

# GUJARAT TECHNOLOGICAL UNIVERSITY

## ELECTRICAL ENGINEERING (09) UTILIZATION OF ELECTRICAL ENERGY AND TRACTION SUBJECT CODE: 2160907 B.E. 6<sup>th</sup> SEMESTER

**Type of Course:** Engineering Science (Power Electronics)

**Prerequisite:** NA

**Rationale:** This subject assumes importance in view of the fact that a technician has to work in a wide spectrum of activities wherein he has to make collections from alternative schemes from technical and economic considerations i.e. to plan and design using basic principles and handbooks, to select equipment, processes and components in different situations. The curriculum has been designed keeping the above objectives in view.

Besides giving him basic knowledge in the topics concerned, attempts have been made to ensure that the knowledge acquired is applied in various fields as per his job requirements. To orient the subject matter in the proper direction, visits to industrial establishments are recommended in order to familiarize the students with the new developments in different areas.

### Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
		PA	ALA		ESE	OEP				
3	0	0	3	70	20	10	0	0	0	100

### Content:

Sr. No.	Content	Teaching Hours	% Weight age
<b>1.</b>	<b>Electric Drives:</b> <ul style="list-style-type: none"> <li>Advantages of electric drives, Characteristics of different mechanical loads, Types of motors used in electric drive,</li> <li>Electric braking, Plugging, Rheostat braking, Regenerative braking, Methods of power transfer by direct coupling by using devices like belt drive, gears, pulley drives etc.</li> <li>Examples of selection of motors for different types of domestic loads</li> <li>Selection of drive for applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane, lift etc. Application of flywheel.</li> <li>Specifications of commonly used motors e.g. squirrel cage, slip ring induction motors, AC series motors, FKW motor</li> </ul>	10	10-20
<b>2.</b>	<b>Illumination:</b> <ul style="list-style-type: none"> <li>Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light,</li> <li>Different type of lamps, construction and working of incandescent and discharge lamps – their characteristics, fittings required for filament lamp, mercury vapour lamp, fluorescent lamp, metal halide lamp, neon lamp</li> <li>General ideas about street lighting, flood lighting, monument lighting and decorative lighting, light characteristics etc., LED Lighting</li> </ul>	04	10-15
<b>3.</b>	<b>Electric Heating:</b> <ul style="list-style-type: none"> <li>Advantages of electrical heating, Heating methods</li> </ul>	12	20-30

	<ul style="list-style-type: none"> <li>Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances and thermostat control circuit</li> <li>Induction heating; principle of core type and coreless induction furnace</li> <li>Electric arc heating, direct and indirect arc heating, construction, working and applications of arc furnace</li> <li>Dielectric heating, applications in various industrial fields</li> <li>Infra-red heating and its applications</li> <li>Microwave heating, Simple design problems of resistance heating element</li> </ul>		
4.	<b>Electric Welding:</b> <ul style="list-style-type: none"> <li>Advantages of electric welding</li> <li>Welding methods, Principles of resistance welding, types – spot, projection seam and butt, welding and welding equipment used</li> <li>Principle of arc production, electric arc welding, characteristics of arc, carbon arc, metal arc, hydrogen arc welding and their applications</li> <li>Power supply required</li> <li>Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits, welding of aluminium and copper, Introduction to TIG, MIG welding</li> </ul>	8	10-15
5.	<b>Electrolytic Processes:</b> <ul style="list-style-type: none"> <li>Need of electro-deposition, Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing, buffing</li> <li>Equipment and accessories for electroplating, Factors affecting electro-deposition</li> <li>Principle of galvanizing and its applications, Principle of anodising and its applications</li> <li>Electroplating on non-conducting materials</li> <li>Manufacture of chemicals by electrolytic process and electrolysis process</li> </ul>	6	10-15
6.	<b>Electrical Circuits used in Refrigeration, Air Conditioning and Water Coolers:</b> <ul style="list-style-type: none"> <li>Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants</li> <li>Description of Electrical circuit used in refrigerator, air conditioner and water cooler</li> </ul>	4	10-15
7.	<b>Electric Traction:</b> <ul style="list-style-type: none"> <li>Electric traction, Advantages of electric traction</li> <li>Different systems of electric traction, DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main lines and their speed-time curves</li> <li>Different accessories for track electrification such as overhead capacitor wire, conductor rail system, current collector-pantograph</li> <li>Factors affecting scheduled speed</li> <li>Electrical block diagram of an electric locomotive with description of various equipment and accessories, Types of motors used for electric traction, Starting and braking of traction motors</li> <li>Introduction to EMU and metro railways</li> </ul>	8	20-30

