Diploma in Acoustics and Noise Control Syllabus

GENERAL PRINCIPLES OF ACOUSTICS MODULE (COMPULSORY)

LEARNING OUTCOMES

On successfully completing this module the student will be able to:

1. describe, quantify, predict, measure and analyse noise and vibration signals;
2. describe the physiological and subjective responses of humans exposed to noise and vibration, quantify the exposure and assess the response;
3. apply engineering and other methods for controlling exposure to noise and vibration;
4. use legislation, statutory regulations, standards and codes of practice relating to the assessment and control of noise and vibration.

LEARNING OBJECTIVES

On successfully completing this module the student should have a knowledge and understanding of:

1. the general classification of the processes by which sound is produced;
2. frequency, wavelength and speed of sound: Doppler effect;
3. sound power, intensity and pressure;
4. the decibel and the relevant indices for quantifying time-invariant and time-variant sound;
5. the measurement of sound and possible measurement uncertainties;
6. the frequency analysis and classification of sound, including digital Fourier techniques;
7. the physical principles underlying the propagation of sound waves in fluids and solids;
8. the wave equation for a one-dimensional plane wave in a fluid;
9. the harmonic solutions to the wave equation;
10. the parameters that can be used to describe vibration;
11. the concept of degrees of freedom of a vibrating system, the equation for a single degree of freedom mass/spring/damper system and the natural frequency.
12. the solutions to the single degree of freedom system equation for under damped, over damped and critically damped conditions;
13. the equation for a forced single degree of freedom system and the solution. Force and displacement transmissibility, resonance;
14. the behaviour of sound outdoors and the propagation equations for point, line and plane sources; Directivity
15. the behaviour of sound in enclosures; the concepts of absorption, energy balance, reverberant sound pressure, reverberation time and the equations which relate these quantities; Room modes

16. the concepts of sound reflection and transmission at the boundary between two media;
17. sound interference, refraction, diffraction and scattering;
18. the sound absorption and insulation provided by materials and structures, and the appropriate indices for describing these quantities;
19. the equations relating a) the sound levels between two rooms, b) the sound level within a room to that outside;
20. the working of the human ear, hearing disorders and the basics of human perception of sound;
21. the relevant legislation concerned with noise at work;
22. the way in which whole body and hand-arm vibration affect humans and the relevant related legislation;
23. the concepts and methods of passive noise and vibration control;
24. the basic concepts of active noise and vibration control;

ACQUIRED/TRANSFERABLE SKILLS

On successfully completing this Module the student will be able to:

1. manipulate decibels and perform calculations using them;
2. identify and use appropriate formulae to calculate sound levels in enclosed spaces and outdoors;
3. identify and use appropriate formulae to calculate the transmission of sound between rooms and from inside to outside and outside to inside;
4. select and prioritise appropriate noise and vibration control measures in simple situations;
5. estimate the effects of noise on hearing acuity and vibration on human response;
6. select the correct indices for assessing noise and vibration environments;
7. use computer spread sheets for performing calculations;
8. demonstrate research and analytical skills through assignment work.

INDICATIVE CONTENT

The contents of this module relating to the regulatory framework will be subject to periodic review. Documents have to be in the public domain for a full twelve months before they are examinable.

1. Sound

Concepts of source, pathway and receiver.

Sound power and sound power level.

Sound intensity and sound intensity level.

Sound pressure, rms and peak values, and sound pressure level.

Addition and averaging of the levels.

Relationship between sound pressure and sound intensity at a location in a free field.

Equations to predict the sound pressure level (and sound intensity level) due to point, line and plane sources under free field conditions. Façade effect.

Source directivity, directivity index, directivity factor.

Indices of time-varying sound.

Physical principles of the propagation of a travelling compression wave: frequency, wavelength, speed (including effects of temperature).

Equation for a one dimensional travelling pressure wave as a function of time and position.

Reflection and the laws of reflection, reflection coefficient; absorption and absorption coefficient. Porous, panel and resonant absorbers.

Refraction, including meteorological effects.

Diffraction, including infinite-length barriers.

Absorption during propagation through the medium.

Coherent and incoherent sources.

Principle of superposition of waves, interference, beats, standing waves (and standing wave ratio). Principle of active noise control. Doppler effect.

2. Sound propagation within and between spaces

Reverberation time, its measurement, prediction and control. Sabine equation.

