

Liverpool John Moores University

Title: ELECTRICAL SERVICES SYSTEMS A
Status: Definitive
Code: **5088UG** (102660)
Version Start Date: 01-08-2011

Owning School/Faculty: Built Environment
Teaching School/Faculty: Built Environment

Team	Leader
Laurence Brady	Y

Academic Level: FHEQ5 **Credit Value:** 24.00 **Total Delivered Hours:** 75.00
Total Learning Hours: 240 **Private Study:** 165

Delivery Options

Course typically offered: Semester 1

Component	Contact Hours
Lecture	48.000
Tutorial	24.000

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Exam	AS1	Formal.	50.0	3.00
Report	AS2	Assignment	50.0	

Aims

To develop students understanding of the power requirements of industrial & commercial building and the methods by which the power can be supplied and distributed.

To develop a detailed understanding of the principles and practices of low voltage electrical distribution and associated installations in a wide range of public sector, commercial or industrial buildings.

To provide students with the knowledge and skills necessary for them to interpret the needs and requirements of buildings, develop practical schemes for a range of

environments and evaluate the effectiveness of alternative schemes.

To develop the learner's understanding of the underlying principles of light and the practices of incorporating lighting into buildings. The module deals with the design, installation and operation of artificial lighting installations.

To enable the student to evaluate the interior, exterior and emergency lighting needs of buildings and provide an opportunity to experience the process of completing lighting designs in complex non-domestic applications.

To allow the students to explore the effectiveness of natural lighting schemes, the integration of artificial lighting with natural daylighting and various other methods of producing energy efficient lighting designs.

Learning Outcomes

After completing the module the student should be able to:

- 1 Investigate and analyse electrical power requirements, identify design criteria and constraints, and evaluate the application of standards and legislation for a range of public, commercial and industrial buildings.
- 2 Analyse power supply and distribution networks to buildings and complexes and produce low voltage electrical distribution system designs to satisfy the needs of a range of public, commercial and industrial buildings.
- 3 Select forms of protection against short circuit, over current, and fault currents in power supplies to buildings and in electrical distribution systems within buildings.
- 4 Investigate and evaluate the requirements for standby and uninterruptible power supplies systems and emergency lighting systems for a range of public, commercial and industrial buildings.
- 5 Identify lighting needs for a range of public, commercial and industrial buildings, assess daylight levels and establish lighting design parameters.
- 6 Investigate lighting equipment and the visual effects of lighting and design lighting schemes for the interior and exterior of range of public, commercial and industrial buildings.
- 7 Investigate and evaluate alternative electrical installation and lighting strategies for sustainable development to establish feasible design solutions.

Learning Outcomes of Assessments

The assessment item list is assessed via the learning outcomes listed:

EXAM	1	3	4	6		
REPORT	1	2	3	5	6	7

Outline Syllabus

Power assessment: power demand and load factors, assessment of demand for large industrial & commercial buildings. Specification and requirements: analysis of client and building needs.

Supply Options: tariff arrangements and alternative supply options, comparison of alternative tariffs, choice of supply voltage, requirements of suppliers network.

Transformers: electromagnetic induction, transformer principles, phasor diagrams,

equivalent circuits, referred values, transformer tests, efficiency and regulation, parallel operation and group references, protection transformers.

Fault currents: types of faults, percentage and p.u. values, fault levels, short circuit currents, network configurations, network analysis for fault levels.

Design criteria: design, designing for health and safety. Alternative approaches.

Assessment of electrical load design standards and publications.

Accommodation of distribution services: distribution patterns, horizontal, vertical, provision for future development and access. Coordination of services. False floor systems, rising mains, sub-main, bus-bar, trunking, conduit, ducting etc.

Environmental issues: vibration, noise, thermal, loads.

Fundamental requirements for safety: periodic inspection; acceptable test percentages, reasons for poor results, format of report, EEBAD for TT and IT supply systems.

Applying designers discretion: volts drop, diversity, extending disconnection times, thermal effects, grouping of cables of different csa and load characteristics, sizing of cables for motor circuits: direct on line, star delta, and inverter control.

Circuit protection: over current and short circuit protection, protection for variable loads.

Determining and protecting against fault currents. Discrimination between protective devices, fuses, MCB, MCCB. Operating time ranges, tripping characteristics.

Common types of heavy current fuses. Select fuses, MCB.s, and MCCB.s for various applications from manufacturers data.

Data Distribution: Category of circuits, types of distribution, WAN, LAN, Category five and six installations, cable types, clean and dirty earth's, earth loops, interference, emission of heat, vibration, earth leakage currents, data/telecommunication installations, electromagnetic compatibility; conducted, electrostatic, radiated.

Lightning protection: determining susceptibility to lightning strike, air termination network, down conductors, earth termination networks, bonding, side flashing, protection of electrical and data equipment within buildings, cable routes and equipment location.

Feasible solutions: Establishment of alternative options, techniques for critical analysis of alternative solutions to identify most feasible.

Standby supplies: essential, critical, non-essential loads, Generator installations, single and multi-generator, automatic start-up arrangements, synchronisation.

Protection against over-current, reverse-power, voltage, frequency etc. Generator fuel and efficiency.

UPS systems; single phase, three phase-three phase, three phase-single phase. Static switch/by-pass.

Fundamentals of lighting: terminology and units of light, inverse square law, cosine law, colour temperature.

Visual effects of lighting: lighting levels, glare, illumination for task performance, appearance, colour rendering, revealing form, display lighting, light modulation.

Specification and requirements: analysis of client and building requirements, balance between client, commercial, aesthetic and energy efficiency considerations.

Requirements of specialised lighting situations Interpretation and application of lighting design standards, publications for complex public sector commercial and industrial buildings. Co-ordination of lighting with other mechanical and electrical services.

Daylighting: Features, significance, advantages & disadvantages of daylight in buildings. Components of the daylight factor. Sunlight admission. Impact of different

forms, shapes, proportion and location of window and rooflights. Effect of glass type, widow bars etc.. Daylight in buildings with atria, advantages and disadvantages. Effect of daylighting on VDU equipment. Techniques for increasing daylight levels and penetration into buildings. No-sky lines, light obstruction and visible sky angles. Day light requirements. Average daylight factors. Manual and Computer calculation/modeling of distribution of daylight in buildings.

Light sources: natural daylight, lamp types and classifications, identification codes, lamp characteristics, luminous efficacy, lamp life and luminous flux maintenance, lamp control gear.

Luminaires: standards and markings, luminaire characteristics, luminaires for hostile and hazardous environments, polar curves and other photometric data, use of illuminance ratio charts, switching and dimming, maintenance. Methods of control.

Design of general lighting systems: for complex and specialised buildings. Layout, specification and control of interior lighting. Exterior lighting, car parks and walkway lighting, integration of lighting with other services installations, integration of artificial lighting with natural day-lighting.

Learning Activities

Lectures, tutorials, case studies, site visits.

References

Course Material	Book
Author	Bayliss, C.
Publishing Year	1999
Title	Transmission and Distribution in Electrical Engineering
Subtitle	
Edition	
Publisher	Butterworth-Heinemann
ISBN	0750640596

Course Material	Book
Author	Hiley, J. Hughes, E. et al
Publishing Year	2004
Title	Hughes Electrical and Electronic Technology
Subtitle	
Edition	9th Edition
Publisher	Prentice Hall
ISBN	0131143972

Course Material	Book
Author	CIBSE
Publishing Year	2005
Title	Guide K

Subtitle	Electricity in Buildings
Edition	
Publisher	CIBSE
ISBN	190328726X

Course Material	Book
Author	Franklin, A.C. & Franklin, D.P.
Publishing Year	1998
Title	The J & P Transformer Book
Subtitle	
Edition	12th Edition
Publisher	Newnes
ISBN	0750611588

Course Material	Book
Author	Warne, D.F.
Publishing Year	2005
Title	Newnes Electrical Power Engineers Handbook
Subtitle	
Edition	2nd Edition
Publisher	Butterworth-Heinemann
ISBN	0750662689

Course Material	Book
Author	Electricity Rating Association
Publishing Year	1995
Title	Power Systems Protection
Subtitle	
Edition	
Publisher	Institution of Engineering and Technology
ISBN	0852968477

Course Material	Book
Author	BSI
Publishing Year	2008
Title	BS 7671 Requirements for Electrical Installations
Subtitle	Wiring Regulations
Edition	17th Edition
Publisher	BSI
ISBN	

Course Material	Book
Author	CIBSE
Publishing Year	2004
Title	Guide F
Subtitle	Energy Efficiency in Buildings
Edition	

Publisher	CIBSE
ISBN	1903287340

Course Material	Book
Author	CIBSE
Publishing Year	2003
Title	Guide E
Subtitle	Fire Engineering
Edition	
Publisher	CIBSE
ISBN	1903287316

Course Material	Book
Author	Cook, P.
Publishing Year	2002
Title	Commentary on IEE Wiring Regulations (BS 7671: 2001)
Subtitle	
Edition	
Publisher	Institute of Engineering and Technology
ISBN	0852962371

Course Material	Book
Author	Robertson, C.R.
Publishing Year	2001
Title	Electrical and Electronic Principles
Subtitle	Volume 1
Edition	2nd Edition
Publisher	Butterworth Heinemann
ISBN	0750651458

Course Material	Book
Author	Steffy, G.R.
Publishing Year	2001
Title	Architectural Lighting Design
Subtitle	
Edition	
Publisher	John Wiley & Sons
ISBN	0471386383

Course Material	Book
Author	CIBSE
Publishing Year	2002
Title	Code for Lighting
Subtitle	(CD Rom + printed extracts)
Edition	
Publisher	CIBSE
ISBN	0750656379

Course Material	Book
Author	Philips, D.
Publishing Year	2004
Title	Daylighting Natural Light in Architecture
Subtitle	
Edition	
Publisher	Architectural Press
ISBN	0750656379

Course Material	Book
Author	CIBSE
Publishing Year	2004
Title	LG12
Subtitle	Emergency Lighting and Design
Edition	
Publisher	CIBSE
ISBN	1903287510

Course Material	Book
Author	Cuttle, C.
Publishing Year	2003
Title	Lighting by Design
Subtitle	
Edition	
Publisher	Architectural Press
ISBN	075065130X

Course Material	Book
Author	Tregenza, P.
Publishing Year	2004
Title	The Design of Lighting
Subtitle	
Edition	
Publisher	Spon Press
ISBN	0419204407

Notes

This module offers a detailed appreciation of power supplies to buildings, electrical distribution within buildings and lighting schemes for buildings suitable for all students studying Building Services Engineering and associated disciplines. It develops an understanding of the technology associated with the provision of electrical power supply to and within large commercial/industrial buildings and complexes. The focus of the module is to increase the range and depth of understanding of power supplies by analysing some of the core concepts and

exploring how these affect the design of power supplies to these types of buildings. The module further aims to develop the student from a basic awareness of the principles and processes of electrical installations to an in-depth understanding of electrical and data installations in commercial and industrial buildings and the necessity and methodology for lightening protection. The module also offers the opportunity for students to develop a detailed understanding of lighting design in the built environment. The need for energy efficient, sustainable engineering design solutions is emphasised, while encouraging innovation and artistic flair where relevant.