


**AUTOVALUTAZIONE DIPARTIMENTI**  
**DEPARTMENT EVALUATION FORM**

1.a	Department name
	 <p style="margin-left: 20px;"><b>Department of Electrical Engineering</b> (DIE – Dipartimento di Ingegneria Elettrica) via Gradenigo 6/a 35131 Padova, Italy <a href="http://www.die.unipd.it">www.die.unipd.it</a></p> <p style="margin-left: 20px;">Contact: <a href="mailto:direzione@die.unipd.it">direzione@die.unipd.it</a></p>
1.a	Scientific area of activity
	Electrical Engineering
1.b	Official collaborations with other Research Institutions
	<p>DIE has consolidated and extended collaborations with several Scientific Institutions. Some of the collaborations derive from old cooperations between DIE and the other Institutions; other ones derive from more recent written agreements.</p> <p>The most significant collaborations are (in alphabetic order):</p> <ul style="list-style-type: none"> <li>• <i>Centro Levi Cases</i>: Centro Interdipartimentale di Economia e Tecnica dell’Energia Giorgio Levi Cases (Interdepartmental Research Center on Energy Economy and Technique, <a href="http://levi-cases.die.unipd.it">http://levi-cases.die.unipd.it</a>);</li> <li>• <i>CESI</i>: Centro Elettrotecnico Sperimentale Italiano (Italian Electrotechnical Research Centre)</li> <li>• <i>CNR</i>: Consiglio Nazionale delle Ricerche (Italian National Research Council, <a href="http://www.cnr.it">www.cnr.it</a>), and <i>ENEA</i>: Ente per le Nuove Tecnologie, l’Energia e l’Ambiente (Italian National Agency for New Technologies, Energy and Environment, <a href="http://www.enea.it">www.enea.it</a>) through Consorzio RFX;</li> <li>• <i>CRF</i>: Centro Interdipartimentale di Ricerca – Centro Ricerche Fusione (Interdepartmental Center for Fusion Research);</li> <li>• <i>DEI</i>: Dipartimento di Ingegneria dell’Informazione (Department of Information Engineering – University of Padova, <a href="http://www.dei.unipd.it">www.dei.unipd.it</a>);</li> <li>• <i>ETU</i>: St. Petersburg Electrotechnical University (St. Petersburg, Russia)</li> <li>• <i>INFN</i>: Istituto Nazionale di Fisica della Materia (National Institute for the Physics of Matter, <a href="http://www.infm.it">www.infm.it</a>);</li> <li>• <i>I.N.R.I.M.</i>: Istituto Nazionale di Ricerca Metrologica (National Metrological Institution for Electrical Quantities), former <i>I.E.N.</i>: Istituto Elettrotecnico Nazionale “Galileo Ferraris” (<a href="http://www.inrim.it">http://www.inrim.it</a>)</li> <li>• <i>NSTU</i>: Novosibirsk State Technical University (Novosibirsk, Russia).</li> <li>• <i>SATC</i>: Faculdade SATC – Criciùma, Santa Catarina, Brasil (<a href="http://www.satc.edu.br">http://www.satc.edu.br</a>)</li> </ul> <p>In the period, DIE carried out National Research Projects (PRIN) in partnership with other Italian Universities. The list of such Research Partners are hereafter reported.</p> <p>Polytechnic of Bari Polytechnic of Milano Polytechnic of Torino University of Bari</p>

University of Bologna  
 University of Cagliari  
 University of Cassino  
 University of Catania  
 University of Cosenza  
 University of Genova  
 University of L'Aquila  
 University of Milano Centrale  
 University Federico II of Napoli  
 University of Palermo  
 University of Parma  
 University of Pavia  
 University of Pisa  
 University of Roma "La Sapienza"  
 University of Trieste  
 University of Udine

In addition DIE collaborates with the following Companies for common actions on education and research in their specific field of activity.

- *ENAV*: Società nazionale per l'assistenza al volo S.p.A. (Italian Company for Air Navigation Services, [www.enav.it](http://www.enav.it))
- *RFI*: Rete Ferroviaria Italiana (Italian Railways, [www.rfi.it](http://www.rfi.it))

DIE collaborates also with Scientific Associations for the dissemination of knowledge about Electrical Engineering topics and results of the researches and for continuous education activities. Some of these Associations have offices hosted in the Department. Among them there are:

*AEIT*: Federazione Italiana di Elettrotecnica, Elettronica, Automazione, Informatica e Telecomunicazioni (former AEI: Associazione Elettrotecnica Italiana), (Italian Federation on Electrotechnique, Electronics, Automation, Informatics, Telecommunications, <http://aeiveneta.die.unipd.it>);

*IEEE*: Institute of Electrical and Electronic Engineers ([www.ieee.org](http://www.ieee.org));

*UIE* – International Union for Electricity Applications - Paris, France ([www.uie.org](http://www.uie.org));

*Aviel*: Albo Veneto Installatori Elettrici, devoted to qualification of electricians ([www.aviel.it](http://www.aviel.it))

*Aidi*: Associazione Italiana di Illuminotecnica (Italian Association of Lighting Scientists and Technicians, [www.aidiluce.it](http://www.aidiluce.it))

