RCP
Regional
Cooperation
Platform

Comparative Study on Curricula for Vocational Teacher Education in Mechanical and Electrical Engineering.

Ha Xuan Hung

Research and Development

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Comparative Study on Curricula for Vocational Teacher Education in Mechanical and Electrical Engineering.

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List of Abbreviations

AEC	ASEAN Economic Community
AM-FM	Amplitude Modulation - Frequency Modulation
APEFE	Association of Promotion of Education and Formation in Foreign countries
APEI	Assosiasi Profesi Electrik Indoneia
APTEKINDO	Indonesia Vocational and Technology Educational Association
ASEAN	Association of Southeast Asian Nations
BA	Bachelor
BAN-PT	Badan Akreditasi Nasional Pendidikan Tinggi
CAD	Computer Aided Design
CAM	Computer-Aided Manufacturing
CDIBB	Institute of Vocational Instructors of Tongji University
CIM	Computer Integrated Manufacturing
CISC	Complex Instruction Set Computers
CNC	Computer Numerically Controlled
CRT	Cathode Ray Tube
EDA	Electronic design automation
EDM	Electro Discharge Machining
EE	Electrical Engineering
EED	Department of Electrical Engineering
ERIC	Educational Resources Information Center
FE	Faculty of Engineering
FE	Faculty of Engineering
FEA	Faculty of Engineering and Architecture
FET	Field Effect Transistor
FKIP	Fakultas Keguruan dan Ilmu Pendidikan
FPTK	Faculty of Technology and Vocational Education
FSK	Frequency Shift Keying
GPA	Grade Point Average
IBB	Institut für Berufsbildung
IC	Compression ignition
IIR	Infinite Impulse Response
IPG	Institut Pendidikan Guru

IT	Information technology
KKN	Kuliah Kerja Nyata
LAN	Local Area Network
LED	Light Emitting Diodes
LPTK	Lembaga Pendidikan Tenaga Kependidikan
LTI	Linear Time-Invariant
MATLAB	Matrix laboratory
ME	Mechanical Engineering
MKDP	Kelompok Mata Kuliah Dasar Profesi
MKK	Mata Kuliah Keahlian
MKKP	Mata Kuliah Keahlian Profesi
MKLP	Kelompok Mata Kuliah Latihan Profesi
MKU	Mata Kuliah Umum
MoET	Ministry of Education and Training
MoLISA	Ministry of Labor – Invalids and Social Affairs
MOSFET	Metal Oxide Semiconductor Field Effect Transistor
NC	Numerical Control
NGN	New Generation Network
NPV	Net Present Value
NuoL	National University of Laos
NUTE	Namdinh University of Technology Education
ODA	Official Development Assistance
OP AMP	Operational Amplifiers
PC	Personal Computer
PCD	Participatory Curriculum Development
PCM	Pulse-Code Modulation
PDR	Politics System of Lao
PERT	Program Evaluation and Review Technique
PLC	Programmable Logic Control
PLD	Programmable Logic Device
PLP	Professional Learning Plan
PT. DI	Perusahaan Terbatas Dirgantara Indonesia
PT. PLN	Perusahaan Terbatas Perusahaan Listrik Negara

PTE	Pendidikan Teknik Elektro
PTEI	Pendidikan Teknik Elektronika Industri
PTPG	Perguruan Tinggi Pendidikan Guru
PTTE	Pendidikan Teknik Tenaga Elektrik
PTTK	Pendidikan Teknik Telekomunikasi
RAM	Random Access Memory
RCBD	Randomized Completely Block Design
RCP	Regional Cooperation Platform for Vacational Education on Asia
RISC	Reduced Instruction Set Computer
ROM	Read Only Memory
SCADA	Supervisory Control And Data Acquisition
SCR	Silicon Controlled Rectifiers
SI	Spark ignition
SMK	Sekolah Menengah Kejuruan
SMT	Thesis Tutoring Team
SPICE	Simulation Program with Integrated Circuit Emphasis
TCP	Transmission Control Protocol
TDM	Time division multiplexing
TOEFL	Test of English as a Foreign Language
TOEIC	Test Of English for International Communication
TPK	Curriculum Developer Team
TPTA	Tutoring Team Final
TriAc	Triode for Alternating Current
TV	Television
TVET	Technical and Vocational Education and Training
UNPAD	Universitas Padjadjaran
UPI	Indonesia University of Education
VTE	Vocational Teacher Education
WTO	World Trade Organization

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Excutive summary

Under the auspices of the Regional Cooperation Platform for Vocational Teacher Education in Asia (RCP), 4 vocational teacher training institutions of Vietnam (Namdinh University of Technology Education – NUTE), Laos (Faculty of Engineering/ National University of Laos – FE/ NuoL), Indonesia (Faculty of Technology and Vocational Education/ Indonesia University of Education – FPTK/ UPI) and China (Institute of Vocational Teacher Education – IBB/ Tongji University) are developing core curricula for VTE in Mechanical Engineering (ME) and Electrical Engineering (EE) at Bachelor Degree level.

The authors compare and analyze the available curricula of the institutions to find out where they differ and what they have in common. In terms of the differing points the authors agree on the basic principle that regarding different academic issues, it is necessary to analyze and compare in order to reach an agreement and at the same time different cultural issues have to be respected. Bearing that in mind, the authors have proposed a common structure for both of the curricula including: (1) Title of the curriculum; (2) Objectives; (3) Duration; (4) Enrollee; (5) Graduation condition; (6) Evaluation; (7) Contents; (8) Brief description of subjects and (9) How to use the core curriculum.

The core curriculum for VTE in ME consists of 134 credits including 28 credits of general knowledge, 52 credits of professional knowledge, 21 credits of pedagogical knowledge, 22 credits of internship – practice and 08 credits of graduation paper.

The core curriculum for VTE in EE consists of 133 credits including 30 credits of general knowledge, 55 credits of professional knowledge, 21 credits of pedagogical knowledge, 22 credits of internship – practice and 8 credits of graduation paper.

The core curricula for vocational teacher education in Mechanical Engineering and Electrical Engineering will be implemented at the institutions taking part in the research. Based on these core curricula, institutions will be able to make exchanges between lecturers and students and in the near future these institutions' qualifications will gain mutual recognition.

1 Introduction

1.1 Background of the study

The Association of Southeast Asian Nations (ASEAN) is a political, economic, cultural and social association of the countries in Southeast Asia. ASEAN emphasizes the regional cooperation regarding the "three pillars" of security, socioculture and economic integration with its goal being to create an ASEAN Economic Community (AEC) by 2015. The establishment of the AEC will bring about many advantages to the region's countries. AEC enhances political trust and friendly relations, ensuring an environment of peace and political stability. AEC also creates a common market with an economic connection based on consistent production, free trade in investment, capital transfer, labour, grounded in common standards and criteria that will enhance the development of the ASEAN member countries. By 2015, ASEAN will become a community. In place of ten labour markets there will be a large labour market in which the nations all recognize one another's qualifications. To gain such qualification recognition, the nations must achieve a consistency of curriculum across the board in all the regions countries. Toward this aim, Namdinh University of Technology Education in collaboration with National University of Laos, Indonesia University of Education and Vocational Training Institute and Tongji University, Shanghai have conducted research on developing the core curricula for vocational teacher eduction in Mechanical Engineering and Electrical Engineering.

For the small scope of this study, the authors chose to develop core curricula for VTE in two majors: Mechanical Engineering and Electrical Engineering. In Vietnam, 327 occupations which are being trained in vocational institutions. However, the Vietnamese government is focusing on building 120 occupations at national, regional and international levels, that feature the occupations of Metal Cutting and Industrial Electrics. There are approximately 100 vocational colleges and more than 150 vocational schools in Vietnam, 80% of which train the two latter occupations referred to. For the purpose of training these two occupations, the vocational teacher musth major in Mechanical Engineering and Electrical Engineering.

Namdinh University of Technology Education (NUTE) is one of four universities training vocational teachers. The school has 45 years of experience featuring 10 majors at college and university levels and 14 occupations. Focused on in the curricula are the two majors of Mechanical Engineering and Electrical Engineering and the two occupations of Metal Cutting and Industrial Electric. NUTE had also concentrated its resources to developing these disciplines.

Furthermore, at the RCP meeting, NUTE discoverfed that the partners of Laos, Indonesia and China share the same interest in training VTE in Mechanical Engineering and Electrical Engineering. For this reason these 4 partners gained the foundation to cooperate with one another and build the draft of core curricula for VTE in mechanical engineering and electrical engineering.

1.2 Goals of the study

The proposed project intends to give an overview of existing models of vocational teacher education in NUTE as well as those of other RCP partners institutions such as UPI, NUoL and IBB to contribute to developing a new model of TVET teacher education for each institution.

The project intends to analyze the existing curricula for vocational teacher education in mechanical engineering and electrical engineering in NUTE, UPI, NUoL, IBB, and draw up recommendations for the development and implementation of core curricula for vocational teacher education in mechanical engineering and electrical engineering.

Addresses of the recommendations will be the governmental institutions responsible for issuing policies on frame curricula.

1.3 Scope of the study

In the scope of this project, the authors focus on studying core curricula in mechanical engineering and electrical engineering of these 4 RCP members: Tongji University Shanghai, National University of Laos, Indonesia University of Education and Namdinh University of Technology Education. It will be too broad to cover all training levels; therefore, this research focuses on the curricula for training vocational teachers in mechanical engineering and electrical engineering at BA level.

1.4 Research methodology

To achieve the goals of this project, partners have to report on the overview of each university, the current model of training vocational teachers, the enrolment of vocational teacher education in general and the enrolment of vocational teacher education in mechanical engineering and electrical engineering. Subsequent to that, the partners enter into discussion together to find out the common and different points such as: the structure of the curricula, training objectives, training duration, enrollee, compulsory subjects,optional subjects and so on. Regarding other aspects, partners have to analyze thoroughly to reach agreement (if possible).

Based on the agreement reached, the partners build core curricula for vocational teacher education in mechanical engineering and electrical engineering for four universities. Last but not least, the partners make recommendations for the partners themselves and other universities with the same majors. Simultaneously, recommendations are given to governmental institutions of RCP partners as references when building frame curricula for vocational teacher education in mechanical engineering and electrical engineering.

2 Theoretical basis

Vietnam has been part of WTO since 2007, meaning that Vietnam has participating positively in globalization and international integration. Joining WTO has had a positive effect on the Vietnamese economy, society and labour market as it resulted in a great breakthrough in human resources. Aside from opportunities, challenges such as backwardness, poverty, cultural barriers, and competition in particular has involved a violent struggle whereby only highly competitive markets have any hope of being developed and those not so competitive simply face elimination.

In such circumstances, training human resources with high quality to meet the requirements of socio-economical development of the country is a privileged task. Our government has emphasized that *"Education is the privileged national policy"*.

A curriculum is considered the backbone of a training process. It not only shows the professional ability but a balance of human resource quality aspects such as: the ability of action, competition, cooperation, creativeness, lifelong learning and the application of new media and materials. A curriculum also reflects the mission of a school and the training quality to develop the human resources to meet the requirements for the country's socio-economical development for the future.

2.1 Curriculum and curriculum development

2.1.1 Curriculum and approaches in education

The term *education* emphasizes the development of human beings for future purposes regarding the distant future without immediate evaluation. The term *training* is often understood as human capacity development for short-term objectives. When training concludes students are expected to do what they learnt at school. In education, there exists training, and vice versa.

After the revolutionary era of educational reform (1920 - 1940) in Europe and North America, the curriculum was transferred from the subject-centered perspective to a learner-centered one that no longer emphasized the knowledge itself but focused on the knowledge students acquire. From the point of view, the curriculum is understood as follows:

- Curriculum includes all of the knowledge that students obtain under the instructions of teachers (Caswell & Campbell, 1935).
- Curriculum is a series of knowledge that students can obtain and is designed by the school to train students in thinking and action (Smith, Stanley & Shores, 1957)
- Curriculum is all the knowledge that students can obtain at schools (Doll, 1989).

The definition of the ERIC (Educational Resources Information Center): *The curriculum is understood as a combination of a system of training objectives and the corresponding learning contents that are organized into a series of subjects.*

Article 6 of the Education Law 2005 (Vietnam): *A curriculum shows educational objectives; standards of knowledge and skills; scope and structure of educational contents; methods and forms of educational activities; how to assess the educational outcomes for subjects in each grade, each school or training level.*

There are many different ways to understand a curriculum, which depends on the perspective and the approach. There are three approaches: the content approach; the objective approach; the development approach.

The approach of content:

- Concept: education is the process of transmitting knowledge.
- Definition: a curriculum is a draft of the educational content through which teachers know what they need to teach and learners know what they need to learn.
- Curriculum = Content
- The approach of objective:
- Concept: Education is a tool to create products which meet the available standards.
- Definition: a curriculum is a training plan that reflects the training objectives. It is an overall design for an educational activity (which may last a few hours, a few days, a few weeks or a few years).
- Curriculum = Content + Objective + Method
- The approach of development:
- Concept: A curriculum is a process and education is the development.
- Definition: a curriculum education is an overall design for an educational activity (which may last a few hours, a few days, a few weeks or a few years). The overall design shows the entire educational contents, what is expected from students after the course, the necessary procedures to provide educational contents, educational methods and how to assess the results. All those things are arranged in a strict timetable (Wentling, 1993)
- A curriculum includes: objectives; contents; methods and procedures; result assessment
- Some definitions basing on the approach of development:

A curriculum is a systematic presentation of a comprehensive plan of educational activities in a specific time, which raises learning objectives, scope and level of learning contents, means of learning, methods of learning, how to organize learning activities and how to assess the learning outcomes, etc, in order to achieve the available learning objectives set out. (Dang, 2006).

2.1.2 Curriculum development

According to the approach of development, a curriculum is not designed once and for all, but should be developed and supplemented depending on the socio-economic development and the scientific and

technological achievements to meet the requirements of the labour market. In other words, once the objectives of national education change to satisfy the social needs, the curriculum must also change. Thus, curriculum development is a continuous process to constantly improve the curriculum. Curriculum development is a sequence of complicated operations, including many steps and actions to incorporate the work into a programmeme. Basically, creating a curriculum consists of three basic steps:

Step 1: Designing a curriculum

- Decision regarding the design made by the curriculum planning group.

Step 2: Implementing the curriculum

- The curriculum plan includes alternative modes with suggestions as to resources, media, and organisation, thus encouraging flexibility and more freedom for the teacher and students.

Step 3: Evaluating the curriculum

- Decisions regarding evaluative procedures for determining learner progress made by teacher.
- Decisions for evaluating the curriculum plan made by the planning group. Evaluative data will form bases for decision making in further planning.

To build or develop a curriculum, it is necessary to identify social needs and focus on the analysis of relevance in terms of connection with the world of work. Principles are set as follows: "In a dynamic and heterogeneous labor market, higher education institutions should rely on not only long-term orientation on the labor market but also on social needs." This requires students to acquire new skills. "Higher education should implement educational methods based on knowledge to train those who know how to study and take responsibility for learning, through which students will be better prepared to make jobs for themselves." "The mutual harmony with the world of work confirms that higher education should take the leading role in the development of the world of work in order to better satisfy the requirements of sustainable development". (Shabani)

We persistently turn to the development of programmemes to satisfy society's needs. The needs of society (government, business, learners) change according to socio-economic development, thus a curriculum has to be continuously updated, adjusted and changed to meet those needs.

Yet, two other important factors that are also to be mentioned here: who builds the curriculum and how it is developed? When referring to the curriculum and curriculum development, we agree that how a curriculum is developed depends on the decision-maker group. The theory of education not only helps us to decide the training objectives but also influences how components of a curriculum are connected. In fact, there is no programmeme that can cover all the knowledge and skills needed to develop a personality and society. Curriculum developers choose to keep or remove content, or increase or cut down on content amount and so on. One team may choose different subjects and activities from another. Therefore, it is important to select the participants in curriculum development (the classical approach tends to select few outstanding people to form curriculum development groups) (Nguyen, 2008).

2.1.3 Curriculum development models

In the curriculum development process, there are two main trends: the classical model and participatory curriculum development model. Classical curriculum development is based on objective learning. The objective of the programmeme is to change the behavior of each person by defining clear learning objectives and developing the knowledge and skills to achieve those objectives. The development of a new curriculum or use of an available curriculum requires input and decisions by a group of experts on how to start. Although in many cases, teachers can decide what to teach and how to teach, the core curriculum is still ultimately decided upon by the higher authorities. Objectives and aims are set by experts who have the power in educational institutions or ministries. Learners are seen as the least important in the system and usually have little or no participation in curriculum development. The researchers call this approach to curriculum development the objective approach, which assumes the objectives of learners. Such a curriculum will be successful through the process of analyzing the needs and situations, setting general objectives, deciding on the content and teaching methods and establishing assessment system. (Nguyen, 2008)

Although there are many curriculum development trends or models, selecting a suitable model to the socio-economic and educational development of the school/institution generally requires consideration of human resources, materials, finance, the needs of the society and learners and other impacts of the environment.

Within the scope of the project, the authors would like to introduce the following curriculum development models:

a. Diamond's systemic curriculum development model (1998)

This model's advantages have made it highly appreciated by managers:

- Its interests lie in the learner-centered trend: a general trend of a modern curriculum is to select a reasonable amount of classroom content learning to avoid knowledge overload and leaving an appropriate amount of time for students' self-study activities.
- It not only focuses on knowledge but also considers the teaching process in terms of the movement and interaction of many factors.
- This model is a synchronous design reviewing the teaching and learning process at the operational stage, in which the objectives, contents, methods and media, teaching and learning organization, assessment forms etc., are focused.
- This model is carried out in five steps:

- **Step 1:** Identify the needs of the students, the community and identify specialized knowledge.
- **Step 2:** Determine general to specific purposes based on the analysis of the real situation and the learning ability of students.
- **Step 3:** When compiling the teaching files and building assessment criteria, take note of the input of students and other short or long-term academic objectives, pay attention to the selection of methods and media. The assessment plays an important role in the compiling and editing process.

- **Step 4:** During implementation and evaluation, pay attention to the identified objectives.
- **Step 5:** Adjust when needed.

b. Participatory Curriculum Development (PCD) model

The PCD approach postulates that learners are completely different from the starting point. While studying, they will change through interaction with different related groups. Curriculum building is therefore implemented with the participation of all related groups, depending on the resources and interests of each group. (Dang, 2006)

The PCD model requires the identification of students' specific responsibilities to achieve good results in each subject; improve note-taking skill; reduce anxiety about exams and hone test-taking skills; help students become familiar with the material organization of each subject; provide the hard-to-find lessons and bind into material distribution; enhance effective learning. Students prepare the study and arrange a convenient time when they have detailed information on the learning content. The PCD model is connected to the five key stages of Skilbeck's model.

Stage 1: Situational Analysis

External Factors: Influences outside educational and/or training institutions which affect the demand for educational/training provision

- Sociological
- Technological
- Economic
- Political
- Professional
- Phisolophical

Internal Factors: Features within educational/training institutions which affect their ability to supply such education/training

- Experience and Expertise
- Reputation
- Ethos
- Community Relationship

Stage 2: Goal Formulation: Anticipated learning outcomes

Long-Medium- and Short Term

- Aims
- Objectives
- Learning Outcomes
- Competences

Stage 3: Programmeme Building: Selecting subject matter

- Length
- Level
- Structure
- Organisation
- Content
- Methods
- Sequence

Stage 4: Interpretation and Implementation: Delivery of the course

- Prescription
- Guidance
- Resource Provison
- Staft Development

Stage 5: Monitoring: Monitoring of the course. Assessment and evaluation

- Assessement of Learning
- Appraisal of Delivery
- Estimate of Relevance
- Quality Assuranse

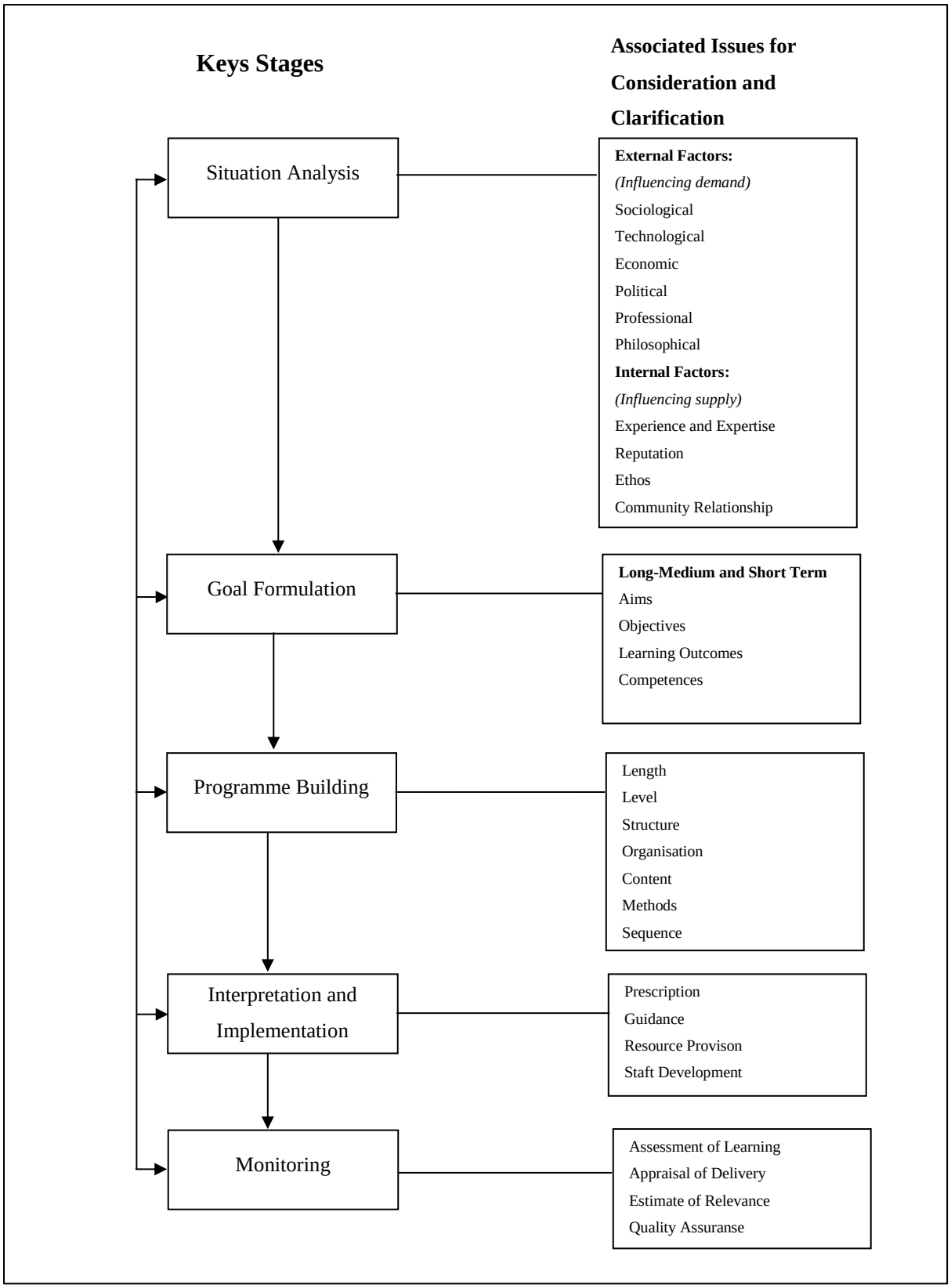

Figure 1: Stages of PCD model

c. Hybrid model

Okebukola's Hybrid model (1997) combines the characteristics of the two models above. The majority of universities and colleges in Vietnam regard it to be the standard and a suitable model for the curriculum design of a bachelor degree. The model comprises the following steps:

- **Step 1:** Diagnosis of needs
  The curriculum development group begins by determining the needs of the society, institution, the students and subject matter which the proposed curriculum hopes to address.

The needs are:

- The relationship between subjects and the purposes, objectives of the training course.
- Information about learners.
- The social demand for learners after graduation.
- School training priorities.

- **Step 2:** Formulation of objectives
  After needs have been diagnosed and identified, the curriculum planning team specifies the objectives to be accomplished.

The Aim is to make a model and a direction to design specific activities to achieve a product or behaviour for the future. The aim is the starting point to create an ideal, or an inspiring vision for future products. Aims reflect the values, aspirations and directions for educators design training process.

The goal in education is a way to determine the outcomes of education. According to Sowell, one goal of education is to answer the question: "In which direction does a curriculum or a course intend to lead learners?" Goals of education only show the tentative direction and do not describe a particular teaching way to a certain degree. Goals raise the basic characteristics learners need to reach. Goals of education refer to the goals of the curriculum or outputs that we wish to achieve as products of the curriculum.

Objectives are specified and explicit. While aim is the most general and a long-term strategic framework, objective is short-term and more specific.

Orstein divides educational objectives into three levels:

- The objectives of the programmeme (related to the courses) at all education levels.
- Objectives of the course (The objectives of the programmeme and the course are made by the curriculum planning designers).
- Objectives of the class including the objectives of the subject created by teachers based on the programmeme and course objectives.

- **Step 3:** Selection of content

The group of experts and users select content for the curriculum in line with the formulated objectives.

The theoretical basis for the selection of content is based on the following four approaches:

- Thematic approach - leads to various themes based on knowledge and experience. There is hardly any relationship between components of contents.
- Conceptual approach - leads to less content regarding the key concepts, sub-concepts and the interaction between them. The relationship between the content components is emphasized.
- Combination of thematic and conceptual approach (sets of concepts with many advantages in terms of conceptual structures combined with flexibility, creativity, and without overload).
- Modular approach leads to provide complete job skills. This is the general approach of technical and professional curricula.

- **Step 4:** Organisation of content
  alongside the selection of content is the task of deciding at what levels and in what sequence the subject matter will be placed. Maturity of learners, their readiness to confront the subject matter, and their levels of academic achievement are factors to be considered in the appropriate placement of content. The methodologies or strategies by which the learners become involved with the content must be chosen by the curriculum planners.
- **Step 5:** Organisation of learning activities
  The curriculum group decides how to package the learning activities and in what combinations and sequences they will be utilised.
- **Step 6:** Determination of what to evaluate and of the ways and means of doing it
  The curriculum planning group selects from a variety of techniques, appropriate means for assessing achievement of students and for determining whether the objectives of the curriculum have been met.
- **Step 7:** Pilot Testing
  Testing the draft curriculum using a sample of the target group of users.
- **Step 8:** Revising and consolidating
  The units are modified on the basis of pilot test data to take cognisance of variations in student needs and abilities, available resources, and different styles of teaching so that the curriculum may suit all types of classrooms.
- **Step 9:** Approval by Faculty, Senate and Governing Council
  Approval is sought at the appropriate level for the curriculum in line with the guidelines applicable in the higher institution.
- **Step 10:** Use of the approved curriculum
  The approved curriculum is put to use in the higher institution.
- **Step 11:** Periodic review

The curriculum is subjected to periodic review and evaluation.

"Evaluation of a curriculum is a process of collecting evidence to be able to decide, approve, modify or remove the curriculum". (Orstein & Hunkins, 1998).

Evaluate a curriculum is to detect whether the curriculum that is designed, developed and implemented may create the expected product.

Evaluation helps identify the strengths and weaknesses of the curriculum before the implementation, or to determine its effectiveness after implementing it for a certain period of time. To see whether a curriculum is effective or not, it is important to emphasise the objectives of the curriculum and ensure two issues:

- Has the curriculum achieved its identified objectives or not? (knowledge, skills, attitudes)
- In what conditions, in what ways, at what time and who is it that improves the curriculum?

2.2 Curriculum development in Vietnam

Curriculum development at universities and colleges complies with the regulations on curriculum standard issued at Decision No. 01/2005/QĐ-GDĐT by the Ministry of Education and Training dated 12/01/2005, in which the curriculum standard is the basic programmeme of a major or a group of majors built by the Advisory Council and approved by the state agency. Based on the curriculum standard, the schools/training institutions develop specific curriculum for schools/training institutions and determine the differences in the corresponding curriculum with different training levels. A curriculum standard of major or a group of majors usually includes the following contents:

- The overall objective of the major/group of majors
- Place of work for graduates and their functions
- Knowledge, skills and attitudes - they have to be able to function well
- The overall design of a curriculum includes a list of the subjects that make up the main and basic knowledge of the major
- Recommendations on the teaching methods
- Guidelines on the assessment process
- The guide on how to use the curriculum standard to design specific curriculum (Department of Undergraduates and Graduates – Ministry of Education and Training, 2003).

Thus, to identify the basic components of a curriculum, it is necessary to take into account: training needs; training objectives; training contents; training methods; organizations of training activities; the form of assessment of training results.

2.2.1 Scientific basis to develop the curriculum standard for engineering major

Improving the quality of training the human resources to meet the requirements of industrialization, modernization, and active integration is the leading task of education. One of the important measures to achieve the objectives of this task is to develop the curriculum.

The following diagram describes the process of developing the curriculum for higher education in Vietnam.

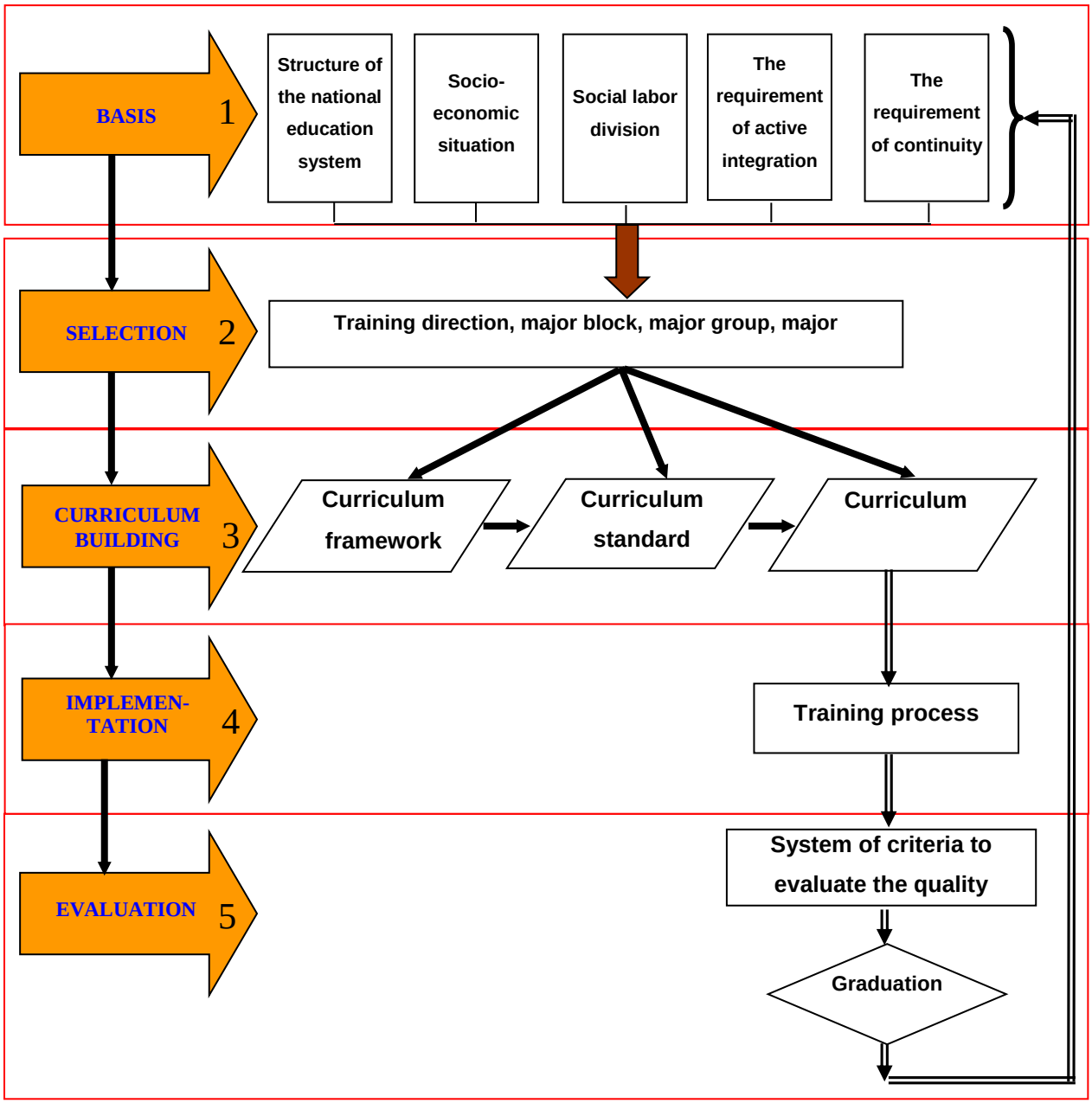

Figure 2: Diagram of curriculum building

To build a qualified curriculum (from the curriculum standard, core curriculum to a specific curriculum), the first requirement is the full set and a thorough analysis of the factors affecting the products created from that programmeme. These factors are the scientific basis that helps us define the position, objectives and contents of the training programmeme in the national and international systems.

- ***The structure of the national education system:*** To build at college and university level, it is essential to understand and analyze the curriculum of general education and professional education to both inherit and improve the academic level in the most scientific and economical way.
- ***Technical and technological level in the country (socio-economical facts):*** A suitable curriculum at the technical and technological level in the country is an important condition for its survival and development.
- ***The labour market and the social division of labour:*** in social activities, particularly in the sphere of industrial labour, the stratification and division of labour is based on the requirements of the process of creating social products. This process can be generalized into the following basic stages:
    a. Outlining the products based on market requirements: this stage is dubbed the product design stage. For this stage human resources are required to have a background in maths and science. According to the current document, such human resources are trained in engineering.
    b. Planning, organizing and operating to turn the design product into a used product: this stage is often referred as the design of technology and organization of production. For this stage human resources are required to have a solid foundation in basic engineering principles and technical skills. Thus human resources for this stage are trained in engineering technology.
    c. Directly implementing the technological process to make products at specific places and on the specific machinery: for this stage human resources must have practical skills and be knowledgeable regarding the technical features of equipment. Vocational training is responsible for training human resources at this stage.

Obviously, the engineering technology direction is responsible for training labour for stage (b) for the process of making industrial products.

From the above analysis we may observe: *majors and occupations are formed from the social requirements (eg, mechanical engineering, electronics, automotive repair, ...), and training direction is based on the social division of labor. Hence, most of the technical majors are also present in the technological major. However, the technological major is related to information and material processing.*

- **The requirements for active integration into the regional economy and the world:**

Regional integration and globalization of the economy is inevitable. This tendency not only creates tremendous opportunities for Vietnam, but also raises severe challenges. For these reasons, the Ninth Party Congress resolutions have affirmed: Vietnam musts actively integrate.

The crucial factor decisive in active integration is the human factor. To get active human factors, programmemes to train and retrain human resources must given the utmost attention in order to reach the regional and the world standard.

- **The tendency of lifelong learning must have continuity in the training programmeme:** With the rapid development of science and technology, no level of training and no type of training can equip lifelong learners sufficiently. As a result lifelong learning is the objective requirement of all kinds of human resources to adapt to the labor market. To improve the effectiveness of training, save the time and money of learners, curricula at all levels must be built to meet the following requirements: Be sufficient in ensuring the training objectives; Create a legacy and that can be upgraded in the best terms of time and finance if learners can transit to higher education.

Hence, a curriculum must meet the following criteria:

- **Criterion 1**: *The curriculum is built in accordance with the hierarchy and division of the national education system.*
- **Criterion 2**: *The curriculum must be practical and suitable to the domestic level of science and technology.*
- **Criterion 3**: *The curriculum helps generate a workforce suitable to the social division of labor.*
- **Criterion 4**: *The curriculum meetes the requirement of active integration into the regional and world economy.*
- **Criterion 5**: *The curriculum should be built in relation to continuity to create convenient conditions for lifelong learners to learn in the most economical way.*

2.2.2 Implementation process

In Vietnam, the Ministry of Education and Training is a state management agency for higher education. The Ministry of Education and Training is responsible for issuing the Curriculum Framework and the Standard Curriculum.

2.2.2.1 Establishing the Advisory Council of technological majors

An Advisory Council of technological majors has been established to support the Ministry of Education and Training in building the Curriculum Framework and the Standard Curriculum. The advisory council has the following specific tasks:

1. Identify specific training objectives of the major.

2. Identify the name and description of the contents of the major:

- The basic knowledge and specialized knowledge.
- The major knowledge and minor knowledge.

3. Introduce authors to write books for the major.

4. In the long run, to help the Ministry of Education and Training accredit curricula of universities and colleges.

2.2.2.2 Developing the tertiary curriculum for technological majors

2.2.2.2.1 General principles:

The curriculum framework includes: objectives of study, duration of study, the structure of knowledge, the minimum amount of knowledge, the amount of time to practice, Curriculum framework technological majors are based on an analysis of the scientific basis mentioned above.

When designing curriculum framework, it is necessary to comply with the following basic principles:

- To be fully aware of the educational principles of the Communist Party: for students to develop a comprehensive morality, intellect, physical health and aesthetism, it is important to ensure the objectives issued in Article 35 of the Education Law: "The objective of higher and postgraduate education is to train learners with political ideology, ethics, sense of serving the people, knowledge and practical skills suitable to professional training and health to meet the requirements of building and defending the country."
- Inheritable
- Inherit the results of the studies which have been applied effectively in the universities and colleges in the country.
- Inherit the results of the studies which have been applied effectively of the region and the world that can be adapted in Vietnam.
- Practical: The requirements of learners, the labour market is the basis for building objectives and structure of knowledge.
- Scientific and pedagogical: It is necessary to pay attention to innovative methods, teaching and learning media when determining the amount of knowledge to enable students to develop autonomy and activeness in the learning process.

2.2.2.2.2 Curriculum framework for technological majors

a. Training objectives

   The curriculum of technological majors aims at training learners to develop comprehensively so that they are able to apply basic technical principles and skills to undertake the work of teaching or design technological processes, organize, manage and control the production process according to the education level and majors.

b. Duration of study

Article 34 of the Education Law regulates:

- College: 3 years.
- University level: 4 years.

c. The structure of knowledge: To achieve identified objectives, the structure of knowledge in the curriculum are as follows:

- General knowledge includes:
  - Social sciences and humanities.
  - Foreign Language.
  - Mathematics and Natural Sciences.
  - Physical Education.
  - National Defense Education.
- Professional knowledge includes:
  - Basic knowledge.
  - Specialized knowledge.
  - Testing, practice.
  - Graduation paper (Exam taking or project, graduation paper).

a. The minimum amount of knowledge for a curriculum at universities and colleges for technological majors:

To achieve the identified objectives, the distribution of knowledge in technological majors has the following main characteristics:

- The amount of general knowledge is sufficient, meets the educational standards, is suitable for the level of training and shows the continuity between the training levels.
- Focus on providing basic technical principles and enabling flexibility in future applications.
- Enhance practical skill and technical applications through sufficient amount of practice.

The total amount of knowledge:

- College level: 150 study units.
- University level: 200 study units.

In which the amount of general knowledge and professional knowledge is shown in the following table:

Table 1: **The structure and minimum amount of knowledge for curriculum at university and college level (Basing on study unit)**

Training level	**Duration** *(year)*	**Total amount of knowledge**	**Amount of general knowledge**	**Professional knowledge**				
				Total amount	**Basic knowledge**	**Specialized knowledge**	**Internship**	**Graduation**
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
College	3	150	60	90	*Assign the Advisory Council of major or major group and institutions to build*		27	5
University	4	200	85	115			27	7

The models mentioned here are the basic models for developing a new curriculum. However, in the scope of this study research, the authors do not attempt to build a new curriculum. Instead the authors are attempting to work out the core curricula for vocational teacher education (VTE) in Mechanical Engineering (ME) and Electrical Engineering (EE). In order to develop the core curricula, the partners of the research study use the base of the current curricula of each partner. Four partners are btaking part in this project; Namdinh University of Technology Education (NUTE) – Vietnam, Faculty of Engineering/ National University of Laos (FE/NuoL) – Laos, Indonesia University of Education (UPI) – Indonesia and Vocational Teacher Training Institution/ Tongji University (IBB) – China. Each of these partners has its own curricula for VTE in ME and EE and these curricula consist of three kinds of knowledge: general knowledge, professional knowledge and pedagogical knowledge. The number of credits of the curriculum is 146 credits, 145 credits, 150 credits and 201.5 credits for NUTE, FE/NuoL, UPI and IBB respectively. In the project, the curricula of all the partners will be taken into consideration. The partners will also compare their current curricula to find out the common points and harmonize the different points to agree on one common core curriculum that can be employed in each partner country. The core curricula will be a combination of curricula of partners but is still loyal to the principles in developing curriculum of each partner county.

3 The curricula for VTE in Mechanical Engineering and Electrical Engineering in some Asian Institutions

3.1 The curricula for VTE in mechanical engineering and electrical engeneering at Namdinh University of Technology Education

3.1.1 Introduction of Namdinh Unversity of Technology Education

Namdinh University of Technology Education was founded on December 21, 1966 under the name Namha Industrial School. The school was subsequently renamed several times and came under the management of different governmental offices; however, the university's mission remains vocational training and vocational teacher training in the country.

The University has trained 10,685 vocational teachers at college and university level; nearly 8,000 technical workers and technicians at vocational college and vocational secondary school level. It has enhanced the pedagogical skill of thousands of vocational teachers to meet the demand of vocational training and other fields in the region and nationwide.

To recognize the achievements of the University, the Government has awarded the University with 1 Independence Medal – Third Class (2011), 1 Labour Medal – First Class (2000), 1 Labour Medal – Second Class (1996), 2 Labour Medals – Third Class (1986, 2001); 1 member of the University staff was awarded the Labour Medal – Third Class, 3 members of the University staff were recognized as "Teachers of Merit". Aside from that, the University has been garnered many other honorable awards.

The function of the university is to train vocational teachers at university and college level; to train engineers at university and college level; to train Bachelor of Economics; to carry out vocational training at all levles; to study and apply science and technology and to serve education and socio-economic development.

The responsibilities of the university are:

a. To train, and cultivate human resources with political quality, professional ethics and practical skills;
b. To study and apply scientific and technological advancement to serve education and socio-economic development; organize production and service activities according to the laws and regulations;
c. To cooperate the training, scientific research and technological transfer internationally;
d. To build and manage the management and teaching staff of the University in terms of quantity, quality and structure;
e. To enrol and manage students;
f. To manage facilities, equipment and finance according to the regulations;
g. To take part in social activities appropriate to the functions and responsibilites of the University;
h. To implement other tasks assigned by MoLISA.

To fulfill the functions and responsibilities, the University has built the curricula and organized courses at university, college, vocational college and vocational secondary school level in technique, technology and economics.

The University is allowed to train the following majors in engineer's and associate programmemes: 1) Information Technology; 2) Computer Science; 3) Automotive Engineering; 4) Mechanical Engineering; 5) Mechanical Engineering *(Welding Technology)*; 6) Electrical Engineering; 7) Electrical electronic Engineering; 8) Controlling and Automation Engineering; 9) Accounting; 10) Business Administration. The curricula of the above major are presented in Table 1 Annex 1.

The University has been allowed to train 11 occupations at college level and 12 occupations at secondary school level: 1) Metal cutting; 2) Welding; 3) Automotive engineering; 4) Industrial electricity; 5) Industrial electronics; 6) Household electronics; 7) Cooling Technique and Air-conditioning; 8) Electrical Installation and Industrial Controlling; 9) Computer Programming; 10) Network Administration; 11) Computer Graphics (with vocational secondary school level); and 12) Accounting. Graduated students are issued with Vocational College Degree or Vocational Secondary School Degree (corresponding to training level).

To fulfill the function to enhance the profession and pedagogical skill of students, teachers, lecturers and trainers, the University trains and issues the following national certificate:

Certificate of proficiency in English and in Informatics level A, B, C basing on the curricula by MoET;

Certificate of Pedagogical skill: pedagogical skill for vocational teachers at college level, secondary school level and elementary level.

The total number of students at NUTE now is more than 5000 students. Besides that, NUTE has trained pedagogical skill for thousands of vocational teachers in nationwide vocational institutions and students graduating from engineering majors and expecting to become vocational teachers. Among 4.538 turns of students studying vocational pedagogy, 1.350 students are graduates at college and university level at NUTE.

By 31/5/2012, the total number of management and teaching staff of NUTE is 293 persons. The number of teaching staff is 203 persons and that of management staff is 84 persons. Among the teaching staff, 131 lecturers and teachers are post-graduates**.**

NUTE is located in Loc Ha ward, Nam Dinh city, Nam Dinh province with the total area of nearly 5,2 ha. The University is planned and built with its full functions such as: lecture hall, workshop, laboratory; administration ward; physical education ward and dormitory. The total floor area is over 31.000 m^2. There are 58 classrooms and 81 laboratories and workshops with modern equipment. A computer network system with over 1.000 PCs serves for administration, academic tasks and R&D activities. There are over 45,000 books in its library. The dormitory has 720 accommodations for students. The campus contains a stadium and gymnasium (with the floor area of 1.580 m^2), which are available for faculty and staff members and students.

3.1.2 Introduction of Faculty of Faculty of Electrical-Electronic Engineering and Faculty of Mechanical Engineering

As stated above, there are various majors and various training programmes at NUTE; however, NUTE always pays great attention to its task as training vocational teachers for the whole country. Among all majors at NUTE, the two key majors are training vocational teachers in Mechanical Engineering and Electrical Engineering. The teaching staff of the two faculties: Electrical-Electronic Engineering and Mechanical Engineering is of great quantity and high quality to ensure the training quality of the faculties and the university as a whole. These are the two faculties which account for most of the number of teachers and lecturers at NUTE (79 lecturers). Among the 79 lecturers, 32 are of graduate level while the rest are of post-graduate level.

Not only can the teaching staff meet the demand to train vocational teachers of high quality, but the facilities are qualified enough to serve the training objectives. NUTE has received support from ODA projects such as the KfW project funded by the German Bank for Reconstruction and the APEFE project (Association of Promotion of Education and Formation in Foreign countries - Belgium) to invest in laboratories and equipment for engineering practice. For these projects, the university received 12 laboratories for Electrical-Electronic Engineering and 6 laboratories for Mechanical Engineering. Aside from that, the university itself has invested much on laboratories and workshops. In addition to the aforementioned laboratories supported by ODA projects, the university has a further 7 laboratories and workshops for Mechanical Engineering and another 22 laboratories and workshops for Electrical-Electronic Engineering equiped with a great deal of modern tools and equipment. Each laboratory or workshop serves corresponding subjects.

From the time the school was upgraded to the status of university, it has recruited 429 students in Mechanical Engineering and 668 students in Electrical Engineering. All these students are sufficiently qualified to serve as vocational teachers following graduation.

3.1.3 Introduction about the curricula of vocational teacher training in Mechanical Engineering and Electrical Engineering

3.1.3.1 Training objectives

Training at university level in the field of Mechanical Engineering and Electrical Engineering Teacher Education satisfies the demand of university education to train TVET teachers to serve the process of industrialization and modernization.

Graduate students must be in possession of good political ideology, ethics and health; be in command of teaching and research capabilities; and have sound professional knowledge and professional skills commensurate to the training level.

Graduate students can continue with post graduate studies in Mechanical Engineering/ Mechanical Engineering or Education Management.

3.1.3.2 Training duration (standard duration)

At NUTE, it takes students 4 and a half years to complete the programme training to be a vocational teacher in Mechanical Engineering. Following graduation, students taking part in this programme are awarded an Engineer in Technology and Certificate of Technical Education, to enable them to become vocational teachers.

3.1.3.3 The amount of knowledge for the whole course

During the course, students are required to accumulate 146 credits including general knowledge, professional knowledge and pedagogical knowledge. These specific kinds of knowledge will be described in detail in the curriculum.

3.1.3.4 Enrollee

This programme enrolls students that have graduated from upper secondary schools or institutions equivalent to upper secondary schools.

3.1.3.5 Process of training and graduation condition

When registering for any courses, students must submit an academic transcript, upper secondary school diploma, birth certificate, approval documents and a register form to study based on a credit system. After the school has recognized the students as official students of the school, students are issued with a student card, academic register booklet and given an academic consultant.

At the beginning of each academic year, the school informs students of the schedule of each semester, the list of compulsory and optional subjects, the syllabus, prerequisites for register for each subject and the test schedules for each subject.

At the beginning of each semester, each student has to register the subjects he/she intends to study that semester.

The assessment of students will be stated in the following section.

Students may graduate as long as:

a. They have not been prosecuted for criminal liability and have not been suspended
b. from the school;
c. They have accumulated enough credits (146 credits);
d. Their grade point average (GPA) is at least 2.00;
e. They have the certificate of national defence education and physical education.

3.1.3.6 Assessment

The assessment is classified into 5 levels as follows:

Table 2: **5 levels of the assessment**

No	Ranking	Numeral score	Letter score	Notes
1	Distinction	From 8.5 to 10	A	
2	Credit	From 7.0 to 8.4	B	
3	Strong pass	From 5.5 to 6.9	C	
4	Pass	From 4.0 to 5.4	D	
5	Fail	Below 4.0	F	

3.1.3.7 The curriculum

In the curriculum for VTE in ME and EE, there are three kinds of knowledge: general knowledge representing 51 credits, pedagogical knowledge 17 credits and professional knowledge at 78 credits. In ME, professional knowledge is classified into basic knowledge (26 credits), specialized knowledge (24 credits), internship (18 credits) and graduation paper (10 credits). In EE, professional knowledge is also categorized into basic knowledge (30 credits), specialized knowledge (20 credits) and internship (18 credits). In general knowledge, aside from a few subjects such as Mathematics, Physics or English, some other subjects based on the curriculum framework of the Ministry of Education and Training (MoET) such as the basic principles of Marxism-Leninism, Hochiminh Ideology or General laws are included. Professional knowledge provides students with the knowledge that they have to apply in their major. Pedagogical knowledge focuses on such subjects as teaching skills and research methodology. The specific curricula of VTE in ME and EE are shown in Annex 2.

3.1.3.8 Facilities for vocational teacher training in Mechanical Engineering and Electrical Engineering

To implement the curriculum, it is necessary for our university to pay attention to facilities. At NUTE, we not only take facilities for professional knowledge but also facilities for general knowledge into consideration. ***For general knowledge*** we have 1 physics laboratory, 1 chemical laboratory and 1 foreign language laboratory.

For professional knowledge of Mechanical Engineering, we have invested in a CNC laboratory, AutoCAD laboratory, handwork cutting practice workshop (2 workshops), lathing practice workshop (3 workshops) and milling-planing practice workshop.

For professional knowledge, the following laboratories have invested in: an electric circuit laboratory, electrical measurement – sensor measurement laboratory, electric machine laboratory, electric

transmission laboratory, electric machine workshop (2 workshops), electrical equipment workshop (3 workshops), electricity supply workshop (2 workshops), Electronic equipment workshop (2 workshops), telecommunication electronics workshop (2 workshops), Basic electrical workshop (2 workshops), basic electronic workshop (2 workshops), digital electronic workshop (2 workshops), micro-processing and circuit design on computers (2 workshops) and PLC workshop (2 workshops).

3.2 The curricula for VTE in mechanical Engineering and Electrical Engineering at The National University of Laos

3.2.1 Introduction about the National University of Laos and Faculty of Engineering

NUOL is the leading university in Vientiane, and the most dynamic university in the Lao PDR in terms of human resources development for the country, it is well known for its diversity programmes for Bachelor Degrees; alonside a few Master Degree programmes are being conducted at the moment in various academic disciplines Doctoral Degree programmes are being prepared for the near future. From the opening of its first academic year on 5th November 1996, the number of the students has increased dramatically from 8,053 of which 2,170 were females to over 40,731 featuring 14,537 females and 725 foreigner students in the 2010-2011academic year. At present, NUOL is regarded as one of the major and most important public organizations in the Lao PDR, today it employs a total of 1,814 teaching and administrative staff of which 741 are women.

Faculty of Engineering (FE), one of nine faculties of National University of Laos (NUOL) it was initially established as the Faculty of Engineering and Architecture (FEA) in 1995 under the decree of Prime Minister No.50/PM/95. It was established by merging five higher Institutions: the National Polytechnic Institute (founded in 1984), School of Electronics (founded in 1977), School of Communication and Transportation (founded in 1972), School of Architecture (founded in 1979), and School of Irrigation Tad Thong (founded in 1983). The faculty has grown to become the largest faculty of National University of Laos. In June 2004 the Department of Architecture then one of seven FEA departments of, was separated from the Faculty of Engineering and Architecture, and became the Faculty of Architecture. Subsequently the faculty named the Engineering and Architecture was renamed the Faculty of Engineering (FE).

FE/NUOL is located in a downtown Vientiane capital city approximately 5 km from the international airport, FE/NUOL is located at a 12-hectare campus with much greenery. Prior to university integration in 1996, the faculty was the only institution producing engineers in Laos. To the present day, FE/NUOL remains the largest, most prestigious engineering school in Laos. 5,000 students are enrolled in 8 departments, of the 311 staff members, 260 are in teaching positions.

FE/NUOL'sgoal is to achieve world standards of excellence in engineering education, and gain international recognition. The faculty's role is to equip engineers with solid scientific knowledge and technical skills to keep pace with rapidly changing technology in the world. Moreover, the faculty maintains an excellent reputation in higher education, fosters intellectual growth, provides a rich learning environment and supports and encourages the development of student potential. To further

enhance quality training, keep apace with international development, and expand research activities, FE/NUOL has also established collaborations and exchange programmes with overseas universities.

FE/NUOL trains engineers for contribution to the development of Laos. Engineers follow a 4-year training programme. Students are selected based on results of a written national entrance examination. The quota system has been designed for selected students from each province based on their academic performance.

Currently, the Engineering Bachelor's programmes in FE/NUOL consist of 16 curricula in the Civil Engineering Department, Mechanical Engineering Department, Electrical Engineering Department, Electronic and Telecommunication Engineering Department, Information Technology & Computer Engineering Department, Road-Bridge and Transportation Engineering Department, Water resources Engineering Department and Vocational Teacher Education Department.

The postgraduate courses are being implemented with the following programmes: Master's programme on Infrastructure Engineering, Master's programme on Environmental Engineering and management, Master's programme on Electrical Engineering and a Specialist IT Course

FE has laboratories for:

1. Electrical Eng. & Electronics Lab.
2. Elec. Machines, Electric Drives & Power Electronic Lab.
3. Construction Materials Lab.
4. Environmental Eng. Lab.
5. Control System Lab.
6. Soil Mechanics Lab.
7. Road Materials Lab.
8. Hydraulics Lab.
9. Materials Lab.
10. Energy Lab.
11. Lathing Workshop
12. Welding Workshop
13. Digital Lab
14. Editor Lab
15. Computer Lab.
16. Physic Lab.
17. Chemistry Lab

Its Central Library holds over 13,319 books, including more than 275 titles of lecture manuscripts at the department library. A central library provides a wide range of reading and referencing. Many more specific titles can be found in the department library.

Staff numbers in NUoL and FE total 1625 and 311 in that order.

Each year, selection and admission-graduates of upper secondary schools can apply for a place in the NUOL, either through a quota system or by a national entrance examination co-organized by the Ministry of Education and NUOL, or by an entrance examination organized by the faculties of NUOL. In the former, each province selects students for admission to NUOL based on their academic performance. In other cases, students can apply to NUOL via entrance examinations. The average number of enrolment of NUoL annually is approximately 1000 students.

3.2.2 Introduction about the model of vocational teacher training in Vocational Teacher Education Department of the University

The vocational teacher training at the Faculty of Engineering, National University of Laos was initially established as a coordinating unit by decree of the Minister of Education No. 480/04 dated March 23rd 2004. A year later, the unit was upgraded to a division dubbed the Vocational Teacher Training Division by decree of the Minister of Education No. 2116/05, dated on September 28, 2005. The division was under the supervision of the Higher Education Department, MOE. The number of the first, second and third group of students graduated as vocational teachers was 22 in the academic year 2007/08, 40 in 2008/09 and 27 in 2009/10 respectively.

In 2011, the Vocational Teacher Training Division has become Department of Teacher Education by decree of the Minister No. 976/MOE/2011 dated April 19, 2011.

a. Function:

The Vocational Teacher Training Department has the following duties:

- To train vocational teachers to bachelor and master level
- To organize distance integral teaching–learning (blended learning) for vocational teachers as well as technical teachers and trainers on theories and practices for both public and private education institutes
- To focus on research in vocational fields
- To coordinate and cooperate with education institutes, faculties, departments within NUOL and factories, to evaluate and improve vocational teacher curriculums gradually

b. Outcomes of graduates

Vocational teacher training has to focus on the quantitative and qualitative aspects to ensure the teaching–learning process is effective. Vocational teachers are well educated with academic knowledge, equipped with methodology, social and individual competences. They are keen and desire to work with responsibilities to participate in the Lao socio-economic system. The participation is particular important for work in the public and private education institutes.

c. Structure of Programme (Curriculum)

The curriculum is structured into modules. The Bachelor's course is designed over 4 years or 8 terms +1 year for mentoring and contains approximately 150 credit points distributed as follows:

Curriculum-Structure

- ⇨ **General subject group** **20 Credits**
- ⇨ **Basic core subject** **46 Credits**
- ⇨ **Core subject group** **80 Credits**
  - Core subject Modules (Professional Subjects) 44 Credits
  - Core Vocational Pedagogies Modules 32 Credits
  - Final Paper 04 Credits
- ⇨ **Final paper** **04 Credits**
- ⇨**Practice:** In industry 4 months and technical school or vocational college 4 months
- ➢ **Study tour:** 2 times per year
- ➢ **National defence** : 2 weeks

3.2.3 Introduction to the curricula of vocational teacher training in Mechanical engineering and Electrical Engineering

Professional subjects are offered by the Mechanical Engineering Department, and pedagogical subjects are provided by the Vocational Teacher Education Department.

Name of Diploma: Bachelor of Vocational Education majoring in *Mechanical Engineering or Electrical Engineering*

3.2.3.1 Philosophy

Bachelor Degree Programme of Vocational Teacher Training is part of the human resource development system and has an important role for the teaching-learning process in vocational institute for it must meet and correspond to the needs of the social-economy of the country and society.

3.2.3.2 Objectives

1. Train students in vocational teaching for the field of engineering,
2. Train students in didactics and methodology,
3. Train students for abilities in setting Problems and seeking information in research science.

The curriculum's main objective is to produce undergraduates with basic knowledge, and an essential, professional attitude with skills in mechanical engineering and electrical engineering, so they may perform equally well in any field related to mechanical engineering/electrical engineering . Furthermore, the curriculum is designed to provide students with sufficient background for them to be able to adapt to the rapidly changing technologies and increasingly complex multi-national markets.

3.2.3.3 Expectation ability after graduation

1. To be vocational teachers that can teach both the theory and practice in engineering field,
2. To be engineers capable of analyzing and solving problems in engineering fields,

3. To be administrators in various public and private sectors,
4. To be able to pursue higher education in their respective fields.

3.2.3.4 Training duration, process of training and graduation condition and assessment

The Department offers four-year undergraduate bachelor degrees consisting of 148 credits. The first two years of the ME programme consist of basic science and engineering classes with two additional introductory mechanical engineering classes. Core subjects are concentrated in the final year two years. In the student's senior year, research projects worth 4 credits are required for the ME programme. Students are also required to carry out practical training for a minimum of four weeks.

3.2.4.5 The curriculum

The curricula of Mechanical Engineering and Electrical Engineering consists of general knowledge (20 credits), pedagogical knowledge (32 credits), professional knowledge and graduation paper (4 credits). The professional knowledge of Mechanical Engineering accounts for 93 credits, while the credit number of the professional knowledge of Electrical Engineering is 94 credits. In Mechanical Engineering, professional knowledge includes basic knowledge (42 credits) and specialized knowledge (51 credits). The specialized knowledge consists of optional energy (21 credits), optional applied mechanic (20 credits) and optional material and production (18 credits). In Electrical Engineering, professional knowledge includes basic knowledge (30 credits), specialized knowledge (59 credits) and elective subjects (5 credits). The detailed curricula for vocational teacher education in Mechanical Engineering and Electrical Engineering are presented in Annex 3.