Diffuse sound fields, energy density, room constant, reverberant sound pressure level and its measurement, prediction and control. Sound intensity at the boundary of a diffuse field. Total sound pressure level in an enclosed space due to a directional source. Room radius.

Sound transmission through single-leaf, homogeneous partitions; transmission coefficient, sound reduction index, mass law, coincidence effect. Composite (but single-leaf) partitions, effects of holes and gaps and flanking. Level difference, Standardised level difference.

Sound transmission between enclosed spaces.

Sound transmission between an enclosed space and free field conditions; and vice versa.

Impact noise: impact sound pressure level; standardised impact sound pressure level.

3. Vibration

For simple harmonic motion: displacement, velocity, acceleration and their relationships; the relationship between rms and peak values.

Displacement level, velocity level, acceleration level; reference quantities

Power radiated from a vibrating plate.

Equation of motion for the free vibration of a single-degree of freedom mass on a spring.

Equation for the natural frequency of a single-degree of freedom mass on a spring.

Effect of damping on the motion. Under-, over- and critically-damped oscillations.

Equation of motion for the forced vibration of a single-degree of freedom mass on a spring.

Response of the system as a function of the forcing frequency, including the effect of damping on the motion.

Vibration isolation: transmissibility, resonance, damping. Predicting transmissibility for zero damping.

4. Human response to sound and vibration; and psychoacoustics

Human auditory system.

Range of audible sound pressure levels and frequencies, infra sound, ultra sound. Pitch.

Loudness: equal loudness contours and loudness level. Loudness calculations. Masking.

Frequency weightings.

Hearing disorders: effects of age, health and noise exposure on hearing acuity.

Individual noise susceptibility.

Audiometry; basic procedures of manual and automatic audiometry; audiograms.

Assessment of noise dose, hearing protectors and their use.

Regulatory issues.

Effects of noise and vibration on humans and human activity.

Indices and methods of assessment of noise and vibration exposures.

5. Measurement of sound and vibration

Measurement microphones: construction and mode of operation, sensitivity, linearity, frequency response, polar response, dynamic range.

Relevant standards for sound level meters.

Calibration and calibrators. The role of reference microphones.

Primary and secondary standards; traceability of standards.

Uncertainties in measured values, tolerance.

Sound level meter features, including: frequency weightings; fast, slow, impulse and peak time weighting; octave and one-third-octave band filters; windshields.

Measurement of sound pressure level (including indices for time-varying sounds and in diffuse and free fields), sound power level, sound intensity level, reverberation time. Measurement of impact noise. Using frequency weighting networks and octave and one-third-octave band filters where appropriate.

Introduction to Fourier techniques.

Principles of vibration measurement: displacement, velocity and acceleration.

Vibration transducers and the principles of associated instrumentation.

6. Standards

A list of relevant documents is provided (annually) by the GPA examiners.

Methods and indices described in relevant standards.

Recommendations and requirements in appropriate guidance and regulatory documents.

LABORATORY AND EXPERIMENTAL METHODS MODULE (COMPULSORY)

LEARNING OUTCOMES

On successfully completing this module the student will be able to;

1. Plan an experimental exercise in sound and vibration measurement, whether it is intended as part of a research programme or of a professional investigation.
2. Use correctly a range of standard sound and vibration measuring equipment and understand the procedural requirements in using equipment.
3. Log data and observations in a clear, competent and professional manner.
4. Process and analyse data to obtain meaningful conclusions.
5. Apply appropriate codes of practice and theory when undertaking investigations and when processing and analysing data.
6. Prepare a structured technical report or research paper of the measurements, observations, calculations, analyses and conclusions comprising a practical investigation.

LEARNING OBJECTIVES

On successfully completing this module a student will have a knowledge and understanding of;

1. The variety of measurements that may be required in the course of an acoustic investigation.
2. The types of measurement equipment available, their characteristics and the factors which affect the choice of equipment for a particular task; and methods of checking their calibration.
3. The practical requirements and difficulties which arise when carrying out a programme of acoustic measurement.
4. The main sources of uncertainty in acoustic measurements, their relative importance and the ways in which they can be quantified and managed to achieve research objectives.
5. The various ways in which raw data can be processed to arrive at parameters for comparison with previous research results, legislative requirements and theoretical predictions.
6. Appropriate ways to report and present acoustic research findings to a variety of technically aware audiences.