**Suggested Specification table with Marks (Theory):**

<b>Distribution of Theory Marks (Revised Bloom's Taxonomy)</b>				
<b>Remembrance R Level</b>	<b>Understanding U Level</b>	<b>Application A Level</b>	<b>Analyse N Level</b>	<b>Evaluate E Level</b>

20%	30%	20%	10%	20%
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Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Reference Books:

1. Generation and Utilization of Electrical Energy by S. Sivanagaraju, Pearson
2. Art and Science of Utilization of Electrical Energy by H.Partap, Dhanpat Rai & Sons
3. Utilization of Electrical Energy by J. B. Gupta, Kataria Publications
4. A Text Book of Electrical Power by Dr. S. L. Uppal, Khanna Publications
5. Modern Electric Traction by H.Partap, Dhanpat Rai & Sons
6. Utilization of Electrical Energy by O. S. Taylor, Pitman Publications
7. Generation, Distribution and Utilization of Electrical Power by C. L. Wadhwa, Wiley Eastern

### Course Outcome:

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

After learning the course the students should be able to:

1. Understand the power electronics technology in efficient utilization of electrical power
2. Apply power electronics technology in efficient utilization of electrical power
3. Analyze effective utilization of Power Electronic Technologies in Electrical Traction.
4. Evaluate the use of Power Electronic Technologies in various process control.
5. Create lighting system using LED Technologies.

### List of Open Source Software/learning website:

1. [http://www.vssut.ac.in/lecture\\_notes/lecture1424084684.pdf](http://www.vssut.ac.in/lecture_notes/lecture1424084684.pdf)
2. [http://www.ene.ttu.ee/elektrijamid/oppeinfo/materjal/AAV0020/4Drives\\_Lehtla.pdf](http://www.ene.ttu.ee/elektrijamid/oppeinfo/materjal/AAV0020/4Drives_Lehtla.pdf)
3. <ftp://ftp.elet.polimi.it/users/Massimo.Ghioni/Power%20Electronics%20Motor%20control/motor%20control%20overview/INTRODUCTION%20TO%20ELECTRICAL%20DRIVES.pdf>
4. [http://www.nptel.ac.in/courses/108105061/Illumination%20%20Engineering/Lesson-05/pdf/L-5\(NKK\)\(IE\)%20\(\(EE\)NPTEL\).pdf](http://www.nptel.ac.in/courses/108105061/Illumination%20%20Engineering/Lesson-05/pdf/L-5(NKK)(IE)%20((EE)NPTEL).pdf)
5. <http://www.lrc.rpi.edu/resources/publications/pdf/illuminationfund.pdf>
6. <http://uotechnology.edu.iq/dep-production/lectures/WL.pdf>
7. [http://www.elektra.eu/pdf\\_en/content/elektra\\_guide\\_book.pdf](http://www.elektra.eu/pdf_en/content/elektra_guide_book.pdf)
8. <https://tstuition.wikispaces.com/file/view/6+-+Electrolysis+and+Its+Uses.pdf>
9. <http://www.nrel.gov/docs/fy06osti/40605.pdf>
10. [http://sudaup.org/Duda\\_course/18-Refrigeration%20and%20air%20conditioning.pdf](http://sudaup.org/Duda_course/18-Refrigeration%20and%20air%20conditioning.pdf)
11. <http://www4.hcmut.edu.vn/~nvnho/Download/PE/A-Seminar-A%20review%20of%20Active%20Power%20Filter.pdf>
12. <http://www.sciencedirect.com/science/article/pii/S0378779605000672#>

### ACTIVE LEARNING ASSIGNMENTS:

Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work. The faculty may allocate chapters or part of chapters to groups of students so that the entire syllabus to be covered. The power-point slides may be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide.