and turbines 6.3 Sustainable water resource management
Additional information about the unit	
Units aim(s)	

Text Book

1. Chadwick, A., Moffett, J., and Borthwick, M. (2013) *Hydraulics in Civil and Environmental Engineering*, 5th Edition. CRC Press.

Recommended Reading

1. White, F.M. (2016) *Fluid Mechanics*, 8th Edition. McGraw-Hill.

Subject	Engineering Mathematics and Modelling
Subject Code	SE406

Summary

Year	1
Unit	6
Status	core
Learning Hours	100 hrs including Lectures and Group Exercises
Credits	10
Period of Study	2 months

Summary of Learning Outcomes

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- QAA Subject Benchmark Statements to ensure: that appropriate and effective teaching, support, assessment and learning resources are provided for students; that the learning opportunities provided are monitored; and that the provider considers how to improve them; and

- The professional competencies required by ICE.

Learning outcomes are expressed under three broad headings of achievement in both threshold and typical standards:

U: Understanding (a general awareness of the activity)
K: Knowledge (a more detailed level of understanding of the activity)
S: Skills (to be able, without supervision, to perform relevant functions)

Learning outcomes: **The learner will:**	**Assessment criteria:** **The Learner can:**
1. Recognise and be able to apply mathematical tools and techniques to solve engineering-based problems [K, U].	1.1 Understand the functions of multiple variables and partial differentiation 1.2 Understand limits, sequences and series 1.3 Understand differential equations including 1st and 2nd order ODE analytical methods 1.4 Understand the numerical methods for ordinary differential equations and partially differential equations
2. Recognise and be able to apply probabilistic and statistical tools and techniques to solve engineering-based problems [K, U].	2.1 Understand the summary statistics, probability distributions, the use and characteristics of the main probability distributions with illustrations. 2.2 Understand the hypothesis testing for examination of significant differences between samples of data. 2.3 Understand basic regression modelling including interpretation of diagnostic statistics.
3. Understand and apply computer programming concepts and methods using MATLAB and SageMath [U, S].	3.1 Understand and use MATLAB and SageMath to solve the engineering and mathematics problems, and present the results in a proper shape.
4. Be able to develop models for problems related to Civil Engineering, and gain experience using computational tools to solve engineering problems [S].	4.1 Be able to translate the real-world Civil Engineering problems into mathematic functions, and to solve the problems using the learnt computational tools.
Additional information about the unit	
Units aim(s)	

Recommended Reading

1. Tony Croft and Robert Davison, *Mathematics for Engineers*, 4th edition, 2015.
2. K.A. Stroud and Dexter Booth, *Engineering Mathematics*, 7th edition, 2013.

Subject	Structural Analysis
Subject Code	SE 501

Summary

Year	2
Status	core
Learning Hours	100 hrs including Lectures and Group Exercises
Credits	10
Period of Study	2 months

Summary of Learning Outcomes

Learning outcomes are results of learning that students will have achieved on successfully completing a course. The following reference points were used in designing the learning outcomes;

- QAA Subject Benchmark Statements to ensure: that appropriate and effective teaching, support, assessment and learning resources are provided for students; that the learning opportunities provided are monitored; and that the provider considers how to improve them; and
- The professional competencies required by ICE.

Learning outcomes are expressed under three broad headings of achievement in both threshold and typical standards:

U: Understanding (a general awareness of the activity)
K: Knowledge (a more detailed level of understanding of the activity)
S: Skills (to be able, without supervision, to perform relevant functions)

Learning outcomes: **The learner will:**	**Assessment criteria:** **The Learner can:**
1. Review material and section properties of structural elements. [K, U]	1.1 Material properties including Young's Modulus, Modulus of Rigidity and Poisson's Ratio. 1.2 Centroids of plane and composite sections 1.2 Elastic section properties of regular and composite sections. 1.3 Plastic section properties of regular and composite sections.
2. Analyse pin-jointed frames using Virtual Work method. [U, S]	2.1 Review of pin-jointed frames. 2.2 Concept of Virtual Work. 2.3 Evaluation of deflection in pin-jointed frames. 2.4 Evaluation of indeterminate frames.
3. Resolve statically indeterminate beams. [S]	3.1 Review of static indeterminacy. 3.2 Analysis of propped cantilevers. 3.3 Analysis of two-span continuous beams.
4. Understand the nature of buckling instability in structural elements and analyse effects. [U, S]	4.1 Euler's theory of buckling. 4.2 Perry-Robertson approach. 4.3 Compression curves in Eurocodes.
5. Analyse three-pin frames and rigid-jointed frames. [U, S]	5.1 Analysis of three-pin frames. 5.2 Analysis of rigid-jointed frames with no-sway. 5.2 Analysis of rigid-jointed frames with sway.
6. Analyse structural elements subjected to torsional effects [U, S]	6.1 Torsion in solid cross-sections 6.2 Torsion in hollow circular and non-circular cross-sections 6.3 Case studies of torsional failure in civil engineering structures
Additional information about the unit	
Units aim(s)	

