

Authorisation A examination syllabus as per regulation 5(3)(b) of the Electrical Installations Regulations applicable as from January 2023		
	Topic description	Objectives to be achieved
	M1 - Electrical Theory	
1	Basic principles of electricity.	Understanding the basic physical principles of electricity, what voltage (e.m.f.) is and what is current, their differences and relation.
2	Electrical units, Quantity & Unit Symbols, dimensional prefixes.	Knowledge of the electrical terms, which will be mentioned in the rest of the course; their units and symbols, and understand the meaning of the magnitude through SI units prefixes (e.g. mW, W, kW, MW)
3	Ohm's Law and its application to a.c. networks.	Learn Ohm's law and its application to impedances in its 3 forms ($V=IR$, $I=V/R$ and $R=V/I$), and the variation of any two parameters when one parameter is kept fixed e.g. voltage fixed current increase on reduction of load impedance.
4	Resistance and load networks, series, parallel and series parallel combinations.	Understand the characteristics of loads in parallel and series and a combination of both with respect to voltages across and currents passing through each branch or load.
5	Resistance of conductors in terms of physical dimensions Resistivity and thermal influence.	Understand the principle (e.g. electron carriers) of what is resistivity or conductivity and why it is different for different materials. Understanding that resistance is a function of resistivity or conductivity, length and cross section area of the material, and how it behaves with temperature.
6	Difference between a.c. and d.c. Peak, average and r.m.s. values of sinusoidal waves. The sine wave and its form factor. Periodic time and frequency.	Knowledge of the difference between d.c. and a.c. voltages and currents, and on the terms of peak, average, r.m.s., form factor, cycle/frequency, harmonics, distortion, phase shift.
7	Voltage drop and power loss in cables. Percentage voltage drop.	Be able to understand and calculate the voltage drop on selected cable and load current for a given length and calculate the percentage voltage drop.
8	Insulation resistance and applicability to cables, equipment.	Knowledge of the different materials used as insulators in an electrical installation, insulators, spacers, protective enclosures, connector housings, cable insulation etc. and the advantages and disadvantages of their uses in specific applications and in difference ambient conditions.
9	Power and the combination with Ohm's law	Understand the Electrical Power formula $P=IV$ and its combination with $V=IR$ to derive $P=V^2/R$ or $P=I^2 R$. The understanding of cable power losses due to their resistance and why in electricity networks the voltage used to transfer power increases the higher the power

10	Heat Energy (specific heat capacity) & Mechanical Energy & efficiency.	Understand Energy as compared to Power (i.e. kWh vs. kW) and be aware of the various energy in its forms particularly as applied to heating and machines. Also to understand the term efficiency and to derive any of the input, output power or energy for a given efficiency.
11	Conversion of Electrical Energy into Heat & Mechanical Energy.	Be able to estimate the output, input or efficiency of a given equipment, knowing any of the other two; applicable to energy and power.
12	Fundamental Laws of magnetism. Permanent magnets, concepts of magnetic fields, flux, and flux density. Quantity and unit symbols.	Understand the principles and laws of magnetism, field direction for a current carrying conductor, attraction and repulsion of magnetic poles, magnetic circuits in magnetic cores and iron losses.
13	Electromagnetic Induction. Magnetic fields around current carrying conductors.	Understand the influence of magnetic fields, fixed or changing on nearby conductors or electronic equipment, or other circuits. The principle that if mechanical energy is applied to a conductor next to a magnetic field, it will induce current hence generation, and that also the reverse applies hence electric motors. Understand the principle that changing magnetic flux may be transferred from one conductor to the adjacent, hence the use in transformers, CT's and tong meters.
14	Magneto motive force. Electromagnets and typical applications.	Understand and apply Fleming's hand rules, vis-à-vis for magneto motive forces in electric motors, or vis-a-vis for induction of current in electrical generators.
15	Concept of capacitance, charge and potential. Connections of capacitors in series and in parallel. Division of charge and potential	Understand the concepts of capacitances, charge and potential, use of capacitors in single phase a.c., and their behaviour when connected in parallel or series or in a combination of both.
16	Concept of reactance and impedance.	Understand the concepts of reactance in inductive loads.
17	Combination of Resistance, Capacitance and Inductance in a.c. circuits, in parallel or series or a combination of both.	Understand the calculations related to the circuits having resistors, capacitors and inductances (R-C-L) in single phase a.c. circuits.
18	Harmonic inducing equipment and line distortion	Be aware of equipment (normally switching equipment e.g. UPS inverters, VSD etc) which generate harmonics on the line and the influence on other loads and equipment.
19	A.c. circuits containing resistance, inductance, capacitance and their combinations for particular cases.	Be aware of the use of inductive and capacitive combined loads as voltage line filters for harmonics and noise. (e.g. Q-factor of L-C circuits)
20	Insulation and conductor resistance of cables in series and in parallel.	Know how to measure the insulation and conductor resistance of cables in series and in parallel
21	Concept of power factor. Power (W) and apparent power(VA) , reactive power (VAR) in a.c. single phase	Understand the concept of power factor, phase shifts due to L-C impedances, and understand the meaning of real power vs. apparent or reactive power, and the term of current magnitude vs. real power. $P = IV \times \text{p.f.}$