ACQUIRED/TRANSFERABLE SKILLS

On successfully completing this module, the student will be able to:

1. Prepare and undertake systematic investigations using standard acoustical techniques and equipment;
2. Appreciate, estimate and make allowance for sources of experimental error;
3. Select appropriate methods of summarising and displaying information and data;
4. Use computer software;
5. Write structured technical reports.

INDICATIVE CONTENT

Accredited centres devise and deliver a bespoke programme of practical/laboratory work designed to cover the range of topics in the General Principles of Acoustics module and to enable students to meet fully the learning objectives and outcomes of this module.

Each Centre's laboratory programme requires the approval of the Institute of Acoustics.

Every Centre-based student is expected to carry out at least eight structured laboratory investigations.

Distance Learning students carry out laboratory work at an approved Centre (currently Liverpool) over four days. The current experiments include:

- *Screening and Enclosure of a Noise Source*
- *Subjective Halving and Doubling of Loudness, Equal Loudness Contours, and Audiometry*
- *Measurement of Absorption Coefficient*
- *Measurement of the Sound Power of a Source*
- *Frequency Analysis using a FFT Analyser*
- *Field Measurement of Airborne and Impact Sound Insulation of Walls and Floors*
- *Sound Attenuation with Distance in a Semi- Reverberant Room*
- *Vibration Measurements*

Each student is expected to keep a record of all the laboratory investigations in a formal laboratory notebook which forms part of the assessment.

Three of the investigations are written up as technical reports and assessed.

PROJECT MODULE (COMPULSORY)

LEARNING OUTCOMES

On successfully completing this Module the student will be able to:

1. demonstrate the ability to use and apply the skills and knowledge gained in the other modules of the course to define and solve an acoustics problem
2. plan and execute investigations and analyses in acoustics
3. report the findings in a clear and concise form within an agreed time

LEARNING OBJECTIVES

On successfully completing this Module the student will be able to:

1. demonstrate initiative and critical thinking skills in selecting aims and objectives for the investigation and identifying an appropriate methodology for the investigation.
2. critically evaluate existing literature in the field of acoustics, relevant to the investigation.
3. collect and interpret primary and/or secondary data and discuss its significance in the context of the investigation and of related studies.
4. reflect upon the conclusions / outcomes of the investigation, reflect critically on the investigative process, and propose ways in which the information from the investigation could be developed by further study.
5. produce a technical report on the investigation in an appropriate style, and within a given time frame.

ACQUIRED/TRANSFERABLE SKILLS

On successfully completing this Module the student will be able to:

1. Based on a literature search, select summarise and critically evaluate literature relevant to a chosen investigation topic.
2. Formulate pertinent aims and objectives for an investigation consistent with limitations of resources and constraints.
3. Formulate an appropriate methodology to meet the aims and objectives.
4. Plan and execute an Investigation in accordance with a proposed methodology
5. Process and analyse data and draw conclusions, including an assessment of the reliability of those conclusions.
6. Prepare a structures technical report.

INDICATIVE CONTENT

Selecting the project

Each student will consult with a tutor at the respective accredited Centre in selecting a project topic which will enable the student to fulfil the Learning Outcomes and Learning Objectives for this module.

In selecting the topic and shaping the project proposal full account must be taken of constraints such as access to reliable resources, available time and delays due to reasons such as the weather or the actions of others.

Formulating a research question, or a hypothesis to be tested, will assist in framing the title, aims and objectives of the project and help to shape the schedule of activities for completion.

When planning the project activities, account needs to be taken of wider issues, such as: health and safety and risk analysis for the student and others involved; ethical conduct, particularly where data relating to individuals are acquired; and commercial confidentiality.

Project Proposal

The project title; a succinct statement of aims, objectives and hypotheses (if appropriate); a brief discussion of the topic and its context including a preliminary statement of essential literature; a formal statement of the aims and the objectives; resources to be deployed and constraints; a proposed schedule summarising the activities to be conducted and the corresponding time allocations; information relating to risk, ethics and/or commercial confidentiality as appropriate.

Project log book

This will include a personal account of progress, problems encountered while carrying out the project and results based on entries at no less than weekly intervals throughout the project period.

Project Report

The recommended structure for the formal project report is as follows.

Title

Abstract

Statement of Aims and Objectives

Introduction

Review of current literature and outcomes of literature search

Methodology and/or Investigation

Results

Evaluation and Discussion

Conclusions and Critical Assessment

References and Bibliography

Appendices

DEADLINES

Project proposal: Mid January

Submission of draft project report for critical appraisal and comment by tutor: End of July

Final submission of project report: Mid October

The above is an indication of the deadline dates. Exact dates will be published at the start of each study year in the Diploma course handbook.