2	<p>Mission</p> <p>DIE originates in 1988 from the splitting of the former Institute of Electrical and Electronic Engineering into the two Departments of Electrical Engineering (DIE) and Electronic Engineering and Computer Science (DEI, at present Dept. of Information Engineering).        Since its foundation DIE promotes and manages scientific and technological research activities in the fields of Electrical Science and its applications, i.e. electrical machinery, generation, transmission, distribution, measurement and utilization of electrical energy.        To this purpose DIE mission includes:</p> <ul style="list-style-type: none"> <li>• strengthening and updating the knowledge in traditional fields;</li> <li>• facing and investigating new emerging fields;</li> <li>• disseminating the results of the researches in national and international symposiums;</li> <li>• supporting innovation processes and developing applied researches and specialized tests for industry.</li> </ul> <p>In addition, DIE promotes and strongly supports the teaching activities in the Electrical Engineering Laurea degree Courses and in the Electrical Engineering PhD Course. It also collaborates in other Laurea, PhD and Master Courses for all the subjects connected to the Electrical Engineering area and some areas of Applied Physics.</p>
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3	Research Program list with Responsible person (Coordinator) and Tasks
	<p>DIE research activities are organized and carried out according to the following Research Programs (in alphabetic order):</p> <ol style="list-style-type: none"> <li><b>1. Electrical Drives</b> (S. Bolognani) – The program is devoted to theoretical studies and experimental validations of topics related to the design and the applications of electrical drives. To this purpose electrical motors and control systems for industrial, civil and commercial drives are analysed, designed, prototyped and tested in the Electric Drives Laboratory of the Department.</li> <li><b>2. Electrical Machines</b> (A. Morini) – The research activity is mainly devoted to the modeling and design optimization of electromagnetic devices, in particular special electrical machines. For this purpose, methodologies for the analysis of the devices by means of self-developed calculation codes and automated procedures for the performance optimization are implemented and used.</li> <li><b>3. Electrical Power Systems</b> (R. Caldon) – The research activities carried out in the years 2001-2005 have been in the fields of generation, transmission and distribution of electric power, with particular emphasis on innovative technologies and means to improve system performances accounting for technical, economical and environmental constrains in a liberalized electricity market.</li> <li><b>4. Electroheat and Electromagnetic Biomedical Applications</b> (L. Lupi) - The research activity is generally devoted to the industrial applications of electroheating technologies but, in particular, to problems related to direct resistance heating, medium- and high-frequency induction heating and dielectric heating. A wide experimental activity is developed at the Laboratory for Electroheat of the Department, a unique laboratory in this field in Italy. A new field of research has been recently started in the laboratory, dealing with the biomedical applications of heating by electromagnetic sources.</li> <li><b>5. Fusion</b> (G.Rostagni) – The program is aimed to the development of controlled thermonuclear fusion in magnetically confined plasmas as a source of energy for the future. The program includes development and exploitation of the RFX experiment, the largest in the world in the Reversed Field Pinch line, contribution to the design of ITER, in particular of its neutral beam injector for plasma heating and current drive, development of related instrumentation and technology.</li> <li><b>6. High Voltage Applications and Measurements</b> (G. Pesavento) – The research activities are addressed to the metrological aspects of the measurements of impulse quantities (high impulse voltages, currents and partial discharges) with respect to the whole measuring chain including transducers and low voltage recording instruments, with the aim to contribute to the qualification of both industrial and reference measuring systems. In parallel an investigation of the physical phenomena occurring during the spark formation in air and of the reactions induced by corona discharges for the abatement of pollutants is carried out.</li> <li><b>7. Industrial Automation</b> (G. Buja) – The program is intended to the development of basic and applied research in the fields of power electronics and mechatronic systems. The main topics of the research line on the power electronics are high-performance drives for industrial applications and active compensators for the power quality. The main topics of the research line on the mechatronic systems are control and networking of motion systems, and drive-by-wire systems for the industrial vehicle sector.</li> <li><b>8. Industrial Electromagnetic Compatibility &amp; Computational Electrical Science</b> (A.Maschio) - The program is aimed to undergo both experimental activities and numerical simulation developments. Activities are performed in the fields of electromagnetic compatibility for industrial and environmental applications, including development of models and new equipments. Novel numerical methods and codes for computational electrical science are developed for analysis of complex configurations.</li> </ol>

**9. Photometry and Lighting Engineering** (L.Fellin) – The research started few years ago partly in response of the needs of the companies located in the North-East of Italy and acting in this field. The activities can be grouped in four main fields strongly connected and interacting, necessarily: exterior lighting, reflectometric analysis of surfaces, works of art lighting, analysis of lighting sources. Furthermore, other initiatives are on the way to start in innovation fields like tunnel lighting and non conventional lighting systems.

4.a Department Staff in the period 2001-2005  
(Annex 1)

Table below reports DIE Staff composition in the last 5 years and the average value for each item. The number of PhD students and Post-Doc Grants refers to positions whose supervisor is a Professor of DIE

	31.12.2001	31.12.2002	31.12.2003	31.12.2004	31.12.2005	Average per year
(F) Full Professors	16	15	15	15	14	15
(A) Associate Professors	9	9	9	11	14	10.4
(R) Researchers	10	10	10	9	8	9.4
PhD Students	22	19	20	19	24	20.8
Post-Doc and Research Grants	1	1	0	0	2	0.8
PTA(Administration and technical personnel)	15	16	16	16	16	15.8

As far as Professors and Researchers are concerned, teaching duties and academic services for all of them are listed in the Annex 1.

5.a Financial resources in the period 2001-2005

General and research funds of the Department are given in the Table below.

year	2001	2002	2003	2004	2005	Average
<b>GENERAL FUNDS</b>	€	€	€	€	€	€
University (ordinary and extraordinary)	96,30 0	98,00 0	92,800	81,90 0	110, 200	95,840
Educational (general and equipment)	87,45 0	54,90 0	54,400	91,500	80,650	73,780
PhD	20,00 0	15,00 0	19,300	11,20 0	4,4 00	13,980
Incomes from testing and measurement services	36,00 0	43,90 0	60,600	65,60 0	79, 300	57,080
Miscellaneous (VAT, meeting fees, bank, .....	143,50 0	66,30 0	58,100	174,80 0	84, 100	105,360
<i>Total general funds</i>	383, 250	278, 100	285,20 0	425, 000	3 58,650	346,0 40
<b>RESEARCH FUNDS</b>						
UE (European Union)	-	-	148,800	101,20 0	78, 800	65,760
MIUR (Instruction, University and Research Ministry)	105,90 0	119,40 0	101,600	92,50 0	154, 700	114,820
University basic research (ex 60%)	59,50 0	57,30 0	51,900	55,50 0	51, 600	55,160
CNR/ ASI (National Research Council/Italian Space Agency)	-	-	21,000			7,000
University contributions for national and specific projects	67,10 0	50,00 0	66,100	131,40 0	138, 000	90,520
Industry research contracts & contributions	512,80 0	285,10 0	324,500	274,80 0	326, 800	344,800
<i>Total research funds</i>	745, 300	511, 800	713,90 0	655, 400	7 49,900	675,2 60
<b>TOTAL</b>	<b>1,128,550</b>	<b>789,900</b>	<b>999,100</b>	<b>1,080,400</b>	<b>1,108,5 50</b>	<b>1,024,100</b>
6	Space and equipment (Annex 2)					
6.a	<p>Since 1966 DIE is located in Padova - via Gradenigo 6/a, sharing the building constructed in that year with the Department of Information Engineering.</p> <p>At present DIE occupies about 2400 m<sup>2</sup>, excluding corridors and stairs, distributed on three floors. Among them, 570 m<sup>2</sup> are devoted to offices for Professors and Researches (also Visiting), 200 m<sup>2</sup> are for administrative offices and services, 165 m<sup>2</sup> are reserved to meeting rooms and 1465 m<sup>2</sup> are for research and testing laboratories. Coloured simplified floor drawings of the Department are attached to this report.</p> <p>Besides the facilities located at DIE, research activities are also carried out at the laboratories of Consorzio RFX, CNR Research Area in Padova (see Research Program Evaluation Form "Fusion")</p> <p>The following main facilities for research activities are present in DIE:</p> <ul style="list-style-type: none"> <li>- Electric Drives Laboratory</li> <li>- Electric Machine Laboratory</li> <li>- Electric Power Systems Laboratory</li> <li>- Electroheat Laboratory</li> <li>- Electromagnetic Compatibility Laboratory</li> <li>- High and Medium Voltage Laboratories</li> <li>- Industrial Automation Laboratory</li> <li>- Photometry and Lighting Engineering Laboratory</li> </ul>					

	<p>Specific equipment of them is described in the pertinent Research Program Evaluation Form.</p> <p>At now DIE has a computer network structured to support clusters for parallel and distributed high performance computation. Some of the deployed solutions have been used as a prototype now replicated in other networks of the University.</p> <p>In addition the Department has a centralized management of the licenses for the most used software for scientific calculation, to permit every afferent to employ such programs without the need to sustain high initial expenses. To reduce the costs and enhance the efficiency, some of these software are managed in agreement with other Departments.</p>
6.b	<p>The Department have been widely renewed in the last years and partially is yet under restoration. The work done allowed to dedicate more space for the research laboratories, to organize better the space for administration and general services and to make more effective also the local communication network.</p> <p>The activity of restoration will be continued and completed in the next future also increasing the number of meeting and seminar rooms.</p> <p>A completely new space for the Interdepartmental Library is planned to be started in the present year.</p>
7	Description of the official collaborations with other Research Institutions
7.a	<p>Hereafter brief descriptions of the more general collaborations with the Scientific Institutions listed in Sect. 1.b are given.</p> <ul style="list-style-type: none"> <li>• <i>Centro Levi Cases</i>: Centro Intertipartimentale di Economia e Tecnica dell'Energia Giorgio Levi Cases (Interdepartmental Research Center on Energy Economics and Technique) – DIE is one of the founder members (together with the Department of Economic Science, the Department of Statistic Science and the Department of Mechanical Engineering), the Head of DIE is right member of the Center Council, and the Administrative office is taken by DIE Administration. The Library of the Center is part of the Interdepartmental Library of DIE. The Center promotes and supports researches on Economics and Technique topics in the area of Energy by financing grants for post-graduated students and positions for young researchers.</li> <li>• <i>CRF</i>: Centro Interdipartimentale Ricerche Fusione (Interdepartmental Center for Fusion Research) – DIE is one of the founder members (together with the Department of Physics and the Department of Information Engineering). The Center is aimed to promote, coordinate and develop studies and basic research in the field of controlled thermonuclear fusion and in general on plasma physics and technology; in particular, it is the reference structure of the Padova University within RFX Consortium. Eleven DIE professors (on average during the period) collaborate to RFX activities through CRF.</li> <li>• <i>CNR and ENEA</i>: they collaborate with University of Padova through Consorzio RFX, that was founded in 1996 by University of Padova, CNR, ENEA and Acciaierie Venete S.p.A. to give a stable organization promoting and managing the activities of the Padova Research Group of the ENEA-Euratom Association for Fusion development. The collaboration is essential to make use of all the possible synergies in such a complex and interdisciplinary area of research, requiring large human and financial resources.</li> <li>• <i>DEI</i>: Dipartimento di Ingegneria dell'Informazione (Department of Information Engineering, University of Padova) – DIE collaborates of course with all the Departments of the University of Padova. However the collaboration with DEI differentiates for some reasons: the two Departments originated from the same common Institute; they divide the same campus; they divide and manage together common services, facilities and workshops as well as the Library.</li> <li>• <i>CESI</i>: Centro Elettrotecnico Sperimentale Italiano (Italian Electrotechnic Research Centre) is a company operating for more than 40 years in the electro-energetic and environmental sectors in more than 35 Countries all over the world. A market leader in testing and certification of</li> </ul>

electromechanical equipment and power system studies and consultancy, CESI competencies cover all stages of power system life cycle and are made available to power producers, electrical utilities, electromechanical industry, electronics manufacturers, large-scale users of electricity as well as to Financial Institutions and Public Administrations as supporting services designed for the solution of their problems.

- *ETU*: St. Petersburg Electrotechnical University (St. Petersburg, Russia) and *NSTU*: Novosibirsk State Technical University (Novosibirsk, Russia) – Agreements have been stated between these two Institutions and the University of Padova, for a common scientific and educational activity in the Electroheat area.
- *INFN*: Istituto Nazionale di Fisica della Materia (Italian National Institute of Physics of Matter) – Physics Researchers with DIE were Member of the Institute till 2004-2005, when INFN was incorporated in CNR. Researches financed by INFN were carried out in the DIE Laboratories.
- *INRIM*: Istituto Nazionale di Ricerca Metrologica (National Metrological Institution for Electrical Quantities) – INRIM carries out studies and researches on the realization of primary standards for the basic and derived units of the International System of units (SI), assures the maintenance of such standards, their international comparison and in general provides measurements traceability to the SI. In addition to physical and engineering metrology, its main R&D areas are in fundamental physical constants, materials, metrology for chemistry, nanotechnology, innovation, quantum information and artificial vision. DIE has a long time collaborations with this Institution (through I.E.N.: Istituto Elettrotecnico Nazionale “Galileo Ferraris”) on metrological field, extended recently to photometry.
- *SATC*: Faculdade SATC – Criciùma, Santa Catarina, Brasil. – An agreement has been stated between this Institutions and the University of Padova, for a common scientific and educational activity in the Energy Technology area.

For further details and for a description of the other more focused external collaborations, please refer to the Research Program Evaluation Forms.

7.b Some professors of the Department are members of Standard Committees in their field of competence or members of Advisory Committees for the coordination of international research programs:

**Ing. (PhD) R. Benato**

- Member of CIGRE WG B1.08 "Cable systems in multipurpose or shared structures"
- SECRETARY of CIGRE Joint WG B3-B1.09 "Application of Long High Capacity Gas-Insulated Lines in Structures"

**Prof. G. Buja**

- Member of the Technical Committee CT 301/22G "Electric Drives"

**Prof. D. Desideri**

- Member of the Technical SubCommittee 106A “Human exposure to electromagnetic fields - Low frequency” of CEI (Comitato Elettrotecnico Italiano) for the years 2004-2006
- Member of the Technical SubCommittee 210A/NON ITE “EMC of NON ITE products” of CEI (Comitato Elettrotecnico Italiano) for the years 2004-2006

**Prof. F. Dughiero**

- Member of the Working Group WG09 of CENELEC TC106X;
- Member of the Technical Committee 27 “Elettroheating” of CEI (Comitato Elettrotecnico Italiano);
- Member of the Technical Committee 106 “Human exposure to electromagnetic fields” of CEI (Comitato Elettrotecnico Italiano).

**Prof. F. Gnesotto**

- Member of the Euratom Scientific and Technical Advisory Committee (STAC)
- Vice-Chairman of the International Energy Agency (IEA) Fusion Power Coordinating Committee (FPCC)

**Prof. S. Lupi**

- Coordinator of the Working Group “Education and Research” of the UIE (International Union for Electricity Applications);
- Member of the Technical Committee 27 “Industrial Electroheating Equipment” of IEC (International Electrotechnical Commission);
- Member of the Working Group WG09 of CENELEC TC106X;
- Member of the Technical Committee 27 “Elettroheating” of CEI (Comitato Elettrotecnico Italiano);
- Member of the Technical Committee 106 “Human exposure to electromagnetic fields” of CEI (Comitato Elettrotecnico Italiano).

**Prof. G. Pesavento**

- Secretary of Technical Committee 42 “HV Testing techniques” of CEI (Comitato Elettrotecnico Italiano);
- Member of the CIGRE WGD1.33 (former WG33.03) “HV Testing and measuring techniques”
- Member of IEC international working groups dealing with the revision of IEC Standard 60060-1 “HV test techniques – Part 1: Definitions and test requirements”, IEC Standard 60060-2 “HV test techniques – Part 2: Measuring systems”.
- Convenor of IEC Working group for the revision of IEC 60052 “Voltage measurement by means of standard air gaps”

**Prof. R. Turri**

- Member of the Technical Committee 106 “Human exposure to electromagnetic fields” of CEI (Comitato Elettrotecnico Italiano).

**Prof. G. Rostagni**

- Member of the Consultative Committee for the Euratom Specific Research and Training Programme in the field of Nuclear Energy - *FUSION* (CCE-FU)
- Member of the Steering Committee of the European Fusion Development Agreement.

**Prof. G. Zingales**

- Member of Technical Committee 42 “HV Testing techniques” of CEI (Comitato Elettrotecnico Italiano);
- Member of Technical Committee 38 “Instrument transformers” of CEI (Comitato Elettrotecnico Italiano);
- President of IEC Technical Committee 38 “Instrument transformers”
- Member of Central Metrological Committee
- President of Technical Commission “Energy Meters” of IMQ
- Member of TC 4 "Measurement of Electrical Quantities" and of TC 7 "Measurement Theory" of IMEKO

For further individual collaborations, focused on the described Research Programs, please refer to the Research Program Evaluation Forms.

8	R&D services to industrial companies by tests and research contracts
	<p>The Department performs specialized tests on industrial products (in some cases they are certificated by a document with legal value). The total amount of the income for such an activity is about 60,000 €/year.</p> <p>In addition DIE carries out research projects ordered by R&amp;D departments of industrial companies through Research Contracts. Table below gives a quantitative view of the Research Contracts in the</p>

period being considered.

<b>Research Contracts</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>Average</b>
<b>Number of contracts</b>	11	16	15	12	20	12.8
<b>Average amount (€)</b>	17.300	12.900	12.100	19.800	28.000	18.020
<b>Average duration (months)</b>	7.5	6.0	8.5	7.0	8.0	7.4

For further details on the topic of each Research Contract, please refer to the Research Program Evaluation Forms.

9 Other Departmental activities relevant to research.

The Department has been directly involved in the organization of the following Workshops, Seminars and Conferences. For some of them, details can be found in the Research Program Evaluation Form of the relevant Research Group.

- **HAKONE IX "Ninth International Symposium on high pressure low temperature plasmas"**, August 2004, with the sponsorship of the University of Padua.
- **Symposium HIS-01 - "Heating by Internal Sources "**, 2001, with the sponsorship of University of Padua, UIE – International Union for Electricity Applications; IEEE- IAS/IES/PELS North Italy Joint Chapter; AEI.
- **Symposium HES-04 - "Heating by Electromagnetic Sources"**, 2004, with the sponsorship of University of Padua, UIE – International Union for Electricity Applications; IEEE- IAS/IES/PELS North Italy Joint Chapter; AEI.
- **Workshop on "AC Motor Drives Technology"**, 2001-03-04-05 (four editions) with the partnership/sponsorship of CPV, IEEE- IAS/IES/PELS North Italy Joint Chapter; AEIT, et al.
- **PhD International Intensive Course on "Induction Heating and Electromagnetic Processing of Materials"** (in cooperation with the UIE - International Union for Electricity Applications), Padova, 16-22 June 2004, (15 participants coming from 7 countries)
- **Symposium CIGRE - AEIT: "EHV XLPE CABLES: their rule in the power transmission"**, Padova, Aula Magna, Palazzo del Bo, 18 February 2005.

10 PhD Courses and Students; Post-Doc Positions (Grants and Contracts)

In the Tables below the number of PhD students whose Supervisor was/is with DIE is reported for each year from 2001 to 2005.

**"Electrical Engineering" PhD Course (Dottorato in Ingegneria Elettrotecnica)**

Cycle	2001	2002	2003	2004	2005	Notes
XIV	3	-	-	-	-	
XV	4	3	-	-	-	
XVI	4	4	4	-	-	
XVII	-	4	4	4	-	
XVIII	-	-	4	3	3	
XIX	-	-	-	5	3	
XX	-	-	-	-	5	
<b>Total</b>	<b>11</b>	<b>11</b>	<b>12</b>	<b>12</b>	<b>11</b>	

**"Energy Engineering" PhD Course (Dottorato in Ingegneria Energetica)**

Cycle	2001	2002	2003	2004	2005	Notes
XIV	4	-	-	-	-	
XV	2	2	-	-	-	
XVI	5	3	3	-	-	
XVII	-	3	3	3	-	
XVIII	-	-	2	2	5	
XIX	-	-	-	2	5	
XX	-	-	-	-	3	
<b>Total</b>	<b>11</b>	<b>8</b>	<b>8</b>	<b>7</b>	<b>13</b>	

**“Bioelectromagnetism and Electromagnetic Compatibility” PhD Course** (Dottorato in Bioelettromagnetismo e Compatibilità elettromagnetica)

Cycle	2001	2002	2003	2004	2005	Notes
XIX	-	-	-	2	2	
XX	-	-	-	-	-	
<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	

**“Mechatronics and Industrial Systems” PhD Course** (Dottorato in Meccatronica e Sistemi industriali). Started in 2005.

Cycle	2001	2002	2003	2004	2005	Notes
XX	-	-	-	-	1	
<b>Total/year</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	

**Post-Doc positions** – DIE hosted also some Post-Doc positions in the form of Grants (Borse post-dottorato) or Contracts (Assegni di ricerca).

	2001	2002	2003	2004	2005	Notes
Post-Doc Grants	0	0	0	0	1	
Post-Doc Contracts	1	1	0	0	1	
<b>Total/year</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>2</b>	

11.a Research Products

Table below reports for each of the years of the period being considered and in total the number of research products authored by DIE personnel.

RESEARCH PRODUCTS	2001	2002	2003	2004	2005	Total
<b>Papers on Journal</b>	30	16	33	26	38	143
<b>Chapters in book</b>	4	2	3	4	2	15
<b>Books/Notes/Reports (Monographies)</b>	5	2	5	13	16	41
<b>Papers on Conf. Proceedings</b>	42	39	47	49	51	228
<b>Patents</b>	0	0	1	2	1	4
<b>Other</b>	0	0	1	0	0	1

List of papers can be found attached to each Program Research Evaluation Form.

12 SWOT (*Strenghts, Weaknesses, Opportunities, Threats*) Analysis of each Research Program

<b>1- Electric Drives</b>	
S	<ul style="list-style-type: none"> <li>- Recognized good level of contributions to international conferences and journals.</li> <li>- Fruitful collaboration with authoritative researchers of international level.</li> <li>- Consolidated relationship with industrial partners as a result of a long time cooperation in industrial initiatives.</li> <li>- Capability to collect institutional and private funding at appropriate level.</li> <li>- Well equipped laboratory for experimental validations.</li> </ul>
W	<ul style="list-style-type: none"> <li>- The number of faculty members is limited with respect to the number of activities and projects also due to the move of a staff component to other Institution.</li> <li>- Increasing teaching load and recent academic duties of a component of the staff have eased down the research work.</li> <li>- Dispersion of work in a large number of small short term activities.</li> <li>- Little number of young researchers and technician personnel.</li> </ul>
O	<ul style="list-style-type: none"> <li>- Agreements with large industrial companies for a continuous consolidated collaboration are in preparation.</li> <li>- Transfer of existing competences to the growing energy technology and home appliances fields should assure an appropriate research volume.</li> <li>- Conclusion of the service of professor Bolognani, as Head of Department, will allow more time devoted to manage and to carry out research work.</li> </ul>
T	<ul style="list-style-type: none"> <li>- Uncertainties in the governmental support of research and technological innovation.</li> <li>- Limitations in the recruitment of young researchers.</li> </ul>
<b>2 -Electrical Machines</b>	
S	<ul style="list-style-type: none"> <li>- Ability to combine theoretical aspects and computing techniques</li> <li>- Good background in developing methodologies for the modeling of electrical machines</li> <li>- Research deals with topics having relevance in innovation technology</li> </ul>
W	<ul style="list-style-type: none"> <li>- Funding continuity uncertainty</li> <li>- Rapid turn-over of research young personnel</li> </ul>
O	<ul style="list-style-type: none"> <li>- Good match between research and teaching</li> <li>- New applications and emerging technologies, in which the group is competent (e.g. in pollutionless transport systems, renewable energies, etc.)</li> <li>- Established relationship with other groups in Italian Universities</li> </ul>
T	<ul style="list-style-type: none"> <li>- Redundant workload from a bureaucratic and administrative point of view and reduced time for research because of teaching and related duties</li> <li>- Difficulty of having a detailed medium term plan because of unpredictable budget and staff</li> <li>- Difficulty in translating interest by industries into research funding</li> </ul>
<b>3 - Electrical Power Systems</b>	
S	<ul style="list-style-type: none"> <li>- The power system group is active at both national and international level, has a recognized good level of contributions to specialized conferences and journals and participation to technical committees.</li> </ul>
W	<ul style="list-style-type: none"> <li>- Rapid turn-over due to the usage of students as research personnel</li> <li>- Difficulties in concentrating resources on few strategic research projects</li> </ul>
O	<ul style="list-style-type: none"> <li>- Good potential for both academic and industrial collaborations since the group expertise covers a wide range of applications in the fields of generation, transmission, distribution and utilization of electrical energy.</li> </ul>
T	<ul style="list-style-type: none"> <li>- Full-time academic personnel overwhelmed by administrative and teaching duties.</li> <li>- Limited resources for recruitment of young motivated researchers</li> </ul>
<b>4 - Electroheat and Electromagnetic Biomedical Applications</b>	
S	<ul style="list-style-type: none"> <li>- The Electroheat Laboratory and its staff members are well known at national and international level in the Electroheat scientific community.</li> <li>- The Laboratory has close and numerous cooperation activities with national industrial partners;</li> <li>- The Electroheat Laboratory is certified UNI EN ISO 9001:2000;</li> <li>- The Laboratory has a special link with the company Inova S.r.l., a spin-off of the University initiated by prof. Dughiero (see point 4., at the name of F. Dughiero).</li> </ul>
W	<ul style="list-style-type: none"> <li>- The uncertainty on continuous and substantial funding of projects;</li> <li>- The lack of availability of a full-time dedicated laboratory technician.</li> </ul>
O	<ul style="list-style-type: none"> <li>- The close international contacts with practically all researchers working in the filed of Electroheat</li> </ul>
T	<ul style="list-style-type: none"> <li>- The limited number of permanent staff.</li> <li>- The heavy and excessive bureaucracy for applications for funding.</li> </ul>

<b>5 - Fusion</b>	
S	<ul style="list-style-type: none"> <li>- This program is fully integrated in the EU program for fusion research</li> <li>- The electrical engineering competences of the group are internationally considered at the top level</li> <li>- The financial resources 2001-2005 have been adequate to the program</li> <li>- The Padova University group is leader in EU for education of young scientists in fusion.</li> </ul>
W	<ul style="list-style-type: none"> <li>- Some delays in receiving financial resources from the national authorities, that caused corresponding delays in the restart of RFX after modifications</li> </ul>
O	<ul style="list-style-type: none"> <li>- The EU fusion program is presently facing a strong expansion after the ITER approval and siting in France.</li> <li>- This will open new opportunities both at the University and at the industry level</li> <li>- The ITER Neutral Beam Injector Test Facility will be built in Padova in the next five years: as a consequence, important research opportunities will be open, in particular in the fields of high voltage engineering, source and beam physics, thermo-structural mechanics, power supplies and control, electromagnetic analysis.</li> </ul>
T	<ul style="list-style-type: none"> <li>- The University personnel is decreasing due to aging and to the difficulty of recruitment of young researchers</li> </ul>
<b>6 - High Voltage Applications and Measurements</b>	
S	<ul style="list-style-type: none"> <li>- Very good experimental facilities that cover both the industrial requirements for testing and more refined research work</li> <li>- Good knowledge of the physical aspects of the various phases of the corona discharges and related modelling</li> <li>- Research deals with topics having relevance both in innovation technology and in field of growing interests (pollution control)</li> </ul>
W	<ul style="list-style-type: none"> <li>- Uncertainty about funding due also the difficulty to find partners within other universities</li> <li>- Difficulties in keeping the laboratory running due to high costs for equipment, lack of general support and reduced availability of personnel.</li> <li>- Reduced interest of students, in particular postgraduate, and associated difficulty of having the research program running</li> </ul>
O	<ul style="list-style-type: none"> <li>- Good opportunities in view of the connection already established with the ITER experiment for which several important topics in the field of HV insulation will be of particular interest</li> <li>- Renewed interest in the field of emerging technologies for the control of pollutants both in the gaseous and in the liquid phase.</li> </ul>
T	<ul style="list-style-type: none"> <li>- Difficulty to find connections with other research groups within Italian Universities</li> <li>- Difficulty to establish research activity with industries of the territory due to their small/medium size which require more often short term technical advice and tests rather than the support to development of new projects.</li> </ul>
<b>7 - Industrial Automation</b>	
S	<ul style="list-style-type: none"> <li>- Research activities well known in the international scientific community</li> <li>- Established relationships with domestic and foreign institutions</li> <li>- Start-up of innovative research activities</li> </ul>
W	<ul style="list-style-type: none"> <li>- Rapid turn-over of the personnel due to the use of students as research assistants</li> <li>- Lack of a medium-term outlook on funds and personnel</li> <li>- Lack of technicians skilled on the specific laboratory activities</li> </ul>
O	<ul style="list-style-type: none"> <li>- Running of advanced research activities in new fields</li> <li>- Growth of the industry collaborations on innovative projects</li> <li>- Interdisciplinary collaborations with research groups working in the fields of electronics and mechanics</li> </ul>
T	<ul style="list-style-type: none"> <li>- Limited number of faculty positions with respect to the research needs</li> <li>- Reduced interest for Ph.D. and post-docs positions from the students after the recent reorganization</li> <li>- of the study curricula</li> <li>- Reduced research time because of the increasing bureaucracy and teaching-related tasks.</li> </ul>
<b>8 - Industrial Electromagnetic Compatibility &amp; Computational Electrical Science</b>	
S	<ul style="list-style-type: none"> <li>- Appropriate collaboration with authoritative researchers of international level.</li> <li>- Consolidated contacts and collaboration with large industrial companies and laboratories.</li> </ul>
W	<ul style="list-style-type: none"> <li>- Rapid turn-over of research young personnel.</li> <li>- Large teaching loads of the staff limit the time for research work.</li> </ul>
O	<ul style="list-style-type: none"> <li>- Good potential for both academic and industrial collaboration.</li> </ul>
T	<ul style="list-style-type: none"> <li>- Limitations in the recruitment of young researchers.</li> </ul>