22	Simple constructional details of core and shell type single phase transformers. Transformation ratio ($K = V_s / V_p = N_s/N_p - I_p/I_s$). Simple calculations.	Understand the principles and be able to carry simple calculations of voltage and current transformation of single phase transformers.
M2 - Technology		
23	Energy meters. Principles and configurations	Energy meters use and connection
24	Principal application and operation of Earth Leakage Circuit Breakers and Residual Current Devices and types A, B, AC	Understand the principle of operation of ELCB's and RCD's, their construction, their parameters as sensitivity delay and quiescent currents, and the various types and their appropriate applications.
25	Conducting and insulating materials commonly used in electrical installations. Properties, applications, advantages and disadvantages, chemical reaction and interactions	Be aware of the different materials used in an electrical installation, insulators and conductors, their properties, applications, advantages and disadvantages, and any chemical reactivity between different conductors.
26	Types, differences and applications of control/protective gear including switches, fuses, fuse switches, MCB's, Line monitoring, isolators, over and under voltage protection, surge protection, distribution boards for single phase circuits.	Understand the principle of operation of control protective gear, their defined parameters, their operation, use and protection they offer and the various types. Understand the various enclosures classes and their protection and IP standards and their application.
27	Compare respective functions, advantages and disadvantages of protection equipment used in single phase, and their maximum ratings (V_{max} , I_{psc} etc) and connection configurations.	Understand the functionality of the equipment, advantages and short falls offered and the related maximum rated parameters their use according to the type of installation, e.g. V_{max} , I_{max} , prospective short circuit currents, and any particular connection configurations e.g. load side and source side, connection to earth etc.
28	Describe methods of obtaining over current protection and discrimination requirements by cascaded protective equipment.	Understand the principles of creating discrimination through protection of various circuits.
M3 - Health and safety		
29	Requirements for safety. Handling of tools & equipment. Lifting loads, Working at heights. Cleansing of area, labelling, isolation and locking, Precautions & Procedures.	Be aware of the safety precautions required to be taken care of in own interests and for all those around the work site, as regards to handling of tools, lifting, and working at heights, as well as H&S measures during maintenance for labelling works in progress and locking critical circuits.
30	Relation of electrical currents and harm to living beings by electrocution	Understand the influence of electric current acting on the cardio members of a living being, and the effect at various intensities.
31	First aid, effects of electrocution, cuts, burns, falls and addressing incidents.	Be aware of basic first aid action, in cases of electrical shock, cuts, burns, falls and method how to address them. Basic First Aid course should be carried through a different course.

32	Fire prevention and controlling, while working and related precautions by over-current or overload, short circuits protection.	Understanding the need of the prevention of overheating of equipment and circuits, fire ignition through correct rating of electric protection, and understand how to prevent the spreading of fires by enclosed chambers and blocked passages.
33	Precautions to be taken when working on or near live equipment.	Understand the precautions and measures to be taken when working close to live equipment.
34	Conditions required for combustion, and controlling a fire	Understand the requirements to start a fire and hence describe methods how to control and definitely extinguish fire.
35	Methods of dealing with different types of fire	Understand the type of fires related to the materials in combustion and associated dangers in the area.
36	Types of fire extinguishers and their appropriate uses	Understand the types of fire extinguishers available and which have to be used for different types of fires.
37	Dangers from toxic fumes and smoke and materials which produce them	Be aware that fire danger is not just heat, burns and explosions, but would also involve toxic fumes and lack of visibility.
<u>M4 - Regulations</u>		
38	Electrical Installations Regulations (S.L.545.24)	Knowledge of the requirements of the local Electrical Installations Regulations (S.L.545.24)
39	Network Code	Be familiar with the local Enemalta Network Code and quality of supply.
40	Electricity Supply Regulations (S.L.545.01)	Knowledge of requirements in particular new services applications, metering, connection fees, connection of motors
41	Electricity Regulations (S.L.545.34)	Be familiar with the requirements of the local Electricity Regulations (S.L.545.34).
42	Eligibility to obtain an Authorisation as per Electrical Installations Regulations	Be aware of how a person may be eligible to apply and obtain an authorisation, conditions to retain the authorisation and consequences of breaching the Regulations
43	Scope of the IET Wiring Regulations BS:7671, applicability and interpretation of and description of its layout, inclusion of amendments and related guidance notifications, and requirement to keep updated on new inclusions and requirements.	Understand the layout of the BS7671, how it is updated and how to keep abreast with such updates and supporting/interpretation guidelines.
44	IET Wiring Regulations BS:7671, Definitions and interpretation and familiarization. Single phase circuits less than 40Amps load.	Understand the definition of terms as specified by the BS:7671 and be familiar to the BS:7671 latest editions
<u>M5 - Installation Theory</u>		
45	Distribution of electricity from secondary side of substation transformers to premises in single phase.	Understand the Enemalta distribution system.

46	Sequence of control and protection in consumer's premises in single phase. Circuit diagrams.	Understand the sequential requirements of metering and protection required in the main consumer unit
47	Assessment of load, maximum demand, diversity and diversity factor. Use of tables.	Be able to calculate and assess the loads, maximum demands, load diversity to calculate the installation requirements
48	Assessment of voltage drop	Be able to calculate the voltage drops of the designed installation and verify whether within limits of those allowed.
49	Assessment of accessibility, external influences, maintainability	Be able to assess the accessibility, external influences and maintainability of the installation and equipment and operation.
50	Identification, labelling and notices.	Be able to assess and provide labelling in various parts of the installation for better comprehension of the users.
51	Standard circuit arrangement. Lighting circuits, socket outlets, ring and radial circuits, fixed high loads as electric cookers etc.	Understand the requirements of standard wiring circuits, as various lighting configurations (e.g. direct, two way, intermediate), socket outlets (ring, and radials), spurs, fixed high load dedicate circuits; there covering area limitation, cable sizing and protection.
52	Factors to be considered when designing an electrical installation	To understand the requirements to design a reliable and safe electrical system; to protect conductors and equipment from overheating based on design allowed temperatures, by the appropriate protection to prevent fire risks ; to ensure that the equipment being used is adequate to sustain worse case conditions e.g. during a fault and until the fault is cleared ; to safeguard against electric shock by earthing protection and equipotential bonding of all conductive parts in the same building establishment and detection of leakage current to earth; to carry out an installation with the correct colour codes and labelling to facilitate safe use and maintenance ; Provide for redundancy where a common earth system serves multiple or commercial or industrial installations by e.g. installing more than one electrode to reduce the single point of failure(Be aware that unlike the Neutral and Live wires , a missing earth may remain undetected until a fault to earth occurs which may lead to electrocution); the importance of discrimination in the protection of circuits to prevent that a disturbance in one circuit does not affected the rest of the installation; to provide appropriate means of isolation to permit safe maintaining of the installation.
53	Need for protection, rating, setting of and discrimination.	Be able to calculate the type and rating of the required protection based on the installation materials and mode of erection, and discrimination of downstream circuits.