3.3 The curricula for VTE in mechanical engineering and electrical engineering at Indonesia University of Education

3.3.1 The model of vocational teacher education in Indonesia

Based on Law No. 14 of 2005 on Teachers and Lecturers of article 10 and government rule No. 19 of 2005 on National Education Standards article 28, it is stated that teachers as professional educators must have four competencies: pedagogical competence, professional competence, personal competence and social competence.

In general, the provision of vocational education teacher in Indonesia is organized by the teacher educational institute (LPTK / lembaga pendidikan tenaga kependidikan) at state and private universities. Currently there are 15 state universities that provide education for vocational educators and very few private universities.

Bearing in mind the importance of educators in vocational education, in 2002, 15 Universities (ex IKIP/ educational science and teaching institute) across the country were declared APTEKINDO organizations (Indonesia vocational and technology educational association).

APTEKINDO has several purposes: (1) Participating actively in successful national development, particularly in the field of vocational education. (2) Developing and promoting vocational education as a professional science. (3) Attempting to develop and advance the teacher educational Institute

(LPTK) particularly in vocational and technology education (PTK) University and other institutions of vocational education. (4) Attempting to develop employment in the broadest sense. (5) Enhancing professionalism of vocational educational teachers in accordance with the demands of community development.

Educators required for secondary vocational schools (SMK) as stipulated in Government Regulation no. 19 of 2005 on National Education Standards in the vocational school where the educator or other forms have:

a. The minimum level of academic qualifications at the very least, Bachelor degree or D4 (Diploma 4)
b. An appropriate educational background in the subjects taught
c. Professional certificate for vocational teachers.

Provisions for educators in secondary vocational education, i.e. the vocational teacher must master advanced skills proven by certificate, in detail as follows:

Teachers of English and productive teachers must have a certificate of competency of international recognition

a. The teacher must have productive work experience in industry of an international standard
b. The teacher has a certificate of competency in didactics and methodology
c. Teachers are productive (at least 50% are certified as an assessor)
d. All active teachers can speak English (TOEFL, TOEIC).

(Priowirjanto, 2001)

The implementation process of vocational education teachers in general is carried out in LPTK under the Directorate General of Higher Education. In improving the quality of teachers and where teachers are given the opportunity to continue to further education on S2 and S3 programmes corresponding to the field. Training to increase the skills of vocational education teachers is conducted at the Center for Vocational Teacher Upgrading Development located in Bandung, Medan, Malang, Yogyakarta, and Cianjur. The programme is a cross programme and constitutes an integral part of the programme enhancement and development of vocational secondary education including upgrading, refresher, upgrading for qualifications, upgrading in stage (penataran penjenjangan), workshop. The main objective of the programme is to increase the ability of vocational teachers via inservice training.

In conclusion a model of vocational education is prepared and educators in secondary vocational schools:

a. Possess academic qualifications, i.e.: Bachelor degree or diploma 4 in accordance with the field.
b. Possess competencies: pedagogic, personal, professional, social
c. Possess teacher certification

3.3.2 Indonesia University of Education (UPI)

Indonesia University of Education is one of the oldest universities in Indonesia. It was founded under the name of Perguruan Tinggi Pendidikan Guru (PTPG) or on October 24th 1954 by Decree of the Minister of Education, Pedagogy, and Culture No. 38742/Kab. dated September 1st , 1954. It was subsequently revised by Decree No. 40719/s dated July 6th 1956 indicating the establishment of three PTPGs in three areas in Indonesia, i.e., PTPG Batusangkar (West Sumatera), PTPG Malang (East Java), and PTPG Bandung (West Java).

Along with the founding of Universitas Padjadjaran (UNPAD), PTPG was integrated as a primary faculty of UNPAD on November 25th 1958 under the name of Fakultas Keguruan dan Ilmu Pendidikan (FKIP) or the Faculty of Teacher Training and Pedagogy. To strengthen the system for providing teachers and educational staff, the then existing courses, Teacher Education B I and B II were integrated into FKIP by Decree of the Minister of Education and Culture No. 6 Year 1961. FKIP was then developed into FKIP A and FKIP B. In the same year, the Institut Pendidikan Guru (IPG) or Institute for Teacher Education was founded, which resulted in two parallel Institutes for Teacher Education. To settle this dualism, the government, by Presidential Decree No. 1 Year 1963, united FKIP and IPG into Institut Keguruan dan Ilmu Pendidikan (IKIP) as the only higher education institutions for teacher education at the university level in Bandung. As a result, FKIP A and FKIP B as well as IPG finally had been merged into Institut Keguruan dan Ilmu Pendidikan (IKIP) Bandung.

In 1999, IKIP Bandung was transformed into Universitas Pendidikan Indonesia (UPI) or the Indonesia University of Education. Through the Government Regulation No. 6 Year 2004 UPI was then given a wider mandate to educate not only prospective teachers but also other professionals and new status was given as a "State-owned Legal Entity University or PT-BHMN". UPI's status was changed again through the Government Regulation 66/2010, to a "Government-owned Higher Education Institution", following the constitutional court decision 11-14-21-126-136/PUU-VII/2009 from 31st May 2010, stating that the PT-BHMN model is not in line with the Indonesian Constitution.

In the course of its development, UPI has become the only institution of higher education in Indonesia which consistently focuses on education. In having this property and its human resources, UPI committed to its vision to become "A Leading and Outstanding University" in the field of educational sciences in Indonesia by 2010 and become one of the leading and outstanding universities in Asia by 2025. In addition, UPI consistently supports and facilitates the growth and development of other disciplines to gain the leading and outstanding role. This implies a commitment to make UPI recognized and be an inspiration nationally and internationally and a reference in establishing educational policies at a national level.

In line with its visions, UPI has formulated the following missions:

1. To educate and prepare human resources in the fields of education, business and industry to cope with the global competitive market.
2. To develop theories of education and other innovative science and its applications for establishing foundations for national education policies.

3. To provide professional social services for the society to solve national issues in education, politics, economics and socio-culture.
4. To promote the internationalization of education via the development and establishment of networks and partnerships at national, regional and international levels. *(Source: http://www.upi.edu/en/profile/vision-mission)*

At present, UPI has an academic staff of 1,261 in seven faculties, the school of postgraduate studies, and branch campuses. Among them are 84 professors, 525 associate professors, 423 lecturers, and 244 assistant lecturers. They include 174 lecturers with a Doctoral degree from Indonesian Universities, 37 from overseas, 689 lecturers with a Masters degree from Indonesian Universities and 45 from overseas. In addition, UPI is also supported by 803 administrative staff including laboratory assistant and librarians.

3.3.3 Faculty of Technology and Vocational Education (FPTK)

The vision of the faculty is to become a productive faculty of technology and vocational education with national and global perspectives and an emphasis on expertise and professionalism.

To achieve this vision, the faculty has formulated its mission (1) to develop professional human resources (teachers, educational scientists, and other technical and vocational educators) and technicians in relevant services and industries, who are qualified, independent, continually improving themselves via self-development able to work in teams, behave ethically with national and global perspectives; (2) by implementing the principle of cross fertilization through the concept of multidisciplinary and multicultural education, to develop technological and vocational education and engineering sciences, and (3) to provide the best services to the community to develop student-friendly learning concepts and scientific, technological, and vocational advances for human resources aiding development and community welfare.

The Faculty of Technology and Vocational Education employs fulltime and part-time lecturers. Part-time lecturers are recruited from the Bandung Institute of Technology, National Institute of Sciences, Industries, Professional Associations, and Telkom to teach specific subject knowledge.

The Faculty of Technology and Vocational Education covers the following fields:

1. Civil Engineering Education
2. Architecture Engineering Education
3. Electrical Engineering Education including study programmes on Electrical Power Engineering, Communication Engineering, and Industrial Engineering.
4. Mechanical Engineering Education with four study programmes i.e. Cooling Effect Engineering, Automotive Engineering, Industrial Machinery, Construction Machinery
5. Family Welfare Education with study programmes on Fashion and Culinary Science

In addition to the Bachelor programme in the engineering education, the faculty offers the following non-education programmes at the Diploma (D3) level: Mechanical Engineering (Automotive), Electrical Engineering (Electrical Installation), Civil Engineering and Agro-Industry Engineering.

Vocational teacher training in the Electrical Engineering Educational Department has been awarded accreditation level "A" (excellent) by the National Accreditation Board for Higher Education (Badan Akreditasi Nasional Pendidikan Tinggi – BAN-PT).

The teaching staff in Electrical Engineering Education consists of 37 lecturers, including 4 Professors, 30 % with a PhD, and 70 % with a Masters degree (most of whom are onPhD programmes). Most Lecturers in Electrical Engineering Education have professional certificates from the Indonesian Association of Electrical Professionals (Assosiasi Profesi Electrik Indoneia - APEI) can been seen on Table 1.

Electrical Engineering Education has enough class rooms for teaching theory and laboratories and workshops for students' practical work and to increase students' skills in the electrical engineering field. Electrical Engineering Education has: electrical workshop, high voltage laboratory, electrical machine laboratory, electrical installation laboratory, measurement laboratory, telecommunication laboratory, industrial electrics laboratory, and control laboratory.

Students in Electrical Engineering Education must take practical and practice subjects on campus. Aside from which, students also do an internship (apprenticeship) in industry for three months. Upon completion of the internship, students have to prepare and submit a report. To pass the internship, students have to defend their reports before a board of examiners.

During the past 5 years, each year approximately 400 students have applied for enrollment, but only 90 – 100 students were accepted in Electrical Engineering Education after undergoing a number of selection steps. The number of teaching staff in Electrical Engineering is 37.

Vocational teacher training in the Mechanical Engineering Education Department has been awarded accreditation level "B" (Good) by the National Accreditation Board for Higher Education (Badan Akreditasi Nasional Pendidikan Tinggi – BAN-PT).
The Mechanical Engineering Education Department is run under the auspices of the Faculty of Technology and Vocational Education Indonesian Education University (UPI). The Mechanical Engineering Education Department consists of three package options / concentration, i.e. Production and Construction, Automotive, and Refrigeration and Air Conditioning Education. The organizational Structure of the Mechanical Engineering Education Department consists of the Chairman of the Mechanical Engineering Education Department and several managers as Chairman of the Group Areas of Expertise / Concentration, Thesis Tutoring Team (SMT), Tutoring Team Final (TPTA), Curriculum Developer Team (TPK), Chairman of the laboratory, administrative personnel and other technicians. The number of students in the Mechanical Engineering Education Department over the next 5 years will be as many as 568 people. The number of lecturers is 46 comprised of 1 professor, 12 lecturers with a PhD, 29 lecturers with an MA and 4 lecturers with a Bachelor Degree.

3.3.4 Introduction about the curriculum of vocational teacher training in Electrical Engineering

3.3.4.1 Training Objectives (general objectives, specific objectives)

The general objective of Electrical Engineering Education is to produce undergraduates able to master technology within the field of electrical engineering and be capable of being professional teachers in electro technology.

The specific objectives are:

a. To produce graduates who are experts in the field of electrical engineering education versed in theory and practical skills, with research capabilities for the development of professionalism in their field.

b. To produce graduates capable of developing their knowledge by working with other institutions, both nationally and internationally.

c. To produce graduates who are able to teach professionally in the field of electrical engineering in secondary vocational schools (SMK: Sekolah Menengah Kejuruan) that can be instructors in electrical engineering at companies or in training centres.

3.3.4.2 Duration of studies (standard duration)

The standard duration of a bachelor programme (S.1 : Strata 1) is 4 years, but it is also possible to complete the study programme within only 3.5 years if a student is very bright, works very hard, and meets all the requirements for graduation. The longest possible study duration is 5 years for this programme.

3.3.4.3 Structure and contents of the study programme

The study programme of Electrical Engineering Education is made up of 60 subjects (lectures, courses, etc.) grouped in 7 study areas:

a. The group of general subjects (General knowledge) includes 7 subjects worth 14 credits

b. The group of Faculty Expertise Subjects (Compulsory Subjects) includes 3 subjects worth 6 credits

c. The group of the study programme's expertise subjects (Compulsory Subjects) includes 33 subjects.

d. The group of a concentration's elective expertise subjects (Optional Subjects) contains 13 subjects.

e. The group of basic profession subjects (pedagogical knowledge) includes 5 subjects

f. The group of Expertise Subjects of the profession's study field (Pedagogical knowledge) is made up of 4 subjects

g. The group of Professional Training Subjects contains only 1 subject worth 4 credits

Details on the study areas and the respective subjects are given in the detailed curriculum structures of Electrical Engineering Education bellow.

3.3.4.4 Enrollment

Students in Electrical Engineering Education come either from a general high school or from secondary vocational school. To be accepted into the study programme they have to pass a number of selection steps and test/examinations, including pre-selection based on data of their achievements at school (scores of the national school leaving examination), academic exams, a physical test, an interest and aptitude test, and so on.

3.3.4.5 Training process and graduation requirements

According to UPI regulations for academic subjects, each semester lasts 16 weeks and includes 14 weeks of face-to-face (classroom teaching) sessions and 2 weeks for midterm exams and at semester end exams. Each course carries between 2 and 4 credits.

1. For lectures and seminars 1 credit is defined based on the weekly workload of three kinds of activities as follows:
    a. For Students:
        i. 50 minutes (1 teaching hour) face to face event scheduled by lecturers, e.g. a lecture.
        ii. 60 minutes of structured academic activities, i.e. work initiated by lecturers, not scheduled for a specific time, e.g. homework assignments.
        iii. 60 minutes of independent learning activities, such as literature study.
    b. For Lecturers:
        i. 50 minutes face to face teaching with students;
        ii. 60 minutes of structured academic planning and evaluation
        iii. 60-minutes lecture material development.
2. For laboratory work, field work, and research 1 credit is defined from
    a. Laboratory work, weekly scheduled experimental activities in the laboratory 3 x 60 minutes plus 60 minutes structured academic activities.
    b. For field work, 1 credit is equivalent to 4 x 60 minutes workload per week for one semester.
    c. For research work / thesis writing 1 credit is assumed as equivalent to a workload of 3 x 60 minutes a day for 25 days.

3.3.4.6 Assessment

Students have to sit tests for individual courses as well as the final programme examination. For each course (subject) there is a compulsory mid-semester exam and a final exam, as well as other

examinations and test assigments given by the lecturer in that subject. Mid-term and final tests are set out in the University's evaluation system. The final programme examination at the end of the study programme includes writing a final paper and defending the paper before an examination board. Upon passing the final programme examination the graduate is awarded a bachelor degree.

3.3.4.7 The Curriculum Structure of Electrical Engineering Education

The S1 or bachelor programme in Electrical Engineering Education (PTE: Pendidikan Teknik Elektro) is designed to be studied within eight semesters and comprises a total of 150 credits, including General Subjects (14 credits), Expertise Subjects (106 credits), Profession Basic Subjects (12 credits), and Profession expertise Subjects (14 credits) and Profession Training Subjects (4). This curriculum refers to the national curriculum of Electrical Engineering and is complemented by a number of local elements that constitute 3 concentrations/majors, namely Electric Power Technical Education (PTTE / Pendidikan Teknik Tenaga Elektrik)), Industrial Electronics Technical Education (PTEI / Pendidikan Teknik Elektronika Industri), and Telecommunication Technical Education (PTTK / Pendidikan Teknik Telekomunikasi) at the Department of Electrical Engineering Education, Faculty of Vocational and Technology Education, Indonesia University of Education (UPI) .

3.3.4.8 Laboratory / workshop Facilities

The Department of Electrical Engineering Education runs the teaching learning process carried out in the laboratory for student practices, and is also used for research by lecturers. Today Electrical Engineering Education has 9 laboratories. The detailed table is presented in Annex 4. As a teacher for vocational education, students should carry out practices in industry for three months (internship within industry related). This is to ensure that students know what is going on industry, and when activities are demanded of the students by employees in carrying out those activities the students gain great experience in the industry. Students can do internship activities such: Textile industry, Aircraft industry, State Electric company, etc.

3.3.5 Introduction to the curriculum of vocational teacher training in Mechanical Engineering Education

3.3.5.1 Training Objectives (general objectives, detailed objectives)

The general objective of Mechanical Engineering Education is to produce undergraduates able to master technology within the field of Mechanical engineering and produce capable professional teachers in the field of Mechanical Technology.
The detailed objectives are:

a. To produce graduates who are experts in the field of Mechanical engineering education possessing theory and practical skills, with research capabilities for the development professionalism in their field.

b. To produce graduates able to develop their knowledge by working with other institutions, both nationally and internationally.

c. To produce graduates able to teach professionally in the field of Mechanical engineering at secondary vocational schools (SMK: Sekolah Menengah Kejuruan) and be instructors within the field of Mechanical engineering in companies or at training centres.

3.3.5.2 Duration of studies (standard duration)

The standard duration of a bachelor programme (S.1: Strata 1) is 4 years, but it is also possible to complete the study programme within only 3.5 years if a student is very bright, works very hard, and meets all graduation requirements. The longest possible study duration is 5 years for this programme.

3.3.5.3 Curriculum Structure and contents of the study programme

The study programme of Mechanical Engineering Education specially Concentration of Production and Construction is made up of 82 subjects (lectures, courses, etc.) worth 150 credits total, grouped in 7 study areas:

a. The group of general subjects (General knowledge) includes 7 subjects worth 14 credits.

b. The group of Faculty Skill Subjects (Compulsory Subjects) includes 3 subjects worth 6 credits.

c. The group of the Study Programme's Skill Subjects (Compulsory Subjects) includes 40 subjects worth 86 credits.

d. The group of a concentration's elective subjects (Optional Subjects) contains 16 subjects, student take 16 credits.

e. The group of profession basic subjects (pedagogical knowledge) includes 5 subjects, worth 12 credits.

f. The group of profession Skill Subjects is made up of 5 subjects worth 12 credits.

g. The group of Professional Training Subjects contains only 1 subject worth 4 credits.

Details on the study areas and the respective subjects are given in the detailed curriculum structures of Mechanical Engineering Education below.

3.3.5.4 Enrollment

Students in Mechanical Engineering Education come either from general high school or from secondary vocational school. For being accepted into the study programme they have to pass a number of selection steps and test/ examinations, including a pre-selection based on data of their achievements in school (scores of the national school leaving examination), academic exams, a physical test, an interest and aptitude test, and.

3.3.5.5 Training process and graduation requirements

According to UPI regulations for academic subjects, each semester last 16 weeks and includes 14 weeks of face-to-face (classroom teaching) sessions as well as 2 weeks for the midterm exams and the end of the semester exams. Each course carries between 2 and 4 credits.

1. For lectures and seminars 1credit is defined based on the weekly workload for three kinds of activities as follows:
    a. For Students:
        i. 50 minutes (1 teaching hour) face to face event scheduled by lecturers, e.g. a lecture.
        ii. 60 minutes of structured academic activities, i.e. work initiated by lecturers, which is not scheduled for a specific time, e.g. homework assignments.
        iii. 60 minutes of independent learning activities, such as literature study.
    b. For Lecturers:
        iv. 50 minutes face to face teaching with students;
        v. 60 minutes of structured academic planning and evaluation
        vi. 60 minutes lecture material development.
2. For laboratory work, field work, and research 1 credit equals
    a. For laboratory work, weekly scheduled experimental activities in the laboratory 3 x 60 minutes plus 60 minutes structured academic activities.
    b. For field work, 1 credit is equivalent to 4 x 60 minutes workload per week for one semester.
    c. For research work/thesis writing 1 credit is equivalent to a workload of 3 x 60 minutes a day for 25 days.

3.3.5.6 Assessment

Students have to sit tests for individual courses as well as the final programme examination. For each course (subject) there is a compulsory mid-semester exam and a final exam, as well as other examinations and test assigments given by the lecturer in the subject. Mid-term and final tests are set out in the University's evaluation system. The final examination at the end of the study programme includes writing a final paper (Skripsi) and the paper has to be before an examination board. Upon passing the final programme examination the graduate is awarded a bachelor degree (S1: Strata 1).

3.3.5.7 The Curriculum Structure of Mechanical Engineering Education

General Subjects	14 credits
Skills (expertise) Subjects	92 credits
Elective subjects	16 credits
Profession Basic subjects	12 credits
Professions Skill Subjects	12 credits
Profession Training Subjects	4 credits

3.4 The curricula for VTE in Mechanical Engineering and Electrical Engineering at Tongji University

3.4.1 Introduction to the University (training major, teaching staff, facilities, training scale, enrolment over the last 5 years)

Tongji University is one of the leading universities directly under the State Ministry of Education in China. It offers degree programmes both at undergraduate and postgraduate levels. The university has a School of Sciences, School of Architecture and Urban Planning, School of Civil Engineering, Mechanical School, School of Environmental Science and Engineering, School of Material Science and Engineering, School of Electronics and Information Engineering, School of Traffic and Transportation, Medical School, School of Liberal Arts and Law, School of Foreign Languages, School of Economics and Management, School of Software Engineering, School of Ocean and Earth Science. In addition, there is an Institute of Further Education, Institute of Higher Technology, Institute of Vocational and Technical Education, Institute of E-Education, Women's College, Institute of Automobile Marketing and Sino-German Institute authorized by Chinese and German governments to run postgraduate courses. There are also six university hospitals located in different campuses.

The university now registers over 50,000 students at all levels from certificate and diploma courses to Bachelors Degrees, Masters, PhD programmes and post doctoral attachments. There are over 4200 academic staff for teaching and/or research, among whom are 6 Members of Chinese Academy of Science, 7 Members of Chinese Academy of Engineering, over 710 professors and 1500 associate professors. The university offers diverse courses in its 82 Bachelor Degrees, 218 Masters, 94 PhD programmes and 16 post doctoral mobile stations. As one of the state's leading centers for scientific research, the university has 22 state key laboratories and engineering research centers.

3.4.2 Introduction to the model of vocational teacher training of the University

The Institute of Vocational Instructors of Tongji University (CDIBB) was expanced in the context of the "training of vocational teachers at the Tongji University of Shanghai" project. The project was a measure taken in 1994 organised between the Chinese ministry of commerce and the Federal Ministry of Cooperation and Development initiative who agreed on increased cooperation in vocational training. It supports the goal of China's plan for comprehensive reform of vocational education. The basic aim is to train qualified specialists and managers for the economic and social development of China.

3.4.3 Introduction of the status of vocational teacher training in Mechanical Engineering and Electrical Engineering (teaching staff, facilities, training scale, the enrolment for the last 5 years)

Many professional courses, basic professional courses are taught by professional university teachers. Education courses are taught by a teacher of the College. Over the past five years, we have trained more than 100 electronic professional students and more than 100 mechanical professional students.

3.4.4 Introduction to the curricula of vocational teacher training in Mechanical Engineering

3.4.4.1 Training objectives (general objectives, detailed objectives)

The professional training to meet the modernization needs of the twenty-first century, the all-round development of physical and moral energy, setting the basic knowledge and skills of mechanical engineering, vocational education teaching theory and practice to produce expert senior personnel

3.4.4.2 Training duration (standard duration): 4 years

3.4.4.3 The amount of knowledge for the whole course

The graduates engaged in teaching, management and research work of the vocational school, and in the development and management of human resources in the corporate human resource management department

Graduates should acquire the following knowledge and ability

Basic theoretical knowledge of the humanities and social sciences and natural sciences

Master technologies such as mechanical, electrical, electronic, mechanical and the basic knowledge and expertise required of vocational school teachers

Mastering basic education and vocational education science, psychology, social sciences and labor science

Being able to use the skills independent of various forms of teacher education teaching process

Preliminary development of instructional media and teaching process innovation capability

3.4.4.4 Enrollee: *High school graduates*

3.4.4.5 Process of training and graduation condition: Completing all courses required for graduation thesis defense

3.4.4.6 Assessment: Based on course grades and performance in school during evaluation

3.4.4.7 The curriculum

- General knowledge: 91.5 credits
- Pedagogical knowledge: 16 credits
- Professional knowledge: 94 credits

Among which:

- Basic knowledge: 26 credits
- Specialized knowledge: 30 credits
- Internship: 21 credits
- Graduation paper: 17 credits

3.4.4.8 Facilities for vocational teacher training in Mechanical Engineering

The facilities of the university are well equipped to meet training demands. The equipment includes metalworking, the internship factories, Mechanics of Materials Laboratory, Physics Laboratory, plc control room.

3.4.5 Introduction to vocational teacher training in Electrical Engineering

3.4.5.1 Training objectives

The professional training is adapted to the needs of socio-economic and technological development. The coordinated development of knowledge, ability, personality, with solid electronic technology, information systems and vocational education theoretical knowledge, general knowledge, practical ability, and a portfolio of electronic information technology expertise skills, vocational education theory and method. For training senior personnel with innovative spirit of great calibre and be well versed in vocational education.

3.4.5.2 Training duration (standard duration): 4 years

3.4.5.3 The amount of knowledge for the whole course:

- Having the basic theoretical knowledge of the humanities and social sciences and natural sciences required by Electronic and Information Engineering vocational school teachers.
- Mastering the basis of theory of knowledge and expertise in electronics, communications, computer network systems and equipment
- Having good electronics and information technology practical ability and engineering skills
- Mastering the basic knowledge of vocational education, education, psychology, labour science
- Being able to use the vocational education theories and methods for the effective organization of the professional teaching process
- Having good foreign language skills and good computer skills
- Understanding the field of electronic information science and vocational education in the field of literature search, data query news
- Having better learning ability and the ability to innovate
- Having a strong ability to adapt, in teaching, management and research work of the vocational schools of electronic information professional direction, and in related professional human resource development, vocational training and technical work in the enterprise

3.4.5.4 Enrollee: High school graduates

3.4.5.5 Process of training and graduation condition

Completing the course requirements of the thesis

3.4.5.6 Assessment

Based on assessment of the students' course grades and performance during the school

3.4.5.7 The curriculum

General knowledge:	84.5	credits
Pedagogical knowledge:	18.5	credits
Professional knowledge:	95	credits
Among which:		
- Basic knowledge:	34	credits
- Specialized knowledge:	20	credits
- Internship:	24	credits
- Graduation paper:	17	credits

3.4.5.8 Facilities for vocational teacher training in Electrical Engineering

The equipment of IBB is of international standard and meets the demand of teaching and studying. The facilities include: metalworking, internship factories, Physics Laboratory, PLC control room and so on.

4 Comparison and analysis

Basing on the curricula for Vocational Teacher Education in Mechanical Engineering and Electrical Engineering of the four institutions, the partners took part in two workshops. The first one was held at Namdinh University of Technology Education in Vietnam to analyze and compare the four curricula to find out the general structure of the core curricula for vocational teacher education in Mechanical Engineering and Electrical Engineering. The second workshop was held at National University of Laos to discuss the details of courses and subjects in each curriculum.

Before taking part in the workshops to discuss and find out the core curricula for VTE in ME and EE, partners were requested to prepare their own country report. In the country report, it is necessary the partners introduce their institutions, the faculties in charge of VTE in ME and EE and how to train a vocational teacher in each institution. Most importantly, they have to introduce their own curricula for VTE in ME and EE. The country report of each partner must follow the same structure to make it easier for analyzing and comparing. The structure is shown below:

1. Introduction
    - 1.1. Introduction to the University (training major, teaching staff, facilities, training scale, the enrolment for the last 5 years)
    - 1.2. Introduction to the model of vocational teacher training of the University
    - 1.3. Introduction to the status of vocational teacher training in Mechanical Engineering and Electrical Engineering (teaching staff, facilities, training scale, the enrolment for the last 5 years)
2. Introduction to the curricula of vocational teacher training in Mechanical Engineering
    - 2.1. Training objectives (general objectives, detailed objectives)
    - 2.2. Training duration (standard duration)
    - 2.3. The amount of knowledge for the whole course
    - 2.4. Enrollee
    - 2.5. Process of training and graduation condition
    - 2.6. Assessment
    - 2.7. The curriculum
    - 2.8. Facilities for vocational teacher training in Mechanical Engineering
3. Introduction to vocational teacher training in Electrical Engineering
    - 3.1. Training objectives (general objectives, detailed objectives)
    - 3.2. Training duration (standard duration)
    - 3.3. The amount of knowledge for the whole course

3.4. Enrollee

3.5. Process of training and graduation condition

3.6. Assessment

3.7. The curriculum

3.8. Facilities for vocational teacher training in Electrical Engineering

This is a good opportunity for partners to understand each others' institutions and curricula for VTE in ME and EE. These country reports are the foundation for partners to discover common points and points where they differ and agree on core curricula for VTE in ME and EE.

4.1 The first workshop at NUTE

According to the project plan, the workshop was organized at Namdinh University of Technology Education (NUTE) from 10 – 12/09/2012 with the participation of members of research team, including:

05 members from NUTE:

- Mr. Ha Xuan Hung, Ph.D – Vice Rector, Head of P8
- Mr. Tran Xuan Thanh, M.A, Vice Dean of Faculty of Mechanical Engineering
- Mr. Nguyen Tien Hung, M.A, Vice Head of Department of Control Technique, Faculty of Electrical Electronic Engineering
- Mr. Nguyen Truong Giang, M.A, Head of Department of Pedagogy, Faculty of Technology Education
- Ms. Tran Hong Van, RCP Coordinator at NUTE – Secretary of P8;

02 members from Indonesia University of Education (UPI)

- Dr. I Wayan Ratnata, Lecturer of Faculty of Technical and Vocational Education
- Dr. Iwa Kuntadi, Lecturer of Faculty of Technical and Vocational Education

02 members from National University of Laos (NUoL)

- Assoc.Prof. Dr. Sengprasong Prakonekham, Dean Assistant, Faculty of Engineering
- Dr. Bounseng Khammounty, Head of Vocational Teacher Education Department, Faculty of Engineering

Aside from that, some participants were guests representing the Rector Board and Faculties of NUTE including the Faculty of Electrical Electronic Engineering, Faculty of Mechanical Engineering, Faculty of Information Technology, Faculty of Economics and Faculty of Technology Education. The total number of the workshop participants was 17.

On the morning of 10th September 2012, after a welcome speech given by Mr. Ha Xuan Hung, Ph.D and an introduction to NUTE, all participants visited workshops and laboratories of NUTE.

