



Government of Karnataka
DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Program	Electrical & Electronics Engineering	Semester	5
Course Code	20EE54I	Type of Course L:T:P	Integrated 104:52:312
Specialization	ELECTRICAL UTILITY ENGINEERING	Credits	24
CIE Marks	240	SEE Marks	160

Introduction:

The electrical power generated at the generating stations is utilized at the load end by various electrical utility equipment in the industries. Efficient utilization of electrical energy contributes to industrial growth and nation's economy. A good electrical wiring system and utility equipment are essential components for normal functioning of any type of industry. Poor design, installation, operation and maintenance of utility equipment would result in loss of electrical energy, frequent breakdowns and non-availability of service of the equipment. This course aims at developing technical skills in the students to operate, monitor, maintain and ensure healthy working condition of the most commonly used utility equipment in industries.

Pre-requisite

Before the start of this specialisation course, student shall have prerequisite knowledge gained in the first two years on the following subjects:

1st year – Engineering Mathematics, computer Aided Engineering Graphics, Fundamentals of Electrical and Electronics Engineering and Basics of Electrical power system, Communication Skills, Statistics & Analysis, Basic IT Skills, Project Management skills and Residential wiring.

2nd year- Transformers and Alternators, Transmission and Distribution, Switchgear and Protection, Analog and Digital electronics, Electrical motors, Power electronics, Fundamentals of Automation Technology and Computer Aided Electrical Drawing.

In the third year of study, student shall be applying previous years learning along with specialised field of study into projects and real-world applications.

Course Cohort Owner

A Course Cohort Owner is a faculty from the core discipline, who is fully responsible for one specialised field of study and the cohort of students who have chosen to study that specialised field of study.

Guidelines for Cohort Owner

1. Each Specialized field of study is restricted to a Cohort of 20 students which could include students from other relevant programs.
2. One faculty from the Core Discipline shall be the Cohort Owner, who for teaching and learning in allied disciplines can work with faculty from other disciplines or industry experts.
3. The course shall be delivered in boot camp mode spanning over 12 weeks of study, weekly developmental assessments and culminating in a mini capstone.
4. The industry session shall be addressed by industry subject experts (in contact mode/online / recorded video mode) in the discipline only.
5. The cohort owner shall be responsible to identify experts from the relevant field and organize industry session as per schedule.
6. Cohort owner shall plan and accompany the cohort for any industrial visits.
7. Cohort owner shall maintain and document industrial assignments, weekly assessments, practices and mini project.
8. The cohort owner shall coordinate with faculties across programs needed for their course to ensure seamless delivery as per time table
9. The cohort owner along with classroom sessions can augment or use supplemental teaching and learning opportunities including good quality online courses available on platforms like Karnataka LMS, Infosys Springboard, NPTEL, Unacademy, SWAYAM , etc.

Course outcome:

On successful completion of the course, the students will be able to:

C01	Perform routine checks on most commonly used electrical utility equipment and carry out maintenance work as per schedule.
C02	Design electrical wiring system for commercial and industrial installations, Co-ordinate with consultants and contractors during implementation stages, Identify electrical faults in electrical wiring system and initiate repair work.
C03	Design LT distribution panels as per IS and IEC standards, Generate BOM (Bill Of Materials), wire up, test and commission it. Read electrical control wiring drawings of AMF, MCC, APFC control panels, wire up and test the control panels.
C04	Identify firefighting system equipment, select and operate the appropriate class of fire extinguishers, test for the normal working condition of electrical equipment related to the firefighting system. Identify STP, ETP and rainwater harvesting equipment, operate and maintain them.
C05	Install and test UPS system, computer LAN and CCTV surveillance. Select and interface smart meters to computer network. Operate EMS (Energy Management System) and Solar power generation monitoring software. Interpret the data from EMS.

Detailed course plan

Week	C O	P O	Day	1 st session (9am to 1 pm)	L	T	P	2 nd session (1.30pm to 4.30pm)	L	T	P
1	1,2,3,4,5	2,3,4	1	Introduction to types of industries- <ul style="list-style-type: none"> Broad classification. Industry 4.0 concept. Introduction to most commonly used utility equipment in the industries. Meaning and Importance of utility engineering and management. Introduction to IS, IEC, NEC - related standards and their significance. Introduction and Significance of IE rules and ACT Functions of -Central Electricity and State Electricity Authorities. Introduction to various ISO certifications and their significance - <ul style="list-style-type: none"> ISO 9001:2015- QMS (Quality Management System) , ISO 14001:2015- EMS- Environment Management System, ISO 45001:2018-OHSMS- Occupational Health and Safety Management system, ISO 8000:2014 SA- Social Accountability, ISO 27001:2013- ISMS- Information Security Management System. 	4			Draw the layout of any large scale factory showing – security room, entrance gate, exit gate, parking, transformer substation, DG power plant, LT room, UPS room, computer network server room, office, Engineering department design department, purchase department, accounts department, canteen, board room, production line, packing section, dispatch section, fire hydrant pumping station, solar power plant, rain water storage and pumping station , STP,ETP, earth pits etc. Functions of each department. <p>Note: This would give an idea about overall industrial setup and understanding of role of engineering department.</p>	1		2

			<p>Concept of TQM, Functions, Features, Elements and tools of TQM-kaizen, 5S and six sigma.</p> <p>Sustainability development goals.</p> <p>Industrial Electrical Safety</p> <ul style="list-style-type: none"> • Causes and prevention of electrical accidents. • General safety practices. • Precautions to be taken during electrical repair and maintenance work. <p>Ref :2</p>						
2,3,4	1,2,3,4,5	2	<p>Electrical Maintenance Department- Objectives,</p> <ul style="list-style-type: none"> • Functions of maintenance department, • Fundamentals of maintenance. • Duties and Requirements, • Maintenance records. <p>Preparation of technical details for maintenance work, job card and log book. Machine History Card. Ref:2</p> <p>Role of maintenance department as related to satisfying the requirements from various boards/departments essential for operating an industry- Fire and Safety, Pollution control board, BWSSB, BBMP, ESCOM, Electrical Inspectorate etc.</p>	4		Identify and demonstrate the use of industrial electrician tools and meters- basic tools, megger, earth tester, lux meter, db meter, thermography meter, smart meters with communication port.	1		2
	1,5	3	<p>Design thinking What is design thinking? 5 steps of Design Thinking. Ref.7a,b</p>	1		3 Examples of design thinking Ref.7d,e,f			3

				Why is design thinking so important? Ref.7c												
	1,5	4		Applying Design Thinking to Sustainable Energy Ref.7.i	1		3	How can 'Design Thinking' help utilities prepare for a new energy future? Ref.7.g Reinventing solar energy supply for rural Africa Ref.7.h.						1	2	
		5		Developmental Assessment	-	-		Assessment Review and corrective action							3	
		6		Industry Class and assessment	2		3									
Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)						L	T	P
2	1	2,3,4	1	Peer discussion on Industrial assignment		4		Sources of power supply in industries- ESCOM, DG Set And On Grid Solar PV Power Plant. Case study : Study the capacity of sources of power supply of anyone industry						2		1
	1	2,3,4	2	TRANSFORMER SUBSTATION- Types, Components of transformer substation. Selection of substation transformer capacity as per load requirements. Introduction to compact /packaged substation-construction. Name plate details of the transformer Selection of cable size of cables on primary and secondary side. Purpose of Spare incomer cable. List the accessories and fitments on a power transformer with their functions - WTI, OTI, OLI. Transformer neutral grounding and floating neutral and if effects. Preventive Maintenance of power transformer. Causes of transformer failure. Recommended maintenance schedule as per IS.	2		2	Familiarize with HT metering panel switchgears, components and their function. Note down the specifications. Transformer substation maintenance- Do various periodic checks on transformer substation. Tap changing (on/offload) and its operation. Ref :1 (Perform the experiment on disconnected old transformer if available at the campus)						1		2

				Preventive Maintenance of transformer oil and breather. Minimum breakdown values of transformer oil. Ref:2 Transformer oil filtration.						
	1	2,3,4	3	DIESEL GENERATOR SET - various devices / accessories and their function, fuel system, lubrication system, exhaust system. select suitable capacity as per load requirements, daily, weekly and monthly checks. Demonstrate operation of AVR Automatic Voltage Regulator and Electronic governing system. Function of turbocharger, AMF panel- concept, components, Block diagram and operation	2		2	Carry out maintenance work on DG set- check radiator water level, engine oil level, battery condition, AVR (automatic voltage regulator). crank and check for normal working condition. Simple trouble shooting. Visit nearby industry with diesel power plant with at least 1000 KVA capacity.		3
	1	2,3,4	4	Auto Electrical System - Wiring diagram and its working. Testing of AVR Testing of batteries.	2		2	Connect and test AVR of DG set. Check the batteries condition and Conduct load test on batteries.		3
			5	Weekly Assessment	-	-	-	Assessment Review and corrective action	-	3
			6	Industry Class and assessment	2		3			
3	1	2,3,4	1	Peer discussion on Industrial assignment		4		SOLAR HYBRID POWER PLANT - Components of solar PV ON Grid power plant and their specifications. Difference between ON grid and OFF grid Solar PV power plant. Design of solar photo-voltaic on grid power plant, monitoring energy generation. Testing and maintenance of solar PV power plant.	1	2

