high surface and large number of particles peculiar of them.

A. Equipment commonly used in Nanocharacterization
SEM.
TEM.
HRTEM.
AFM.
Raman.
XRD.
EELS.
Others.
B. Equipment commonly used in Nanosynthesis
Reactors and equipment to:
Arc Method.
Laser Methods.
Chemical Vapor Deposition.
Ball Milling.
Diffusion flame synthesis.
Electrolysis.
Heat treatment of a polymer.
Low-temperature solid pyrolysis.
Others.

Table 1.- Equipment required for Nanocharacterization and Nanosynthesis.

It is possible to obtain funds to acquire nanotechnology equipment for the Bachelor in Nanotechnology(Table 1) by means of projects supported by the CONACYT and the European Union taking advantage of the Seventh Framework Programme (FP7) administered by the office of UEMEXCYT. Mexico and the European Union will dedicate 20 million for research projects on themes ranging from nanotechnology to materials, metrology and manufacturing technology where each line of research will receive about 400,000 Euros and will run for three years [23]. The creation of an engineering degree in nanotechnology will improve local investment in nanotechnology, strengthening local companies that employ nanotechnology. Today four universities have Bachelor of Nanotechnology in Mexico (Table 2) and other universities are interested in opening this degree during 2010, namely Polytechnic University of the Valley of Mexico [24] and the University of Guanajuato [25]. Also, there are at least 58 institutions doing research in nanotechnology or nanoscience based in 20 Mexican States.

2.2 Human Resources

The number of universities offering a Nanotechnology Engineering Program in Mexico is growing at a rate of approximately one per year, and there are 87 academic programs related to nanotechnology [26-32]. There are more than 400 Mexican specialists in nanotechnology, and most of them have an excellent position in research within and outside the country, making it difficult to recruit them as faculty in new universities.

Mexican Nanotechnology Research Groups have a mean size of 5 and networks of these research groups have been created recently although a Mexican Nanotechnology Initiative needs to be created in the near future [33]. The difficulty of hiring faculty trained in nanotechnology can be overcome with the help of the PROMEP Program for Faculty Improvement [34], but this relies on the preferences of faculty which is not always interested in doing postgraduate studies on Science and Technology

Name	*Academic Program*
UNAM at Ensenada	Nanotechnology Engineering
Tijuana Institute of Technology	Nanotechnology Engineering
University of La Ciénega at Michoacán	Nanotechnology Engineering
University of Las Americas	Nanotechnology and Molecular Engineering

Table 2.- Mexican Universities with a Bachelor in Nanotechnology.

Fig. 5 shows a correlation between the number of researchers funded by PROMEP and the number of PROMEP scholarships granted in engineering an basic sciences to the university where these researchers are based. These statistics prove that in several Mexican universities, faculty has participated actively in Mexican Nanotechnology although in some Mexican States their faculties are not involved yet in Nanotechnology.

PROMEP program has consolidated several Nanotechnology research groups in Mexico. Postgraduate Studies in Nanotechnology can be pursued by faculty and others at universities and institutes in Mexico such as Universidad Autónoma Metropolitana which has a Nanotechnology Network and a Nanotechnology Laboratory unique in Latin America. Universidad Nacional Autónoma de Mexico which has a General Network of Nanoscience and is classified between the 50 best universities worldwide. Instituto Potosino de Investigación Científica y Tecnológica which has a National Nanotechnology Laboratory I. Centro de Investigación y Estudios Avanzados with the National Nanotechnology Laboratory II. Instituto Mexicano del Petróleo with the Laboratory of Ultra High Resolution Electron Microscopy. Instituto Nacional de Astrofísica, Óptica y Electrónica with

the National Laboratory of Nanoelectronics. Instituto Politécnico Nacional with the Nanoscience and Nanotechnology Center. Centro de Investigación y Estudios Avanzados with a PhD. Program in Nanosciences; and Centro de Investigación en Química Aplicada, among others [35-42]. On the other hand there are universities from abroad such as Erlangen-Nürnberg, Toronto University, Cambridge, Sussex, Oxford, Rice, and Waterloo who offer graduate courses in Nanotechnology and Nanosciences [43-48]. Another way to obtain a degree in Nanotechnology is an online course in Nanotechnology offered by Oxford University who was the pioneer in these kinds of open university courses [49].

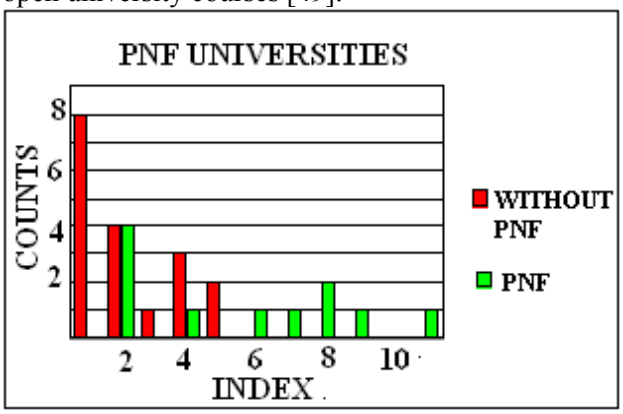

Fig. 5.-Correlation between the number of universities with PROMEP Nano Faculty (PNF) and an index that multiplies the percentage of PROMEP scholarships granted to that university times the percentage of these scholarships dedicated to Science and Technology.

The number of Mexican scientists in nanoscience and nanotechnology is nowadays insufficient to achieve a technological development in the short-term. Many Mexican postgraduates are waiting for an opportunity to be repatriated and a new undergraduate program should offer job opportunities for them. Also, programs to educate faculty in nanotechnology will be needed in the following years as nanotechnology is being developed in the country. A larger number of scientists and technologists trained in nanotechnology is necessary to design national policies in nanoscience and nanotechnology that ensure global competitiveness.

CONACYT set up since 1991 a repatriation program that by 2001 ad provides funds to install 2000 Mexican postgraduates in Mexican universities. New faculty specialized in advanced technologies will enhance innovation in Mexico as well as patents registration [50]. Nevertheless, CONACYT repatriated 320 graduates in 2003 but this number was reduced to 104 in 2004, due to administrative problems in CONACYT [51].

Notwithstanding, statistics prove that the number of nanotechnology researchers does not depend neither on the GDP of the State where the university is based (Fig. 6) or on the excessive expenses by State Government (Fig. 7). This means that involvement in Nanotechnology relies always on a personal choice as well as on priorities of local companies and the development plan of the local government.

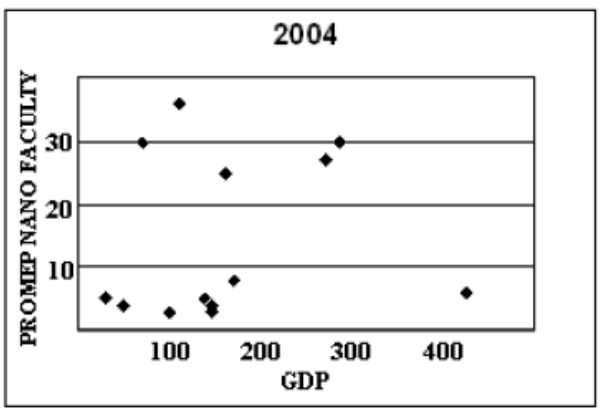

Fig 6.- Number of Nanoresearchers in a PROMEP nano research group versus GDP of the State where these groups are based.

Women can be recruited from local High School Students and statistics show that some engineering majors like Chemistry and Environmental (40% of women participation), Physical, Industrial ad Metallurgy (20%) have acceptable rates of women participation [52].

Fig 7.- Number of Nanoresearchers in PROMEP nano research groups versus Excessive Spending by the State Government where these groups are based.

Therefore a good number of women students could be allocated from these disciplines to the new undergraduate program in nanotechnology. As a

matter of fact several Mexican States lack faculty women and incorporating more women to nanotechnology starting from the undergraduate level will temper the segregation experienced by women in the group of faculty dedicated to nanotechnology. Statistics suggest that Women participation in engineering can be enhanced by PRONABES scholarships for undergraduate students. Hence special scholarships for incorporating women in this kind of undergraduate nanotechnology programs should mitigate the gender nanodivide experienced in Mexico [52].

2.3 Academic Programs

We believe that designing an Academic Program is essential for success of the Undergraduate Program in Nanotechnology. Such Academic Program must be consistent to new times, considering a comprehensive approach focused on technological and scientific research as well as involving students in the development of Nanotechnology Business Studies.

The academic Program (4.5 years) proposed by us hereby is shown in Fig. 8, based on Physics, Chemistry and Biology. This academic program has an emphasis on synthesis and characterization of Nanomaterials with areas of concentration in electronics, biology and materials.

Several universities have offered advanced materials development in their undergraduate programs. Penn State offers nanofabrication facilities with 1 and 10 class clean rooms for the Minor in Nanotechnology offered at that institution. And University of Wisconsin-Stout offers a B.Sc. in Engineering Technology with a minor in Nanotechnology, where students develop new nanotechnology manufacturing processes based on industrial needs. Therefore similar activities should be included in the curricula of our undergraduate program using the facilities of Mexican National Nanotechnology Labs.

Societal and environmental impacts of Nanotechnology are also addressed in the first year of our Bachelor, as required by the National Science Foundation since Nanotechnology may change our world and education in these dimensions is needed to attain an informed citizenry and a competitive workforce [15]. The University of Leeds at UK has included philosophical, ethical, environmental and economical studies on Nanotechnology as part of the modules of its B.Sc. in Nanotechnology. Several studies have indicated the open problems related to environmental impacts of nanotechnology, which is still remain obscure which may hinder the health of workers exposed in a daily basis to nanoparticles. Ultrafine particles are well known for their toxic effects and nanoparticles are expected to have the

FOREIGN LANGUAGE I	FOREIGN LANGUAGE II	FOREIGN LANGUAGE III
CHEMISTRY I	CHEMISTRY II	CHEMISTRY III
PHYSICS I	PHYSICS II	PHYSICS III
DIFFERENTIAL CALCULUS	INTEGRAL CALCULUS	DIFFERENTIAL EQUATIONS
LINEAR ALGEBRA	VECTOR CALCULUS	MATERIALS SCIENCE
HUMAN DEVELOPMENT I	TROUBLE IN ENGINEERING	NANOTECHNOLOGY ENGINEERING
FOREIGN LANGUAGE IV	FOREIGN LANGUAGE V	FOREIGN LANGUAGE VI
THERMODYNAMICS	COMPUTATIONAL CHEMISTRY	ELECTRONICS I
SOLID STATE PHYSICS I	SOLID STATE PHYSICS II	PHYSICS-CHEMISTRY OF MATERIALS
FOURIER ANALYSIS	NUMERICAL METHODS	PROBABILITY AND STATISTICS
PROPERTIES OF MATERIALS	MOLECULAR MATERIALS AND NANOMATERIALS	ELECTRICAL CIRCUITS
RESIDENCY I	CHARACTERIZATION TECHNIQUES I	CHARACTERIZATION TECHNIQUES II
FOREIGN LANGUAGE VII	FOREIGN LANGUAGE VIII	FOREIGN LANGUAGE IX
ELECTRONICS II	MICRO & NANOELCTRONICS	SENSORS & TRANSDUCERS
MOLECULAR MODELS	BIOLOGY	APPLICATION OF NANOTECHNOLOGY TO BIOLOGY
ALGORITHMS AND PROGRAMMING SOLUTIONS	DESIGN AND CONSTRUCTION EQUIPMENT	REVERSE ENGINEERING & BUSINESS
RESIDENCY II	ENVIRONMENTAL PROBLEMS	PRACTICAL OR RESEARCH STAY I
CHARACTERIZATION TECHNIQUES III	NANOMATERIALS SYNTHESIS I	NANOMATERIALS SYNTHESIS II

Fig. 8.- Academic Curriculum of Bachelor in Nanotechnology Engineering proposed by us.

same effects so that strong safety regulations need to be enforced on the basis of an ethical approach the secures the health of all the workers working in nanotechnology [54].

And the B.Sc. in Nanoscale Science at State University of New York Albany [53] is based at the mega research center CNSE where recently the field of Nanoeconomics has been included. At that place the first PhD in Nanoeconomics was granted in 2008. Research conducted at this Nanoeconomics group led to the conclusion that Nanotechnology requires new manufacturing strategies to attain a convenient technological and economical route. The Nanoeconomics group is part of CNSE a $4.2 billion nanotechnology research center with a 2500 peoples affiliated as scientists, students, faculty and technicians. CNSE holds Summer Internships for undergraduate research every year in several fields of Nanotechnology including Mexican Students in these experiences.

Industry internships are proposed to be held during three courses, namely Residency I and II, Practical or Research Internship. Griffits University also devotes the third year of its undergraduate degree in nanotechnology to an internship in an industry or research laboratory. And the University of Technology at Sydney offers a Bachelor of Arts in International Studies with nanotechnology as optional, where students may be nanotechnology professionals aware of the international contexts of nanotechnology.

An optimal way of majoring the students is by means of a major project on nanotechnology. This has done by several Australian universities, namely U. of Western Australia, University of Adelaide, Curtin U. of Technology. La Trobe University. They include a major research project on nanotechnology as part of the last year of their undergraduate program in Nanotechnology.

Hence this Bachelor in Nanotechnology will make every effort to provide internships to educate undergraduate student in new materials development, teach them on the ethical issues related to nanotechnology, make them aware of the economical concerns related to the development of Nanotechnology industries.

3 Conclusion

We conclude that all conditions are met to properly establish this new Undergraduate Program in Mexico, in terms of infrastructure, human resources and the group of courses offered to the students.

As explained before, this undergraduate program complies with the requirements of several other nanotechnology bachelors in Australia, USA and UK. As long as a Mexican faculty devoted to nanotechnology has been majoring postgraduate students in nanotechnology since many years ago, it will be easy to hire experts in nanotechnology to strengthen this Bachelor in Nanotechnology. Involvement with local companies and keeping the actual government support will be crucial for having success. Providing technical service to local industries may also help in achieving a better distribution of wealth in the surroundings of the University where this Undergraduate Nanotechnology Program will be based. A.B acknowledges the support of a Postdoctoral Fellowship at CINVESTAV granted by CONACYT-48795 Fund.

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