Authorisation B examination syllabus as per regulation 5(3)(b) of the Electrical Installations Regulations applicable as from January 2021			
	Topic description		**Objectives to be achieved**
	M1 - Electrical Theory		
1	Variation of Resistance with temperature in metals, alloys and non-metals		Understand the principle how temperature influences the resistivity of materials.
2	Define temperature coefficient		Understand the term temperature coefficient and what it actually represents.
3	Calculate resistance with temperature change		Be able to anticipate the change of resistance with temperature changes.
4	Concept of capacitance, charge and potential. Connections of capacitors in series and in parallel in three phase a.c. Division of charge and potential		Understand the concepts of capacitances, charge and potential, use of capacitors in three phase a.c., and their behaviour when connected in parallel or series or in a combination of both. Understand change in capacitance impedance in relation to frequency.
5	Concept of reactance and impedance.		Understand the concepts of reactance in inductive loads in three phase a.c. Understand change in reactive impedance in relation to frequency.
6	Combination of Resistance, Capacitance and Inductance in a.c. three phase circuits, in parallel or in series or a combination of both.		Understand the calculations related to the circuits having resistors, capacitors and inductances (R-C-L) in a.c. circuits, the impedance of capacitors and inductances in relation to frequency and the changes of the calculations related to circuits having R-C-L in case of different a.c. frequencies e.g. harmonics.
7	Harmonic inducing equipment and wave form distortion in three phase circuits.		Be aware of equipment (normally switch mode equipment e.g. UPS, inverters, variable speed drive (VSD) etc) which generate harmonics on the line and the effect of these harmonics on other loads and equipment.
8	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)

9	Concept of power factor. Power and apparent power in a.c. three 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 effect of power factor correction on the current magnitude in three phase circuits. Understand the power equations for real and apparent in three phase systems .Apparent power (KVA), Reactive power (KVAr), True Power (KW), power triangles
10	Star and Delta connections. Relationship between line and phase voltages and currents in balanced systems.		Understand the difference between star and delta connection in three phases, the neutral point. Understand the terms of Line vs. Phase voltages or currents, the phase shift between each line in a balanced three phase load.
11	Measurement of power and power factor with two-wattmeter method		Understand the method of measurement of power and power factor using the two-wattmeter method.
12	Describe the causes and effect of low power factor and understand the benefits of power factor correction to consumers and for the grid.		Understand the disadvantages of low power factor installations on own installation requirements and distribution losses.
13	Circuit and phasor diagrams and their use in solution of problems		Understand the phasor diagrams, applying phase shifts and different magnitudes in complex three phases unbalanced and phase shifted loads to determine resultant Neutral currents and shift.
14	Describe the methods of power factor improvement, e.g. capacitors, synchronous motors and phase advancers		Understand the power factor correction methods and equipment available on the market.
15	Neutral current in three phase four wire system, and influence of harmonics on the Neutral current.		Understand the possibility of having a consistent neutral current in an apparently balanced (I1=I2=I3) three phase load due to harmonics and the requirement to constantly monitor the neutral currents.
16	Compare and state the merits of individual and group power factor improvement methods		Understand the advantages and disadvantages of the individual or group power factor improvement methods.
17	Power factor improvement calculations.		Be able to calculate the required capacitance/inductance required to achieve a targeted power factor, in single phase and three phases.
18	Calculate values of power, apparent power and power factor of parallel loads		Be able to calculate the real power, apparent and reactive power in parallel loads in single and three phase systems.