	1	2,3,4	2	Design a solar photo-voltaic on-grid power plant for a given roof area- No of solar panels, wiring, metering and controls. Measure kWp power generation.	1		3	Case study: Visit any industry with ON grid Solar PV power plant and prepare a report. Setup a small solar standalone power unit, connect solar panel, MPPT controller, batteries, inverter and test it. Testing and maintenance work of solar panels.		3
	1,5	2,3,4	3	INDUSTRIAL UPS SYSTEM- Types of UPS, Sizing of UPS capacity, battery type and battery backup as per load requirement. Sizing of battery connecting cables/jumps. Trouble Shooting of 3 phase UPS system.	1		3	Case study: Visit industry, note down the capacity, DC voltage and current ratings, connected load on UPS, Maintenance details and prepare a report on UPS system installed in that industry.		3
	1,5	2,3,4	4	Install and test any small capacity UPS system.			4	Install and test any small capacity UPS system.		3
			5	CIE 1- Written and practice test	-	-	-	Assessment Review and corrective action		3
			6	Industry Class + Assignment	2		3			
4	1,3	2,3,4	1	Peer discussion on Industrial assignment			4	LT DISTRIBUTION PANEL- Design a simple LT distribution panel as per load requirements consisting of metering section, indicators, digital meters-ammeter, voltmeter, trivector meter/multifunction meter, isolators, ct, busbar chamber, cable alley chamber, MCCB linked with ELR. Design factors to be considered, related IS standards. Draw SLD as per standard. Selection of power contactors, auxiliary contactors, protective devices, size of control circuit wire, power circuit wire, busbar rating, MCCB, Air Circuit Breaker. design factors to be considered Applicable standards.		3
	1,3	2,3,4	2	ACB (Air Circuit Breaker) with Motorized spring charging - Parts of ACB, control circuit and its working.			4	Prepare GA diagram and SLD using CAD. Design metering section.	1	2

				EXAMPLE : Design a main LT distribution panel for the following load requirements in a factory. <ul style="list-style-type: none"> • Machineshop-10 HP load, • Borewell pump-5HP x 2nos, • Office with 20 computers, • Office lighting – 1 kw, • Floor lighting for 3 floors • Street light in premises– 2 kw • Painting section - 5 KW • Lift – 5HP Estimate the cost of above LT panel.			Selection of cables, wire sizes, switchgears and accessories. Automatic phase sequence corrector, SPP, OV, UV protection, ELR, Prepare Bill Of Materials with Specifications Note: standard sizes of lt panels with standard cuttings for meters, indicators, isolators, MCB,MCCB etc.. are available in the market. One may choose any LT distribution panel matching with their requirements, wireup and test it ref: Annexure			
		2,3,4	3	Mount the components on the panel		4	Wire-up the power circuit of LT panel and test			3
		2,3,4	4	Wire-up the control circuit of LT panel and test		4	Wire-up the control circuit of LT panel and test			3
			5	Developmental Assessment			Assessment Review and corrective action			3
			6	Industry Class:	2	3				
5	1,3	2,3,4	1	Peer discussion on Industrial assignment	-	4	-	CONTROL PANELS – Main types and their function-PCC, MCC, AMF, APFC, Design factors to be considered, Applicable IS and IEC standards. Study and read simple control panel drawings. List the control panel components. List control wiring accessories with their specifications. Preparation of ferrule numbers as per standard practice. Selection of control panel components, their ratings and wire sizes.	2	1

	1,3	2,3,4	2	Design a simple AMF panel- Prepare the GA diagram, SLD and control wiring drawings as per standard practice using CAD.	1		3	Design a simple AMF panel- Prepare the GA diagram, SLD and control wiring drawings as per standard practice using CAD.			3
	1,3	2,3,4	3	Design a simple AMF panel- Design the cubicle as per standards.	1		3	Design a simple AMF panel- select the switchgears and its ratings as per load requirement.			3
	1,3	2,3,4	4	Design a simple AMF panel- Generate the BOM.	1		3	Design a simple AMF panel- Generate the BOM.			3
			5	CIE 2- Written and practice test	-	-		Assessment Review and corrective action			3
			6	Industry Class:	2		3				
Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 nd session (1.30pm to 4.30pm)	L	T	P
6	1,3	2,3,4	1	Peer discussion on Industrial assignment		4		Design a simple AMF panel- Mount the switchgear and accessories			3
			2	Design a simple AMF panel- Mount the switchgear and accessories			4	Design a simple AMF panel- wire up the panel as per the electrical drawings			3
	1,3	2,3,4	3	Design a simple AMF panel- Wire up the panel as per the electrical drawings.			4	Design a simple AMF panel- Test the panel.			3
	1,3	2,3,4	4	Visit nearby industry and prepare a report on PCC, MCC, APFC panel, Fire hydrant pump control panel, STP and ETP control panel.			4	Visit nearby industry and prepare a report on PCC, MCC, APFC panel, Fire hydrant pump control panel, STP and ETP control panel.			3
			5	Developmental Assessment	-	-	-	Assessment Review and corrective action			3
			6	Industry Class:	2		3				
7	1,2	2,3,4	1	Peer discussion on Industrial assignment		4		INDUSTRIAL WIRING- Identify and list the industrial range electrician tools, cabling/wiring accessories. Note down the specifications.	1		2
	1,2	2,3,4	2	INDUSTRIAL WIRING-	1		3	INDUSTRIAL WIRING-	1		2