Text Book

1. McKenzie, W.M.C. (2013) *Examples in Structural Analysis*, 2nd Edition. CRC Press.

Recommended Reading

1. Kassimali, A. (2011) *Structural Analysis*, 4th Edition. Cengage Learning.

2. Williams, M.S. and Todd, J.D. (2000) *Structures: Theory and Analysis*. Palgrave Macmillan.

Subject	Structural Design of Concrete
Subject Code	SE 502

Summary

Year	2
Status	core
Learning Hours	100 hrs including Lectures and Group Exercises
Credits	10
Period of Study	2 months

Summary of Learning Outcomes

Learning outcomes are results of learning that students will have achieved on successfully completing a course. The following reference points were used in designing the learning outcomes;

- QAA Subject Benchmark Statements to ensure: that appropriate and effective teaching, support, assessment and learning resources are provided for students; that the learning opportunities provided are monitored; and that the provider considers how to improve them; and

- The professional competencies required by ICE.

Learning outcomes are expressed under three broad headings of achievement in both threshold and typical standards:

U: Understanding (a general awareness of the activity)
K: Knowledge (a more detailed level of understanding of the activity)
S: Skills (to be able, without supervision, to perform relevant functions)

Learning outcomes: The learner will:	Assessment criteria: The Learner can:
1. Develop a deeper understand of concrete as a structural material. [K, U]	1.1 Manufacture and properties of cement. 1.2 Properties of fresh and hardened concrete. 1.3 Experimental analysis of concrete.
2. Design reinforced concrete beams. [S]	2.1 Limit state design philosophy. 2.2 Introduction to BS EN 1991 & BS EN 1992 2.3 Design of singly reinforced (simple) beams. 2.4 Design of doubly reinforced (simple) beams. 2.5 Design of continuous beams.
3. Design reinforced concrete slabs. [S]	3.1 Construction of various kinds of slabs. 3.2 Design of one-way slabs. 3.3 Design of two-way slabs.
4. Design reinforced concrete columns. [S]	4.1 Effective length of columns. 4.2 Design of isolated column. 4.3 Design of columns in multi-storey structures.
Additional information about the unit	
Units aim(s)	

Text Book

1. Mosley, B., Bungey, J. and Hulse, R. (2012) *Reinforced Concrete Design to Eurocode 2*, 7nd Edition. Palgrave Macmillan.

Recommended Reading

1. Arya, C. (2009) *Design of Structural Elements*, 3rd Edition. Spon Press.

2. Bhatt, P., MacGinley, T.J. and Choo, B.S. (2014) *Reinforced Concrete Design to Eurocodes: Design Theory and Examples*, 4th Edition. CRC Press.

Subject	Structural Design of Steel
Subject Code	SE503

Summary

Year	2
Unit	3
Status	core
Learning Hours	100 hrs including Lectures and Group Exercises
Credits	10
Period of Study	2 months

Summary of Learning Outcomes

Learning outcomes are results of learning that students will have achieved on successfully completing a course. The following reference points were used in designing the learning outcomes;

- QAA Subject Benchmark Statements to ensure: that appropriate and effective teaching, support, assessment and learning resources are provided for students; that the learning opportunities provided are monitored; and that the provider considers how to improve them; and
- The professional competencies required by ICE.

Learning outcomes are expressed under three broad headings of achievement in both threshold and typical standards:

U: Understanding (a general awareness of the activity)
K: Knowledge (a more detailed level of understanding of the activity)
S: Skills (to be able, without supervision, to perform relevant functions)

Learning outcomes: The learner will:	Assessment criteria: The Learner can:
1. Understanding and Knowledge of structural metals in the construction industry. [K, U]	1.1 Explain the standardization of steel and structural shapes. 1.2 Explain design and analysis methods for structural steel. 1.3 Review of BS EN 1991
2. Able to design steel beams. [S]	2.1 Introduction to BS EN 1992 2.2 Section classifications. 2.3 Design for Ultimate Limit state. 2.4 Design for Serviceability Limit state.
3. Able to design steel columns. [S]	3.1 Effective length of compression members. 3.2 Design of slender and stocky compression members. 3.3 Column base plate design.
4. Understanding features of combined stress members of symmetrical members. [U]	4.1 Combined flexure and axial load.
5. Able to design simple bolted and welded connections. [S]	5.1 Bolts types and types of connections. 5.2 Bolt holes. 5.2 Types of welds. 5.4 Weld strength. 5.5 Plate girders proportioning limits.
Additional information about the unit	
Units aim(s)	

Text Books

1. Arya, C. (2009), *Design of Structural Elements*, Spon Press

Recommended Reading

1. McKenzie, W.M.C. (2013), *Design of Structural Elements to Eurocode*, Palgrave Macmillan

2. Davidson, B. and Owen, G. (2013), *Steel Designers' Manual*. 7th edition. Wiley Blackwell, UK.

Subject	Advanced Structural Design
Subject Code	SE 504

Summary

Year	2
Status	core
Learning Hours	100hrs including Lectures and Group Exercises
Credits	10
Period of Study	2 months

Summary of Learning Outcomes

Learning outcomes are results of learning that students will have achieved on successfully completing a course. The following reference points were used in designing the learning outcomes;

- QAA Subject Benchmark Statements to ensure: that appropriate and effective teaching, support, assessment and learning resources are provided for students; that the learning opportunities provided are monitored; and that the provider considers how to improve them; and
- The professional competencies required by ICE.

Learning outcomes are expressed under three broad headings of achievement in both threshold and typical standards:

U: Understanding (a general awareness of the activity)
K: Knowledge (a more detailed level of understanding of the activity)
S: Skills (to be able, without supervision, to perform relevant functions)

Learning outcomes: The learner will:	Assessment criteria: The Learner can:
1. Develop conceptual design solutions for building structures. [K, U]	1.1 Various stake holders and their roles in concept development. 1.2 Influence of site conditions. 1.3 Building form, façade and envelope design. 1.4 Sustainability considerations: BREEAM and LEED.
2. Design reinforced concrete slabs commonly used in multi-storey frames. [U, S]	2.1 Temporary works and the state of the art in concreting. 2.2 Interrelationships between frame elements. 2.3 Design of flat slabs. 2.4 Case studies.
3. Design reinforced concrete columns with complex loading arrangements. [U, S]	3.1 Review of column design and analysis. 3.2 Design of reinforced concrete columns with bi-axial bending. 3.3 Design of slender columns.
4. Gain deeper understanding of prestressed concrete construction. [U, S]	4.1 Evolution of prestressed concrete. 4.2 Principles and methods of prestressing. 4.3 Analysis and design of prestressed concrete elements.
Additional information about the unit	
Units aim(s)	

Text Book

1. Mosley, B., Bungey, J. and Hulse, R. (2012) *Reinforced Concrete Design to Eurocode 2*, 7nd Edition. Palgrave Macmillan.

Recommended Reading

1. Arya, C. (2009) *Design of Structural Elements*, 3rd Edition. Spon Press.

2. Bhatt, P., MacGinley, T.J. and Choo, B.S. (2014) *Reinforced Concrete Design to Eurocodes: Design Theory and Examples*, 4th Edition. CRC Press.

Subject	Design and computing
Subject Code	SE505

Summary

Year	2
Unit	5
Status	core
Learning Hours	100 hrs including Lectures and Group Exercises
Credits	10
Period of Study	2 months

Summary of Learning Outcomes

Learning outcomes are results of learning that students will have achieved on successfully completing a course. The following reference points were used in designing the learning outcomes;

- QAA Subject Benchmark Statements to ensure: that appropriate and effective teaching, support, assessment and learning resources are provided for students; that the learning opportunities provided are monitored; and that the provider considers how to improve them; and

- The professional competencies required by ICE.

Learning outcomes are expressed under three broad headings of achievement in both threshold and typical standards:

U: Understanding (a general awareness of the activity)
K: Knowledge (a more detailed level of understanding of the activity)
S: Skills (to be able, without supervision, to perform relevant functions)

Learning outcomes: The learner will:	Assessment criteria: The Learner can:
1. Recognise strategies for decomposing a (mathematical) model of an engineering system or process into smaller tasks that may be solved sequentially [K, U].	1.1 Understand the design process and design context. 1.2 Observe and analyse an engineering situation, and interpret it into a computer model. 1.3 Understand material behaviours, structural connections and structural failures.
2. Recognise techniques by which a computer program (BENTLEY and ANSYS) can be built up using the appropriate algorithm. Basic techniques for the solution of linear equations, linear and non-linear regression, root finding and numerical differentiation and integration [K, U].	2.1 Use general programming skills such as; executing basic modelling to solve and analysis of a mathematical equation or simple structural elements and frames, and writing and executing algorithms to demonstrate the linear and non-linear analysis (ANSYS). 2.2 Use numerical methods skills such as; writing and executing functions to solve linear and non-linear equations, iterative solutions, integration and graphical plots (ANSYS). 2.3 Use computer modelling skills such as; structural modelling, analysis and design of the structures according to Euro Code and BS to solve linear and non-linear solutions, structural report preparation, integration and graphical plots (BENTLEY STAAD Pro.).
3. Understand the steps necessary to solve practical problems in engineering using an appropriate algorithm to solve the problem. Use verification techniques to confirm the viability of simple structural designs [S].	3.1 Analyse a real-world engineering problem, find a methodological solution for the problem and verify the results according to the scientific techniques and standards.
Additional information about the unit	
Units aim(s)	

Recommended Readings

1. D.E. Knuth, *The Art of Computer Programming* (4 volumes), 2011.
2. William Palm III, *Introduction to MATLAB for Engineers*, 3rd edition, 2010.

Subject	Structural Engineering Design Project
Subject Code	SE 506

Summary

Year	2
Status	core
Learning Hours	100 hrs including Client Meetings and Group Exercises
Credits	10
Period of Study	2 months

Summary of Learning Outcomes

Learning outcomes are results of learning that students will have achieved on successfully completing a course. The following reference points were used in designing the learning outcomes;

- QAA Subject Benchmark Statements to ensure: that appropriate and effective teaching, support, assessment and learning resources are provided for students; that the learning opportunities provided are monitored; and that the provider considers how to improve them; and
- The professional competencies required by ICE.

Learning outcomes are expressed under three broad headings of achievement in both threshold and typical standards:

U: Understanding (a general awareness of the activity)
K: Knowledge (a more detailed level of understanding of the activity)
S: Skills (to be able, without supervision, to perform relevant functions)

Learning outcomes: **The learner will:**	**Assessment criteria:** **The Learner can:**
1. Demonstrate understanding of client and project requirements. [K, U]	1.1 Engage with the project brief and seek clarifications where appropriate. 1.2 Produce preliminary sketches for consultation with the client. 1.3 Develop resource-based project estimates.
2. Develop detailed conceptual designs. [U, S]	2.1 Work in multi-disciplinary teams to collectively produce multiple, viable conceptual designs. 2.2 Refine concept design based on client feedback.
3. Plan and deliver work to industry standards. [S]	3.1 Plan and develop detailed programmes of work. 3.2 Maintain regular correspondence with the project team in a professional manner. 3.3 Demonstrate good team work. 3.4 Take health and safety considerations into account within the design concepts.
4. Display effective communication and interpersonal skills. [S]	4.1 Show effective written and oral communication skills by contributing towards drawings/sketches, technical reports and presentations.
Additional information about the unit	
Units aim(s)	

Recommended Reading

1. Arya, C. (2009) *Design of Structural Elements*, 3rd Edition. Spon Press.
2. Bhatt, P., MacGinley, T.J. and Choo, B.S. (2014) *Reinforced Concrete Design to Eurocodes: Design Theory and Examples*, 4th Edition. CRC Press.
3. Davidson, B. and Owen, G. (2013), *Steel Designers' Manual*. 7th edition. Wiley Blackwell, UK.
4. Westbrook, R., and Walker, D. (1997) *Structural Engineering Design in Practice*, 3rd Edition. Pearson.