BUILDING ACOUSTICS MODULE (OPTIONAL)

LEARNING OUTCOMES

On successfully completing this Module the student will be able to:

1. analyse the acoustical performance of enclosed spaces in buildings;
2. identify means of achieving desired acoustical characteristics in spaces;
3. analyse the acoustical performance of building components and structures;
4. identify means of achieving desired acoustical performance;
5. analyse and predict noise generated by building services; and
6. specify electroacoustic system requirements for use in buildings.

LEARNING OBJECTIVES

On successfully completing this Module the student will have knowledge and understanding of:

1. factors governing the acoustic characteristics of enclosed spaces, and how these characteristics are described, predicted, measured and adjusted by design
2. physical principles governing the sound insulation provided by building structures
3. how sound insulation is characterised, measured and adjusted by design
4. principles of electroacoustic system design for buildings

ACQUIRED/TRANSFERABLE SKILLS

On successfully completing this Module the student will be able to:

1. identify and select appropriate indices, criteria and standards for assessing the acoustical performance of buildings
2. formulate an appropriate design protocol in a specific indoor situation
3. carry out measurements and calculations to justify and implement an acoustical design strategy
4. write structured technical reports
5. demonstrate research and analytical skills through assignment work.

INDICATIVE CONTENT

The indicative content of this module will be subject to periodic review in respect of the regulatory framework. Documents have to be in the public domain for a full twelve months before they are examinable.

1. Sound in enclosed spaces

Review the geometrical, wave and statistical approaches to modelling the behaviour of sound in enclosures. Examples of the appropriate use of each approach in internal acoustic design. Principles of computer modelling techniques (e.g. ray techniques).

Types and characteristics of absorbers and diffusers.

Departures of enclosures from the basic Sabine description and approaches to quantifying non-Sabine spaces. Behaviour of enclosures in respect of the effects of shape, size and distribution of material with some reference, in each case, to extreme or unusual examples.

Parameters and criteria for describing and assessing acoustic spaces, according to the intended use, including measurement and assessment procedures. Room impulse response and parameters derived from it.

General principles of acoustic design to achieve the required criteria, to include examples of spaces for special purposes such as, but not restricted to: acoustic test rooms; radio and television studios; small and large auditoria for various purposes; classrooms; sporting enclosures; offices; factories; railway stations; airports; restaurants; bars; atria etc.

2. Transmission of sound

Review mass law and coincidence effects. Resonance.

Single and multiple layer partitions. Flanking transmission at boundaries and junctions.

Review sound reduction index, level difference between two spaces and D_{nT}.

Field and laboratory measurement of sound reduction index and standardised level difference; the determination of relevant sound insulation indices. ISO and British Standard methods.

Impact noise: field and laboratory measurement of standardised impact sound pressure level; the determination of relevant impact sound insulation indices. ISO and British Standard methods. Rain noise and design against it.

Building Regulations relating to sound insulation.

Design features and typical performances of single- and multiple- layer partitions.

Examples of noise transmission, and generation, by building services – plumbing, lighting, air conditioning – and the need to incorporate the control of these at the design stage.

Practical vibration isolation: resilient mounts and hangers; floating floors.

3. Electroacoustic aids

Types and general design features of loudspeakers and microphones, with emphasis on sensitivity and directivity.

Speech intelligibility and methods of assessing it. Design of systems for sound distribution and sound reinforcement for different acoustic environments, indoors and outdoors.

Artificial reverberation. Special needs of the hearing impaired.

4. Planning and layout

Use of environmental noise and vibration survey information; planning and layout of buildings to help provide appropriate sound insulation and quiet areas.

5. Standards

Methods and indices described in relevant standards. Recommendations and requirements in guidance documents and regulatory documents.

List of relevant documents to be provided by examiner.

ENVIRONMENTAL NOISE: PREDICTION, MEASUREMENT AND CONTROL (OPTIONAL)

LEARNING OUTCOMES

On successfully completing this module the student will be able to:

1. Understand, select and use environmental noise indices/indicators, criteria and assessment procedures;
2. Use a systematic approach to the assessment of environmental noise and its impact;
3. Select and design methods of environmental noise control.

LEARNING OBJECTIVES

On successfully completing this module, the student should have a knowledge and understanding of the:

1. Origins and use of current environmental noise exposure descriptors;
2. Methods for assessing the effects of environmental noise, including social surveys and long-term noise monitoring;
3. The magnitude of environmental noise exposure in the UK and future trends;
4. Systematic of noise propagation, including topographical and meteorological effects relevant to environmental noise propagation;
5. Cost-benefit techniques for environmental noise control, including revenue-raising related to noise control financing;
6. Techniques for analysing transportation systems, noise control strategies, fractional and multi-modal impact analysis;
7. Law and regulation of environmental noise (UK, EU and International);
8. Mechanisms of noise generation and techniques for control of noise from environmental sources, including road traffic, aviation, railways, industry, wind turbines, mineral, landfill and construction sites, leisure and powered watercraft; entertainment and leisure activities;
9. Prediction and measurement of noise from environmental sources such as those listed above.
10. Sources of vibration including piling and traffic; types and attenuation of wave motion in the ground; Measurement, assessment and mitigation in accordance with ISO and British Standards.

ACQUIRED/TRANSFERABLE SKILLS

On successfully completing this module, the student will be able to:

1. Select appropriate environmental noise exposure descriptors for particular cases;
2. Measure, calculate and predict noise exposure levels from environmental noise sources;
3. Assess the level of noise impact arising from environmental noise sources, using recognised procedures;
4. Design noise and vibration control systems, including reduction of noise at source, on the propagation path and at the receiver, using technical, noise management and multi-modal strategies;
5. Use computer spreadsheets for technical calculations;
6. Demonstrate research and analytical skills through assignment work.

INDICATIVE CONTENT

The indicative content of this module will be subject to periodic review in respect of the regulatory framework. Documents have to be in the public domain for a full twelve months before they are examinable.

1. Introduction to transportation noise

Historical background: including the emergence of current noise exposure descriptors, such as $L_{A10,T}$, $L_{Aeq,T}$ (including the use of SEL), NNI, NEC etc and national surveys that have shaped aspects of policy. Estimate of the magnitude of transportation noise problems in the UK. Future trends in transportation.

Systematics of noise propagation including topographical effects that are particularly relevant to transportation noise. Cost benefit techniques for transportation noise control. Revenue raising related to noise control financing. Techniques for analysing transportation systems/noise control strategies/fractional impact analysis. Statutory laws and regulations. UK/EEC/international. Assessment techniques, e.g. social surveys, long term monitoring.

2. Road transport noise

Prediction and measurement of traffic noise including the effects of traffic flow rates, traffic mix, highway layout, screening etc. Vehicles as noise sources: engine noise and rolling noise. Methods for Reduction of vehicle noise. Regulations, standards and guidelines concerning Motor Vehicles, traffic noise, racing vehicles and circuits, Land Use planning, Insulation of dwellings and road traffic noise prediction.

3. Air transport noise

Prediction and measurement of aircraft noise: PNdB, EPNdB, NNI, L_{Aeq}. Aircraft engines as noise sources, turbo-jet, turbo-fan, HBPR and propeller engines. Noise from SST aircraft and helicopters. Noise from taxiing and APU operations. Noise from general aviation, noise from military aircraft.

Noise certification. Brief overview of Noise control in aero-engines. Aircraft noise abatement procedures, approach techniques and minimum noise routes.

Noise control/management strategies at UK airports.

Review of legislation and standards relevant to aircraft and airport noise.

4. Rail transport

Prediction and measurement of railway noise including recent developments from the Mitchell Report. Trains as noise sources: diesel engine, gas-turbine and electric traction motor noise. Rail-wheel interaction noise. Control of noise from trains. Noise within trains. Noise and vibration from underground trains.

Noise Insulation regulations and Calculation of Railway Noise.

5. Water transport

Prediction and measurement of noise from and in ships. Codes of practice and standards. Leisure and power boat noise sources. Hovercraft noise, engines and rotor. Design progress in hovercraft noise reduction. Legislative controls.

6. Industrial Noise

Typical sources of industrial noise; Standard methods for rating and assessing industrial noise; case studies.

7. Mineral, Landfill and Construction site noise

Review of noise sources at mineral/landfill/construction sites; relevant legislation, standards and guidelines.

8. Control of Wind turbine noise

Overview of environmental impact of wind farms in the UK; Sources of wind turbine noise; control of wind turbine noise; Planning guidance, ETSU-R-97 Assessment and rating of noise from wind farms.

9. Review of noise from entertainment sources and other leisure activities

Noise from Pubs and clubs – code of practice; outdoor music events – guidance on control.

Clay pigeon shooting; noise from operation of model aircraft; noise from water skiing activities; motor sports; relevant codes of practice

10. Vibration Indices

measurement methods and acceptable levels used in vibration assessment from construction work and other sources according to relevant British Standards.

11. Standards

A list of relevant documents is provided by the Module examiners. Methods and indices described in the relevant standards. Recommendations and requirements in appropriate guidance documents and regulatory documents.

REGULATION AND ASSESSMENT OF NOISE (OPTIONAL)

LEARNING OUTCOMES

On successfully completing this module the student will be able to:

1. identify and interpret the relevant EU/UK legislative drivers and codes of practice for noise and vibration;
2. apply the EIA process in the context of noise assessment;
3. use standard prediction methods, including noise prediction and mapping tools, for environmental noise assessment;
4. outline and apply methods and regulations relating to the exposure to and control of noise and vibration in the workplace; and
5. use standard methods and tools to predict and assess environmental noise and vibration.

LEARNING OUTCOMES

On successfully completing this module, the student should have a knowledge and understanding of the:

1. The terminology and the policy and administrative frameworks associated with UK and European law for environmental noise;
2. UK based legislation dealing with Noise Nuisance;
3. Neighbourhood Noise Policies and practice for local authorities in the UK;
4. recent UK National Noise Incidence and Attitude surveys and their outcomes and recommendations;
5. UK Planning legislation and the requirements and application of published guidance on planning;
6. Application of MPS2 to mineral workings and the subsequent use of BS5228;
7. World Health Organisation guidelines for community noise and their applicability to the UK;
8. Building control legislation and guidance documents and their role in reducing environmental noise impact;
9. Purposes, requirements and applications of noise mapping in the UK;
10. Range of noise prediction methods available;
11. Purposes, requirements and application of the EIA and IPPC processes in the context of environmental noise control;
12. Measurement and assessment of vibration levels in accordance with published standards and guidance.
13. UK legislation relating to the control of noise in the workplace.
14. Procedures for assessing and controlling risk in respect of Noise at Work.

ACQUIRED/TRANSFERABLE SKILLS

On successfully completing this module a student will be able to:

1. refer to and select the appropriate legislation and/or guidance document for a given environmental noise situation;
2. select the correct indices and units for assessing environmental noise
3. identify the possible limitations of guidance documents and methodologies
4. perform a noise prediction calculation for a given case study
5. interpret noise maps and identify their limitations
6. identify and perform the main aspects of an EIA process
7. use computer spreadsheets for performing calculations
8. write structured technical reports
9. demonstrate research and analytical skills through assignment work

INDICATIVE CONTENT

The indicative content of this module will be subject to annual review in respect of the regulatory framework. Documents have to be in the public domain for a full twelve months before they are examinable.

1. Legislative drivers for Environmental noise assessment and control

Overview of the European and UK National Policy on environmental noise:
Green paper 1996, EU Noise expert network, environmental noise directive 2002/49/EC (25 June 2002), National Ambient Noise strategy; World Health Organisation guidelines on Community Noise.

Review of Neighbour and Neighbourhood noise:
Control of Pollution Act 1974; Environmental Protection Act 1990; Principle of Nuisance; Noise and Statutory Nuisance Act 1993; Noise Act 1996 and Noise Act circular 2004; role of Anti-social behaviour orders, Crime and Disorder Act 1998; the Neighbourhood Noise Strategy (2007); Review of the UK National Noise attitude survey 1999/2000 and the UK National Noise incidence surveys (2000/2001); effect of noise on health – review of "health effect-based noise assessment methods", Porter et al (1998). Licensing Act 2003 and its implications. Clean Neighbourhoods and Environment Act 2005: extension of night time noise offence provisions to licensed premises.
Anti-social Behaviour Act 2003: extension of Noise Act 1996 powers; closure of licensed premises due to public nuisance.
Neighbourhood Noise Policies and Practice for Local Authorities – a Management Guide published jointly by CIEH and DEFRA 2006.

Impact of Planning and Building Control legislation on environmental noise:
Town and Country planning legislation including associated relevant statutory instruments and circulars. PPG24 Planning and Noise (including draft planning guidance). Role of planning conditions. The application of MPG11 and MPS2 to minerals working. BS5228 Noise and Vibration control on construction and open sites. Building Regulations Part E together with the associated approved document, Part H. WHO guidelines for community noise (1993). Building Bulletin 93: Acoustic design of schools. BS8233 (1999) Sound insulation and reduction for buildings – code of practice.

2. Overview of legal and administrative frameworks

Relationships between primary legislation and associated regulations, circulars and codes of practice. Consultation procedures in policy making. Role of European regulations and directives. Standardisation including the relationship between British, International and European standards and procedures for preparing such standards.

Hierarchy. European, English, Scottish procedures when dealing with criminal, and civil cases, public inquiries, appeals, tribunals. Principles of evidence. The role of common law.

3. The role of noise prediction and mapping for the control and assessment of environmental noise

The emphasis will be on the contribution of the various prediction schemes to assessment rather than on the details of the prediction methods. These details are covered more extensively in the 'ENVIRONMENTAL NOISE: PREDICTION, MEASUREMENT AND CONTROL' Module

Review of Environmental Noise directive 2002; principles of noise mapping – inputs, outputs, limitations of noise maps; small and large scale applications of noise mapping; Noise mapping England – the London noise maps; Birmingham noise maps; good practice guide for strategic noise mapping. Noise indices for mapping – $L_{Aeq,T}$, L_{den}, $L_{A10,T}$.

Review of noise prediction models, including:

ISO 9613-2:1993 Attenuation of sound during propagation outdoors – part 2.

Concawe model: Propagation of noise from petroleum and petrochemical complexes to neighbouring communities.

Design Manual for Roads and Bridges (DMRB).

4. Introduction to Environmental Impact Assessment (EIA)

Definition and role of EIA, EIA legislation (EU directive 85/337/EEC).

The EIA process – screening, scoping, identification of impacts, establishment of baseline conditions, mitigation, environmental statement, implementation and on-going environmental monitoring and auditing.

Role of consultation and participation; relationship to project planning.

5. Integrated Pollution Prevention Control (IPPC)

The role of IPPC; the IPPC directive 96/61.EC and its amendments; the Pollution Prevention and Control Regulations 2000; review of process. Case studies.

6. Noise and Vibration at Work

Health and Safety at Work Act 1974 and the Control of Noise at Work Regulations (2005). Related documents that deal with noise and the worker. Compensation for hearing loss either through common law or statute.

7. Vibration

Vibration Indices, measurement methods and acceptable levels of vibration from construction work and other sources according to BS6472, BS 7385 and the revised BS 5228

8. Standards

A list of relevant documents is provided by the Module Examiners.

Methods and indices described in relevant standards.

Recommendations and requirements in appropriate guidance and regulatory documents.

NOISE AND VIBRATION CONTROL ENGINEERING (OPTIONAL)

LEARNING OUTCOMES

On successfully completing this Module the student will be able to:

1. identify sources of noise and vibration and their respective generation and propagation mechanisms;
2. decide priorities for noise and vibration control through supplied data, site surveys and measurements;
3. assess the exposure of people and properties to noise and vibration in the context of current legislation, standards, codes of practice etc; and
4. implement pertinent noise and vibration control strategies at the sources, along the pathways and at the receivers.

LEARNING OBJECTIVES

On successfully completing this Module the student will have knowledge and understanding of:

1. noise generation mechanisms;
2. radiation and propagation of noise from point, line and plane sources;
3. the procedures and techniques for identifying and quality labelling noise sources;
4. the concepts of absorption, insulation and damping and the types of materials that provide these properties;
5. the calculation of sound levels within enclosed spaces, between enclosed spaces and into and out of enclosed spaces;
6. the calculation of boundary noise levels from multi-sourced situations;
7. the characteristics and mechanisms of absorptive materials and the roles that these materials can have in noise control;
8. single and multi-leaf partitions in noise control;
9. the design and use of full and partial noise enclosures;
10. the concept of flanking transmission
11. absorptive and reactive silencers, their specification and use;
12. the use of noise barriers, the types of construction, the calculation of performance and the limitations and short-comings;
13. the use of damping material to control vibration and noise radiation
14. the single degree of vibration system and its application in vibration isolation;
15. the qualitative behaviour of multi-degree of freedom vibration systems;
16. the types of vibration isolators that are available and their use;
17. sound generation and propagation in air handling systems;
18. the control of noise in and from air handling systems;
19. the qualitative principles of active noise and vibration control and examples of their use;
20. the legislation, standards and codes of practice relating to the exposure of people and buildings to noise and vibration.