In the afternoon, representatives of each institution presented reports on curricula and the situation of enrolment and training vocational teacher education in Mechanical Engineering and Electrical Engineering over the past 5 years. After each presentation, research members discuss the content of the presentation. These discussions enabled the training models and curricula of each institution to be much better understood by research members.

Over the days of the workshop, participants were divided into two groups based on two majors: Mechanical Engineering and Electric Electronic Engineering. Each group consisted of the members from each partner. The first group was in charge of general knowledge and professional knowledge in ME and the second one for professional knowledge in EE and pedagogical knowledge. In each group, the comparison was conducted via analysis of the objectives, training duration, enrollee, graduation condition, assessment and the structure of the curriculum of each partner. In the discussion, each partner clearly explained the features of the curricula for VTE in ME and EE of their own institution to the partners so they could understand these features clearly. Thanks to such understanding, partners discovered common points in the curricula. For the points that differed attempts were made to reach overall agreement on curricula.

The results of the comparison of general issues among the partners are shown in the table below:

Table 3: **The results of the comparison of general issues among the partners**

No	Parameters	NUoL	UPI	NUTE	IBB	Group Remark
1	**Objectives**	- Have knowledge in vocational teacher in didactic methodology and mechanics - Have capacity in setting problems and seek for information in research science - Have ethical responsibilities to society - Know how to reserve national cultures and customs	Produce undergraduates who are able to master technology within the field ME and are also able to be professional teacher in the field of ME	Train TVET teachers to serve the process of industrialization and modernization Graduates have teaching and research capability, have professional knowledge and skill, have good ethics and health	Meet the modernization needs of the twenty-first-century, the all-round development of physical and moral energy, setting the basic knowledge and skills of mechanical engineering, vocational education teaching theory and practice in a compound of senior personnel	To train Ss with - knowledge - skills - ability to teach in Mechanical Engineering in vocational institutes and industry
2	**Training duration**	2 phases: 4 years: NUoL 1 year: Industry Practice/ Vocational School Practice	4 years longest possible duration: 5 years	4.5 years - 4 years for engineering - 0.5 year for pedagogy	4 years	4 years
3	**Enrollee**	Upper secondary school Technical Vocational School	- high school (majoring in natural science) - vocational school	Ss graduating from upper secondary school or equivalent	High school graduates	Graduates from upper secondary schools or equivalent institutes
4	**Graduation condition**	min GPA = 2.0	min GPA = 2.0	- accumulate enough credits (146 cre.) - GPA >= 2.0 - have national defence certificate and physical education certificate	Completing all courses required for graduation thesis defense	- take all required subjects - GPA >= 2.00 - No "F"
5	**Assessment**	A = 4.0 B+ = 3.5 B = 3.0 C+ = 2.5 C = 2.0	A = 4.00 - 3.50 B = 3.49 - 3.00 C = 2.99 - 2.50 D = 2.49 - 2.00	Distinction 8.5 - 10 A Credit 7.0 - 8.4 B Strong pass 5.5 - 6.9 C Pass 4.0 - 5.5 D Fail < 4.0 F	Based on course grades and performance in school during evaluation	Either like NUTE + UPI or NuoL

Table 3: **The results of the comparison of general issues among the partners**

No	Parameters	NUoL	UPI	NUTE	IBB	Group Remark
		D+ = 1.5	F < 2.00			
6	**Structure of the curriculum**	1. General subjects: 20 credits 2. Basic core subject: 42 credits 3. Core subjects: 80 credits + Professional mechanic: 44 credits + Core Vocational Pedagogy: 32 cre. + Final paper: 4 cre. 4. Elective subjects: 4 cre. 1 year practice: + 4 months in Industry + 4 months in vocational school Total: 149	- General subjects: 14 cre. - Skill subject: 92 cre. - Elective subjects: 16 cre. - Professional skill subjects: 12 cre. - Professional basic subjects: 12 cre. - Professional training subjects: 4 cre. Total: 150 cre.	1. General knowledge: 51 credits 2. Pedagogical knowledge: 17 credits 3. Professional knowledge: 78 credits + Basic knowledge: 26 credits + Specialized: 24 cre. + Internship: 18 cre. + Graduation paper: 10 cre. Total: 146 cre.	- General knowledge: 91.5 credits - Pedagogical knowledge: 16 credits - Professional knowledge: 94 credits + Basic knowledge: 26 credits + Specialized knowledge: 30 credits + Internship: 21 credits + Graduation paper: 17 credits Total: 201.5 credits	1. General knowledge + basic knowledge + core knowledge 2. Professional knowledge + Basic knowledge + Specialized knowledge 3. Pedagogical knowledge 4. Internship 5. Graduation paper

Aside from comparing the general issues, partners compared the title of subjects and the number of credits to agree on the subjects and the total number of credits for each curriculum The outcomes of this comparison are shown clearly in Annex 6.

In general, after the first workshop, partners agreed on training objectives, training duration, enrollee, graduation condition, how to assess and the general structure of the core curricula for VTE in ME and EE. In the structure of the core curricula, partners reach agreement on the name of the subjects or courses and the number of credits for each subject or course and the total number of credits for each core curriculum. However, the detailed description of each subject or course was not mentioned in the first workshop. Which iswhy it is necessary to organize another workshop in Laos.

4.2 The second workshop at National University of Laos

After the success of the first workshop, the second workshop of P8 is conducted at Faculty of Engineering, National University of Laos on 18-19/3/2013. Participants are members of P8 project, including:

3 members from NUTE:

- Mr. Ha Xuan Hung, Ph.D – Vice Rector, Head of P8
- Mr. Tran Xuan Thanh, M.A, Vice Dean of Faculty of Mechanical Engineering
- Ms. Tran Hong Van, RCP Coordinator at NUTE – Secretary of P8

2 members from Indonesia University of Education (UPI)

- Dr. I Wayan Ratnata, Lecturer of Faculty of Technical and Vocational Education
- Dr. Iwa Kuntadi, Lecturer of Faculty of Technical and Vocational Education

4 members from National University of Laos (NUoL)

- Prof Dr Boualins Soysouvanh, Dean of Faculty of Engineering
- Assoc.Prof. Dr Sengprasong Prakonekham, Dean Assistant, Faculty of Engineering
- Dr Bounseng Khammounty, Head of Vocational Teacher Education Department, Faculty of Engineering
- Mr. Thomas Bohlmann, CIM Expert at Faculty of Engineering

The workshop begun with a warm welcome from Prof. Dr. Boualins Soysouvanh. Subsequently members were given the opportunity to discover the Faculty of Engineering and National University of Laos by Prof. Dr. Boualins Soysouvanh's introduction and a guided tour around the National University of Laos.

In the afternoon, a NUTE representative presented an overview of the P8project, the background, goals, scope of the research and the research methodology. In this presentation, the outcomes of the first workshop were also reviewed. Aside from the outcomes of the previous workshop, NUTE also proposed the detailed contents of each subject, so members were able to discuss this proposal. The

members of the workshop were divided into two groups. One group was in charge of discussing the detailed subjects of general knowledge and professional knowledge of ME and the other in charge of detailed subjects of professional knowledge of EE and pedagogical knowledge. In the discussion, NUTE proposed the description of subjects and other partners share the detailed description of their own curricula. The same features, make it difficult to agree. Regarding the differences among the curricula, partners attempted to explain the differences. Regarding academic differences, partners had to analyze properly to identify the root of the differences. Some subjects with the same name were different, partners the negotiated to find the same name for a subject. Regarding differing descriptions, partners discuss what should be added, omitted for suitability for all involved. In terms of cultural differences, partners agree to respect these differences and maintain them in the curricula of each participating country. Due this in depth discussion, an agreement was reached on the core curricula for vocational teacher education in Mechanical Engineering and Electrical Engineering. The results of the discussion i.e. the results of the research are presented in part 5.

5 Results: The core curricula for vocational teacher education in Mechanical Engineering and Electrical Engineering

Based on the points held in common between the four curricula and agreements reached on different points, the four partners constructed the core curricula for vocational teacher education in mechanical engineering and electrical engineering. The two core curricula are shown in the following parts.

5.1 Core curriculum for vocational teacher education in Mechanical Engineering

5.1.1 Title of the core curriculum: *Core curriculum for vocational teacher education in mechanical engineering*

5.1.2 Objectives of study: *To train students with knowledge, skills and ability to teach in Mechanical Engineering in vocational institutes and industry.*

5.1.3 Duration of study: 4.5 years

5.1.4 Enrollee: Graduates from upper secondary schools or equivalent institutes

5.1.5 Graduation condition:

- Take all required subjects
- GPA >= 2.00
- No "F"

5.1.6 Assessment: based on each country's national assessment system.

5.1.7 Structure of the knowledge:

+ General knowledge: 28 credits

+ Professional knowledge 55 credits

- *Basic knowledge: 29 credits*
- *Specialized knowledge: 26 credits*

+ Pedagogical knowledge 21 credits

+ Internship – Practice: 22 credits

+ Graduation paper: 8 credits

Total: 134 credits

5.1.7.1 General knowledge: **28 credits**

Table 4: **General knowledge (Mechanical Engineering)**

No.	Subject	Credits	Description	Remarks
1	Introduction to Informatics	2	This subject provides students with some basic concepts of informatics; solving a problem using a computer; Windows operating system; programming language C; basic data types; and structures to create sub-programmes	
2	General English I	2	This subject provides students basic knowledge of grammar and vocabulary in communication	
3	General English II	2	This subject provides students with advanced knowledge of grammar and vocabulary in communication. It helps students improve 4 skills: speaking, listening, reading and writing	
4	Technical English	2	This subject includes activities to develop reading skills, speaking skill and writing skills for Mechanical Engineering/ Electrical Engineering in English.	
5	Physics I	2	This subject deals with mechanisms and thermodynamics. a. Mechanisms: This part provides students with basic knowledge on classical mechanisms and the foundation of relative mechanisms. It includes concepts of motion, the cause of motion, Newtonian law of attraction, law of conservation in the motion of a subject, subject system, solid, and a brief introduction to relative dynamics. b. Thermodynamics: This part provides students with knowledge on molecule movements and some principles of thermodynamics.	
6	Physics II	3	This subject deals with electricity, and optics. a. Electricity: provides students with basic knowledge of electricity and magnetism.	

No.	Subject	Credits	Description	Remarks
			The main content includes: concepts, laws, theorems and phenomena. b. Optics: Provides students with knowledge on geometrical optics, wave optics and quantum optics.	
7	Mathematics I	2	This subject teaches students: the concept of function; sequence and continuity of function; limit of sequence and function; how to calculate differential and integral of function with one variable; concept of a sequence string and function string; the investigation of the convergence of a sequence string; finding the domain of a function string.	
8	Mathematics II	2	This subject teaches students: the concept of a matrix; inversed matrix and determinant; operations on matrix; methods to calculate inversed matrix and determinant; the concept of set of linear equations; methods to solve the set of linear equations; concept of complex number and operations on complex number; vector space, Euclidean space – linear mapping; diagonalized matrix, specific vector, specific value; quadratic form, canonical form and change quadratic form into canonical form.	
9	Mathematics III	2	This teaches students: the basic concept of multi-variable functions; how to calculate the derivative and differential of a multi-variable function; the maximum value of a multi-variable function; the basic concept of differential equation; how to solve differential equations level 1 and level 2; the concept of path integral level 1 and level 2; how to calculate path integral; the concept of double integral and triple integral.	
10	Engineering Mathematics	3	Differential equations, Second and higher order differential equations, Laplace	

No.	Subject	Credits	Description	Remarks
			transforms, Series solution of Linear differential equations, Introduction to partial differential equations.	
11	Probability And Statistics	2	Definition of random variables, probability distribution, mathematical expectations of order I and II, permutations, combinations, probability distribution 2 variables, parameters and statistics of the difference between the 2 variables, estimated values, hypothesis testing and statistical depiction	
12	Psychology	2	Provides students with basic knowledge on general psychology. It is an introduction to the field of psychology and the major perspectives including the biological basis of behaviour, sense, perception, memory, motivation, emotion, personality, stress, as well as abnormal, developmental and social psychology.	
13	Introduction to Economics	2	This subject provides students with the following knowledge: introduction of economics; supply, demand and price; choices of consumers; theory of production and production costs; Enterprises' behaviour in all types of markets; general macro-economics; total supply and demand and balanced output; currency and banking; unemployment and inflation; international commerce.	
	Total	**28**		

5.1.7.2 Professional knowledge: **55 credits**

Table 5: **Professional knowledge (Mechanical Engineering)**

No.	Subject	Credits	Description	Remarks
	Basic knowledge	**29**		
	Compulsory subjects	***27***		
1	Graphic and Technical Drawings 1	2	Requisite: mathematics I, II, physics I, II. This subject provides students with the basic knowledge on:	

No.	Subject	Credits	Description	Remarks
			- projections to show geometric objects via drawings on a plane and how to solve problems of solid geometry in drawings. - Drawing equipment, formats, types of line, lettering, simple representations (geometry drawing), scales, free sketching; dimensions; title block; principles of orthographic projection; electrical and mechanical drawings.	
2	Graphic and Technical Drawings 2	1	Isometric and oblique representations; section view, sections of cones; reading of drawings; part drawing and assembly; surface finish symbols; civil and mechanical drawings.	
3	Heat Transfer	2	This course discusses the concepts of heat transfer: conduction, convection and radiation, condensation and boiling heat transfer, heat exchangers and heat transfer as special topic.	
4	Mechanics I	3	Statics: Basic concepts. Scalars and vectors. Forces and their resolution. Centre of gravity and centroids. Couple and moment. Equilibrium of a rigid body. Systems of rigid bodies. Friction. Concepts of stress and strain. Hooke's law and Poisson's ratio. Mohr's circle of plain stress and strain. Pin-jointed trusses. Statics and displacements. Methods of joints and sections. Displacement diagram. Deflection of beams. Sheer force and bending moment diagrams.	
5	Mechanics II	2	Dynamics: Kinematics of particles and rigid bodies: rectilinear and curvilinear motion; absolute and relative motion concept; kinetics of particles, system of particles and rigid bodies: equations of motion, work, power, energy, impulse. Introduction to space kinetics of rigid bodies.	
6	Engineering material 1	2	Crystal structure of metals, bonds and geometry; theory of alloys; imperfections in	

No.	Subject	Credits	Description	Remarks
			crystals; equilibrium phase diagram; iron carbon systems; non-ferrous alloys; structure and properties of polymers and ceramics. Nondestructive tests: visual, magnetic, eddy-current, ultrasonic and radiography. Destructive tests: tensile, bending, hardness, impact and creep tests. Materials used in Electrical Engineering.	
7	Engineering material 2	2	Strengthening of metals and alloys; heat treatment of steels; classification and properties of steel; effects of alloying. Cast irons: grades, properties and applications. Non-ferrous metals and alloys; properties and applications. Non-metallic materials: polymers, ceramics and cermet, composites. Friction and wear; corrosion and its prevention.	
8	Metal processing	2	Requisite: Mechanics 1, 2; engineering material 1,2 This subject provides students with basic knowledge about: - Casting in sand mold technology, casting in metal mold, special casting and casting defects, - Press machining technology: rolling, dragging, forging, stamping. - Joining technology: + Welding Technology: arc welding, gas welding, + soldering, reveling, nut and bolt…	
9	Tolerance and Measurement Technique	2	Requisite: Technical drawing, Metal technology This subject provides students with basic knowledge about: - Functional interchange property in mechanical engineering, assembly tolerance of common joints: smooth pillar, latch - The way to solve the dimension string problem, the principle to write the dimension on detailed drawings	

No.	Subject	Credits	Description	Remarks
			- Definitions; units; standards; instruments; errors; accuracy; calibration; analogue and digital methods; measurement of displacement, area, volume, force, torque, strain, density and pressure etc. Statistical treatment of data; error analysis.	
10	Mechanical design	2	Requisite: Technical drawing, Metal technology, Tolerance – Measurement technique, Mechanics 1, Engineering material 1 This subject provides students with basic knowledge about: - Structure, kinetic analysis, plane structure dynamics, friction in joints and the concept of cam structure - Overview of the design of part, their work target - Calculation of jointed details, joint with rivet, joint with welding, joint with lace - Calculation and design of mechanical transmission: belt, chain, gear, friction gear, screw gear, screw shaft, - Calculation of the shaft design, calculation and selection of axle-bearing, joint	
11	Mechanical design Project	1	Requisite: Machine principle and part. The contents of this subject includes: Methods to calculate and select electric engine for one-level deceleration box, select the mode of lubrication and lubrication oil Apply the knowledge of the subject machine principle and part to design transmission set, make assembly drawing	
12	Electric-electronic technique	2	Requisite: mathematics I, II, physicsII. This subject provides students with the following basic knowledge: Basic concepts of electrical circuit, sinusoidal alternating current circuit, methods to solve electrical circuit, three-phase alternating current circuit, transformer, asynchronous electric	

No.	Subject	Credits	Description	Remarks
			machine, synchronous electric machine, direct current machine, electrical safety, physical basis of semiconductor, semiconductor components, amplifying diagrams using transistor, operation amplifiers (Op.Amp) and applications, application circuit, power block and voltage stabilizer.	
13	Fluid Mechanics	2	Properties of fluids; fluid statics; buoyancy; fluid kinematics; patterns of flow; fluid dynamics; Euler's equation; Bernoulli's equation and its applications; momentum equation; introduction to boundary layers; laminar and turbulent flow in pipes; Hagen-Poiseuille flow; Couette flow; loss of head due to friction; flow through pipe networks.	
14	Strength of Material	2	Problems in direct stress; analysis of plain stress and plane strain; statics of beams and frames; geometric properties of plane sections; stresses due to bending and shear in beams; torsion of circular and thin walled non-circular sections; combined loading.	
	Elective Subject	***2***		
1	Computer Aided Designing and Drawing	2	Requisite: Graphics – Technical drawing, Tolerance – Measuring technique. This subject provides students with knowledge about AutoCAD, inventor or solidworks software, so that students are able to: - Draw 2 dimensions drawing on computer - Design 3 dimensions model of objects on computer.	
2	Industrial Economics and Quality Management	2	Requisite: mathematics I, II,physics I, II. The contents of this subject include: - Engineering Economics: time value of money, interest rate, net present value (NPV), break even analysis, risk analysis. - Production and operation management: concept of management, product design, job design, forcating demand; production	

No.	Subject	Credits	Description	Remarks
			management, capacity management, location and layout management, quality management, invest analysis, project management.	
	Specialized knowledge	**26**		
	Compulsory subjects	***24***		
1	Metal Cutting Principle	3	Requisite: Engineering materials 1, 2 The subject provides students with the following knowledge: General theory of metal cutting; Physical phenomena in cutting process; Structure, geometric parameter of cutting tool; Calculation of cutting parameter, cutting forces and power; tool materials, wear and coolant.	
2	General Metal Cutting Machines	2	Requisite: Metal cutting principle. The subject provides students with the following knowledge: The basis of machining surface graphic depiction on metal cutting machine, Dynamics of metal cutting machine, Structure, transmission of some common metal cutting machines.	
3	Manufacturing processing and Fixture	4	Requisite: graphics and technical drawing, tolerance and measuring technique. The subject provides students with the following knowledge: Basic concepts of mechanical engineering, machining surface quality and machining accuracy, characteristics of machining methods (lathing, milling, drilling, grinding...). The method to design specialized fixture on multi-functional metal cutting machine, accessories, assembly fixture, Testing fixture	
4	Manufacturing processing project	1	Requisite: metal cutting principle, General metal cutting machine, mechanical manufacturing technology and fixture. The subject provides students with the following knowledge: to design and build technical drawing of a part, analyze	

No.	Subject	Credits	Description	Remarks
			working and technological features in the structure of the detail, Select the method to make workpiece and calculate stock left for machining, create technological procedure of manufacturing, design specialized fixture for a specific operation.	
5	CNC Technology	2	Requisite: metal cutting principle, mechanical manufacturing technology and fixture. The subject provides students with the following knowledge: concept of manufacturing technology on CNC machine, fixture, tools used on CNC machine, Basic concepts of machining programming on CNC machines, Machining programming on lathing machine, milling machine, drilling machine and machining center.	
6	Unconventional processing methods	3	Requisite: mechanical manufacturing technology and fixture. The subject provides students with the following knowledge: machining methods with electric spark, machining methods with electrochemistry, machining methods with beam, ultrasonic machining methods, machining methods with heat.	
7	CNC machine and industrial robotics	3	Requisite: general metal cutting machine. The subject provides students with the following knowledge: using numerical controlled machine, shift measurement system, sensor system, comparison set and interpolation set, controlling transmission, dynamic of robot and robot.	
8	Industry Safety and Maintenance	2	maintenance management and organization; types of maintenance, maintenance support systems; computer applications; quantitative methods; pareto analysis; normal distribution; exponential functions; Weibull distribution; replacement decisions; overhaul and repair decisions.	

No.	Subject	Credits	Description	Remarks
			Safety: objectives; causes of accidents and injuries; working conditions; safety training; monitoring; motivation; safety practice; hazard control, Industrial waste.	
9	Mold Manufacturing Technology	2	Requisite: mechanical manufacturing technology and fixture. The subject provides students with basic knowledge about: Overview of mould, design mould with some mould softwares (Catia, Pro/Engineering, VISI Series...), methods to treat defects in a product.	
10	Automatic Controlling	2	Requisite: electric-electronic technique. The subject provides students with the following knowledge: overview of automatic controlling, mathematical basis of the theory of automatic controlling, dynamic description of automatic controlling system, study of automatic controlling system, numerical controlling system.	
	Elective Subject	***2***		
1	Experimental method and Data Processing	2	The subject provides students with the following knowledge: The rule of distributing the processing accuracy and the method for assessing the processing accuracy.	
2	CAD/CAM-CNC Technology	2	Requisite: CNC technology. The subject provides students with the following knowledge: Concept of CAD/CAM-CNC technology, technology and tool to automatically programme CNC lathing machine, CNC milling machine, concept of post-processing.	
	Total	**55**		

5.1.7.3 Pedagogical knowledge: **21 credits**

Table 6: **Pedagogical knowledge (Mechanical Engineering)**

No.	Subject	Credits	Description	Remarks
	Compulsory subjects	***19***		
1	General Vocational Education	2	- History, significance of vocational education system. - Difference between general education and vocational education. - Principles and methods of education. - Principles and methods of teaching. - Vocational teacher standard and training of vocational teacher.	
2	Psychology of Learning and Teaching	2	**Chapter 1: Psychology ages** Some characteristics of vocational students: age, cognition, emotion, will… and notes **Chapter 2: Psychology of teaching profession** Psychological characteristics of vocational psychological characteristics of learning activities Technical thinking, concept formation, movement, skills and notes	
3	Research Methodology	2	The basic knowledge of educationally scientific research methods: - general theory of research methodology and - educationally scientific research methods, stages for educationally scientific research, - the assessment and practice of educationally scientific research	
4	Vocational Curriculum Development	2	**Chapter 1: An overview of vocational teaching curriculum** Some theories on the development of vocational training programmes. Meaning, significance, structure and components, characteristics, procedures and formulation of objectives in such a way that the learning-teaching syllabus is in line with the actual country's socio-economic situation.	

			Chapter 2: Development of vocational teaching curriculum Review on vocational education system Defining curriculum Curriculum assessment Establish curriculum based on job description	
5	Teaching Skill	3	Chapter 1: Lecture preparing skill Chapter 2: Lecture making skill Chapter 3: Testing and assessing skill	
6	Teaching Media	2	The theoretical foundation of the use of media; The characteristics of educational media; Functions and benefits of educational media; usefulness of educational media; type and characteristics of the media, media selection; development of educational media; utilization of educational media; equipment media education: media evaluation.	
7	Practice in Vocational School	4	Chapter 1: general issues about practice in vocational school Chapter 2: pedagogical practice in vocational schools	
8	Teaching Measurement and Evaluation	2	Basic knowledge on the role, function of assessment in teaching, training students the skill to identify the aim of a subject and lessons on building an assessing process objectively, logically and fairly. This subject equips students methods to design questions and all types of tests.	
	Elective Subject	***2***		
1	Teaching Methodology	2	Chapter 1: An overview of specialized teaching methodology Chapter 2: Approach to specialized teaching: - Teaching theory: Teaching concepts, structure, principle, classification ... - Teaching practice - Integrated teaching	

2	Professional Didactic	2	Introduction to sciences of specialization teaching. Basic knowledge of sciences of specialization teaching. Education planning and researches on the learning of pedagogical subjects. Research methodology of specialization teaching. Planning of the vocational education system. Teaching practices for students (based on their specializations).	
	Total	**21**		

5.1.7.4 Internship – Practice: **22 credits**

Table 7: **Internship Practice (Mechanical Engineering)**

No.	Subject	Credits	Description	Remarks
1	Technical Internship in workshop/Lab	16		
1.1	Handwork cutting practice	*1*	The subject provides students with knowledge and basic skills in mechanical manufacturing technology with some hand tools and simple machining devices: marking, testing, basic filing, filing parallel plane, perpendicular plane basing on size, drilling, metal sawing, threading with tapping and screw plate, work bench.	
1.2	Basic lathing practice	*4*	Requisite: mechanical manufacturing technology and fixture. The subject provides students with the following knowledge: how to operate lathing machine and use technological equipment of lathing machine, method of lathing smooth outer cylinder surface and inner cylinder surface, method of lathing head surface, method of cutting groove, method of machining cone surface (outer, inner). Method of machining long axis L/D > 8, method for lathing lace, method of	

No.	Subject	Credits	Description	Remarks
			shaping lathing, method for offset lathing.	
1.3	Advanced lathing practice	*3*	Requisite: basic lathing practice The subject provides students with the following knowledge: Method for lathing multiple thread and transmission thread, Method for lathing complicated part.	
1.4	Basic milling-planing practice	*3*	Requisite: basic lathing practice. The subject provides students with the following knowledge: How to operate milling-planing machine, Method to machine horizontal plan, vertical plane and inclined plane, Method to machine groove.	
1.5	Advanced milling-planing practice	*2*	Requisite: Basic milling-planing practice. The subject provides students with the following knowledge: Method to machine twisted groove on milling machine, Method to machine jaw clutch, Method to machine gear, Method to machine gear bar.	
1.6	CNC practice	*3*	Requisite: CNC technology, Basic lathing practice, Basic milling-planing practice. The subject provides students with the following knowledge: skill in programming how to machine on CNC milling machine, Programming how to machine details on CNC lathing machine, Programming how to machine details for machining CNC center, How to operate CNC machine.	
2	Technical Internship in Factories	2	The subject helps students to be familiar with the production in mechanical field. Students have a chance to visit mechanical factories, understand the organization of those factories, and attend in one phase of factories. The subject provides students with the following knowledge: production method of a mechanical workshop, production plan, organization of factories, industrial safety and hygiene, working style suitable to industrialization and modernization process.	

No.	Subject	Credits	Description	Remarks
3	Teaching internship in Vocational Institutions	4	The subject content consist of: -Forms and models used in practice -Prepare necessary documents and material for teaching practical exercises. - join the class as observation or assistant teacher - Teaching a few hours when having prepared something and are ready to teach. - Evaluation of the learner's lesson.	
	Total	**22**		

5.1.7.5 Graduation paper: **08 credits**

5.2 Core curriculum for vocational teacher education in electrical engineering

*5.2.1 Title of the core curriculum***:** Core curriculum for vocational teacher education in electrical engineering

5.2.2 Objectives of study: To train students with knowledge, skills and ability to teach in Electrical Engineering in vocational institutes and industry.