54	Cable selection, size, use of Rating Factors and Rating Tables for single phase installations.	Be able to calculate the type of cable to be used, considering the derating factors, Ci, Cg, Ca, Cf and voltage drops, and use of the tables in the BS:7671. Understand the requirement of over sizing of cables in particular conditions is necessary. Understand the effect of voltage drop on equipment operation, particularly lighting and motors.
55	Wiring systems. PVC sheathed, metal and plastic conduits. Mini trunking and skirting and other methods.	Be aware of the various methods of cable laying, fixing and installations and pros and cons of the different methods.
56	Required size of conduits, conduit capacity and the use of tables. Fixing methods.	Be able to select the method of installation, fixing and laying of cables and calculate the required conduit, trunking for proper heat dissipation and the applicable mechanical protection.
57	Lamps circuits. Cable colour coding in line returns and common strappers in two way switches.	Be aware of the standard colour coding in all circuits , including returns and strappers, and the need that in any junction box all conductors that may carry live current are clearly identifiable.
58	Setting of an Over-voltage protection in single phase installations	Understand the scope of the overvoltage and under voltage protection in the installation. Be able to define the appropriate setting of an over and/or under voltage protection.
59	RCD arrangement and discrimination in multi consumer facility in single phase	Understand methods of offering protection and discrimination by RCD's in a multi consumer facility. Understand possible configurations that may be used whereby multiple circuits are each provided with a separate and dedicated RCD.
60	Scope of Earthing. Description of earth circuits, cpc, and bonding of extraneous metalwork.	Understand the scope of earthing protection, direct and indirect contact, earth circuits and circuit protective conductor (c.p.c.) and bonding of extraneous metal-works and plumbing systems. Risks of multiple earth systems in the same premises where sharing services is involved.
61	Installation requirements in garages	Be aware of the special local requirements of installations in garages.
62	Describe provision for future extension	Be aware that the design of the installation must provide for future addition of load circuits and related protective equipment.
63	State factors governing the choice of system	Be able to evaluate technically and financially the choice of a single phase to a three phase electricity service requirements.
64	Basic preparatory requirements of fire alarm systems (Fire protection systems installations not within the scope of this course. Requires a specialised course inclusive of BS:5839)	Understand what is to be prepared in terms of electrical installation points for fire detection and alarm systems, including the correct choice of cables and any specific cable termination requirements (e.g. fire retardant, M.I.M.S. cables and dedicated essential circuits).

65	Basic preparation for emergency lighting systems (Emergency lighting systems is not within the scope of this course. Requires a specialised course inclusive of BS:5266)	Understand what is to be prepared in terms of electrical installation points, for an emergency lighting system, including the correct choice of cables and any specific cable termination requirements (e.g. fire retardant, M.I.M.S. cables and dedicated essential circuits).
66	IET requirements for conductor joints and terminations. Common joints and terminations for conductors used up to 40Amps.	Understand the different methods of cable jointing and cable terminating, be able to perform them and apply the appropriate method.
67	Requirements for standby generators connected in single phase	Understand the protection (e.g. change over switch) and the appropriate location of standby generators.
68	Requirements for grid connected generators in single phase. (The PV installation is not within the scope of this course, refer to PV installer's course)	Understand the protection equipment (e.g. anti-islanding protection, grid synchronisation) and proper location of the protection in the case of grid-connected generators. (Note that the installation of the generator itself (e.g. PV, wind turbine, CHP) is not within the scope of this course, refer to PV installer's course)
69	Requirements for motor loads in single phase	Understand the different starter protection types and the requirements for single phase connected a.c. motors.
70	Design in considering energy efficiency in installation and schemes in the use of electricity	Understand the requirements of reducing losses, the designing of segregation of circuits that can allow only the required load in use, switched off the unnecessary or occupancy sensing, possibility of metering for consumption monitoring purposes.
M6 - Earthing		
71	Methods of earthing and types of earth electrodes in basic 40Amp serviced premises.	Understand the methods and principles of earthing and the various types of earthing system methods.
72	Earth loop impedance	Understand and be able to calculate and measure the earth loop impedance.
73	Earth fault currents, touch voltages, earth leakage currents, and prospective earth fault current in a single phase installation.	Understand the meaning of earth fault currents, earth leakage currents, induced touch voltages and be able to calculate/understand the prospective earth fault currents for the installation in order to ensure that the ratings of the earth system can withstand such faults without degradation and for the earth fault protection to perform correctly.
74	The TT- system	Be able to describe the TT- earthing system which is the standard method of earthing used in Malta and be aware of the other earthing systems.
75	Earthing in single consumer facility	Be able to design , install and test an earthing system appropriate for a single consumer premises
76	Earthing in multi consumer facility	Be able to design, install and test an earth system in a multi consumer facility and understand the importance of having one common earth point for all the electrical installations in the facility.

77	Electrical earthing in conjunction with lightning protection (lightning protection not within the scope of this course)	Understand the method of connection of the electrical earthing system with other earthing systems provided for other purposes (e.g. earthing system for lightning protection).
M7 - Special locations		
78	Special requirements for areas mentioned in Sections 7XX of the IET Wiring Regulations BS:7671 (baths, showers, pools, saunas, basins, construction & demolition sites, agricultural, conducting sites, restricted sites, caravans and camp sites, marinas, medical clinics, exhibition stands, mobile units, motor caravans, gangways, amusement parks, floor/ceiling heating, electric vehicle charge points ...)	Understand the special requirements of the special locations and particular installations described in Part 7 of the IET BS:7671.
M9 - Documentation & maintenance		
79	Testing of installations inclusive of the earth system, new, alterations, extension, and re-certification. Use of testing instruments. Documentation, recommendation of period of testing and re-certification. Fault finding and remedies.	Be able to list, perform and report tests on an electrical installation and understand the proper instruments to be used for testing and their operation. Understand the requirement to provide endorsed drawings and schematics to the client and the obligation to recommend in writing the scheduled re-certification required according to the use of the premises. Be able, through the use of appropriate instruments, to carry out fault finding and repair on the electrical installation.
80	Specifications and schedules of quantities.	Be able to understand specifications and drawings, and be able to produce specification and drawings and bill of quantities for works on electrical installations.
81	Reading of architects plans, use of graphical and circuit symbols and produce schematics and circuit diagrams of installation.	Be able to understand architects' plans, and provide as fitted wiring diagrams with the appropriate symbols and description on such plans.
82	Obligations to the customer, documentation and recommendations	Understand the obligations to the clients, the requirements to provide documentation, correct labelling, maintenance schedules and recommended re-certification requirements, and be aware to keep records of documents related to the installation as endorsed by both parties for any future references, particularly in case of future extensions or alterations.

Amendments:

v2 January 2023:

41	Electrical Market Regulations	Be familiar with the requirements of the local Electricity Market Regulations.
Changed to		
41	Electricity Regulations (S.L.545.34)	Be familiar with the requirements of the local Electricity Regulations (S.L.545.34) .