ACQUIRED/TRANSFERABLE SKILLS

On successfully completing this Module the student will be able to:

1. predict noise and vibration levels having researched data, undertaken site surveys and applied appropriate modelling procedures;
2. assess the impacts of noise and vibration levels on people and property through identifying and applying relevant legislation, standards and codes of practice;
3. evaluate appropriate noise and vibration control strategies and recommend effective control measures;
4. use computer calculations and modelling;
5. undertake problem solving; and
6. demonstrate research and analytical skills through assignment work.

INDICATIVE CONTENT

The indicative content of this module will be subject to periodic review in respect of the regulatory framework. Documents have to be in the public domain for a full twelve months before they are examinable.

1. Noise sources

Types of noise sources - vibratory, impact and aero- and hydro-dynamic; factors that influence sound power.

Qualitative examples of control at source based on an understanding of the processes involved in generating the noise.

Sound quality testing and labelling

Measurement techniques for identifying individual source contribution in a mixed source situation

Formulating, in a mixed source situation, control strategies based upon the relative contribution of noise sources

2. Noise control

Sources outside:

Prediction of the sound level, at a distance, from a point, line and area source.

Effects of atmospheric conditions, refraction and turbulence, ground and other reflections; theoretical and practical treatments. atmospheric absorption.

Use of screening and barriers; types of barrier and prediction of performance; practical limitations to performance.

Sources inside:

Direct and reverberant sound fields according to Sabine room acoustics.

Dealing with non-Sabine conditions such as irregularly shaped spaces.

Types, distribution and effectiveness of surface treatments

Use of screening and barriers in reverberant and semi-reverberant conditions.

Sound insulation of single and multiple layer partitions. Typical constructions design features and performance. Sound reduction index, level difference between two spaces.

Field and laboratory measurement of sound reduction index and standardised level difference; the determination of standard performance indicators. ISO and British Standard methods.

Impact noise: field and laboratory measurement of standardised impact sound pressure level; the determination of standard performance indicators. ISO and British Standard methods.

Methods of reducing impact noise e.g. resilient layers, floating floors; practical examples and performance figures.

Building Regulations relating to sound insulation. Flankng transmission. Design of enclosures for both noise sources and people: insertion loss of an ideal enclosure: Limitations on performance; practical examples; Partial enclosures and hoods.

Guides and standards that relate to the protection of workers from noise-induced auditory effects. Engineering management of noise at work.

3. Ventilation and exhaust noise

Mechanisms of primary and secondary noise generation in air-conditioning systems. Attenuation and flow noise generation in duct systems. Duct break-in and duct break-out. Cross-talk. Primary and secondary control. Principle of the absorptive silencer: effect of location. Method of specifying package attenuators. Proprietary noise control devices e.g. attenuators, lagging, duct discontinuities. CIBSE guidance for HVAC.

Diesel and gas turbine exhausts noise: level and frequency content; use of absorptive and reactive silencers. Typical constructions, operating range and performance. Shrouds and diffusers for air exhausts; low noise nozzles.

General principles and examples of active noise control.

4. Vibration control

Overview of vibration sources: out of balance machinery; road and rail; etc. typical levels and frequency content.

Measuring and specifying vibration values. Displacement, velocity and acceleration; Use of decibels and standard reference values;

Radiation of noise from a vibrating surface, expression for radiated power (above and below the critical frequency.) Use of damping to control radiated noise.

Typical materials, applications and performance.

Free and forced vibration of a one-degree of freedom mass-spring-damper system. Qualitative analysis of multiple degree of freedom systems.

Vibration isolation: force and displacement transmissibility. Types of vibration isolator; design criteria and specification.

Examples of practical applications; limitations of performance; Machine motion and inertia blocks. Dynamic vibration absorber; Principles of operation and practical examples.

General principles and examples of active vibration control.

Standards in respect of vibration comfort and damage to buildings and equipment therein.

Effects of vibration on man; whole-body and hand-arm vibration. ISO and British Standard methods.

Estimating the likelihood of building damage arising from vibration. ISO and British Standard methods.

5. Standards

A list of relevant documents is provided by Module Examiners.

Methods and indices described in relevant standards. Recommendations and requirements in appropriate guidance and regulatory documents.