5.2.3 Duration of study: 4 years

5.2.4 Enrollee: *Graduates from upper secondary schools or equivalent institutes*

5.2.5 Graduation condition:

- Take all required subjects
- GPA >= 2.00
- No "F"

5.2.6 Assessment: Based on the national assessment system of each country.

5.2.7 Structure of the knowledge:

+ General knowledge: 30 credits

+ Professional knowledge 52 credits

- *Basic knowledge: 34 credits*

- *Specialized knowledge:* *18 credits*

+ Pedagogical knowledge 21 credits

+ Internship – Practice: 22 credits

+ Graduation paper: 8 credits

Total: 133 credits

5.2.7.1 General knowledge: **30 credits**

Table 8: **General knowledge (Electrical Engineering)**

No.	Subject	Credits	Description	Remarks
1	Introduction to Informatics	2	See at Core curriculum for VTE in ME	
2	General English I	2		
3	General English II	2		
4	Technical English	2		
5	Physics I	2		
6	Physics II	3		
7	Mathematics I	2		
8	Mathematics II	2		
9	Mathematics III	2		
10	Engineering Mathematics	3		
11	Probability And Statistics	2		
12	Psychology	2		
13	Introduction to Economics	2		
14	Engineering Drawing	2	Introduction to drawing equipment, formats, types of line, lettering, simple representations (geometry drawing), scales, free sketching; dimensions; title block; principles of orthographic projection; civil, electrical drawings.	
	Total	**30**		

5.2.7.2 Professional knowledge: **52 credits**

Table 9: **Professional knowledge (Electrical Engineering)**

No.	Subject	Credits	Description	Remarks
	Basic Knowledge	**34**		
1	Electrical circuit 1	3	Fundamentals of electrical circuit analysis, electrical circuit components, law-legal electric circuit, simplifying the circuit, the method of settlement of the circuit, circuit theorems, waveform, sinusoidal waveform, forced response, the average price and price effective, meter readings, calculations single phase power, and dual analog.	
2	Electrical circuit 2	3	Three-phase, three-phase power measurement system, frequency response, transformers, circuit pole 4, a series of first order, second order circuits, excitation at natural frequency, operational amplifier.	
3	Electronic 1	2	Requisite: electrical circuit 1. Brief description of the subject: some basic electronic components such as diode; bipolar transistor; CMOS transistor; thyristor and multilayer components, feed, rectifier; bias circuit for transistor; other special electronic components.	
4	Electronic 2	3	Requisite: basic electronic 1. Brief description of this subject: cascade amplification circuit; negative feedback; high-frequency amplification; resonant amplification; positive feedback circuit; sinusoidal signal generator and non-sinusoidal signal generator; operational amplifying circuit and application; electronic power supply.	
5	Electrical Measurement and Instrumentation	2	Requisite: mathematics 1, 2, 3, engineering mathematics, Physics 1, 2. Content: the concept of measuring basis, unit system and standard system; the measurement of R, L, C and M; the measurement of power and power factor; The clock indicator AC / DC, sphere AC /	

No.	Subject	Credits	Description	Remarks
			DC converters, recording devices, oscilloscopes, measuring techniques, measuring devices.	
6	Digital Technique	3	Requisite: electronic 1. Content: original concepts of Boolean algebra, logic gates; digital IC and the performance of logic gates; combinatory circuit; sequential circuit; ADC and DAC converter; semiconductor memory, Karnaugh maps.	
7	Power Electronic	2	Requisite: digital techniques this subject provides students with the following knowledge: rectifiers, inverters; DC and AC converters; Chopers; basic knowledge of the inverter.	
8	Electric Machine 1	3	Requisite: electronic-electrical materials, electrical measurement and instrumentation, electrical circuit 1,2. Content: transformers: structure, circuit and equations, operational principles (characteristics, voltage regulation, parallel, group of vectors), the quantity of norm, the wiring circuit from the transformer, electromagnetic relation and the characteristics of work load in symmetric and asymmetric mode; some special types of transformers; knowledge of AC electric machine, 3 phase asynchronous machine, single phase AC motors	
9	Electric Machine 2	3	Requisite: electric machine 1. This subject provides students with the following knowledge: synchronous electric machines: structure, operational principles, the quantity of norms, the working characteristics, turning on and synchronizing the machine. Some special synchronous machines, DC machine: structure, classification, operational principles, the quantity of norms, winding, distribution and power transmission, the	

No.	Subject	Credits	Description	Remarks
			characteristics of starting the machine and adjusting the speed, load; some special DC machinery.	
10	Electric drives	2	Requisite: electric machine 1, 2. Content: characteristics of DC motor, asynchronous motor, synchronous motor; methods to start and adjust the speed of electric motors; choose the electric motor power	
11	Electronic-Electrical Materials	2	Requisite: electrical circuit 1 Content: basic concept of electrical engineering materials; insulation materials and applications; conductive materials and applications; semiconductor materials and applications; other materials.	
12	Automatic Controlling Systems	3	Requisite: digital techniques. Content: basic theory of automatic control; transfer function and block diagram transformation; analysis and survey on stability criteria of linear systems (time and frequency response, root locus), nonlinear and discontinuous systems; industrial controllers; quality assessment of a system; using MATLAB software to design (controllers) and analyze a system.	
13	Microprocessor	2	Requisite: digital techniques. The subject provides students with the following knowledge: block diagram of microprocessing system and functional of each block; operational cycle of the processing system, the architecture of Intel 8086 processor; 8086 script and writing programme using assembly language for 8086; 8051 microcontroller architecture and programming for 8051.	
14	Project 1	1	The course project requires students to apply what they have learnt, synthesize specialized knowledge to complete the analysis, design calculation or test a problem in the field of digital technology.	

No.	Subject	Credits	Description	Remarks
			Students must think independently, explore reference documents under the guidance of the supervisor. Student defences the course project at the end of the semester.	
	Specialized knowledge	**18**		
1	Electrical installation technique	3	Standardization and electrical installation requirements. Low voltage, Medium and high. Equipment and materials in electrical installations. Loads in the installation. Circuit for the equipment and components. General provisions in the planning of electrical installations. Illumination calculations on the room (the building), certain objects and paths. Calculation the number of points of light in a room. Technique placement of the light point. Engineering division of a group of power distribution in the control unit. Calculation, sizing and planning the installation of cables, capacitors, circuit breakers. Planning the installation of the buildings. Planning installation of sports field. Planning power installations (electrical machinery). Mechanical installation of lightning rods.	
2	Power system analysis	3	Requisite: Electrical circuit 1, 2, Electrical machine 1, 2 Power system problems, Representation of power systems, reduction of power systems, power flow analysis, economic operation of power systems, fault analysis, stability of power systems, symmetrical components.	
3	Power system protection	3	Requisite: Power system analysis, Electrical machine 1, 2, Electrical installation technique Fundamentals of power system protection; relay operating principles; induction-type relays; overcurrent protection; differential relays; distance relays; pilot relaying;	

No.	Subject	Credits	Description	Remarks
			generator protection; transformer and busbar protection; system and equipment grounding; current transformers; introduction to digital protective systems.	
4	Power station & Substation	2	Requisite: Power system protection, electrical machine 1, 2. Brief description of the subject: An overview of power station and substation; the forms of electrical energy and power station; the generator systems; the high-voltage and low-voltage substations.	
5	Power transmission	2	Requisite: power system protection, power system analysis transmission lines, map establishment study; mechanical calculation of overhead line; state changing equation; load coefficient; mechanical calculation of poles; fundamental of basement of pole arrangement; example of high voltage and extra high voltage calculation; geometry property of overhead line; conductor configuration problems, structural and architectural interest of transmission lines.	
6	SCADA	2	Requisite: Power transmission, Microprocessor Technology-based power control system SCADA: basic functions, system software, system hardware configuration, the man-machine interface, SCADA systems, energy management system, distribution management system, customer automation, facility control center, a data communication system.	
7	Programming control	2	Requisite: Microprocessor; automatic controlling system. Content: An overview of controlling technique and programming controller; programming language of programmable logic control (PLC); programming techniques and their applications.	

No.	Subject	Credits	Description	Remarks
8	Project 2	1	Brief description of the subject: assign research topics to students and guide students to implement the project according to schedule; organize assessment of the students' projects. The content of the project is to design the electricity supply system for a practical load: studying the equipment selection in the network of high-voltage and low-voltage power supply; short circuit themes, lighting, power compensation.	
	Total	**52**		

5.2.7.3 Pedagogical knowledge: **21 credits**

Table 10: **Pedagogical knowledge (Electrical Engineering)**

No.	Subject	Credits	Description	Remarks
	Compulsory subjects	***19***		
1	General Vocational Education	2	See core curriculum for VTE in mechanical engineering	
2	Psychology of Learning and Teaching	2		
3	Research Methodology	2		
4	Development Vocational Curriculum	2		
5	Teaching Skill	3		
6	Teaching Media	2		
7	Practice in Vocational School	4		
8	Measurement And evaluation Teaching	2		
	Elective Subject	***2***		
1	Teaching Methodology	2	See dore curriculum for VTE in mechanical engineering	
2	Professional	2		

	Didactic			
	Total	**21**		

5.2.7.4 Internship – Practice: **22 credits**

Table 11: **Internship Practice (Electrical Engineering)**

No.	Subject	Credits	Description	Remarks
1	Technical Internship in workshop/Lab	16	Students learn to do practical tasks, develop their professional skills. The number, time and content of subjects may dependon the country but it must satisfy the demand for skills in the training programme.	
2	Technical Internship in Factories	2	Meeting work requirements at the factory like an actual staff; obeying the regulations of the factory; practicing soft skills; collecting data to report the internship.	
3	Teaching internship in Vocational Institutions	4	The subject content consists of: -Forms and models used in practice -Prepare necessary documents and material for teaching practical exercises. - join the class as observer or assistant teacher - Teaching some lessons when they have prepared something and are ready to teach. - Evaluation of the learner's lesson.	
	Total	**22**		

5.2.7.5 Graduation paper: **8 credits**

6 Conclusions and recommendations

6.1 Conclusions

Within the regional integration context, especially regarding to goal to establish an ASEAN Economic Community by 2015 i.e. a community not consisting of 10 separate labour markets but instead one huge labour market, ASEAN nations have to recognize each other's qualification. To give qualification mutual recognition it is vital that the curriculum be recognized. Within the Regional Cooperation Platform of Vocational Teacher Education in Asia, NUTE together with NUoL, UPI and IBB attempt to develop the core curricula for VTE in EE and ME. The curricula of the two above majors have been chosen for development because they are popular majors the partner countries have invested heavily in. In the scope of the study, the authors only focus on developing the core curricula for VTE in EE and ME at bachelor level. The development of these two core curricula will be the foundation for the development and modification of core curricula for other majors. The authors also expect that the study will offer some recommendations related to core curriculum development for policy makers.

Before implementing the study, the authors review the theory on curriculum and curriculum development in the world and in Vietnam, in which the authors focus on the models of curriculum development in the world and principles for developing a curriculum in Vietnam. In the study, the authors use the systemic curriculum development model by Diamond (1998), Participatory Curriculum Development (PCD) model, and hybrid model. The first model is a combination of the first and second model. This model is also the most suitable for curriculum design at bachelor level inVietnam. Based on this model, curriculum developers define the criteria that a curriculum satisfactory for Vietnam i.e. a curriculum built in accordance with the hierarchy and division of the national education system; the curriculum must be practical and suitable at the domestic level of science and technology; the curriculum helps generate a workforce suitable to the social division of labor; the curriculum must meet the requirement to help it actively integrate into the regional and world economy; the curriculum should be built for continuity and creating convenient conditions for lifelong learners to learn in the most economical way. To develop the curriculum in Vietnam, an Advisory Board has to be established to build principles for developing a curriculum. In this study, the aim of the authors is not to develop a new curriculum, but develop the core curricula for VTE in EE and ME based on the available curricula of the partner countries. Therefore, implementation methods may differ to the above models of curriculum development, however, the findamental of developing a curriculum will not be transgressed.

To develop the core curricula for VTE in EE and ME, partners taking part in the study including NUTE, UPI, NUoL and IBB analyse and compare the curricula for the above majors of each partner to agree on the core curricula. The analysis and comparison is conducted through 2 workshops: the first is conducted in Vietnam and the second in Laos. In the first workshop, after the sharing of curricula of partners, the structure of the core curricula is agreed on in general, the subjects in these two core curricula and the credit number of each subject. However, the detailed contents of the subjects have not been mentioned in the two core curricula. Therefore, a second workshop is held in Laos to agree

on the contents of each subject. After two workshops, the core curricula for VTE in EE and ME is developed. The core curriculum for VTE in ME includes 134 credits, of which general knowledge accounts for 28 credits, professional knowledge 55 credits (basic knowledge: 19 credits, specialized knowledge: 26 credits), pedagogical knowledge 21 credits, internship – practical 22 credits and graduation paper 8 credits. The core curriculum for VTE in EE includes 133 credits, of which general knowledge accounts for 30 credits, professional knowledge 52 credits (basic knowledge: 34 credits, specialized knowledge: 18 credits), pedagogical knowledge 21 credits, internship – practical 22 credits and graduation paper 8 credits. The core curricula are suitable to partners but remain true to the nature of each country.

6.2 Desiderata

It is expected that these core curricula will be adapted successfully in all partner universities to develop their own curricula. The two core curricula can serve as references for other universities in ASEAN regions when they want to develop their curricula. The authors hope these curricula can be a recommendation to policy makers responsible for establishing policies on frame curricula.

6.3 Recommendations

Basing on these core curricula, institutions build their own curricula according to the following recommendations:

- In terms of "objective of study", institutions should add specific objectives suitable to the education and specific cultural tradition of each country.
- In terms of "assessment" institutions specify the assessment according to the assessment system of each country.
- Institutions add elective subjects to the list of "General knowledge", "Basic knowledge", "Specialized knowledge", "Pedagogical knowledge" and "Internship – Practice" and increase the number of required credits appropriate to the national education system of each country.
- Each institution can decide to replace the "graduation paper" with other subjects so the credit number of subjects is equal to the "graduation paper". In this case it is necessary for the institutions to list the subjects replacing the graduation paper.

Due to the scope of the study, the authors have only focused on the core curricula for VTE in ME and EE. There are as yet many other VTE majors requiring core curricula building among institutions in Asia for these institutions to gain the opportunity to exchange training programmes, teachers and students.

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Annex 1: Glossary of concepts in curriculum and curriculum development

Curriculum: The entire set of activities scheduled to ensure achievement of the goals and aspirations of a system of education in a nation state or institution

Curriculum Development: The identification and organisation of a set of activities scheduled to ensure the achievement of the goals and aspiration of a system of education based on an existing design or model.

Core Curriculum: A set of courses or subjects that is of absolute necessity in a programme of study. The core is usually the set of subjects that must be done by everybody as it is required by all areas of specialisation.

Electives/ Optionals: These are subjects or courses that the learner can add on to the core subject or courses. The learner has choice of selection.

Integrated Curriculum: A set of subjects fused together by breaking the traditional boundaries between them.

Teaching resources. Materials and facilities used by teachers in their classroom transaction

Goals. Global statements of intentions and aspirations

Aims. Broad statements of what is intended to be achieved

Objectives. Specific behaviour to be produced as a result of exposure to some

Sequence. The arrangement of content in a specific order

Scope. The level to which a topic can be taught

Syllabus. List of topics arranged in a sequence

Content. Body of knowledge contained in a course

Taxonomy. A classification of teaching objectives into broad categories and sub-categories

Cognitive domain: A category of educational objectives concerned with behaviours related to thinking or manipulation of abstract symbols

Affective domain: A category of educational objectives that is concerned attitudes and values

Psychomotor domain: A category of educational objectives that is concerned with learnt responses

Evaluation: The collection and analysis of objectively measured data and their use to reach a judgement on an educational practice or experience.

Annex 2: The curricula for VTE in Mechanical Engineering and Electrical Engineering Namdinh University of Technology Education

1 Introduction to the curriculum of vocational teacher training in Electrical Engineering

1.1 Training objectives (general objectives, specific objectives)

General objectives:

Training at university level in the field of Mechanical Engineering Teacher Education has to satisfy the demand of university education to train TVET teachers for serving the process of industrialization and modernization.

Graduate students must have good political ideology, ethics and health; have teaching and research capability; and have professional knowledge and professional skills corresponding to training level.

Graduate students can continue with post graduate studies in Mechanical Engineering or Education Management.

Specific objectives:

Graduate students must meet the following requirements:

- *Ethics:*
  - Be patriotic, love socialism, be a good citizen, obey the policies of the Party, and the laws.
  - Love teaching job; respect and treat students equally; be respected by students.
  - Be responsible for work, honest, cooperative and curious to learn from colleagues, get on well with the public.
  - Be active to improve political and professional knowledge, and physical health.
- *Knowledge:*
  - Have wide general knowledge and basic knowledge of Marxism, Hochiminh Ideology; understand policies to develop social economics, education and culture of the country;
  - Master professional knowledge of metal cutting, mechanical engineering, metal cutting machine and advanced processing methods and new technology.
  - Have basic knowledge of psychology, education, teaching methodology and assessment in the field of vocational training.
- *Skills:*
  - Have proficient practicing skills in lathing, milling, planing in traditional and CNC machines.
  - Proficiently implement pedagogical skills.

- Upon graduating, students can work as teachers teaching metal cutting in vocational schools, or teach theory and practice at university training mechanical engineering; or become engineers or researchers in manufacturing, repairing, business and research institutions relating to mechanical engineering.

1.2 Training duration (standard duration)

At NUTE, it takes students 4 years and a half to finish the programme training to be a vocational teacher in Mechanical Engineering. Upon graduation, students taking part in this programme will be awarded the Engineer in Technology and Certificate of Technical Education, for them to become vocational teachers.

1.3 The amount of knowledge for the whole course

During the course, students are required to accumulate 146 credits including general knowledge, professional knowledge and pedagogical knowledge. These specific kinds of knowledge will be described in details in the curriculum.

1.4 Enrollee

This programme enrolls students graduating from upper secondary schools or institutions equivalent to upper secondary schools.

1.5 Process of training and graduation condition

When registering for any courses, students have to submit an academic transcript, upper secondary school diploma, birth certificate, approval documents and a register form to study basing on credit system. After the school has recognized students become official students of the school and issued with a student card, academic register booklet and academic consultant.

At the beginning of each academic year, the school informs students of the schedule of each semester, the list of compulsory and optional subjects, the syllabus, prerequisites for registering for each subject and the test schedule for each subject.

At the beginning of each semester, each student has to register the subjects he/she intends to study in that semester.

The assessment of students will be stated in the following section.

Students may graduate as long as:

a. They have not been prosecuted for criminal liability or not suspended from the school;

b. They have accumulated enough credits (146 credits);

c. Their grade point average (GPA) is at least 2.00;

d. They meet specific requirements of their majors regulated by the Rector;

e. They have the certificate of national defence education and physical education.

1.6 Assessment

The assessment is classified into 5 levels as follows:

No.	Ranking	Numeral score	Letter score	Notes
1	Distinction	From 8.5 to 10	A	
2	Credit	From 7.0 to 8.4	B	
3	Strong pass	From 5.5 to 6.9	C	
4	Pass	From 4.0 to 5.4	D	
5	Fail	Below 4.0	F	

1.7 The curriculum

- General knowledge: 51 credits
- Pedagogical knowledge: 17 credits
- Professional knowledge: 78 credits

this includes:

- Basic knowledge: 26 credits
- Specialized knowledge: 24 credits
- Internship: 18 credits
- Graduation paper: 10 credits

1.7.1 General knowledge

No.	Subject	Credits	Content of subject
	Compulsory subjects	**44**	
1	Basic principles of Marxism-Leninism	5	The subject is 5 credits. It establishes the most basic theoretical background for Hochiminh Ideology and the revolutionary ways of the Communist Party of Vietnam and helps students understands the ideological foundation of the Communist Party. It builds revolutional belief of the students. It establishes an overview and methodology for students to approach their specific major.
2	Hochiminh Ideology	2	Requisite: basic principles of Marxism-Leninism The subject is of 2 credits and provides students

No.	Subject	Credits	Content of subject
			with Hochiminh's philosophy, ethics and cultural values and some basic knowledge about Marxism – Leninism in order to build the ethical foundation.
3	Revolutionary ways of the Communist Party of Vietnam	3	Requisite: Basic principles of Marxism-Leninism, Hochiminh Ideology. Besides introduction chapter, this subject includes 8 chapters presenting systematically revolutionary ways of Vietnamese Communist Party, particularly in the modern era.
4	Introduction to Informatics	3	This subject provides students with some basic concepts of informatics; solving a problem using a computer; Windows operating system; programming language C; basic data types; and structures to create sub-programmes
5	English	5	This subject provides students with a basic knowledge of grammar and vocabulary necessary for communication
6	English for Mechanical Engineering	2	This subject includes activities to develop reading skills, accumulate vocabulary related to Electrical Engineering, exercises to practice and develop speaking and writing skills about Mechanical Engineering in English.
7	General physics 1	2	This subject deals with mechanisms and thermodynamics. *a. Mechanisms:* This part provides students with a basic knowledge of classical mechanisms and the foundation of relative mechanisms. Its content includes some concepts of motion, the cause of motion, Newtonian laws, the law of attraction, law of conservation in the motion of a subject, subject system, solid, and a brief introduction of relative dynamics. *b. Thermodynamics:* This part provides students with knowledge of molecule movements and some principles of thermodynamics.
8	General physics 2	3	This subject mentions electricity, and optics. *a. Electricity:* This part provides students with some basic knowledge of electricity and magnetism study. The main contents include: concepts, laws, theorems and phenomena. *b. Optics:* Provides students with knowledge of

No.	Subject	Credits	Content of subject
			geometrical optics, wave optics and quantum optics.
9	General chemistry	2	This subject provides students with knowledge of atomic structure; circulation system; chemical bonding and molecular structure; the application of thermodynamics to chemistry; solution; electrolyte solution; electrochemistry; dynamic chemistry; colloid surface phenomenon; chemical substances.
10	Advanced mathematics 1	2	This subject provides students with the following knowledge: concept of function; sequence and continuity of function; limit of sequence and function; how to calculate differential and integral of function with one variable; concept of sequence string and function string; the investigation of the convergence of sequence string; finding the domain of function string.
11	Advanced mathematics 2	2	This subject provides students with the following knowledge: concept of matrix; inversed matrix and determinant; operations on matrix; methods to calculate inversed matrix and determinant; concept of set of linear equations; methods to solve the set of linear equations; concept of complex number and operations on complex number; vector space, Euclidean space – linear mapping; diagonalized matrix, specific vector, specific value; quadratic form, canonical form and change quadratic form into canonical form.
12	Advanced mathematics 3	2	Requisite: Advanced mathematics 1. This subject provides students with the following knowledge: the basic concept of multi-variable functions; how to calculate derivative and differential of a multi-variable function; the maximum value of a multi-variable function; the basic concept of differential equation; how to solve differential equations level 1 and level 2; the concept of path integral level 1 and level 2; how to calculate path integral; the concept of double integral and triple integral.
13	Special subject	2	This subject provides students with the following

No.	Subject	Credits	Content of subject
	mathematics 1		knowledge: combinatorial analytic; event and the possibility of an event; probability formulae: adding formula, multiplying formula, conditioned probability formula, full probability formula and Bayets formula; random event and probability distribution law of random variables; characteristics of random variables; common probability distribution: binomial distribution, Poisson distribution; sample theory; estimation theory; Statistical Hypothesis Testing; Correlation and regression.
14	General laws	2	This subject includes 11 chapters with basic contents of general theory of government, laws, laws branches in Vietnamese law system
15	National defence	4	The subject is 5 credits. It provides students with some basic issues regarding national defence and Vietnamese military art. The subject helps students to practice some necessary military skills and disciplinary lifestyle to contribute to comprehensive education.
16	Physical education 1,2	3	The subject provides students with knowledge on long jump, shot-put and athletics. It focuses on the history, the principles and major techniques in these sports.
	Elective subjects	**7**	
1	Special subject mathematics 2	2	Requisite subject: Advanced maths 2 This subject provides students with the following knowledge: examples leading to linear planning problem such as: production planning problem, fuel mixing problem, transportation problem; simplex method; duality problem.
2	Special subject mathematics 3	2	Requisite subject: Advanced maths 1, 2. This subject provides students with the following knowledge: complex number and complex sequence; complex variable function; orthopaedic function; integral theory; Laplace transformation.
3	Formal logic	2	This subject provides students with the following knowledge: - What is formal logic? Its aim, subject and mission? The relationship between formal logic

No.	Subject	Credits	Content of subject
			and dialectical logic. - Some forms of thinking such as concept, judgment and inference. - Hypothesis, proof and disproof, some basic laws of formal logic.
4	Professional psychology	2	Provides students with basic knowledge on general psychology, pedagogical psychology, professional psychology; support students in developing the skill to analyze psychological factors in teaching theory and practice and discover psychological factors of professional ethic education and the correct attitude regarding issues of vocational teacher training. It includes 3 chapters: Chapter 1: General psychology Chapter 2: Pedagogical psychology Chapter 3: Professional psychology
5	Introduction to economics	2	This subject provides students with the following knowledge : introduction of economics; supply, demand and price; choices of consumers; theory of production and production costs; Enterprises' behaviors in all types of markets; general macro-economics; total supply and demand and balanced output; currency and banking; unemployment and inflation; international commerce.
6	Introduction to sociology	2	This subject provides students with the system of concepts, basic and modern knowledge about sociology such as subjects, functions, research methods, the formation and development of sociology, the formation of the general knowledge about basic fields of sociology such as social human, social structure and the general knowledge about specialized society such as family sociology, urban and rural sociology, ethical sociology, scientific-technological society.
7	Physical education 3	1	This subject helps students practice volleyball. Students are provided with the history of volleyball, the principles of volleyball and techniques for playing volleyball.

No.	Subject	Credits	Content of subject
8	Physical education 4	1	Requisite: Physical education 1,2 This subject helps students practice football. Students are provided with the rules of football, techniques and strategies to play volleyball.
	Total	**51**	

1.7.2 Professional knowledge

No.	Subject	Credits	Content of subject
	Basic knowledge	***26***	
	Compulsory subjects	*24*	
1	Graphics – Technical drawing	3	Requisite: Advanced mathematics, General physics. This subject provides students with a basic knowledge of: - The projection to show geometric objects via drawings in the plane and the way to solve problems of solid geometry on the drawings. - The conventional way of drawing the details which have complex shapes such as lace, latch, gear, spring,... - The way to build and read drawings such as detailed drawings, assembly drawings
2	Heating Technique	2	Requisite: Advanced mathematics, General physics. The contents of this subject include: - Technical Thermodynamics: basic concepts, heat capacity and the total energy, the first law of thermodynamics, the second law of thermodynamics, - Basic cycle and heat exchanger: The process of evaporation of water vapour, the flow of gas or steam, gas equipment, - Thermal cycle of dynamic steam equipment, ideal cycle of internal combustion engine, refrigeration and heat pump cycle, - The heat transfer: Conduction, convection heat transfer, radiation heat transfer, heat transfer and heat exchange equipment.
3	Mechanics 1	3	Requisite: Advanced mathematics, General physics. This subject provides students with basic knowledge about:

No.	Subject	Credits	Content of subject
			Part 1: Absolute solid mechanics - Equilibrium study of the object under the effects of forces; basic concept and the set of axioms of statics; the set of spatial forces and specific forces, friction, solid focus. - Study on object motion regardless of the cause of motion: point kinetics, basic motion of the solid, the integration of motion point, the motion of solid in orbit round a fixed point, the integration of motion object. Part 2: Distortion mechanics - Study on the strength, hardness, stability of details or structure. This part provides students with basic knowledge to cater for technical subjects and knowledge for practical applications after graduation. - Three basic problems of material strength: the problem of testing, the problem of determining the allowed size, the problem of determining the allowed load.
4	Mechanics 2	2	Requisite: Mechanics 1. The subject provides students with a basic knowledge of: Part 1: Absolute solid mechanics Study on the motion of objects under the forces: concepts and axiom of thermodynamics, motion differential equation, general theorem of dynamics; mechanic principles: possible motion principle, Dalambe principle; general dynamic equation, non-free set of motion differential equation, top integrals; solid dynamics, corrosion theory. Part 2: Distortion mechanics The contents include: - Cases under complicated forces together with cases under basic forces - Hyperstatic system: define basic methods to calculate the general and specific hyperstatic system. - Stability for a bar and a set of bar under compression.

No.	Subject	Credits	Content of subject
			- Cases under specific forces such as dynamic load.
5	Engineering material 1	2	Requisite: Advanced Mathematics, General Chemistry, General Physics This subject provides students with basic knowledge about: The basis of materials science: the crystal structure of the material, the crystalization, alloy theory, distortion and mechanical properties of materials, corrosion and material protection.
6	Engineering material 2	2	Requisite: Technical material 1 This subject provides students with basic knowledge about: Common engineering materials, iron-based materials, metal and ferrous alloys, inorganic materials, polymer materials, composite materials, material selection.
7	Metal technology	2	Requisite: Mechanism 1, mechanism 2, engineering 1, engineering 2 This subject provides students with a basic knowledge of: - Casting in sand mould technology, casting in metal mold, special casting and casting defects, - Pressure machining technology: rolling, dragging, forging, stamping, - Welding Technology: arc welding, gas welding, - Cutting technology: lathing, milling, planing, drilling, piercing, grinding, boring, - Machining technology with electrophysics and electrochemistry: electric spark machining, laser beam machining, ultrasonic machining, electrochemical machining, ...
8	Tolerance – Measurement technique	2	Requisite: Technical drawing, Metal technology This subject provides students with basic knowledge of: - Functional interchange property in mechanical engineering, assembly tolerance of common joints: smooth pillar, latch - The way to solve the string problem, the principle to write the size on detailed drawings dimensioning - The principle, structure, and use of some basic

No.	Subject	Credits	Content of subject
			measuring tools in Mechanical Manufacturing Technology - Methods of measuring basic geometrical parameters of the details
9	Machine principle and part	3	Requisite: Technical drawing, Metal technology, Tolerance – Measurement technique, Mechanics 1, Engineering material 1 This subject provides students with a basic knowledge of: - Structure, kinetic analysis, plane structure dynamics, friction in joints and the concept of cam structure - Overview of the design of machine details, their work target - Calculation of jointed details, joint with rivet, joint with welding, joint with lace - Calculation and design of mechanical transmission: belt, chain, gear, friction gear, screw gear, screw shaft, - Calculation of the shaft design, calculation and selection of axle-bearing, joint
10	Part course project	1	Requisite: Machine principle and part. The contents of this subject include: Methods for calculating and selecting an electric engine for one-level deceleration box, selecting the mode of lubrication and lubrication oil Applying the knowledge of the subject Machine principle and in part to design transmission set, make assembly drawing
11	Electric-electronic technique	2	Requisite: Advanced mathematics, General physics. This subject provides students with the following basic knowledge: Basic concepts of electrical circuit, sinusoidal alternating current circuit, methods to solve electrical circuit, three-phase alternating current circuit, transformer, asynchronous electric machine, synchronous electric machine, direct current machine, electrical safety, physical basis of semiconductor, semiconductor components, amplifying diagrams using transistor, operation amplifiers (Op.Amp) and

No.	Subject	Credits	Content of subject
			applications, application circuit, power block and voltage stabilizer.
	Elective subjects	*2*	*2/6 credits*
1	Technical oscillation	*2*	Requisite: Mechanics 1 The subject provides students with the following knowledge: - Characteristics and expression of oscillation quantities - Free linear oscillation set of equations with one grade - Free linear oscillation set of equations with multi-grade - Defining specific oscillation frequency, forms of specific oscillation, methods to reduce oscillation - Set of turning off force shock
2	Computer Aided Designing and Drawing	2	Requisite: Graphics – Technical drawing, Tolerance – Measuring technique. This subject provides students with knowledge about AutoCAD software, so that students are able to: - Draw two dimension drawing on computer - Design 3 dimension model of objects on computer
3	Industrial economics and quality administration	*2*	Requisite: Advanced mathematics, General physics. The contents of this subject include 5 chapters, providing students with knowledge about industrial economics and quality.
	Specialized knowledge	***24***	
	Compulsory subjects	*20*	
4	Metal cutting principles	3	Requisite: Engineering materials 1 The subject provides students with the following knowledge: General theory of metal cutting; Physical phenomena in cutting process; Structure, geometric parameter of cutting tool; Calculation of the cutting parameter of metal cutting methods.
5	General metal cutting machine	2	Requisite: Metal cutting principle. The subject provides students with the following knowledge: The basis of machining surface graphic depiction on metal cutting machine, Dynamics of metal cutting machine, Structure, transmission of some common metal cutting machines.