				Busbar trunking and rising mains, Design of LT distribution system for a given factory layout or an apartment per applicable standards.				Lighting – Design lux levels as per standards, Design energy efficient illumination for the given factory layout or an apartment, Design lighting circuit and its distribution board. Methods to reduce energy consumption towards lighting.			
	1,2	2,3,4	3	Design the conduit layout for lighting circuit using cad as per standards.	1		3	Design the conduit layout for lighting circuit using CAD as per standards.			3
	1,2	2,3,4	4	Prepare the BOM for lighting circuit.	1		3	Estimate the cost for industrial wiring for lighting circuit.			3
			5	CIE 3 Written and practice test	-	-	-	Assessment Review and corrective action			3
			6	Industry Class:	2		3				
8	1,2	2,3,4	1	Peer discussion on Industrial assignment	-	4	-	Power circuit- Design power circuit for power outlets as per requirement for the given factory layout. Design suitable distribution panels, select suitable size of cables, protective devices and switch gears. Applicable standards			3
	1,2	2,3,4	2	Design the conduit layout/cable tray layout for power circuit using CAD as per standards.	1		3	Prepare the BOM for power circuit.	1		2
	1,2	2,3,4	3	INDUSTRIAL PUMPS- Types and their application Select borewell pump for a given discharge and head. Identify types of valves and their applications.	1		3	Connect a 3 phase, 415 v, 3 ph bore well or open-well submersible pump with suitable starter. Interconnect 3ph starter and 3 phase automatic water level control. Manually simulate and test for normal operation Dis-assemble any one type of motor pump set, identify the parts, service, re-assemble and test			3

								Note: The above experiment setup shall be done indoor and tested.			
	1,2	2,3,4	4	Connect a 3 phase, 415 v, 3 ph. bore well or open well submersible pump with suitable starter. Interconnect 3ph starter and 3 phase automatic water level control. manually simulate and test for normal operation Dis-assemble any one type of motor pump set, identify the parts, service, re-assemble and test	1		3	EARTHING SYSTEM in industries and its maintenance. Earth mats, Standard values. Testing and maintenance of earth pit, methods of reducing earth resistance, equipment earth, neutral earth, power circuit earthing, lightening arrestor earthing, Visit nearby industry and prepare a report on LT distribution system, lighting system, power circuit and earthing system.	1		2
		5	Developmental Assessment			-	-	-	Assessment Review and corrective action		3
		6	Industry Class:			2		3			
9	1,2	2,3,4	1	Peer discussion on Industrial assignment		4		COMMUNICATION AND COMPUTER NETWORK- Computer network components / devices/accessories, list of materials and their specification.	1		2
	1,2	2,3,4	2	COMMUNICATION AND COMPUTER NETWORK- Meaning of data communication and computer network, OSI layers, types of network and their applications, classification of network architectures, networking devices/components-workstation, Hub, Bridge, Repeater, switch, router, server...server types, networking terminologies...subnet, internet, intranet, ethernet, bandwidth, IP address, TCP/IP, LAN, WAN, CAN,	2		2	Wired networking cables-category 3/5/6/6A/7 and their standards and speeds. Fibre optical cables- General construction, working and application. Crimping exercise- LAN network cable and RJ45 connector.	1		2

				WLAN,MAN,SAN, firewall, functions of router, network topologies and their application, Communication protocols and their applications- RS232, RS485, modbus, profibus and BACnet. Prepare the list of materials with specifications to set up a LAN for an office or a computer lab with 20 computers							
	1,2	2,3,4	3	Design and setup LAN for an office or computer lab with 20 computers. Select suitable network switch, cable. Connector and power supply. Connect, configure and test the LAN	1		3	Design and setup LAN for an office or computer lab with 20 computers. Select suitable network switch, cable. Connector and power supply. Connect, configure and test the LAN			3
	1,2	2,3,4	4	CCTV SURVELANCE- Types and applications, components / devices required and their specifications. Design CCTV surveillance system for a given layout of an industry, Select - DVR, NVR, type of camera, coaxial cable and display unit. Design conduit layout and cabling system. List the materials and estimate their cost	2		2	Connect DVR, Power Supply, Camera, Configure and Test CCTV by rigging up on the work table in the laboratory.	1		2
			5	CIE 4 Written and practice test	-	-	-	Assessment Review and corrective action			3
			6	Industry Class:	2		3				
10	1,2	2,3,4	1	Peer discussion on Industrial assignment		4		LIFTS- Types, construction and working, major components, type and specification of motor, essential spares, controllers operation and	3		

							maintenance. selection of lifts capacity as per requirement, and erection procedures.			
	1,2	2,3,4	2	ESCALATORS- construction and working, major components, type and specification of motor, operation and maintenance. INDUSTRIAL OVERHEAD CRANES- construction and working, major components, type and specification of motor. Operation and maintenance. Controller, type of motor and specifications.	2	2	General maintenance and servicing of lifts, escalators and cranes. simple trouble shooting Visit nearby industry and document the details found. Ref: 3	1		2
	1,2	2,3,4	3	HVAC EQUIPMENT- Block diagram, Main components, construction, operation and maintenance of centralized air conditioning plant ,chillers, AHU, FCU, blowers, compressors , condensers, cooling tower etc.. note down the specification of all the above components. Methods to reduce energy consumption towards HVAC.	2	2	Visit nearby industry and document the details found.			3
	1,2	2,3,4	4	Visit nearby industry and document the details found.		4	Visit nearby industry and document the details found.			3
			5	Developmental Assessment			Assessment Review and corrective action			3
			6	Industry Class:	2	3				
11	1,2,4	2,3,4	1	Peer discussion on Industrial assignment	-	4	- FIRE FIGHTING SYSTEM- Causes of fire, type and class of fire extinguishers their application. installation of smoke detectors, heat sensors. fire annunciation and alarm panel.	3		

							PA system, fire hydrant system-sprinklers, water curtain, water jet/spray,			
1,2,4	2,3,4	2	Selection of main pump, jockey pump. Starter control panel Select DG set capacity for fire hydrant pump as per requirements Operation and Maintenance. Draw the layout of fire hydrant system pump house for a given shopping complex or a factory layout.	2		2	Read the electrical drawings of the power circuit and control circuit of fire hydrant pumps. Draw the wiring layout of smoke detectors. Draw the wiring layout of PA system. Procedure for testing of fire hydrant system. Connect and test -smoke detector, heat sensor, fire console, PA system etc..	1		2
1,2,4	2,3,4	3	RAIN WATER HARVESTING SYSTEM- Components of rain water harvesting system. Pumping station- selection of pump. method of measuring rainfall , available rain water collection and storage. Design simple rain water harvesting system depending on the land area of the industry. List the materials required with their specification.	2		2	Visit nearby industry and prepare a report on the firefighting system and rain water harvesting system. Prepare a detailed report on volume of water collected during a year. Co-relate water consumption from bore well with and without rain water harvesting			3
1,2,4	2,3,4	4	STP AND ETP PLANT- Block diagram, construction and working. Components of STP and their functions. Components of ETP and their functions. Operation and Maintenance of STP and ETP	4			Visit nearby industry and study the operation and maintenance of STP and ETP. Co-relate amount of fresh water saved due to recycling the water. Prepare a report.			3
		5	CIE 5 Written and practice test	-	-		Assessment Review and corrective action			3
		6	Industry Class:	2		3				

12	1,5	2,3,4	1	Peer discussion on Industrial assignment	-	4	-	Energy Management System (EMS)- Energy flow in industries -General block diagram, Components and their functions. Building Automation System (BAS)/Building Management System (BMS)-General Block diagram ,Components and their functions. Merits and Demerits of BAS/BMS IOT- Components and their functions. Applications of IOT in industries.	3		
	1,5	2,3,4	2	Install any open source software, interface hard ware with software, read current, voltage, power, energy , power factor and display the energy generated by various sources in form of graph and pie chart	2		2	Install any open source software, interface hard ware with software, read current, voltage, power, energy , power factor and display the energy generated by various sources in form of graph and pie chart			3
	1,5	2,3,4	3	ENERGY MANAGEMENT – Meaning, need, Approaches and General principles. ENERGY AUDIT -Meaning, Types, Pre-requisites, methodology/procedure, scope of energy audit. Data collection and Data Analysis. General formats used for energy audit. Energy Management opportunities in industrial lighting and heating.	4			Note down the type, ratings of domestic appliance- electric iron, geyser, fan, food mixer, washing machine. Identify the type of motors used in domestic appliances.			3
	1,5		4	Conduct energy audit of home / college campus/any one industry Collect the details in a standard format. Compare energy consumption with energy bill. Suggest suitable remedies to reduce energy consumption and energy bill.	1		3	Introduction to AMC. (Annual Maintenance Contract) Need for AMC, Scope of AMC for major equipment like AMC for UPS system AMC for DG set AMC for HVAC AMC for Elevators			3

								Case study: visit near by industry , note down various AMC details and submit a report.			
			5	Developmental Assessment				Assessment Review and corrective action			3
			6	Industry Class:	2		3				
Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 nd session (1.30pm to 4.30pm)	L	T	P
13	1,2,3,4,5	2,3,4		Internship a) Secondary research on various industries and their operations to identify at least 3 companies along with the areas of work interest and develop an internship plan that clearly highlights expectations from the industry during the internship. b) Design and develop a cover letter for an internship request to all 3 identified companies and the resume to be submitted to potential companies. c) Prepare for an internship interview to highlight your interests, areas of study, career aspirations and personnel competence – including the areas of learning you expect to learn during internship			4	Project a) Identification of the problem statement (from at least 3 known problems) the students would like to work as part of the project – either as provided by faculty or as identified by the student. Document the impact the project will have from a technical, social and business perspective. b) Design and develop the project solution or methodology to be used to solve at least one of the problems identified. Prepare a project plan that will include a schedule, WBS, Budget and known risks along with strategies to mitigate them to ensure the project achieves the desired outcome.			3

References:

Sl No	Description	Reference / Link
1	Building Electricals design	Electricity in buildings, GOOD PRACTICE GUIDE, International Copper Association India. – McGrawHill
2	Maintenance of electrical equipment	Installation Maintenance and Repair of Electrical Machines and Equipments by Madhvi Gupta- KATSON BOOKS.
3	Electrical system design	Electrical system design- T. Giridharan – wiley publication