	M2 - Technology		
19	Double wound, Delta to star transformers and auto-transformers, principle of operation, application, precautions, advantages and disadvantages.		Understand the principles of operation and applications of double wounded, delta to start and auto transformers, their precautions, advantages and disadvantages.
20	Principles and types of a.c. motors		Understand the various types of a.c. motors in single and three phase and the basic principles of their construction, operation and characteristics.
21	Types, differences and applications of control/protective gear including switches, fuses, fuse switches, MCB's, MCCB's, Line monitoring, isolators, over and under voltage protection, surge protection, distribution boards, bus-bar chambers and motor control boards		Understand the principle of operation of control protective gear, their defined parameters, their operation, their use and the protection they offer and the various types. Understand the various enclosures classes, IP (ingress protection) standards and their application.
22	Compare respective functions, advantages and disadvantages of protection equipment, and their maximum ratings (Vmax, Ipsc 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. Vmax, Imax, prospective short circuit currents, and any particular connection configurations e.g. load side and source side, connection to earth etc.
23	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.
24	Three phase residual current devices for high loads - Toroidal unbalance detection and shunt tripping		Understand the principles of how to detect earth leakage currents in a high current three phase circuit using toroidal CT detection and shunt trip of the MCCB.
25	The main function and location of a.c. machines control gear		Understand the functionality of a.c. motors control gear and appropriate location for installation.
26	The application of protection devices on a.c. machines, bimetallic, thermal and oil dashpot overload/over current relays/circuit breakers, under voltage and overvoltage protection, no volt release , single-phasing protection and phase reversal protection		Understand the basic requirements of protection to three phase a.c. motors, the principles of such protection detection and operation and configurations.
27	The methods of starting and reversing a.c. machines.		Understand the methods and requirements of starting a.c. machines, and methods how to reverse a.c. machines. The importance of the correct phase sequence when connecting three phase motors

28	The advantages and disadvantages of each method of starting of a.c. machines		Understand the advantages and disadvantages and limitations of different a.c. motor starters.
29	Basic principles of speed control of a.c. machines		Understand various principles of how to control the speed of a.c. machines, their advantages and disadvantages.
	M3 - Health and safety		
30	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.
31	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.
32	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.
33	Fire prevention and controlling, while working and related precautions by over current or overload, short circuits protection.		Understanding the need for 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.
34	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.
35	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.
36	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.
37	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.

38	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.
	M4 - Regulations		
39	Electrical Installations Regulations		Knowledge of the requirements of the local Electrical Installations Regulations
40	Network Code		Be familiar with the local Enemalta Network Code and quality of supply.
41	Electricity Supply Regulations		Knowledge of requirements in particular new services applications, metering, connection fees, connection of motors
42	Electrical Market Regulations		Be familiar with the requirements of the local Electricity Market Regulations.
43	IET Wiring Regulations BS: 7671, Definitions and interpretation and familiarization.		Understand the layout of the BS:7671, how it is updated and how to keep abreast with such updates and supporting/interpretation guidelines.
	M5 - Installation Theory		
44	Distribution of electricity from secondary side of substation transformers to premises in three phases.		Understand the Enemalta distribution system. Including the basic layout of a substation, voltage levels, safety precautions
45	Sequence of control and protection in consumer's premises in three phases. Circuit diagrams.		Understand the sequence of installation metering and protection equipment both in single phase and three phases, domestic, commercial and industrial installations.
46	Short circuit ratings of equipment		Be able to distinguish between the continuous rating of protective equipment/ circuits and the maximum short circuit current ratings (kA). The variation in magnitude of the short circuit current along the circuit.
46	Non recommended use of metal armour cable as an earth conductor		Understand that the use of metal armour as protective earth conductor presents certain risks of deterioration with time and caution regarding the conditions under which the metal armour may be used as protective earth instead of a separate earth conductor.

48	Assessment of load, maximum demand, diversity and diversity factor. Use of tables.		Be able to calculate and assess the loads, maximum demands, and diversity to calculate the installation requirements.
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	Cable selection, size, use of Rating Factors and Rating Tables.		Be able to calculate the type of cable to be used, considering the de-rating factors, Ci, Cg, Ca, Cr, Ch and voltage drops, and use of the tables in the BS:7671
51	Wiring systems. PVC sheathed, metal and plastic conduits. Mini trunking and skirting, cable trays and other methods.		Be aware of the various methods of cable laying, fixing and wiring installations and their adaptation for the site conditions and use.
52	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.
53	Bus-bars and trunking systems: overhead and rising mains		Understand the use of bus-bars and trunking systems in overhead and rising mains.
54	Setting of an Over-voltage protection in three phase installations		Be able to define the appropriate setting for over and/or under voltage protection.
55	RCD arrangement and discrimination in multi consumer facility in three 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.
56	Describe the need for balancing single-phase loads on three-phase systems		Understand the need for balancing of loads on a three phase system and the requirement of also monitoring and of providing protection on the Neutral of the three phase supply.
57	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.
58	Under floor duct systems		Be aware of the requirements and precautions of an under floor duct system.
59	IET requirements for conductor joints and terminations. Common joints and terminations, particularly for high current carrying cables.		Understand the different methods of cable jointing and cable terminating, be able to perform them and apply the appropriate method.

60	Requirements for standby generators in three phase		Understand the protection and location requirements for standby generators, e.g. change over switching.
61	Requirements for grid connected generators in three phase (PV installation not within the scope of this course, refer to the PV Installer's courses)		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)
62	Requirements for three phase motor loads		Understand the regulatory requirements for motor power capacities and the type of a.c. motor starters that are allowed.
63	Possibilities of including arc fault detection devices		Understand the use and requirements where to use arc fault detection devices
64	The assessment whether to include surge protection devices and what type.		Understand the protection requirements and be capable of defining the risks of occurrences of damages done through electromagnetic disturbances as voltage disturbances.
65	Designing for non-automatic local and remote isolation for prevention of dangers, or switching for control of circuits and equipment.		Understand the requirements of these switching schemes.
66	The requirements of particular cabling erection methods in fire emergency escape routes.		Understand the requirements of the wiring installation methods in critical passage ways in case of emergency and fire.
67	The requirements of onshore units of electrical shore connections for commercial navigation vessels (not marinas)		Understand the requirements of the power supplies erection close to the shore for providing electricity to large commercial vessels.
	M6 - Earthing		
68	Methods of earthing and types of earth electrodes.		Understand the methods and principles of earthing and the various types of earthing electrodes.
69	Earth fault currents, touch voltages, earth leakage currents, and prospective earth fault current.		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.

70	The TT- system		Be able to describe the TT-system earthing method (earthing system used in Malta) and be aware of the other types of earthing methods. Be able to describe the testing method of an earth system after installation.
71	Earthing in industrial facilities		Be able to design , install and test an earth system for industrial applications and the need to have one common earth reference point for safety reasons
72	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		
73	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, photovoltaic, 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.
74	Requirements where automatic re-closing protective devises are used.		Understand the special requirements and competences where auto re-closing protective equipment is used.
	M8 - Metering		
75	Methods of extending the range of instruments by shunts and multipliers, VT's and CT's		Understand the methods of wiring voltmeters and ammeters and the methods of protecting them and extending their range.
76	Simple calculations on range extension of ammeters and voltmeters		Be able to calculate the values and parameters of the added components to extend the ranges of the meters.
77	Draw and describe the use of current transformers and voltage transformers including selector switches and precautions to be taken		Be able to design the configuration to include voltmeters and ammeters in order to monitor phase and line voltages, and phase line and neutral currents, with related metering protective equipment.
78	The use of three-phase energy meters and maximum demand meters		Understand the application of the three-phase energy meters and maximum demand meters.

79	Describe the need to measure the current in the Neutral line in a 4 wire three phase supply, and the influence on the Neutral due to harmonics.		Understand the requirement for the monitoring of Neutral currents in a three phase supply, and the effect of harmonics generated by particular loads.
	M9 - Documentation & maintenance		
80	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. Prepare a bill of quantities
81	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.
82	Describe maintenance requirements for switchgear, transformers and electrical machines		Understand the routine maintenance requirements to be carried out and recommended for the installation, protection and related equipment.
83	Describe planned maintenance routines, the use of inspection lists and manufacturers' recommendations.		Be able to propose a maintenance schedule to the consumer, as per regulations and manufacturers' recommendations.
84	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.
85	Obligations to the customer, documentation and recommendations		Understand the obligations to the consumer, the requirements to provide documentation, correct labelling, maintenance schedules and recommended re-certification requirements, and be aware to self document the installation endorsed by both parties for any future references, particularly in case of future extensions or alterations.