No.	Subject	Credits	Content of subject
6	Hydroneumatic transmission in industrial machine	2	Requisite: Machine principle and part The subject provides students with the following knowledge: Hydraulic system, Compressed air system, Operating, using, servicing hydraulic system, Operating, using and servicing compressed air system, Designing hydraulic system, compressed air system.
7	Mechanical Manufacturing Technology and fixture	4	Requisite: Graphics – Technical drawing, Tolerance – measuring technique. The subject provides students with the following knowledge: Basic concepts of mechanical engineering, Machining surface quality and machining accuracy, Standard and location (part, cutting tool), Characteristics of machining methods. The method to design specialized fixture on multi-functional metal cutting machine, Accessories, Assembly fixture, Testing fixture, Standardization and flexibility of technical equipment.
8	Mechanical Manufacturing Technology course project	1	Requisite: Metal cutting principle, General metal cutting machine, Mechanical Manufacturing technology and fixture. The subject provides students with the following knowledge: Design and build technical drawing of a part, Analyze working and technological features in the structure of the detail, Select the method to make workpiece and calculate stock left for machining, Create technological procedure of manufacturing, Design specialized fixture for a specific operation.
9	CNC technology	2	Requisite: Metal cutting principle, Mechanical Manufacturing technology and fixture. The subject provides students with the following knowledge: Concept of manufacturing technology on CNC machine, Fixture, tools used on CNC machine, Basic concepts of machining programming on CNC machines, Machining programming on lathing machine, milling machine, drilling machine and machining center.
10	Unconventional processing methods	3	Requisite: Mechanical Manufacturing technology and fixture.

No.	Subject	Credits	Content of subject
			The subject provides students with the following knowledge: Machining methods with electric spark, Machining methods with electrochemistry, Machining methods with beam, Ultrasonic machining methods, Machining methods with heat.
11	CNC machine and industrial robot	3	Requisite: General metal cutting machine. The subject provides students with the following knowledge: Numerical controlled machine, Shift measurement system, Comparison set and interpolation set, Controlling transmission, dynamic of robot, robot.
12	CAD/CAM-CNC technology	2	Requisite: CNC technology. The subject provides students with the following knowledge: Concept of CAD/CAM-CNC technology, Technology and tool to automatically programme for CNC lathing machine, CNC milling machine, concept of post-processing.
	Elective subject	*2*	*2/4 credits*
1	Mold manufacturing technology	2	Requisite: Mechanical Manufacturing technology and fixture, CAD/CAM-CNC technology. The subject provides students with basic knowledge about:Overview of mold, Design mould with some software to design mould, Methods for treating defects in a product.
2	Automatic controlling	2	Requisite: Electric-Electronic technique. The subject provides students with the following knowledge: Overview of automatic controlling, Mathematical basis of the theory of automatic controlling, Dynamic description of automatic controlling system, Study on automatic controlling system, Numerical controlling system.
	Internship - Practice	***18***	
	Compulsory subjects	*16*	
1	Handwork cutting practice	1	The subject provides students with knowledge and basic skills in Mechanical Manufacturing technology with some hand tools and simple machining devices: marking, testing, basic filing, filing parallel plane, perpendicular plane basing on size, drilling, metal sawing, threading with tapping and screw plate.

No.	Subject	Credits	Content of subject
2	Basic lathing practice	4	Requisite: Mechanical Manufacturing technology and fixture. The subject provides students with the following knowledge: How to operate lathing machine and use technological equipment of lathing machine, Method to lathe smooth outer cylinder surface and inner cylinder surface, Method to lathe head surface, Method to cut groove, Method to machine cone surface (outer, inner). Method to machine long axis L/D > 8, Method to lathe lace, Method of shaping lathing, Method for offset lathing.
3	Advanced lathing practice	3	Requisite: basic lathing practice The subject provides students with the following knowledge: Method to lathe multiple thread and transmission thread, Method to lathe complicated part.
4	Basic milling-planing practice	3	Requisite: Basic lathing practice. The subject provides students with the following knowledge: How to operate milling-planing machine, method to machine horizontal plan, vertical plane and inclined plane, method to machine groove.
5	Advanced milling-planing practice	2	Requisite: Basic milling-planing practice. The subject provides students with the following knowledge: method to makemachine twisted groove on milling machine, method to make machine jaw clutch, method for machine gear, method to machine gear bar.
6	CNC practice	3	Requisite: CNC technology, Basic lathing practice, Basic milling-planing practice. The subject provides students with the following knowledge: skill in programming how to machine on CNC milling machine, Programming how to machine details on CNC lathing machine, Programming how to machine details for machining CNC center, How to operate CNC machine.
	Elective subjects	*2*	*2/4 credits*
1	Internship	2	Requisite: CNC practice The subject helps students to be familiar with the production in mechanical field. Students have a

No.	Subject	Credits	Content of subject
			chance to visit mechanical factories, understand the organization of those factories, and attend in one phase of factories. The subject provides students with the following knowledge: Production method of a mechanical workshop, production plan, organization of factories, industrial safety and hygiene, Working style that is suitable to industrialization and modernization process.
2	Grinding practice	2	Requisite: Basic lathing practice. The subject provides students with the following knowledge: How to operate grinding machine and use technological equipment of grinding machine, Method to grind outer cylinder surface and inner cylinder surface.
	Graduation paper	***10***	Requisite: Seniors are not disciplined by suspension or prosecuted for criminal liability. - Students are eligible for graduation paper under regulations. They are allowed to take graduation by the Faculty and University. - Graduation paper is an applied research to solve a technical problem relating to students' major. The topics are selected by students or suggested by supervisors. - Students are assigned their topics, make research plan and conduct their research under the guidance of their supervisors. - After finishing the graduation paper, students are agreed by their supervisors and reviewers to be eligible to defend their graduation paper in front of the judgment board of the university.
	Elective subjects to replace graduation paper		*10/16 credits*
1	Hydraulic technique	2	The subject provides basic knowledge of hydraulic technique and its applications including: - Basic concepts of hydraulic technique; - Fluid statics; - Kinetic basis and fluid dynamics; - Hydraulic controlling machine and equipment.
2	Friction and wear	2	The subject provides students with the following

No.	Subject	Credits	Content of subject
			knowledge: 1. Friction - Surface property and defining method - Contact of surfaces - Theories of sliding friction - Sliding friction of some engineering materials 2. Corrosion - Concept of corrosion - Classification of corrosion - Material corrosion - Factors affecting corrosion - Corrosion limitation
3	Lifting machine	2	The subject introduces to students the following knowledge: - The characteristics and classification of the crane - The details and lifting equipment including lifting structure, load carrying components, cables and winding components, brake and lifting equipment - The common crane such as jack, winch, bridge crane and spinning crane - The continual lifting machine such as machine with dragging components and machine without dragging components
4	Finite element method	2	The subject provides students with the following knowledge: Introduction of some modeling techniques to exploit and calculate some static and dynamic problems for bar set, 2D elasticity, axisymmetry, beam and frame, heat-conducting problem, composite structure
5	Experimental method and data processing	2	The subject provides students with the following knowledge: The rule of distributing the processing accuracy and the method to assess the processing accuracy.
6	Reversed design technology	2	Requisite: CAD/CAM-CNC technology. The subject provides students with the following knowledge: The concept of reversed design technology, the procedure of reversed design technology and basic order, post-designing testing function, Exporting data to other softwares to use for next steps.

No.	Subject	Credits	Content of subject
7	Optimizing process of cutting technology	2	Requisite: Metal cutting principle. The subject provides students with the following knowledge: The concept of optimizing process of cutting technology, optimal methods, Optimizing process of cutting technology, positive controlling of cutting process.
8	CAD/CAM-CNC technology practice	2	Requisite: CNC practice. The subject provides students with the following knowledge: The skill in automatically programming to machine details on CNC milling machine, CNC lathing machine, CNC machining center.
9	Industrial maintenance	2	Requisite: General metal cutting machine. The subject provides students with the following knowledge: Basic knowledge about machine-tool maintenance such as: assembling and disassembling, replacing main shaft, main shaft bearing, saddle, tail-stock, bed…
10	CIM system	2	Requisite: Manufacture engineering and fixture. The subject provides students with the following knowledge: The concept of CIM system, Basic elements of CIM system, programming to control CIM system.
11	Geometric modelling	2	Requisite: Computer Aided Designing and Drawing, General metal cutting machine. The subject provides students with the following knowledge: The concept of geometric modeling, using informatic tools to model mechanical system, study on kinetics and dynamics for a system.
	Total	**78**	

1.7.3 Pedagogical knowledge

No.	Subject	Credits	Contents of subject
	Compulsory subjects	**13**	
1	Professional education	2	The subject including 2 credits is divided into 3 chapters: CHAPTER 1: AN OVERVIEW OF PROFESSIONAL EDUCATION Chapter 2: Education theory Chapter 3: Teaching theory

2	Teaching management	2	The subject including 2 credits is divided into 3 chapters: Chapter 1: General issues in teaching management Chapter 2: Teaching organization Chapter 3: Teaching management
3	Specialized teaching methodology	2	The subject including 2 credits is divided into 2 chapters: Chapter 1: An overview of specialized teaching methodology Chapter 2: Approach to specialized teaching
4	Teaching skills	3	The subject provides students with the following knowledge: Chapter 1: An overview of teaching skills Chapter 2: Lecture preparing skill Chapter 3: Lecture making skill Chapter 4: Testing and assessing skill
5	Practicum	4	The subject is divided into 3 chapters: Chapter 1: General issues about practicum Chapter 2: Forms and models used in practicum Chapter 3: Practicum exercises
	Elective subjects	**4**	
1	Research methodology	2	Research methodology belongs to the field of pedagogy. Within 2 credits, the subject is divided into 3 chapters with the aim to establish in students the basic knowledge of educationally scientific research methods: general theory of research methodology and educationally scientific research methods, stages for educationally scientific research, the assessment and practice of educationally scientific research.
2	Development of vocational teaching curriculum	2	This subject provides students with the following knowledge: Chapter 1: An overview of vocational teaching curriculum Chapter 2: Development of vocational teaching curriculum
3	Measurement and assessment in teaching	2	Measurement and assessment in teaching is a subject providing students with basic knowledge about the role, function of assessment in teaching, training students the skill to identify the aim of a

			subject and a lesson to build an assessing process objectively, logically and fairly. This subject equips students methods to design questions and all types of tests.
4	Pedagogical communication	2	The subject includes the following knowledge: 1. General issues of pedagogical communication: concept, role and features of pedagogical communication, principles of pedagogical communication, forms of pedagogical communication. 2. Structure and psychology mechanism of communication: psychology basis of pedagogical communication, structure and psychology mechanism of pedagogical communication, requirements and conditions to ensure the success of pedagogical communication. 3. Communication skill of a teacher: psychology structure of pedagogical communication ability, pedagogical communication skill of a teacher, practicing pedagogical communication.
5	Teaching technology	2	The subject includes 2 chapters: Chapter 1: General issues of teaching technology Chapter 2: Using teaching techniques from the point of teaching technology
	Total	**17**	

1.8 Facilities for vocational teacher training in Mechanical Engineering

To implement the curriculum, it is necessary for our university to be very aware of the need for facilities. At NUTE, we not only take facilities for professional knowledge but also facilities for general knowledge into consideration. ***For general knowledge*** we have the following equipment:

- Physics laboratory: 1 lab
  - Equipment: physics pendulum (2 items), moment of inertia (2 items) measuring equipment of liquid viscosity coefficient (2 items); measuring equipment of gas molecule thermal capacity (2 items); measuring equipment of solid specific mass (2 items) ...
  - Each class is divided into 2 shifts to practice – approximately 25 students.
- Chemical laboratory: 1 lab
  - Equipment:

    Glass tools: flasks, cups, pots, tubes...

Metal tools: grids, iron tripods, knives, scissors, aluminum trays

Ceramic tools: mortars, pestles, bowls with grip ...

Other tools: scale, ovens, refrigerators...

Chemicals: over 50 types

- Foreign language laboratory: 1 lab
  - Equipment: 1 server; 30 cabins; 2 cassettes.
  - Each class is divided into 2 shifts to practice - approximately 25 students/shift to practice listening skill, pronunciation and speaking with right speed.

For professional knowledge, we invest on the following laboratories:

- CNC laboratory: For CNC practice.

There is 1 CNC milling machine and 1 CNC lathing machine, 8 computers with software to control milling and lathing machine, 01 Projector.

- AutoCAD laboratory: for computer aided design.

There is 01 Projector, 40 LAN computers and AutoCAD software 14, 2000, 2004, Inventer...

- Handwork cutting practice workshop (2 workshops):

For handwork cutting practice. There are 2 drilling machines, 25 vices and tools: hammers, files, screw-cutters, thread... in each workshop.

- Lathing practice workshop No. 1:

There are 7 multi-functional screw lathing machines, 1 cutting tool grinding machine.

- Lathing practice workshop No. 2:

There are 7 multi-functional screw lathing machines, 1 cutting tool grinding machine, 1 sawing machine.

- Lathing practice workshop No. 3:

There are 7 multi-functional screw lathing machines, 1 cutting tool grinding machine.

- Milling-planing practice workshop:

For basic and advanced milling-planing practice.

There are 5 multi-functional milling machines, 1 cutting tool grinding machine, 2 planing machines, 1 surface grinding machine, 1 inner and outer grinding machine.

2 Introduction to the curriculum of vocational teacher training in Electrical Engineering

2.1 Training objectives

General objectives:

Training at university level in the field of Electrical Engineering Teacher Education satisfies the demand of university education to train TVET teachers to serve the process of industrialization and modernization.

Graduate students must have good political ideology, ethics and health; have teaching and research capability; and have professional knowledge and professional skills corresponding to training level.

Graduate students can continue with post graduate studies in Electrical Engineering or Education Management.

Detailed objectives:

Graduate students must meet the following requirements:

- *Ethics:*
  - Be patriotic, love socialism, be a good citizen, obey the policies of the Party, and the laws.
  - Love teaching job; respect and treat students equally; be respected by students.
  - Be responsible for work, honest, cooperative and curious to learn from colleagues, get on well with the public.
  - Be active to improve political and professional knowledge, and physical health.
- *Knowledge:*
  - Have wide general knowledge; have basic knowledge about Marxism, Hochiminh Ideology; understand policies to develop social economics, education and culture of the country;
  - Master professional knowledge of electrical engineering theory, electrical engineering technology, electric equipment, electrical materials and new technology;
  - Have basic knowledge of psychology, education, teaching methodology and assessment in the field of vocational training.
- *Skills:*
  - Have proficient practicing skills in electrical engineering, electronic engineering, electrical measurement, electricity supply, electrical facilitating, micro-processing and programming-controlling techniques.
  - Proficiently implement pedagogical skills.

After graduating, students can work as TVET teachers in Electrical Engineering at vocational training schools and vocational training colleges; teachers teaching theory and practice at university training electrical engineering; as engineers or researchers at manufacturing, repairing, business and research institutions relating to electrical engineering.

2.2 Training duration (standard duration)

At NUTE, it takes students 4 years and a half to finish the programme training to become a vocational teacher in Electrical Engineering. Upon graduation, students will be awarded an Engineer in Electrical Technology and Certificate of Technical Education, so that they can become vocational teachers.

2.3 The amount of knowledge for the whole course

During the course, students are required to accumulate 146 credits including general knowledge, professional knowledge and pedagogical knowledge. These specific kinds of knowledge will be described in details in the curriculum.

2.4 Enrollee

This programme enrolls students graduating from upper secondary schools or institutions equivalent to upper secondary schools.

2.5 Process of training and graduation condition

When registering for any courses, students have to submit academic transcript, upper secondary school diploma, birth certificate, approval documents and a register form to study basing on credit system. After the school has recognized students as official students of the school, students are issued with a student card, academic register booklet and an academic consultant.

At the beginning of each academic year, the school informs students the schedule of each semester, the list of compulsory and optional subjects, the syllabus, prerequisites for registering for each subject and test schedule for each subject.

At the beginning of each semester, each student has to register the subjects he/she intends to study in that semester.

The assessment of students will be stated in the following part.

Students can graduate as long as:

a. They have not been prosecuted for criminal liability and have not been suspended from the school;

b. They have accumulated enough credits (146 credits);

c. Their grade point average (GPA) is at least 2,00;

d. They meet some specific requirements of their majors regulated by the Rector;

e. They have the certificate of national defence education and physical education.

2.6 Assessment

The assessment is classified into 5 levels as follows:

No	Ranking	Numeral score	Letter score	Notes
1	Distinction	From 8.5 to 10	A	
2	Credit	From 7.0 to 8.4	B	
3	Strong pass	From 5.5 to 6.9	C	
4	Pass	From 4.0 to 5.4	D	
5	Fail	Below 4.0	F	

2.7 The curriculum

- General knowledge: 51 credits
- Pedagogical knowledge: 17 credits
- Professional knowledge: 78 credits

Among which:

- Basic knowledge: 30 credits
- Specialized knowledge: 20 credits
- Internship: 18 credits
- Graduation paper: 10 credits

2.7.1 General knowledge ***51 credits***

No.	Subject	Credits	Content of subject
	Compulsory subjects	**44**	
1	Basic principles of Marxism-Leninism	5	The subject merits 5 credits. It establishes the most basic theoretical background of Hochiminh Ideology and the revolutionary ways of the Communist Party of Vietnam and helps students understands the ideological foundation of Communist Party. It builds the revolutional belief for students. It establishes the overview and methodology for students to approach their specific major.
2	Hochiminh Ideology	2	Requisite: Basic principles of Marxism-Leninism The subject is of 2 credits and provides students with Hochiminh's philosophy, ethics and cultural values and some basic knowledge of Marxism – Leninism in order to build the ethical foundation.
3	Revolution ways of the Communist Party of Vietnam	3	Requisite: Basic principles of Marxism-Leninism, Hochiminh Ideology. Aside from the introduction chapter, this subject includes 8 chapters presenting

No.	Subject	Credits	Content of subject
			systematically revolution ways of Vietnamese Communist Party, especially in modern era.
4	Introduction to Informatics	3	This subject provides students with some basic concepts of informatics; solve a problem using a computer; Windows operating system; Programming language C; basic data types; and structures to create sub-programmes
5	English	5	This subject provides students with basic knowledge about grammar and vocabulary which are necessary in communication
6	English for Mechanical Engineering	2	This subject includes activities for developing reading skills, accumulating vocabulary related to Electrical Engineering, exercises for practicing and developing speaking and writing skills on Mechanical Engineering in English.
7	General physics 1	2	This subject mentions mechanisms and thermodynamics. *a. Mechanisms:* This part provides students with basic knowledge about classical mechanisms and the foundation of relative mechanisms. Its content includes some concepts of motion, the cause of motion, Newtonian law, the law of attraction, law of conservation in the motion of a subject, subject system, solid, and a brief introduction to relative dynamics. *b. Thermodynamics:* This part provides students with knowledge about molecular movements and some principles of thermodynamics.
8	General physics 2	3	This subject mentions electricity, and optics. *a. Electricity:* This part provides students with some basic knowledge about electricity and magnetism study. The main contents include: concepts, laws, theorems and phenomena. *b. Optics:* Provides students with knowledge about geometrical optics, wave optics and quantum optics.
9	General chemistry	2	This subject provides students with knowledge about atomic structure; circulation system; chemical bonding and molecule structure; the application of thermodynamics to chemistry;

No.	Subject	Credits	Content of subject
			solution; electrolyte solution; electrochemistry; dynamic chemistry; colloid surface phenomenon; chemical substances.
10	Advanced mathematics 1	2	This subject provides students with the following knowledge: concept of function; sequence and continuity of function; limit of sequence and function; how to calculate differential and integral of function with one variable; concept of sequence string and function string; the investigation of the convergence of sequence string; finding the domain of function string.
11	Advanced mathematics 2	2	This subject provides students with the following knowledge: concept of matrix; inversed matrix and determinant; operations on matrix; methods to calculate inversed matrix and determinant; concept of set of linear equations; methods to solve the set of linear equations; concept of complex number and operations on complex number; vector space, Euclidean space – linear mapping; diagonalized matrix, specific vector, specific value; quadratic form, canonical form and change quadratic form into canonical form.
12	Advanced mathematics 3	2	Requisite: Advanced mathematics 1. This subject provides students with the following knowledge: the basic concept of multi-variable functions; how to calculate derivative and differential of a multi-variable function; the maximum value of a multi-variable function; the basic concept of differential equation; how to solve differential equations level 1 and level 2; the concept of path integral level 1 and level 2; how to calculate path integral; the concept of double integral and triple integral.
13	Special subject mathematics 1	2	This subject provides students with the following knowledge: combinatorial analytic; event and the possibility of an event; probability formulae: adding formula, multiplying formula, conditioned probability formula, full probability formula and Bayets formula; random event and probability distribution law of random variables;

No.	Subject	Credits	Content of subject
			characteristics of random variables; common probability distribution: binomial distribution, Poisson distribution; sample theory; estimation theory; Statistical Hypothesis Testing; Correlation and regression.
14	General laws	2	This subject includes 11 chapters with basic contents of general theory of government, laws, laws branches in Vietnamese laws system
15	National defence	4	The subject is of 5 credits. It provides students with some basic tenets of national defence and Vietnamese military art. The subject helps students to practice some necessary military skills and disciplinary lifestyle to contribute to comprehensive education.
16	Physical education	3	The subject provides students with knowledge about long jump, shot-put and athletics. It focuses on the history, the principles and major techniques in these sports.
	Elective subjects	**7**	
1	Special subject mathematics 2	2	Requisite subject: Advanced maths 2 This subject provides students with the following knowledge: examples leading to linear planning problem such as: production planning problem, fuel mixing problem, transportation problem; simplex method; duality problem.
2	Special subject mathematics 3	2	Requisite subject: Advanced maths 1, 2. This subject provides students with the following knowledge: complex number and complex sequence; complex variable function; orthopaedic function; integral theory; Laplace transformation.
3	Formal logic	2	This subject provides students with the following knowledge: - What is formal logic? Its aim, subject and mission? The relationship between formal logic and dialectical logic. - Some forms of thinking such as concept, judgment and inference. - Hypothesis, proof and disproof, some basic laws of formal logic.
4	Professional psychology	2	Provides students with basic knowledge of general

No.	Subject	Credits	Content of subject
			psychology, pedagogical psychology, professional psychology; support students to develop the skill to analyze psychological factors of teaching theory and practice and to find out psychological factors of professional ethic education and right attitude towards issues of vocational teacher training. It includes 3 chapters: Chapter 1: General psychology Chapter 2: Pedagogical psychology Chapter 3: Professional psychology
5	Introduction to economics	2	This subject provides students with the following knowledge : introduction of economics; supply, demand and price; choices of consumers; theory of production and production costs; Enterprises' behaviors in all types of markets; general macro-economics; total supply and demand and balanced output; currency and banking; unemployment and inflation; international commerce.
6	Introduction to sociology	2	This subject provides students with the system of concepts, basic and modern knowledge of sociology such as subjects, functions, research methods, the formation and development of sociology, the formation of the general knowledge of basic fields of sociology such as social human, social structure and the general knowledge about specialized society such as family sociology, urban and rural sociology, ethical sociology, scientific-technological society.
7	Physical education 3	1	This subject helps students practice volleyball. Students are provided with the history of volleyball, the principles of volleyball and techniques to play volleyball.
8	Physical education 4	1	Requisite: Physical education 1,2 This subject helps students practice football. Students are provided with the rules of football, techniques and strategies to play volleyball.
	Total	**51**	

2.7.2 Professional knowledge

No.	Subject	Credits	Notes
	Basic knowledge	**30**	
	Compulsory subjects	*26*	
1	Electrical circuit 1	2	Requisite subjects: Advanced mathematics, general physics This subject provides students with the following knowledge: basic concepts about electrical circuit; methods to analyze electrical circuit; 3-phase circuit; 2-door network.
2	Electrical circuit 2	2	Requisite subject: Electrical circuit 1. Brief description of this subject: circuit analysis in a time domain; circuit analysis in a frequency domain; nonlinear circuit.
3	Basic electronic 1	2	Requisite: Electrical circuit 1. Brief description of this subject: some basic electronic components such as diode; bipolar transistor; CMOS transistor; Thyristor and multilayer components, feed, rectifier; bias circuit for transistor; other special electronic components.
4	Basic electronic 2	2	Requisite: Basic electronic 1. Brief description of this subject: cascade amplification circuit; negative feedback; high-frequency amplification; resonant amplification; positive feedback circuit; sinusoidal signal generator and non- sinusoidal signal generator; operational amplifying circuit and application; electronic power supply.
5	Electrical measurement and measuring equipment	2	Requisite: Advanced Mathematics, General Physics. Content: The concept of measuring basis, unit system and standard system; the measurement of R, L, C and M; the measurement of power and power factor; The clock indicator AC / DC, sphere AC / DC converters, recording devices, oscilloscopes, measuring techniques.
6	Digital techniques	2	Requisite: Basic electronic 1. Content: Original concepts of Boolean algebra, logic gates; Digital IC and the performance of

No.	Subject	Credits	Notes
			logic gates; combinatory circuit; sequential circuit; ADC and DAC converter; semiconductor memory.
7	Micro-processing	2	Requisite: Digital techniques. The subject provides students with the following knowledge: Block diagram of microprocessing system and functional of each block; operational cycle of the processing system, the architecture of Intel 8086 processor; 8086 script and writing programme using assembly language for 8086; 8051 microcontroller architecture and programming for 8051.
8	Data transmission techniques	2	Requisite: Digital techniques, Micro-processing. The subject provides students with the following knowledge: An overview of data transmission; data transmission techniques, transmission environment; The formal and practical protocol; network and data communication protocols.
9	Sensor measurement	2	Requisite: Electrical measurement, electrical-electronic materials, micro-processing. The subject provides students with the following knowledge: basic concept of sensor; temperature sensor; optical sensor; positional and shift sensor; velocity acceleration and vibration measurement; Measurement of distortion, force and weight; measurement of flow, fluid velocity and level; other sensoring measurements; combining processing devices.
10	Automatic controlling system	2	Requisite: Digital techniques. Content: Basic theory of automatic control; transfer function and block diagram transformation; analysis and survey on stability of linear systems, nonlinear and discontinuous; quality assessment of a system; using MATLAB software to design and analyze a system.
11	Electric machine 1	2	Requisite: Electrical-Electronic materials, electrical instrument, electrical circuit 1,2. Content: Transformer: structure, operational principles, the quantity of norm, the wiring circuit from the transformer, electromagnetic relation

No.	Subject	Credits	Notes
			and the characteristics of work load in symmetric and asymmetric mode; some special types of transformers; the knowledge about AC electric machine, asynchronous electric machine...
12	Electric machine 2	2	Requisite: Electrical-Electronic materials, electrical instrument, electrical measurement and measuring equipment, electric machine 1. This subject provides students with the following knowledge: synchronous electric machines: structure, operational principles, the quantity of norms, the working characteristics, turning on and synchronizing the machine. Some special synchronous machines, DC machine: structure, classification, operational principles, the quantity of norms, winding, distribution and power transmission, the characteristics of turning on the machine and adjusting the speed...; some kinds of special DC machine.
13	Electricity transmission	2	Requisite: Electric machine 1, 2. Content: basic concepts of electricity transmission; characteristics of DC motor, asynchronous motor, synchronous motor; The method to adjust the speed of electric motors; Choose the electric engine power.
	Elective subjects	*4*	
1	Electrical safety	2	Requisite: advanced mathematics, general physics. Content: Basic concept of electrical safety; methods to operate electric equipment and electrical network safely; measures to prevent electrical shock as well as cure for people involved in electrical accidents; industrial hygiene and safety standards.
2	Electrical-electronic materials	2	Requisite: Electrical circuit 1 Content: basic concept of electrical engineering materials; insulation materials and applications; conductive materials and applications; Semiconductor materials and applications; other materials.
3	Electrical instrument	2	Requisite: Electrical circuit 1.

