

Liverpool John Moores University

Title: POWER SUPPLIES & ELECTRICAL INSTALLATIONS FOR BUILDINGS
Status: Definitive
Code: **5506BEFDS** (118449)
Version Start Date: 01-08-2011

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

Team	Leader
Derek King	

Academic Level: FHEQ5 **Credit Value:** 24.00 **Total Delivered Hours:** 111.00
Total Learning Hours: 240 **Private Study:** 129

Delivery Options

Course typically offered: Standard Year Long

Component	Contact Hours
Lecture	72.000
Tutorial	24.000
Workshop	12.000

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Report	Project		50.0	
Exam	Exam		50.0	3.00

Aims

The aim of this module is to develop students understanding of the power requirements of industrial & commercial building and the methods by which the power can be supplied and distributed within the building. It will enable them to interpret the requirements of a building, develop practical schemes and evaluate the effectiveness of alternative schemes. The module also aims to further develop the principles and practices of low voltage electrical distribution in buildings to include

some of the more specialised aspects found in complex buildings.

Learning Outcomes

After completing the module the student should be able to:

- 1 Investigate and categorise the power needs of large buildings & complexes and the effects of abnormal loads to design appropriate power supply and distribution networks.
- 2 Investigate and analyse the use and operation of transformers and motors in building services applications.
- 3 Calculate fault currents in power supply networks and thereby analyse the rating of HV switchgear, cables and protection equipment.
- 4 Evaluate alternative electrical installation proposals and strategies to establish feasible design solutions.
- 5 Investigate the application of rectification systems in uninterruptible/standby power supplies and the control of other plant/equipment and evaluate the system uninterruptible/standby power supply requirements to produce suitable designs.
- 6 Analyse modes of vertical and horizontal transportation for buildings and develop appropriate electrical installation provision.

Learning Outcomes of Assessments

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

Project based assignment	1	4	5	6
Exam	2	3		

Outline Syllabus

Power assessment: power demand and load factors, assessment of demand for large industrial & commercial buildings.

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.

Large Power equipment: space and installation requirements of large power transformers, electrical machines, large power consuming plant & switchgear at 11kV & above, large power cables, protection systems, fire and explosion risk, health & safety, authorised operators. Noise & Vibration from electrical equipment, effect on buildings.

Design of Power Installations: design of large power supply and distribution at up to 11kV for complex buildings, layout, specification and control of the main power distribution within buildings. Power distribution: networks, radial, rings,

interconnected mesh, HV Switchgear types. (RMU, Oil, Vacuum, and SF6), protection systems, relay settings and grading, HV fuses, HV Switchgear ratings, protection systems and relays, power system earthing.

Abnormal loads: load assessment, maximum demand, load management, large motor loads, welding, voltage interference, harmonics.

Design criteria: design, designing for health and safety, risk assessment, Electricity Safety, Quality & Continuity Regulations. and other current standards and regulations. Alternative approaches. Design for resilience and reliability assessment.

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, multi module & redundant systems. Earthing arrangements for Generator/UPS systems.

Lift Operation & requirements: Passenger, goods and service lifts, fire fighting, evacuation and lifts for the disabled.

Lift control: attendant, single automatic push button control, collective, duplex, dispatch. Speed control safety devices, services in lift wells.

Roping and winding systems: above well, below well, compensating. Geared and gearless winding.

Hydraulic lifts: control, oil cooling

Design of lift & Escalators: location of lifts, grouping. Assessment of demand: waiting time, handling capacity, arrival rate, estimation of population, daily occupancy, building type and height

Passenger demand: handling capacity, traffic profiles, up-peak, round trip time, calculation of handling capacity

Escalators and walkways: safety devices, discharge capacity, fire control, guards at intersections, angle of inclination

DC and AC motors: dc series/shunt motors, speed/torque characteristics, , induction/synchronous motor characteristics, starting methods, inverters, soft-start, DOL, star-delta etc, speed control, motor selection and ratings. Operating principles of inverters, use of inverters to control speed of motors.

Principles of rectification: diode, half-wave, full-wave, rectifier circuits single and three phase, smoothing circuits, thyristor and applications, phase control and integral cycle control.

Learning Activities

Lectures, tutorials, case studies, workshops, 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	0-7506-4059-6

Course Material	Book
Author	Hughes E.
Publishing Year	2008
Title	Hughes Electrical and Electronic Technology
Subtitle	
Edition	
Publisher	Pearson Education Ltd.
ISBN	978-0-13-206011-0

Course Material	Book
Author	Chartered Institution of Building Services Engineering
Publishing Year	2005
Title	Guide K
Subtitle	Electricity in Buildings
Edition	
Publisher	CIBSE, London
ISBN	190328726X

Course Material	Book
Author	Franklin, A.C. Franklin, D.P., Stigant S.A.
Publishing Year	1998
Title	The J & P Transformer Book
Subtitle	
Edition	12th
Publisher	Newnes
ISBN	0-7506-1158-8

Course Material	Book
Author	Warne, D.F.
Publishing Year	2005
Title	Newnes Electrical Power Engineer's Handbook
Subtitle	
Edition	2nd
Publisher	Butterworth-Heinemann
ISBN	0-7506-6268-9

Course Material	Book
Author	Electricity Training Association
Publishing Year	1995
Title	Power System Protection

Subtitle	
Edition	
Publisher	Institution of Engineering and Technology
ISBN	0-85296-847-7

Course Material	British Standards
Author	British Standards Institute
Publishing Year	2010
Title	BS7671:2008 Requirements for Electrical Installations
Subtitle	IEE Wiring Regulations
Edition	17th Edition
Publisher	BSI
ISBN	0863413700

Course Material	Book
Author	Chartered Institution of Building Services Engineering
Publishing Year	2004
Title	Guide F
Subtitle	Energy Efficiency in Buildings
Edition	
Publisher	CIBSE, London
ISBN	1903287340

Course Material	Book
Author	Chartered Institution of Building Services Engineering
Publishing Year	2005
Title	Guide D
Subtitle	Transportation Systems in Buildings
Edition	
Publisher	CIBSE, London
ISBN	1903287618

Course Material	Book
Author	Cook, P.
Publishing Year	2008
Title	Commentary on IEE Wiring Regulations 17th Edition (BS 7671: 2008)
Subtitle	
Edition	
Publisher	Institution of Engineering and Technology
ISBN	9781849191456

Course Material	Book
Author	Berney G.C., Cooper, D.A. & Inglis J.
Publishing Year	2006
Title	Elevator and Escalator Micropedia
Subtitle	

Edition	
Publisher	International Association of Elevator Engineers
ISBN	0-9525696-8-X

Notes

This module is a key component for those students wishing to complete the programme following an 'electrical' building services pathway. It aims to develop 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 electrical installations and power supplies for students from an electrical installations.