<b>9 - Photometry and Light Engineering</b>	
S	- One full professor (part time); one associated professor; one technician (not completely devoted to this program); some students working on thesis; two persons should work on works of art lighting, supported by a grant .
W	- A deficiency on the side of human resources has to be highlighted. The lack is at least one researcher and a technician with “laurea” degree, together with the need of a full time technician.
O	- The possibility of developing further research activities also in collaboration with external companies dealing with this field characterized by a current strong growth.
T	- Without a growth in this programme the surrounding companies dealing with photometry and lighting engineering could not have a close support in their research activities.
13	Position of the Department in the national and international scientific community
<p>The Department of Electrical Engineering originates from the “Istituto di Elettrotecnica” founded at the University of Padova more than one century ago. In its long life, it hosted eminent scientists whose contributions to the knowledge of the electrical science and electrical applications and technologies are still reported in many books and used in several teaching, research and industrial fields.</p> <p>In the today general line of the Department activities one can still recognise the legacy of Giovanni Smeda (1901-1978) a distinguished scientist who led (together with few others) the development of the Electrical Engineering in Italy after the World War II and directed the “Istituto di Elettrotecnica” for a long period, stimulating emerging research areas.</p> <p>Now the Department of Electrical Engineering covers also new fields of interest while others have been discontinued. In some of the fields DIE has a recognized reputation at national and international level confirmed by the involvement of its researchers in important international projects, in steering committees of important conferences and international cooperation agreements, in specialized seminars and tutorials.</p> <p>Hereafter the acknowledge by the scientific community for each Research Program as judged by each Program Coordinator are reported:</p> <ol style="list-style-type: none"> <li><b>1. Electric Drives:</b> The activity and the competences of the Department in this field is well known at local and international level for both basic and applied research works. Research results are referred in high ranking publications and books as well as presented in invited and special sessions of international conferences.</li> <li><b>2. Electrical Machines:</b> The results of the research work of the group have produced appreciated publications in international reviews and conferences.</li> <li><b>3. Electrical Power Systems:</b> The long established and qualified activity in the field of analysis and simulation of large power systems has lead the group to be a traditional reference and research partner for the main Italian research centres in this field (formerly ENEL - Centro Ricerche di Automatica and now CESI Ricerca). The research outputs have produced appreciated publications regularly presented in the main international specialized conferences and journals.</li> <li><b>4. Electroheat and Electromagnetic Biomedical Applications:</b> In this field the Department has a leading role at the national level; the Laboratory for Electroheat is the only one dealing with these topics in Italy. At the international level it is well known in the Electroheat community and can be classified among the first five laboratories working in this field.</li> <li><b>5. Fusion:</b> DIE is the only Electrical Engineering Department in EU directly involved in a big experimental facility (RFX) for fusion. The electrical engineering competences of the group are considered at the top level by the world fusion community</li> <li><b>6. High Voltage Applications and Measurements:</b> The HV laboratories of this Department are among the very few still operating within the Italian Universities. Research activities is carried out in close cooperation with national and international bodies operating in this field. Work on corona applications is experiencing a growing interest and it is carried out at multidisciplinary level in close contacts with foreign institutions.</li> <li><b>7. Industrial Automation:</b> The research activities carried out under this umbrella have received a number of recognitions from the international scientific community for the contribution given to the advancement of the technology and the knowledge in the fields of competence.</li> <li><b>8. Industrial Electromagnetic Compatibility &amp; Computational Electrical Science:</b> The results of</li> </ol>	

	<p>the research work of the group have produced appreciated publications in international reviews and conferences.</p> <p><b>9. Photometry and Lighting Engineering:</b> In this field the Departments has a leading role at the national level; the Laboratory for Photometry and Lighting Engineering is the only one in the North-East part of Italy and one of the five most important laboratory dealing with in this field in Italy. At the international level it is not well known up to now due to its recent birth.</p>
14	Lines for a future strategy of development
	<p>The uncertainties of the Italian Research policy and related financial resources make arduous planning a rigid future strategy of development of the Department. However, a spread of actions has been already identified and pursued in the last years for improving DIE research effectiveness. They will be continued in the next future, together with new ones that will be started. Among them there are:</p> <ul style="list-style-type: none"> <li>• increasing quantitatively and qualitatively the technical staff of the Department to support more effectively and to qualify the experimental works of all the laboratories;</li> <li>• promoting at different levels (local/national/international) and enlarging the Department activities by stipulating technological transfer agreements with industrial associations, by enforcing the collaboration with other Italian Departments (not necessarily in the Electrical Engineering field) in common research projects, and by offering DIE competences in European and International research cooperations.</li> <li>• using the existing competence in large international scientific and technologic enterprises (e.g. Fusion, Nanotechnology, Energy Technology, ...)</li> <li>• improving research capability and performance by internal regulations for the use of resources, by extending quality standard UNI ISO 9001:2000 to other laboratories and services, and by stimulating a continuous evaluation of the research activity.</li> </ul>