No.	Subject	Credits	Notes
			Brief description of the subject: Introduction of electrical instruments operated by manual switching, auto switching, protective electrical instruments.
4	Electromagnetic field	2	Requisite: Special subject mathematics, electrical circuit 1. Content: The basic concepts and equations of the electromagnetic field; static electric field; stopping electromagnetic field stop; variable electromagnetic field; electromagnetic radiation; illustrative examples.
5	Electronic power	2	Requisite: Digital techniques This subject provides students with the following knowledge: rectifiers, inverters; DC and AC converters; basic knowledge of the inverter.
	Specialized knowledge	**20**	
	Compulsory subjects	*16*	
1	Course project 1	1	The course project requires students to apply what they have learned, synthesize specialized knowledge to complete the analysis, design calculation or testing a problem in the field of digital technology. Students must think independently, explore reference documents under the guidance of the supervisor. Student defences the course project at the end of the semester.
2	Course project 2	1	Requisite: electric machine 1, 2, electricity supply Brief description of the subject: assign research topics to students and guide students to implement the project according to schedule; Organize to assess the students' projects. The content of the project is to design the electricity supply system for a practical load: studying the equipment selection in the network of high-voltage and low-voltage power supply; short circuit themes, lighting, power compensation.
3	Electricity supply	2	Requisite: Electrical circuit 1, 2; Electrical instrument Content: Basic concepts of electricity network

No.	Subject	Credits	Notes
			and electricity supply; wiring diagrams of high-voltage, low-voltage network; electrical load calculation, equipment selection in high-voltage and low-voltage power supply network; short circuit themes, lighting, power compensation.
4	Electrical system	2	Requisite: Electrical supply The subject provides students with the following knowledge: An overview of the electrical system, power plants and substations; structural diagram of the transmission and distribution network; the calculation of the parameter of the electrical network; power distribution in the electrical network; the calculation of electricity losses in the electrical network; voltage regulation in the electrical network; the economic calculation of the technique to select the optimal measure.
5	Programming control	2	Requisite: micro-processing; Automatic controlling system. Content: An overview of controlling technique and programming controller; programming language of the Simatic S7 - 300; programming techniques and their applications.
6	Data collection and controlling system	2	Requisite: Data transmission technique; Programming control. Content: An overview of data collection system; similar data collection system; digital data collection system; some applications of the data collection system.
7	Power station and substation	2	Requisite: Electrical safety, Electrical machine 1, 2. Brief description of the subject: An overview of power station and substation; The forms of electrical energy and power station; The generator systems; The high-voltage and low-voltage substations.
8	Computer aided design (CAD)	2	Requisite: Electricity supply, electrical instrument, electrical measurement and measuring equipment. The subject provides students with the knowledge of the modeling of the element of controlling

No.	Subject	Credits	Notes
			systems on computer, using software to design and draw.
9	Automation of technological process	2	Requisite: Automatic controlling system. The subject provides students with the basic knowledge of the automation of the production process, the feeder automation method, transport automation in the factory, assembly automation...; an overview comprehension of the CAD/CAM/CNC, SCADA, DCS; industrial robot applications. Students have the ability to design, analyze and select the appropriate measures to automate the feeding and product transporting processes.
	Elective subjects	*4*	
1	Protection and automation of industry	2	Requisite: Electrical safety, electricity supply. This subject provides students with knowledge of protective equipment in the electricity system in industrial factories; generator protection, transformer protection, the electric motor; automation in factory: closing reserves automatically, compensating reactive power automatically.
2	Protection of relays and automation	2	Requisite: Electrical safety, electric supply. The subject provides students with the following knowledge: The general issue of protecting the electrical system: the calculation of failure or abnormal modes of the system; main protected elements in the system including generator, transformer, busbar, high-voltage electric motor, transmission and distribution line; automation in electrical system: automatic line reclosing, automatic load firing based on frequency; automatic voltage regulation...
3	Heating and cooling technique	2	Requisite: General physics. The subject provides students with basic knowledge of heating and cooling technique; domestic and industrial refrigeration; refrigeration line, heating supply line in industry.
4	Calculation of repairing electric machine winding	2	Requisite: Electrical machine 1, 2. Provides the necessary knowledge, technological

No.	Subject	Credits	Notes
			process for manufacturing electrical machines and the basic theory of the calculation of repairing rotary electric machines and transformers; then it is possible to calculate the wiring of electric machines when samples are lost; the introduction of the Matlab software used in the electrical machine design.
	Internship – Practice	**18**	
	Compulsory subjects	*18*	
1	Electrical measurement practice	1	Requisite: Electrical measurement and measuring equipment. Provides students with the following knowledge: Basic knowledge about measuring equipment through factual observation of machine structure; To check and calibrate before measuring; To measure electrical quantities such as: current, voltage, power, R-L-C measurement, frequency and phase angle measurement with various methods.
2	Basic electricity practice	1	The subject provides students with basic knowledge of the use of measuring instruments, assembling, repairing industrial and domestic lighting circuits; support students to operate and maintain single phase and three phase electric motors.
3	Basic electronic practice	2	Requisite: Basic electronic 1, 2. Provides practical and experimental exercises of linear circuits using diode, BJT, FET, amplifying circuit and broadcasting circuit. This subject requires students to know how to use electronic measuring equipment such as multi-functional measuring equipment, oscilloscope machine, ... Get the characteristics of semiconductor devices, design amplifying circuit; Design, build and test a single-stage transistor amplifying circuit; understand the principles to design an oscillating circuit, AM-FM modulation, filtering and feedback amplifying; Digital practice.
4	Micro-processing practice	2	Requisite: Micro-processing Content: Use software to programme and

No.	Subject	Credits	Notes
			simulate micro-processing; Load programme for micro-processing; assembly micro-processing interface circuit with peripherals; write programmes of micro-processing interface with peripheral.
5	Programming control practice	2	Requisite: Micro-processing Content: Use software to programme and simulate micro-processing; Load programme for micro-processing; assembly micro-processing interface circuit with peripherals; write programmes of micro-processing interface with peripheral.
6	Electronic power practice	1	Requisite: Electrical safety, Electrical measurement and measuring equipment, Electronic power. The subject provides students with the following practical knowledge: identification practice, static parameter measurement, refering to parameters and applications of electronic power components; selecting, assembling, adjusting or doing experiments on parameters, signal wave form of the circuits Thyristor and TriAc; assembling, adjusting or doing experiments to get parameters, signal wave form of single phase and three phase power rectifier circuit; identifying, selecting, adjusting, doing experiments to get parameters, signal wave form of power DC - DC inverter; adusting, doing experiments to get signal wave form of frequency variable according to voltage variation.
7	Electric machine practice	2	Requisite: Electric machine 1, 2. The subject supports students practical skills in electric machine and enhances the theory of this field; supports students in the practical wiring of small power transformers, single phase, three phase electric motor.
8	Electricity supply and network analysis practice	3	Requisite: Electricity supply. The subject provides students with knowledge of installing electrical network in industrial factories; installing protective circuits; basic

No.	Subject	Credits	Notes
			automation in factories; practicing the calculation, design, simulation of electricity supply system using softwares (Matlab, Ecodial, Docwin, Power world, PSS/E)
9	Electricity transmission practice	2	Requisite: Electricity transmission. Identifying basic stages of electricity transmission; practicing to adjust the motor speed by varying electric circuit, varying voltage and varying frequency; using soft boot...
10	Internship	2	Meeting work requirements at the internship site like a member of staff; obeying the regulations of the factory; practicing soft skills; collecting data to report the internship.
	Graduation paper	**10**	
	Optional subjects to replace graduation paper		
1	Programming language	2	The subject provides students with some knowledge of the method for subject controlling programming; using high-level software such as C; Visual C++ for process automation controlling.
2	Operating and controlling electricity system	2	Requisite: Electrical system. Content: An overview of regulations for operating and controlling electrical systems; studying some standards, operating regulations, controlling specific electrical system.
3	Industrial mechatronics system	2	Requisite: Programming control. The subject provides students with some general knowledge of the mechatronics systems, features and structure of mechatronics systems, theory of mechatronics system design; sensor technique, PLC controlling, pneumatic in mechatronics, mechatronics applications in industry.
4	Electricity manufacture engineering	2	Requisite: Electric machine 1, 2. The subject provides students with knowledge of the calculations to design and produce transformers, generators, electric motors...
5	Electricity controlling equipment	2	Requisite: Electric instrument, electrical measurement and measuring equipment, sensor measurement.

No.	Subject	Credits	Notes
			The subject provides students with basic knowledge of the operating principles and electricity controlling equipment design such as voltage, current, frequency switching regulator...
6	Industrial robot	2	Industrial robotics provids students with basic knowledge in robotics and some applications of robots in industrial production. The course content includes knowledge of the structural principle, dynamics, kinetics, operating principles and methods of programming to control a robot in real time. The subject also introduces hardware equipment, sensors and the introduction of the application of artificial intelligence onto robots, especially for mobile robots, controlling methods applied to industrial robots and the scope of their applications in industrial production.
7	Business administration	2	Brief description of the subject: Business and business administration; application of rules in business administration, principles and methods of business administration; information, decision and planning in business administration; organizing, controlling and testing in business administration; innovation of business administration
8	Project management	2	Requisite: General subjects Content: The subject equips students with basic knowledge for considering all stages of a project in terms of administration, economy, technology and finance for managing a project efficiently. The aim of this subject is to provide students with basic knowledge and skills in project management such as analyzing and selecting projects, planning and scheduling projects, monitoring, controlling projects and approaches for solving problems arising in project management. Aside from this the subject introduces related software for improving the quality of project management.
	Total	**78**	

2.7.3 Pedagogical knowledge

No.	Subject	Credits	Content of subject
	Compulsory subjects	**13**	
1	Professional education	2	The subject including 2 credits is divided into 3 chapters: CHAPTER 1: AN OVERVIEW OF PROFESSIONAL EDUCATION Chapter 2: Education theory Chapter 3: Teaching theory
2	Teaching management	2	The subject including 2 credits is divided into 3 chapters: Chapter 1: General issues in teaching management Chapter 2: Teaching organization Chapter 3: Teaching management
3	Specialized teaching methodology	2	The subject including 2 credits is divided into 2 chapters: Chapter 1: An overview of specialized teaching methodology Chapter 2: Approach to specialized teaching
4	Teaching skills	3	The subject provides students with the following knowledge: Chapter 1: An overview of teaching skills Chapter 2: Lecture preparing skill Chapter 3: Lecture making skill Chapter 4: Testing and assessing skill
5	Practicum	4	The subject is divided into 3 chapters: Chapter 1: General issues about practicum Chapter 2: Forms and models used in practicum Chapter 3: Practicum exercises
	Elective subjects	**4**	
1	Research methodology	2	Research methodology belongs to the field of pedagogy. Garnering 2 credits, the subject is divided into 3 chapters aimed at giving students basic knowledge of educationally scientific research methods: general theory of research methodology and educationally scientific research methods, stages for educationally scientific research, the assessment and practice of educationally scientific research.

2	Development of vocational teaching curriculum	2	This subject provides students with the following knowledge: Chapter 1: An overview of the vocational teaching curriculum Chapter 2: Development of vocational teaching curriculum
3	Measurement and assessment in teaching	2	Measurement and assessment in teaching provides students with basic knowledge of the role and function of assessment in teaching, training students in the ability to identify the aim of a subject and a lesson to build an assessing process objectively, logically and fairly. This subject equips students methods for designing questions and all types of tests.
4	Pedagogical communication	2	The subject includes the following knowledge: 1. General issues of pedagogical communication: concept, role and features of pedagogical communication, principles of pedagogical communication, forms of pedagogical communication. 2. Structure and psychology mechanism of communication: psychology basis of pedagogical communication, structure and psychology mechanism of pedagogical communication, requirements and conditions to ensure the success of pedagogical communication. 3. Communication skill of a teacher: psychology structure of pedagogical communication ability, pedagogical communication skill of a teacher, practicing pedagogical communication.
5	Teaching technology	2	The subject includes 2 chapters: Chapter 1: General issues of teaching technology Chapter 2: Using teaching techniques from the point of teaching technology
	Total	**17**	

2.8 Facilities for vocational teacher training in Electrical Engineering

Facilities play an important role in implementing the curriculum. Understanding the importance of facilities in the quality of training, NUTE is constantly aware of the importance of facilities not only

for professional knowledge but also for general knowledge. ***For general knowledge,*** we have the following laboratories:

- Physics laboratory: 1 lab
  - Equipment: physics pendulum (20 items), moment of inertia (2 items) measuring equipment of liquid viscosity coefficient (2 items); measuring equipment of gas molecule thermal capacity (2 items); measuring equipment of solid specific mass (2 items)...
  - Each class is divided into 2 shifts to practice – approximately 25 students.
- Chemical laboratory: 1 lab

  Equipment:
  - Glass tools: flasks, cups, pots, tubes...
  - Metal tools: grids, iron tripods, knives, scissors, aluminum trays
  - Ceramic tools: mortars, pestles, bowls with grip ...
  - Other tools: scale, ovens, refrigerators...
  - Chemicals: over 50 types
- Foreign language laboratory: 1 lab
  - Equipment: 1 server; 30 cabins; 2 cassettes.
  - Each class is divided into 2 shifts to practice – approximately 25 students/shift to practice listening skill, pronunciation, and speaking with right speed.
  - For professional knowledge, the following laboratories are invested in:
- Electric circuit laboratory
  - There are 10 experimental modules connected with PC, LAN, 1 Projector
- Electrical measurement – Sensor measurement laboratory
  - There are 10 experimental modules connected with PC, LAN, 1 Projector
- Electric machine laboratory
  - There are 4 multi-functional experimental desks including: multi-functional measuring module; experimental boards; electric motors.
- Electric transmission laboratory
  - There are 4 electric transmission experimental desks including: experimental boards; 1 three-phase inverter; 2 PLC S7-2 sets; 1 electronic power experimental desk controlling 3-phase motor; 3-phase AC and DC motor; 2 PCs to connect with controlling equipment.
- Electric machine workshop: 2 workshops
  - Serve the subject of Electric machine: 3 weeks
  - Include: 14 electric machine experimental desks; electric machines of all types; measuring-testing equipment
- Electrical equipment workshop: 3 workshops
  - Include: 10 electrical equipment practice desks; equipment board, electric instrument; measuring-testing equipment; electric motors of all types.
- Electricity supply workshop: 2 workshops
  - Include: 1 electricity supply practice mocks; equipment boards; measuring-testing equipment; switching system of all kinds.

- Electronic equipment workshop: 2 workshops
  - Include: 10 electronic equipment practice mocks; equipment board; measuring-testing equipment; switching system of all kinds, signal receiving and sending equipment...
- Telecommunication electronics workshop: 2 workshops
  - Include: 10 telecommunication electronics practice mocks; equipment board; measuring-testing equipment; switching system of all kinds, signal receiving and sending equipment...
- Basic electrical workshop: 2 workshops
  - Include: 10 basic electrical practice mocks; equipment board; measuring-testing equipment; switching system of all kinds, signal receiving and sending equipment...
- Basic electronic workshop: 2 workshops
  - Include: 1 basic electronic practice mocks; equipment board; measuring-testing equipment; switching system of all kinds, signal receiving and sending equipment...
- Digital electronic workshop: 2 workshops
  - Include: 1 digital electronic practice mocks; equipment board; measuring-testing equipment; switching system of all kinds, signal receiving and sending equipment...
- Micro-processing and circuit design on computers: 2 workshops
  - Include: 20 PCs to practice micro-processing and circuit design on computers, boards connected to PCs, micro-processing and micro-controlling feeders, test boards, signal receiving and sending machines...
- PLC workshop: 2 workshops
  - Include: 20 computers to practice PLC, boards connected to PCs, loads and masks.

Annex 3: The curricula for VET Mechanical Engineering and Electrical Engineering at National University of Laos

1 Introduction to the curricula of vocational teacher training in Mechanical engineering

The professional subjects are offered by the Mechanical Engineering Department, and the pedagogical subjects are provided by Vocational Teacher Education Department.

Name of Diploma: Bachelor of Vocational Education majoring in *Mechanical Engineering*

1.1 Philosophy

The Bachelor Degree Programme of Vocational Teacher Training is under human resource development system and it has an important role to teaching-learning process in vocational institute to meet and correspond to the need of the social-economy of the country and society.

1.2 Objectives

1. Train students to have knowledge in vocational teacher in engineering field,
2. Train students to have knowledge in didactic and methodology,
3. Train students to have capacity in setting problems and discovering information in research science.

The main objective of the MED NUOL's curriculum is to produce undergraduates with basic knowledge, and essential professional attitude and skills in mechanical engineering, so that they can perform equally well in any mechanical engineering related field. In addition, the curriculum is designed to provide students with sufficient background that will enable them to adapt tp the rapidly changing technologies and increasingly complex multi-national markets. The Mechanical Engineering Study Programme comprises of four technical sections or streams, i.e., Mechanics and design, Energy, Industrial & Manufacturing and Material in order to:

- Train experts to have ethical..., responsibilities to society and know how to preserve national cultures and customs,
- Train students to have responsibilities on their duties, keenness to teach, good characteristics, good relationship, ethics and love of country,
- Train engineers to have knowledge, ability in carrying out their duties developing the country with the acceptance of the society.

1.3 Expectation ability after graduation

1. Being vocational teachers that may teach both theory and practice in the engineering field,
2. Being engineers that can analyze and solve problems in engineering fields,
3. To be administrators in various public and private sectors,
4. Be able to pursuit higher education in their respect fields.

1.4. Training duration, process of training and graduation condition and assessment

The Department offers four-year undergraduate bachelor degrees consisting of 148 credits. The first two years of the ME programme are made up of basic sciences and engineering classes with two additional introductory mechanical engineering classes. Core subjects are concentrated in the final year two years. In the student's senior year, research projects worth 4 credits are required for the ME programme. Students are also required to carry out practical training for a minimum of four weeks.

1.5 The curriculum

- General knowledge: 20 credits
- Pedagogical knowledge: 32 credits
- Professional knowledge: 93 credits

  Among which:

  - Basic knowledge: 42 credits
  - Specialized knowledge: 51 credits
    - Optional Energy 21 credits
    - Optional Applied Mechanic 20 credits
    - Optional Material and Production 18 credits
- Graduation paper 4 credits

1.5.1 General knowledge

No.	Subject	Credits	Content of subject
	Compulsory subjects		
1	Lao Study I	2	Description of Lao society and Economic situation in Lao PDR, Lao History, Evolution and change of Lao Demography. Politics System of Lao PDR, their Policies: State Administration, Social-Economic Development, National Defense and Foreign Affairs Policies

No.	Subject	Credits	Content of subject
2	Philosophy	2	Study philosophy as the role of mother of various academic sciences. Try to think arguments in pure philosophy: Metaphysics, Epistemology, Axiology (Ethics and Aesthetics), Logic and ones in the applied philosophy in order to practice in creating a deep, wide-perspective, and systematic thinking. Basic principles of Marxism-Leninism, It provides students with philosophy, ethics and cultural values and some basic knowledge of Marxism – Leninism in order to build the ethical foundation.
3	Lao Study II	2	Basic contents of the general theory of government, constitution, background of law, Lao law system, law on civil procedure.
4	Mathematic I	3	Matrix Calculation, Linear System of Equations, Linear spaces, Bilinear Forms, Linear Programming
5	Mathematic II	3	Series, Function of Several variables, Multiple Integrals, and Vector Calculus
6	General English I	2	**Areas**: Introduction to technical report writing format, practice of specific reading skills. Written proof of the understanding of lectures.
7	General English II	2	**Areas**: Application of report writing on practical work. Introduction to summarizing and paraphrasing from written texts.
8	General Psychology	2	General psychology is an introduction to the field of psychology and the major perspectives including the biological basis of behavior, sensation, perception, learning, memory, motivation, emotion, personality, stress, as well as abnormal, developmental and social psychology.
9	National defense	1	It provides students with some basic issues of national defense and Lao military art. The subject helps students to practice some necessary military skills and disciplinary lifestyle to contribute to comprehensive education.
10	Workshop Training I	1	**Building workshop**: introduction to building technology; leveling and setting out of buildings; foundation design etc. Electrical workshop: domestic and industrial machine installations; use of tools and instruments; electric circuits; fault finding; safety regulations. Machine and bench shop: use of measuring instruments; sheet metal work; introduction to turning, shaping and milling machines; safety precautions and maintenance of machines.

No.	Subject	Credits	Content of subject
	Optional subjects		***None***
	Total	**20**	

1.5.2 Professional knowledge

No.	Subject	Credits	Content of subject
	Compulsory subjects		
	Basic Professional Subjects	**42**	
1	Physic I	2	Electrostatics; Coulomb's law and electric field; electric flux and Gauss' law; electric potential; capacitance; electric current and resistance; EMF and circuits; magnetic fields; Ampere's law; electromagnetic induction and Faraday's law; inductance; vibration and waves; photometry; reflection and refraction; interference; diffraction; polarization; optical instruments.
2	Physic II	2	**Topics:** Special theory of relativity; the experimental basis of relativity; alternate theories; Lorentz transformations; consequences for the measurement of length, time, energy and mass; quantum effects; constituents and structure of the atom; wave particle duality; black body radiation; photo-electric effect; pair production; bremsstrahlung; Compton effect; production, scattering and absorption of X-rays; de Broglie hypothesis, diffraction of particles; quantum mechanics; wave packets; uncertainty principle; Schrodinger Equation; correspondence principle; particle in a box; qualitative description of the wave functions of the hydrogen atom; discovery and properties of particles of nuclear physics, decay laws, binding energies of nucleons; nuclear reactions; fission and fusion; cosmic rays; origin of the elements; statistical distribution functions; particle in a period potential; energy bands; impurity states; physics of the p-n junction and transistor.
3	Introduction to Informatics	3	**Topics:** Computers and information processing; operating system; "hands on" practice on some application software such as word processing and spreadsheets
4	General Chemistry	3	**Topics:** Atomic theory, chemical bonding, structure; simple organic molecules and reactivity; thermodynamics and thermo Œ chemistry; gases, liquids and solutions;

No.	Subject	Credits	Content of subject
			atomic structure and its influence on the mechanical and electrical properties of engineering materials such as adhesives, cement, fuels, metals, polymers and semiconductors; electrochemistry and corrosion; kinetics and radiation chemistry; hardness of natural waters, problems and treatment
5	English Technic I	2	**Areas**: Revision of major structures and functions previously studied. Familiarity with several types of written text. Introduction to methods of presenting seminars.
6	English Technic II	2	This subject includes activities for developing reading skills, accumulating vocabulary related to Mechanical Engineering, exercises for practicing and developing speaking and writing skills about Mechanical Engineering in English.
7	Introduction to economy and accounting	3	This course includes the following topics: method of economics study, economic fundamental problem solving, consumer behaviour theory, terminology applications of flexibility of demand, theory, production and cost, cost setting under different market situations, demand and supply of production factors, estimation of national incomes, role of monetary and banking in the economic system, cause and problem of inflation, applications of monetary and financial policy for economic stabilization and international economic relations. This course also includes: recording and posting of the accounting in terms of money, accounting equation and business transaction analysis, principles of double entry bookkeeping, general journal, general ledger and trial balance, financial statements, closing and adjusting entries.
8	Engineering Mathematic I	3	**First order** differential equations, Second and higher order differential equations, Laplace transforms, Series solution of linear differential equations, Introduction to partial differential equations.
9	Engineering Mathematic II	3	**Introduction:** Numerical Computing and Computers; Solving Nonlinear Equations; Solving Sets of Equations; Interpolation and Curve fitting; Numerical Differentiation and Numerical Integration; Numerical Solutions of

No.	Subject	Credits	Content of subject
			Ordinary Differential Equations; Boundary-value Problems and Characteristic-Value Problems; Numerical of Partial Differential Equations.
10	Advance Statistics	2	Distribution function of several random variables, Normal distribution; Mathematical Statistics; Introduction to Information Theory.
11	Theory Mechanics I – Statics	3	Basic concepts. Scalars and vectors. Forces and their resolution. Centre of gravity and centroids. Couple and moment. Equilibrium of a rigid body. Systems of rigid bodies. Friction. Concepts of stress and strain. Hooke's law and Poisson's ratio. Mohr's circle of plain stress and strain. Pin-jointed trusses. Statics and displacements. Methods of joints and sections. Displacement diagram. Deflection of beams. Sheer force and bending moment diagrams.
12	Theory Mechanics II - Dynamics	3	Kinematics of particles and rigid bodies: rectilinear and curvilinear motion; absolute and relative motion concept; kinetics of particles, system of particles and rigid bodies: equations of motion, work, power, energy, impulse. Introduction to space kinetics of rigid bodies.
13	Engineering Drawing I	3	Introduction to drawing equipment, formats, types of line, lettering, simple representations(geometry drawing), scales, free sketching; dimensions; title block; principles of orthographic projection; civil, electrical and mechanical drawings.
14	Engineering Drawing II	3	Isometric and oblique representations; section view, sections of cones; reading of drawings; part drawing and assembly; surface finish symbols; civil and mechanical drawings.
15	Fluid Mechanics I	2	Properties of fluids; fluid statics; buoyancy; fluid kinematics; patterns of flow; fluid dynamics; Euler's equation; Bernoulli's equation and its applications; momentum equation; introduction to boundary layers; laminar and turbulent flow in pipes; Hagen-Poiseuille flow; Couette flow; loss of head due to friction; flow through pipe networks.
16	Fundamentals of Electrical Engineering	2	Electrical quantities and measurements; definitions and laws; circuit analysis; electronic devices and circuits; characteristics and measurement of circuit elements; basic electrical measuring, recording, and display instruments.

No.	Subject	Credits	Content of subject
17	Workshop Training II	1	**Building workshop**: building technology; reinforcement preparation; composition and use of concrete; roof construction; introduction to wood work. Mechanical workshop: introduction to casting and welding; sheet metal cutting, filing, drilling, bending. Metal cutting machine tools; introduction to drilling, turning, shaping and milling.
	Core Professional Subject	**51**	
1	Thermodynamics I	2	Fundamental concepts; First and Second Laws of Thermodynamics; enthalpy and entropy; thermodynamic processes; properties of fluids; Steam Tables and Charts; steam cycles; gas power cycles; gas turbine cycles; refrigeration cycle; properties of mixture, psychometric; combustion processes; calorific value of fuels
2	Strength of Materials I	3	Concepts of stress and strain; problems in direct stress; analysis of plain stress and plane strain; statics of beams and frames; geometric properties of plane sections; stresses due to bending and shear in beams; deflections of beams; torsion of circular and thin walled non-circular sections; combined loading.
3	Fundamentals of Machine Component Design I	3	Introduction to machine design principle; general solutions to design problems; code and standardization, surface quality, tolerances and fits; design considerations and rules; mechanical properties of engineering materials; failure theory; power transmission devices (belt drives; chain drives; tooth wheel devices) shafts and keys.
4	Workshop Training III	1	Mechanical shop practice: sand moulding and casting, pressure casting; gas and arc welding; sheet metal work: bending, riveting; further shaping, turning and milling practice.
5	Strength of Materials II	2	Theories of elastic failure; thin and thick pressure vessels; deflection of thin curved members; column design; bending and twisting beyond elastic limit; unsymmetrical bending; analysis of rotating discs and circular plates.
6	Mechanical Laboratory I	2	Basic experiments in strength of material and engineering material: Bending, torsion, impact test, anneals, quenching and e.g. which relate to strength of material and engineering material.
7	Mechanical	2	Basic experiments in fluid mechanics and

No.	Subject	Credits	Content of subject
	Laboratory II		thermodynamics: heat transfer air conditioning and refrigeration
8	Engineering Materials II	2	Strengthening of metals and alloys; heat treatment of steels; classification and properties of steel; effects of alloying. Cast irons: grades, properties and applications. Non-ferrous metals and alloys; properties and applications. Non-metallic materials: polymers, ceramics and cermet, composites. Friction and wear; corrosion and its prevention.
9	Fundamentals of Machine Component Design II	3	Clutches, brakes and couplings; power screw; rolling contact bearings; lubrication and journal bearings; mechanical joints; springs.
10	Design Project	1	A detailed design of a machine part will be submitted. This will include design calculations and complete technical drawings.
11	Heat Transfer 1	2	Steady state conduction in one dimension; two dimension steady state conduction; finite difference methods with computer applications; electric analogy; unsteady conduction. Convection: laminar and turbulent heat transfer; non-dimensional groups; natural convection; radiation; heat exchangers.
12	Heat Transfer 2	3	Introduction to heat convection; fluid properties and fluid characteristics; equation of fluid mechanics and energy equations for fluid flows; dimension analysis, force convection external and internal fluid flows; heat transfer equation for external and internal fluid flows; fluid flows passed tube bank; natural heat convection; fluid flows over vertical and inclined flat plate; double pipe, shell and tube heat exchanger; heat radiation
13	IC Engines	3	Construction of IC engines; 4-stroke and 2-stroke engines; compression and spark ignition; combustion in SI and CI engines; gas exchange processes in IC engines; carburation and fuel injection; cooling and heat losses; performance; friction; lubrication and engine wear; materials; design of IC engines; emissions.
14	Fluid Mechanics II	2	Viscous flow in real liquids; Navier-Stoke's equation; ideal flow theory; boundary layer theory; physical similarity; open channel flow; unsteady flow in pipes; principles of fluid machinery.
15	Engineering Materials	2	Crystal structure of metals, bonds and geometry; theory of

No.	Subject	Credits	Content of subject
	I		alloys; imperfections in crystals; equilibrium phase diagram; iron carbon systems; non-ferrous alloys; structure and properties of polymers and ceramics. Nondestructive tests: visual, magnetic, eddy-current, ultrasonic and radiography. Destructive tests: tensile, bending, hardness, impact and creep tests. Materials used in Electrical Engineering.
16	Manufacturing Processes I	2	Principles of metal cutting: tool geometry; mechanics of tool cutting; cutting forces and power; tool materials and wear. Economics of metal cutting: tool life; optimization of cutting process. Machine tool design: drives for feed motion; beds, slides, spindles and bearings.
17	Manufacturing Processes II	3	Basic principles of metal forming; hot and cold working; sheet metal press work; lubricants, press tool design. Forming of plastics and rubbers. Casting processes; crystallization and development of cast structures; casting techniques; defects in casting. Welding, brazing and soldering; arc and gas welding; resistance welding; solid phase welding; welding defects.
18	Engineering Measurements	3	Definitions; units; standards; instruments; errors; accuracy; calibration; analogue and digital methods; measurement of displacement, area, volume, force, torque, strain, density and pressure etc. Statistical treatment of data; error analysis.
19	Thermodynamics II	3	Maxwell's relations; compressibility, Joule-Thomson effect; Clapeyron's equation; Kinetic theory of gases; availability. Work transfer: reciprocating compressors, steam nozzles.
20	Industrial Safety and Maintenance	2	Maintenance management and organization; types of maintenance, maintenance support systems; computer applications; quantitative methods; Pareto analysis; normal distribution; exponential functions; Weibull distribution; replacement decisions; overhaul and repair decisions. Maintenance problems in Lao. Safety: objectives; causes of accidents and injuries; working conditions; safety training; monitoring; motivation; safety practice; hazard control.
21	Electro technic and Electronic	3	This course is an introductory course into semiconductor components that are used in present day electronic devices. This course will delve into semiconductor theory

No.	Subject	Credits	Content of subject
			and the manufacture and design of semiconductor components. It will also cover analog as well as digital components not to be limited to the following semiconductor devices: diodes, silicon controlled rectifiers (SCR's), bipolar junction transistors, field effect transistors (FET's), operational amplifiers (OP AMP's), digital logic gates, microprocessors, random access memory (RAM), and read only memory (ROM). The student will also be introduced to common circuits that employ these devices such as oscillators, amplifiers, flip-flops, multivibrators, shift registers, counters, frequency dividers, and microprocessor circuit.
22	Electrical Machine	2	Types of electrical motor, principle of motor design, transformer motor control, generator and controller system, instruments usage and testing in laboratory.
	Elective subjects		
A	**Optional Energy**	**21**	
1	Power Plant Engineering	2	Load calculation, power plant economic, fuel and combustion, steam power plant, internal combustion engine power plant, gas turbine and hydroelectric power plant, instrumentation and control.
2	Gas Dynamics	3	Thermodynamic concepts; equations of state, continuity and energy; subsonic and supersonic flow; isentropic flow; one dimensional flow with negligible friction in convergent-divergent nozzles; elastic waves; normal shock waves; Fanno and Raleigh flow.
3	Refrigeration	3	Review of thermodynamics; methods of refrigeration; vapour compression cycle; multi-pressure systems; compressors; condensers; expansion devices and evaporators; refrigerants; piping; absorption and adsorption refrigeration. Psychro metrics; cooling and dehumidying coils.
4	Thermal Engineering	2	One- and two-dimensional steady-state conduction; fluid dynamics; laminar and turbulent flow; dimensional analysis; forced and free convection; radiation heat transfer.
5	Energy Conversion	2	Conversion energy from natural energy to mechanical energy such as: hydropower energy, wind energy, conversion heat energy from fossil fuel: coal, petroleum oils, natural gas;