4	Electrical Installation for Modern Buildings	Electrical Installation for Modern Buildings- M.P. krishna Pillai- Standard Publishers and Distributors https://s3.ap-south-1.amazonaws.com/aipnpc.org/downloads/T_5052_ENERGY_EFFICIENCY_IN_ELECTRICAL_UTILITIES_BOOK_03.pdf
5	Energy Efficiency in Electrical Utilities	https://mppolytechnic.ac.in/mp-staff/notes_upload_photo/CS595EnergyEfficiencyinElectricalUtilities-5391.pdf
6	Electrical Power Distribution	Hand book of Electrical Power Distribution by Gorti Ramamurthy , Universities Press
7	Operation and maintenance of Transformers	Operation and maintenance of Transformers – hand book by H N S Gowda, published by H N S Gowda , No. 98, 7 th A main, 3 rd Block, 4 th stage Basaveshwaranagar, Bangalore 560079. Phone: 080-23203070
8	Electrician tools	https://www.youtube.com/watch?v=PAPPwrCPIqg
9	Design thinking	a. https://careerfoundry.com/en/blog/ux-design/design-thinking-examples/ b. https://online.hbs.edu/blog/post/design-thinking-examples c. https://www.healing-power-of-art.org/positive-art-news-creativity-turns-scary-mri-scanner-for-kids-into-an-adventure/ Examples of design thinking d. https://careerfoundry.com/en/blog/ux-design/design-thinking-examples/ e. https://online.hbs.edu/blog/post/design-thinking-examples f. https://www.healing-power-of-art.org/positive-art-news-creativity-turns-scary-mri-scanner-for-kids-into-an-adventure/ g. https://www.linkedin.com/pulse/how-can-design-thinking-help-utilities-prepare-new-energy-singh h. https://thisisdesignthinking.net/2016/05/reinventing-solar-energy-supply-for-rural-africa/ i. http://innodigest.com/design-thinking-to-sustainable-energy/
10	Compact substation	https://www.youtube.com/watch?v=3Yo_g_WfQSS
11	Transformer substation SLD	https://www.youtube.com/watch?v=wlgcF4ynTB8
12	AVR wiring of DG set	https://www.youtube.com/watch?v=82BsoaVKKBw https://www.youtube.com/watch?v=3FCBovUH0-M
13	DG set governor	https://www.youtube.com/watch?v=TGpAH1W-0ss
14	DG set maintenance	https://www.youtube.com/watch?v=JCv_uR4FqHM https://www.youtube.com/watch?v=gZzBhXQjY8

15	DG starting problem	https://www.youtube.com/watch?v=XwvPq_0WFjA
16	Automatic changer over switch for DG set	https://www.youtube.com/watch?v=PnIVNb2l524
17	Automatic change over switch	https://www.youtube.com/watch?v=-QjPlnwErTE https://www.youtube.com/watch?v=-QjPlnwErTE
18	Solar inverter connection diagram	https://www.youtube.com/watch?v=x-05gKrdg3U
19	Solar power calculation	https://www.youtube.com/watch?v=4WAgQ_19B5k
20	Solar grid tie system	https://www.youtube.com/watch?v=WuXcuQSToTE
21	Types of control panel	https://www.youtube.com/watch?v=tDhy72peJ0
22	How to Read Electrical Diagrams	https://www.youtube.com/watch?v=GHhcyH99inE
23	How to Read Electrical Schematics	https://www.youtube.com/watch?v=Et-gHKTdzuU
24	AMF panel	https://www.youtube.com/watch?v=X2fL8AV2fV4 https://www.youtube.com/watch?v=tidxKmtUBBE https://www.youtube.com/watch?v=4KvRnkuswD0 https://www.youtube.com/watch?v=0s5XBMfawlk
25	Contactor selection and sizing	https://www.youtube.com/watch?v=loIsOKQWjSY
26	Cable size calculation	https://www.youtube.com/watch?v=z7kArhBowxg
27	Different Types of Electrical Wires and Cables	https://www.electricaltechnology.org/2020/04/types-wires-cables.html
28	HVAC system	https://www.youtube.com/watch?v=iX4-06A7bJ8 https://www.youtube.com/watch?v=ScVBPAitibQ
29	Building Management system	https://www.youtube.com/watch?v=eoUha0APBJU https://www.youtube.com/watch?v=rgk7UdEWMpQ

30	Fire fighting hydraulics calculation	https://www.youtube.com/watch?v=QcM9dWpF1-c
31	Fire sprinklers	https://www.youtube.com/watch?v=DjvcDCo-MA https://www.youtube.com/watch?v=Gmi1dTP4DMo https://www.youtube.com/watch?v=yCIIHMvQ_0 https://www.youtube.com/watch?v=osyylLey5ipU https://www.youtube.com/watch?v=1wB8WkbaXpc
32	Fire alarm system	https://www.youtube.com/watch?v=cVjyDgFrB2g
33	Fire alarm panel	https://www.youtube.com/watch?v=ui3t0PnCPRo https://www.youtube.com/watch?v=rZ_2PjskrAM https://www.youtube.com/watch?v=xmNZUPIfebE
34	Smoke detector connection	https://www.youtube.com/watch?v=ORjybbBXxRQ https://www.youtube.com/watch?v=VpKydvGn_js
35	Fire detection panel	https://www.youtube.com/watch?v=3NhSngT3LNA https://www.youtube.com/watch?v=s17FhnnwsA8
36	Classification of fire extinguishers and classes of fire	https://www.youtube.com/watch?v=yzGe_8bvSE0
37	Fire Emergency Procedures	https://www.youtube.com/watch?v=7gHEtGY4chE
38	Fire prevention at work place	https://www.youtube.com/watch?v=ReL-DM9xhpI
39	How to use fire extinguishers	https://www.youtube.com/watch?v=PQV71INDaQY
40	Computer networking	https://www.youtube.com/hashtag/networkingbasics https://www.youtube.com/watch?v=1z0ULvg_pW8
41	Network cables	https://www.youtube.com/watch?v=_NX99ad2FUA
42	IP addressing	https://www.youtube.com/watch?v=ThdO9beHhpA
43	CCTV basics	https://www.youtube.com/watch?v=e3JZWDyG6Yk
44	CCTV wiring	https://www.youtube.com/watch?v=urrj0Pnlzc0 https://www.youtube.com/watch?v=AQ1EP1_4O2w
45	RJ45 crimping	https://www.youtube.com/watch?v=SrdFw6Kunxo
46	Sewage treatment plant	https://www.youtube.com/watch?v=b0G8R2YfW5k
47	Cable tray sizing	https://www.youtube.com/watch?v=9PHN2zTNZT0
48	Electrical design for high rise buildings	https://www.youtube.com/watch?v=z6_7jpO8zPE

CIE and SEE Assessment Methodologies

CIE Assessment	Assessment Mode	Duration In hours	Max Marks
Week 3	CIE 1- Written and practice test	4	30
Week 5	CIE 2- Written and practice test	4	30
Week 7	CIE 3- Written and practice test	4	30
Week 9	CIE 4- Written and practice test	4	30
Week 11	CIE 5- Written and practice test	4	30
	On line Course work (Minimum 10 hours online course with certification from (SWAYAM/NPTEL/Infosys Springboard)		40
	Profile building for Internship / Submission of Synopsys for project work		20
Portfolio evaluation (Based on industrial assignments and weekly developmental assessment) *			30
TOTAL CIE MARKS (A)			240
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		3	60
SEE 2 - Practical		3	100
TOTAL SEE MARKS (B)			160
TOTAL MARKS (A+B)			400

* The industrial assignment shall be based on peer-to-peer assessment for a total of 10 marks (on a scale of 1 to 10) and in the event of a group assignment the marks awarded will be the same for the entire group, the developmental assessment will be for a total of 20 marks and based on MCQ/case study/demonstration and such other assignment methods

Assessment framework for CIE (1 to 5)

Note : Theory to be conducted for 1 hour and practice for 3 hours, total duration of exam - 4 hours

Programme	Electrical & Electronics Engineering	Semester	V
Course	ELECTRICAL UTILITY ENGINEERING	Max Marks	30
Course Code	20EE54I	Duration	4 hours
Name of the course coordinator			

Note: Answer one full question from each section.

Qn.No	Question	CL L3/L4	CO	PO	Marks
Section-1 (Theory) - 10 marks					
1)	Design GA diagram of an LT panel of factory with the following loads. <ul style="list-style-type: none"> • Machineshop-3 phase, 10 HP load, • Borewell pump- 3 phase 5HP x 2nos, • Office with 20 computers, • Office lighting - 1 kw, • Floor lighting for 3 floors • Street light in premises- 2 kw • Painting section - 3phase 5 KW • Lift-3 phase 5HP 	L3	1	3	10
2)	Select a suitable transformer for a factory with load of 150 HP and write its specifications	L4	1	1,2	10
Section-2 (Practical) - 20 marks					
3)	Conduct routine test on DG set and check for the normal working conditions of the DG set.	L3	1	4	20
4)	Commission and test the given UPS and batteries.	L3	1	4	20

Note : Theory questions shall be aligned to practical questions

Assessment framework for SEE 1 (Theory)

Programme :	Electrical & Electronics Engineering	Max Marks :	100
Semester :	V	Duration :	3 Hrs
Course :	ELECTRICAL UTILITY ENGINEERING		
Course Code :	20EE54I		

Instruction to the Candidate: Answer one full question from each section.

Instruction to the Candidate: Answer the following questions from each section.				
Q.No	Question	CL	CO	Marks
Section-1				
1.a)	Select a suitable DG set for an apartment with the following load requirements. <ul style="list-style-type: none">• Borewell pump – 3 HP x 2 Nos.• Sump pump – 2 HP• Lift – 5HP• Common Area lighting – 1 KW• 12 houses each with 5 KVA load	L3	1	10
b)	List the causes for voltage fluctuation in a DG set.	L4		5
c)	It was observed that all the 3 phase equipment in a factory like lifts , water pumps , lathes etc suddenly started malfunctioning after a maintenance job undertaken by the power supply company on HT line. What could be the reason for malfunction of the equipment which were working properly before maintenance work?	L3		5
2.a)	Select a suitable transformer for a factory with 150 HP load and writes its specifications.	L3	2	10
b)	While checking a transformer, it is found that the breakdown voltage of its oil is 20 KV. What are the corrective actions to be taken.	L4		5
c)	One particular phase of a 3 phase cable in a factory keeps burning often. On measuring the load current , it was found to be within the normal. range of the cable. On scanning the temperature using a thermography meter, the temperature was found to be 75 degree centigrade. What could be the reason for over heating up of the cable?	L3		5
Section-2				
3.a)	Select a suitable starter for a 5 HP submersible borewell pump set and write its specifications	L3	2	10

b)	On measuring the line current using of a 3 phase 10 HP induction motor it is observed that the current drawn is 20 A. What should the normal rated current of the motor and what should be the OLR setting on the starter.	L4		5
c)	It is observed that a raw water pump motor switches ON but the starter trips after few seconds. While the motor windings, starter and wirings are found to be in good condition, On checking the 3 phase power supply using a neon tester, the neon tester glows on both incoming and outgoing sides of fuse units at LT panel end as well as Motor Starter end. What could be the reason for motor starter tripping	L4		5
4)	Design illumination for a factory shed measuring 60 L x 15 W x 9 H. Select suitable type of light fitting, draw the arrangement of lighting points and conduit layout for wiring	L4		20
Section- 3				
5.a)	Design and draw the GA diagram of an LT panel for a factory with the following loads. <ul style="list-style-type: none"> • Machineshop-10 HP load, • Borewell pump-5HP x 2nos, • Office with 20 computers, • Office lighting – 1 kw, • Floor lighting for 3 floors • Street light in premises– 2 kw • Painting section - 5 KW • Lift – 5 HP 		3	15
b)	Draw the SLD for the above LT panel.	L3		5
6.a)	Design and draw the control circuit of an AMF panel, label the parts and mark the ferrule numbers for the wires.	L3		15
b)	Write the specification of ELR suitable for commercial building with 100 KVA load			5
Section-4				
7.a)	Draw neat block diagram of STP and explain the maintenance carried out on STP.	L3	4	10
b)	With a neat layout diagram explain fire hydrant system and its components.	L3		10
8. a)	Explain various routine tests on firefighting system equipment.	L4		10
b)	List the classes of fire and the type of fire extinguisher to be used on them.	L4		10
Section-5				

9.a)	Design an LAN system for an office with 20 computers. List the components / devices/cables/connectors etc.. required with their specifications.	L3	5	10
b)	Design an CCTV surveillance system for a factory premises to cover 10 zones including 2 outdoor/ open area zones. List the components/ devices/cables /connectors etc.. required with their specifications.			10
10.a)	Design UPS system for an office with 25 KVA load. Select the UPS capacity, type of UPS and batteries for 3 hours backup.	L3		15
b)	It was observed that the UPS is not supplying the load during power failures. List the possible causes and suggest suitable remedies.	L4		5

Scheme of Evaluation for SEE 2

Sl. No	Description	Marks
1	Demonstrate routine checks on DG set/ trouble shoot DG set electrical problems/transformer substation/Earthing system	10
2	Test and Identify faults in electrical wiring system (conduct OC, SC and Insulation resistance test on the electrical installations)	10
3	Reading of control wiring drawing and identifying control panel components/Demonstrate ferrule numbering as per standards	10
4	Tracing and testing control wiring of LT control panel/AMF panel/APFC panel.	10
5	Install and test – 3 phase Submersible pump starter with water level controller /UPS system/ CCTV/LAN/ fire alarm/annunciation panel a. Circuit diagram and Procedure= 15 b. Connection =25 c. Testing =10 Note : the above experiment may be setup on table and demonstrated	50
6	Select appropriate fire extinguisher and operate / Demonstrate operation of firefighting control panel/ PA system/Alarm/Annunciation panel.	10
Total		100

Equipment/Software list with Specification for a batch of 20 students

Sl. No.	Description of the equipment/ Hardware/ Software	Specification	Total Quantity Required (A)
1	Digital megger	1000 V	2
2	Digital earth tester	1000 V	2
3	Hand driven megger	2500 V	2
4	Hand driven earth tester	1000 V	2
5	Lux meter	Any Basic model	2
6	Sound level meter	Any Basic model	2
7	Thermography meter	Any Basic model	1
8	Hydraulic crimping tool	16 to 400 sqmm	2
9	LT Distribution panel with 200 A MCCB, ELCB, 200 A Isolator -4 nos, 32 A TPMCB 2 Nos, 16 A DP MCB 4 Nos. Digital meters- Ammeter, Voltmeter, Multifunction meter	set	1
10	AMF panel with ACCL and meters	Basic features	1
11	APFC Panel with Capacitor bank	3 ph 6 KVAR	1
12	Fire hydrant pump control panel	5 HP	1
13	Fire alarm control panel	8 zones	1
14	Fire PA system	8 zones	1
15	CCTV demonstration set	4 channel DVR with power supply cameras etc..	1
16	Computer Networking demo set	set	1
17	Network cable tester	Any Basic model	2
18	Miscellaneous items.. tool set, basic meters ...		2
19	Basic Industrial Tools, Meters-Thermography meter, Lux meter, DB meter, Megger, Earth tester, smart meters and PPE kit		
20	Solar PV standalone demonstration setup.	3kW	2
21	AVR and electronic governor of DG set		2

22	Any Small capacity UPS with batteries.	Upto 1 KVA capacity	2
23	Firefighting- smoke detector, Heat sensor, simple -PA system, Alarm console, fire hydrant pump control panel.		2