No.	Subject	Credits	Content of subject
6	Non - Conventional energy	2	The potential of solar energy; solar energy water heater and water distiller design; the potential of wind energy; wind turbine design, efficiency of wind turbine; waves energy; conversion energy from biomass.
7	Energy Management in Buildings	2	Energy audit programme for building and facilities; initiating energy management programme; guideline for methods of reducing energy usage in each area in buildings, conservation of the energy in the planning, design, installation, utilization, maintenance and modernization of microcomputer in the energy management and in automatic controls of air conditioning and ventilation systems in building.
8	Energy Management in Industrial	2	Energy balance studies for various equipment in industrial plants and option for improved efficiencies; waste heat recovery technique; first law of thermodynamics analysis; electrical and heat production; cogeneration concept in industry and management for efficient use of energy; electrical and heat production by gas turbine.
9	Air conditioning	3	Nature of air; human comfort; cooling load estimation; applied psychrometrics; air duct design; piping design; air conditioning systems; equipment; application.
B	**Optional applied mechanic**	**20**	
1	Construction Equipment	3	Conveyors; cranes: hoisting and derricking; slewing and travelling mechanisms; crane structure and stability, crushing, screening and washing machines.
2	Elasticity, Plasticity	3	Experimental stress analysis; theory of photoelasticity; strain methods; brittle coating. Fracture Mechanics: impact tests; ductile-brittle transition temperatures; stresses around a crack; rupture criteria; plastic zone; fatigue failure; introduction to finite element method.
3	Design and Analysis of Experiments	2	Introduction to experimental design; basic statistical concepts; sampling and sampling distributions; hypothesis testing; inference about the difference in means, paired, comparison designs; completely randomized design; The randomized completely block design (RCBD), Latin square design, the split- plot design, the split –split plot design, the split design, confounding design
4	Engineering Design	3	The design process, design in a broader context, design

No.	Subject	Credits	Content of subject
			methodology, modeling & simulation, optimization, material selection, interaction of materials, processing, economic decision making, cost evaluation, planning & scheduling, engineering statistic, risk and reliability, quality, -source information and communicating the design
5	Electrical Engine and Electronic System Service	2	Electrical signal and electronic, electrical voltage, current and resistance, electrical measurement instruments and oscilloscope application, electrical field and armature, relay and sensor, electronic and digital equipment.
6	Engineering Piping System	3	Size and design piping systems in building; steam piping design; gas piping design, steam strapping, condensate recovery, flash steam, principle of industrial compressed air piping system, air compressor and equipment, compressed air system design; principle of low pressure gas piping, pressure reducing station, calculate and sizing of gas pipes
7	Computer Applications in Mechanical Engineering II	1	Revision of numerical methods; revision of Pascal programming; solution of problems in two-dimensional heat conduction, pressure waves in a surge tank; stresses in a beam etc.
8	Special Topics in Mechanical Engineering	2	New technologies or existing technologies applied to specific areas: The topics to be proposed by the lecturer(s) offering the course(s) and must be approved by the department committee. New technologies or existing technologies applied to specific areas: The topics to be proposed by the lecturer(s) offering the course(s) and must be approved by the department committee.
9	Agricultural Machinery	2	Introduction to agricultural machinery; construction and application of agricultural machinery; maintenance; equipment selection and performance test of machine; study of fundamental equipment used in Laos.
C.	**Materials and Productions**	**18**	
1	Advanced Manufacturing Processes	2	Principles of jig and fixture design; mechanization; control actuation circuits for production and inspection using hydraulics and pneumatics. principles and applications of numerical control; CNC machines; process and quality control.
2	Polymer Engineering	3	Physical properties of polymers; importance of molecular

No.	Subject	Credits	Content of subject
			structure; visco-elastic nature of polymers; time and temperature dependence; environmental effects; effect of additives; flow properties; commercial applications; manufacturing and fabrication techniques; handling and storage.
3	Plastic Production and Mold Design	3	Basic concept of mould designing, shrinkage, flash line, taper and draft Materials used for dies and moulds and their characteristics General design considerations for various types of moulds Machining methods - general introduction to lathe machine, grinder, shaper, milling, spark erosion, CNC wirecut
4	Industrial Robotics	2	Introduction to industrial robots; review of feedback control; Cartesian and joint coordinates control; motion control; strategies of industrial robots; position control of single joint; industrial of manipulator arm; joint controller for conveyor application.
5	Quality Management	2	Quality control management; quality control techniques; engineering reliability for quality control.
6	Engineering Economy	2	Cost accounting: nature of costs; product costing; profit-volume relationship. Engineering economy: annual value method; present worth method; internal rate of return, income statement; balance sheet; ratio analysis. Behavioral science; organization design; remunerations; industrial relationships.
7	Operational Research	2	Introduction; linear programming; non-linear programming; transportation networks; dynamic programming; game theory; Markov processes; Queuing models; system simulation; project management; forecasting; time series analysis and computer applications.
8	Quality Management and Control	2	Quality control management; quality control techniques; engineering reliability for quality control.

1.5.3 Pedagogical knowledge

No.	Subject	Credits	Content of subject
	Compulsory subjects		
	Basic Course		

No.	Subject	Credits	Content of subject
1	General Vocational Pedagogies	2	To learn and understand the meaning and significance of a vocational education system, its development history tills the current system. To be able to compare this education system in every era and distinguish their advantages and disadvantages in such a manner that the problems incurred during their implementation stand could be solved in accordance with the socio-economic of the country. To understand and put vocational teacher standard into effect. **Content:** 1. Meaning and significance of a vocational education system 2. System and history of vocational education 3. Current vocational education 4. Difference between general education and vocational education 5. Vocational teacher standard 6. Training of vocational teacher
2	Didactics of Vocational Education	2	To learn and understand the meaning and significance of teaching sciences and to be able to use various basic teaching techniques, principles, components and definition of various terminologies. **Content**: 1. Objectives and functions of teaching sciences 2. Procedures of theory teaching and practices 3. Introduction to theory of teaching sciences 4. Principles of teaching sciences 5. General structure of teaching sciences
3	Psychology of Learning and Teaching	2	To learn and understand various psychology developments. To know measures for solving various problems concerning behavior of teenaged students in such a way that they can be applied to the learning-teaching process and to the education of students.
	Strategies and Methodology	2	To learn and understand the meaning and significance of using various basic teaching techniques, methods of teaching and learning implementation. **Content:** Explanation teaching, discussion teaching, trial or practical teaching, Problem solving oriented teaching,

No.	Subject	Credits	Content of subject
			observatory teaching, investigating teaching, project approach teaching, group teaching, class room centered teaching, Reduction and induction teaching, creative teaching, role playing teaching, programmed teaching etc.
	Core Course		
1	Subject oriented Didactics	4	To know and understand the meaning, significance and function of hands on practice, and the relation between sciences of specialization teaching and teaching techniques. Knowledge gained can be then applied to improve exerted duties or functions in accordance with the actual country's socio-economic situation. **Content:** 1. Introduction to sciences of specialization teaching 2. Basic knowledge of sciences of specialization teaching 3. Education planning and researches on the learning of pedagogical subjects 4. Research methodology 5. Planning of vocational education system 6. Teaching practices for students (based on their specializations)
2	Methods of Social Sciences	1	To know and understand methods and procedures of researches, problem setting, proposal finding, assumption setting, data collecting, information finding and references. These could be applied to solve various problems incurred in professional work and vocational education for steady improvement to be achieved. **Content:** 1. Introduction to research sciences 2. Problem gathering, finding, formulating and directions for problem solving 3. Assumption formulating and editing 4. Planning and designing research methodology 5. Data collection methods 6. Design scientific research writing
3	Theory of Curricula	1	To know and understand the meaning, significance, structure and components, characteristics, procedures and formulation of objectives in such a way that the learning-teaching syllabus is in line with the actual country's socio-

No.	Subject	Credits	Content of subject
			economic situation. **Content:** 1. Review of vocational education system 2. Defining curriculum 3. Curriculum assessment 4. Establish curriculum based on job description
4	Interaction and Communication	2	To know and understand the meaning and significance of the communication between sender and receiver. To have basic knowledge and various techniques in discussion guiding. To foresee the significance of the preparation as to be in line with various discussion situations, the meeting and lecturing arrangement. **Content:** 1. Basic knowledge in discussion guiding 2. Discussion guiding techniques 3. Discussion preparation 4. Various situation of complete discussions 5. Management of discussions and lecturing
5	Adult and Further Education	2	To know and understand the significance of adult education in professions, profession skill and skill formation in profession. To know psychology and social characteristics of the adult learning and teaching, and job description of the adult education/training teachers To be familiar with adult technical education points of views as components for developing skills in professions. To know principles and technical teaching duties for adult education. To know activity-oriented teaching methods for adult education/training, and various interactive processes in group working for adult education/training
6	Production Lines and Voc. Education	1	To train professional talents with practice ability for the first line of production, service, and description of professional post ability to be more in line with the actual need of the market and society. To train students in how to use school-enterprise cooperation to enrich and enhance the vocational teachers, strengthen the teacher development, improve the education quality. Finally through the teaching staff construction

No.	Subject	Credits	Content of subject
7	Teaching Practice	2	To rehears theoretical and practical teaching in the department concerned and within the group of classmates. To gain more competence in preparing and teaching students' own specialization. For this the students select their specialization for the rehearsal of the teaching methodology to be used in the future.
8	Teaching Media	4	To learn, understand, distinguish, apply, develop and maintain various learning-teaching media in accordance with teaching contents. To know the meaning, significance and function of the learning-teaching media starting with simple to modern models e.g. using computers for faster communication. **Content:** **Theory** 1. Introduction to the understanding of media 2. Meaning of symbols and signs 3. Differences between media, tools and projectors 4. Media classification according to various characteristics 5. Meaning of media in learning-teaching methods 6. Uses of languages and learning-teaching media **Practices** 1. Create teaching media (transparences) for your specialization 2. Review the use of Microsoft Word 3. Review the use of Microsoft Excel 4. Use Power Point for teaching preparation
	Practice in Industry and Vocational School	1	Practical training is an important part of a vocational education system. The theory of teaching sciences indicates that when being carried out in society, vocational colleges or industries would enable vocational teachers to gain more knowledge and competences. Furthermore, practical training would enable students to adapt to real work and future colleagues. **Content:** 1. Teaching auditing Students will appraise classes and follow various functions and duties in vocational and technical colleges to gather and gain competences in teaching.

No.	Subject	Credits	Content of subject
			2. Rehearsing theoretical teaching Let students become familiarized with the rules and principles of teaching, and rehearse theoretical teaching in vocational or technical colleges. This should be carried out with advice and suggestions of their supervisors to prepare students to better undertake their duties in the future. 3. Rehearse practical teaching Let students become familiarized with the rules and principles of teaching, and rehearse practical teaching in vocational or technical colleges. This should be carried out with advice and suggestions of their supervisors to prepare students to better undertake their duties in the future. 4. In the last week students will summarize their practical training and submit the report to the parties concerned.
	Final Paper(6 weeks)	4	To know and understand sciences of research writing, be able to prove original and sources and other problems. To know how to find information and various approaches that are parts of research writing. To be able to reference various literature, summarize and elaborate information obtained from other sources. Preparation of a realistic solution for a real world mechanical engineering problem, normally on an individual basis, with the minimum of supervision and direction. Students are expected to identify sub problems, retrieve information and collect the necessary data and deal with them in a logical sequence. They are expected to organize their own time to produce results by a specified date, and present results in both written and oral form. **Content:** Contents and title given by the units concerned, students themselves or by other parties must be involved with sciences for vocational education, specialization and training that are in line with the country socio-economy.
	Optional subjects	**2**	
1	Special Problem of Vocational Education	2	To learn and understand the meaning and significance of the development and maintain learning-teaching media in

No.	Subject	Credits	Content of subject
			accordance to teaching content. To know the meaning, significance and function of learning-teaching media for distance learning that uses computer networks for information and data communication. **Prerequisite**: 361TM321 1. Planning learning-teaching media for students' own specialization 2. Create contents of students' specialization to be posted in Website 3. Design Website

2 Introduction about vocational teacher training in Electrical Engineering

The Department of Electrical Engineering (EED) offers a four-year 150 credit undergraduate programme. The initial two years provide a broad exposure to other engineering fields and an introduction to electrical engineering. In the final two years, the curriculum concentrates on core courses, such as network analysis, electronics circuits and design, linear systems, alternating-current machines, communication theory, etc. Elective courses in a wide range…In the senior year, a three-credit research project must be undertaken. Students are also required to carry out practical training for a minimum four weeks period

2.1 Philosophy

Bachelor Degree Programme of Vocational Teacher Training comes under the human resource development system and has an important role for the learning-teaching process in the vocational institute to meet and correspond to the need of the socio-economy of the country and society.

2.2 Objectives

1. Train students to have knowledge in vocational teacher in electrical engineering field,
2. Train students to have knowledge in didactic and methodology,
3. Train students to have capacity in setting problems and seeing information in research science,
4. To train engineers to solve problems in the field of electro technics correctly. Train experts to have ethical, responsibilities to society and know how to reserve national cultures and customs,
5. Train students in the responsibilities of their duties, keenness to teach, good characteristic, good relationship, ethics and love of country,
6. Train engineers to have knowledge, ability in carrying out their duties developing the country with the acceptance of the society.

2.3 Expectation ability after graduation

1. Being vocational teachers can teach both the theory and practice in electrical engineering field,
2. Being engineers can analyze and solve problems in electrical engineering fields,
3. To be administrators in various public and private sectors,
4. Be able to pursue higher education in their own field.

2.4 The Curriculum

- General knowledge: 20 credits
- Pedagogical knowledge: 32 credits
- Professional knowledge: 94 credits

Among which:

- Basic knowledge: 30 credits
- Specialized knowledge: 59 credits
- Elective subjets: 5 credits

Final paper: 4 credits

2.4 General knowledge

No.	Subject	Credits	Content of subject
	Compulsory subjects	**20**	
1	Lao Study I	2	Description of Lao society and Economic situation in Lao PDR, Lao History, Evolution and change of Lao Demography. Politics System of Lao PDR, their Policies: State Administration, Social-Economic Development, National Defense and Foreign Affairs Policies
2	Philosophy	2	Study philosophy as the role of mother of various academic sciences. Try to think the arguments in pure philosophy: Metaphysics, Epistemology, Axiology (Ethics and Aesthetics), Logic and ones in the applied philosophy in order to practice in creating the deep, a wide-perspective, and systematic thinking. Basic principles of Marxism-Leninism, it provides students with philosophy, ethics and cultural values and some basic knowledge of Marxism – Leninism to build their ethical foundation.
3	Lao Study II	2	Basic contents of the general theory of government, constitution, background of law, Lao law system, Law on civil procedure.
4	Mathematic I	3	Matrix Calculation, Linear System of Equations, Linear spaces, Bilinear Forms, Linear Programming
5	Mathematic II	3	Series, Function of Several variables, Multiple Integrals, and Vector Calculus
6	General English I	2	**Areas**: Introduction to technical report writing format,

No.	Subject	Credits	Content of subject
			practice of specific reading skills. Written proof of understanding of lectures.
7	General English II	2	**Areas**: Application of report writing on practical work. Introduction to summarizing and paraphrasing from written texts.
8	General Psychology	2	General psychology is an introduction to the field of psychology and major perspectives including the biological basis of behaviour, sensation, perception, learning, memory, motivation, emotion, personality, stress, as well as abnormal, developmental and social psychology.
9	Technical defense	1	It provides students with some basic issues of technical defense and Lao military art. The subject helps students to practice some necessary military skills and disciplinary lifestyle to contribute to comprehensive education.
10	Workshop Training I	1	**Building workshop**: introduction to building technology; leveling and setting out of buildings; foundation design etc. Electrical workshop: domestic and industrial machine installations; use of tools and instruments; electric circuits; fault finding; safety regulations. Machine and bench shop: use of measuring instruments; sheet metal work; introduction to turning, shaping and milling machines; safety precautions and maintenance of machines.
	Elective subjects		**None**
	Total	**20**	

2.2 Professional knowledge

No.	Subject	Credits	Content of subject
	Compulsory subjects	**92**	
	Basic Professional Subjects	**30**	
1	Physic I	2	Electrostatics; Coulomb's law and electric field; electric flux and Gauss' law; electric potential; capacitance; electric current and resistance; EMF and circuits; magnetic fields; Ampere's law; electromagnetic induction and Faraday's law; inductance; vibration and waves; photometry; reflection and refraction; interference; diffraction; polarization; optical instruments.
2	Physic II	2	**Topics:** Special theory of relativity; the experimental basis of relativity; alternate theories; Lorentz

No.	Subject	Credits	Content of subject
			transformations; consequences for the measurement of length, time, energy and mass; quantum effects; constituents and structure of the atom; wave particle duality; black body radiation; photo-electric effect; pair production; bremsstrahlung; Compton effect; production, scattering and absorption of X-rays; de Broglie hypothesis, diffraction of particles; quantum mechanics; wave packets; uncertainty principle; Schrodinger Equation; correspondence principle; particle in a box; qualitative description of the wave functions of the hydrogen atom; discovery and properties of particles of nuclear physics, decay laws, binding energies of nucleons; nuclear reactions; fission and fusion; cosmic rays; origin of the elements; statistical distribution functions; particle in a period potential; energy bands; impurity states; physics of the p-n junction and transistor.
3	Introduction to Informatics	2	**Topics:** Computers and information processing; operating system; "hands on" practice with some application software such as word processing and spreadsheets
4	General Chemistry	2	**Topics:** Atomic theory, chemical bonding, structure; simple organic molecules and reactivity; thermodynamics and thermo Œ chemistry; gases, liquids and solutions; atomic structure and its influence on the mechanical and electrical properties of engineering materials such as adhesives, cement, fuels, metals, polymers and semiconductors; electrochemistry and corrosion; kinetics and radiation chemistry; hardness of natural waters, problems and treatment
5	Technical English I	1	**Areas**: Revision of major structures and functions previously studied. Familiarity with several types of written text. Introduction to methods of presenting seminars.
6	Technical English II	1	This subject includes activities to develop reading skills, accumulate vocabulary related to Mechanical Engineering, exercises to practice and develop speaking and writing skills about Mechanical Engineering in English.
7	Introduction to economy and	3	This course includes the following topics: bound and method of economics study, economic fundamental

No.	Subject	Credits	Content of subject
	accounting		problem solving, consumer behavior theory, terminology applications of flexibility of demand, theory, production and cost, cost setting under different market situations, demand and supply of production factors, estimation of national incomes, role of monetary and banking in the economic system, cause and problem of inflation, applications of monetary and financial policy for economic stabilization and international economic relations. This course also includes: recording and posting of the accounting in terms of money, accounting equation and business transaction analysis, principles of double entry bookkeeping, general journal, general ledger and trial balance, financial statements, closing and adjusting entries.
8	Engineering Mathematic I	3	First order differential equations, second and higher order differential equations, Laplace transforms, Series solution of Linear differential equations, Introduction to partial differential equations.
9	Engineering Mathematic II	3	**Introduction:** Numerical Computing and Computers; Solving Nonlinear Equations; Solving Sets of Equations; Interpolation and Curve fitting; Numerical Differentiation and Numerical Integration; Numerical Solutions of Ordinary Differential Equations; Boundary-value Problems and Characteristic-Value Problems; Numerical of Partial Differential Equations.
10	Advance Statistics	3	Distribution function of several random variable, Normal distribution; Mathematical Statistics; Introduction to Information Theory.
11	Engineering Mechanics	3	Basic concepts. Scalars and vectors. Forces and their resolution. Centre of gravity and centroids. Couple and moment. Equilibrium of a rigid body. Systems of rigid bodies. Friction. Concepts of stress and strain. Hooke's law and Poisson's ratio. Mohr's circle of plain stress and strain. Pin-jointed trusses. Statics and displacements. Methods of joints and sections. Displacement diagram. Deflection of beams. Shear force and bending moment diagrams.
12	Engineering Drawing	2	Introduction to drawing equipment, formats, types of line, lettering, simple representations(geometry drawing),

No.	Subject	Credits	Content of subject
			scales, free sketching; dimensions; title block; principles of orthographic projection; civil, electrical and mechanical drawings.
13	Fluid Mechanics	2	Properties of fluids; fluid statics; buoyancy; fluid kinematics; patterns of flow; fluid dynamics; Euler's equation; Bernoulli's equation and its applications; momentum equation; introduction to boundary layers; laminar and turbulent flow in pipes; Hagen-Poiseuille flow; Couette flow; loss of head due to friction; flow through pipe networks.
	Core Professional Subject	**59**	
1	Electrical engineering materials	2	Conducting materials; semi conducting materials; magnetic materials; insulation materials.
2	Electrical measurement and instrumentation	3	Principles of operation of analogue meters; extension of instrument range; probability and error; measurement of power, energy, frequency and phase angle; potentiometers and bridges; measurement of resistance, inductance and capacitance; introduction to electronic instruments; oscilloscope; transducers.
3	Electronics 1	3	Characteristics of semi-conductor devices; diodes; bipolar and field-effect transistors; device and circuit modeling; biasing; single-stage amplifiers; frequency response; design procedures.
4	Electronics 2	3	Multistage amplifiers: analysis and design; negative feedback amplifiers; oscillator circuits; characteristics and applications of MOSFET, thyristor, UJT and PUT; operational amplifiers and circuits.
5	Circuit theory I	3	Kirchhoff's laws; topological properties of networks; mesh current; node voltage and cut-set analysis; free and forced response of networks; sinusoidal steady state analysis, phasor and impedance concepts.
6	Circuit theory II	3	Complex plane methods; network analysis via Laplace transforms; network theorems; poles and zeros; Fourier series and transform applications; multi-port networks; state-space and matrix methods.
7	Automatic controls	3	Methods of classical control systems. System models represented by transfer functions and state equations, simulation. System time and frequency responses. Properties of feedback control systems, stability,

No.	Subject	Credits	Content of subject
			sensitivity, robustness, error coefficients. Stability analysis, Routh's stability criterion. Analysis and design using root-locus, lead, lag and PID compensators. Analysis and design in the frequency domain, lead, lag and PID compensators.
8	Electromagnetic field theory	3	Electrostatics. Magnetostatics. The equations of Laplace and Poisson. Equation of continuity for time-varying fields. Maxwell's equations. Energy of the electromagnetic field. Electromagnetic waves. Plane waves in dielectric and conducting media. Elementary radiating systems. Reflection and refraction. Transmission lines. Wave guides. Electromagnetic radiation.
9	Electromechanical energy conversion1	3	Magnetic circuits; ferromagnetic materials; principles of electromagnetic and electromechanical energy conversion; electromechanical devices; coupled circuits; transducers; steady-state performance of D.C. machines; speed control of D.C. motors.
10	Electromechanical energy conversion 2	3	Balanced and unbalanced 3-phase systems; 3-phase transformers; rotating magnetic fields; steady-state performance of synchronous and induction machines; fractional horsepower A.C. motors.
11	Digital electronics	3	Combinational logic; simplification of logic expressions; Karnaugh map; Quine-McCluskey minimisation; sequential logic; flip-flops; registers; clock; timing and synchronization problems; sequential machines; timing diagrams and state tables.
12	Power electronics	3	Electronic devices and circuits; single phase and three phase rectification: controlled and uncontrolled applications; phase control, inverters and converters. Power transistors, MOSFET's and diodes; commutation; forced commutated inverter techniques, drive and protection; waveform control and filtering; choppers; uninterruptible power supply systems.
13	Power system analysis 1	3	Load flow; symmetrical components; short-circuit calculations; economic operation of power systems; stability; voltage control; power control; system protection.
14	Power system analysis 2	3	Computer applications in the analysis, operation and control of power systems; off-line and on-line considerations.

No.	Subject	Credits	Content of subject
15	Power system protection	3	Fundamentals of power system protection; relay operating principles; induction-type relays; overcurrent protection; differential relays; distance relays; pilot relaying; generator protection; transformer and busbar protection; system and equipment grounding; current transformers; introduction to digital protective systems.
16	Electric drives	3	Overload and short circuit protection, Basic Symbols in motor control circuits, starting, speed control, reversing or plugging for DC and AC motors.
17	Power system operation and control	3	Modeling of power system components; isolated operation; operation and control of interconnected networks; economic considerations; frequency, voltage and power control; emergency control; load shedding and islanding.
18	Mechanical calculation of transmission lines	3	Transmission lines, Map establishment study; mechanical calculation of overhead line; state changing equation; load coefficient; mechanical calculation of poles; fundamental of basement of pole arrangement; example of high voltage and extra high voltage calculation; geometry property of overhead line.
19	Renewable energy	3	A general introduction, Fossil and nuclear energy, reserves, energy cycle of the earth, solar energy, bio-mass energy, wind energy, wave energy, tidal energy, geothermal energy.
20	Design of electrical power system	3	National electric wiring standards and practices; distribution systems; principles of electrical design; lighting design; wiring design; commercial and industrial installations; protection of installations; system and equipment grounding; lightning protection; emergency power systems; specifications and cost estimation.
	Elective subjects	**3**	
1	Power system stability	3	Dynamic and transient stability; acceleration equations; stability criteria; two-machine and multi-machine applications; stability improvement measures.
	High voltage engineering	3	Generation of high voltages; ionization and decay processes; breakdown mechanisms in gas, liquid and solid; high voltage measurement techniques.
3	Illumination engineering	3	Illumination, Non-imaging, and Concentrators; Sources: Incandescent, Fluorescent, LED, HID, Modeling, and Experimental Measurement; Modeling: Ray Tracing,

No.	Subject	Credits	Content of subject
			Radiometry and Photometry, Color, Polarization, and Scattering; Theory: Radiometry, Photometry, Étendue, Skew Invariant, and Concentration; Design Methods: Edge Ray, Flow Line, Tailored Edge Ray, Non-Edge Ray, and Imaging; Optics: Reflectors, Lightpipes, Couplers, Films, and Hybrids.

2.4.3 Pedagogical knowledge

No.	Subject	Credits	Content of subject
	Compulsory subjects	**32**	
	Basic Course	8	
1	General Vocational Pedagogies	2	To learn and understand the meaning and significance of a vocational education system, its development history tills the current system. To be able to compare this education system in every era and distinguish their advantages and disadvantages in such a manner that the problems incurred during their implementation stand could be solved in accordance with the socio-economic of the country. To understand and put vocational teacher standard into effect. **Content:** 1. Meaning and significance of a vocational education system 2. System and history of vocational education 3. Current vocational education 4. Difference between general education and vocational education 5. Vocational teacher standard 6. Training of vocational teacher
2	Didactics of Vocational Education	2	To learn and understand the meaning and significance of teaching sciences and to be able to use various basic teaching techniques, principles, components and definition of various terminologies. **Content**: a. Objectives and functions of teaching sciences b. Procedures of theory teaching and practices c. Introduction to theory of teaching sciences d. Principles of teaching sciences

No.	Subject	Credits	Content of subject
			e. General structure of teaching sciences
3	Psychology of Learning and Teaching	2	To learn and understand various psychology developments. To know measures for solving various problems concerning behavior of teenaged students in such a way that they can be applied to the learning-teaching process and to the education of students.
	Strategies and Methodology	2	To learn and understand the meaning and significance of using various basic teaching techniques, methods of teaching and learning implementation. **Content:** Explanation of teaching, discussion of teaching, trial or practical teaching, Problem-solving oriented teaching, observatory teaching, investigating teaching, project approach teaching, group teaching, class room centered teaching, Reduction and induction teaching, creative teaching, role playing teaching, programmed teaching etc.
	Core Course	22	
1	Subject oriented Didactics	4	To know and understand the meaning, significance and function of hands-on practice, and the relation between sciences of specialization teaching and teaching techniques. Knowledge gained can be then applied to improve exerted duties or functions in accordance with the actual country socio-economic situation. **Content:** 1. Introduction to sciences of specialization teaching 2. Basic knowledge of sciences of specialization teaching 3. Education planning and researches on the learning of pedagogical subjects 4. Research methodology 5. Planning of vocational education system 6. Teaching practices for students (based on their specializations)
2	Methods of Social Sciences	1	To know and understand methods and procedures of research, problem setting, proposal finding, assumption setting, data collecting, information finding and references. These could be applied to solve various problems incurred in the professional work and vocational education so that steady improvement could be achieved.

No.	Subject	Credits	Content of subject
			Content: 1.5 Introduction into research sciences 1.6 Problem gathering, finding, formulating and direction for problem solving 1.7 Assumption formulating and editing 1.8 Planning and designing research methodology 1.9 Data collection methods 1.10 Design scientific research writing
3	Theory of Curricula	1	To know and understand the meaning, significance, structure and components, characteristics, procedures and formulation of objectives in such a way that the learning-teaching syllabus is in line with the actual country socio-economic situation. **Content:** 1. Review on vocational education system 2. Defining curriculum 3. Curriculum assessment 4. Establish curriculum based on job description
4	Interaction and Communication	2	To know and understand the meaning and significance of the communication between sender and receiver. To have basic knowledge and various techniques in discussion guiding. To foresee the significance of the preparation as to be in line with various discussion situations, the meeting and lecturing arrangement. **Content:** 1. Basic knowledge in discussion guiding 2. Discussion guiding techniques 3. Discussion preparation 4. Various situation of complete discussions 5. Management of discussions and lecturing
5	Adult and Further Education	2	To know and understand the significance of adult education in professions, profession skill and skill formation in profession. To know psychology and social characteristics of adult learning and teaching, and job description of adult education/training teachers To know some adult technical education points of views as components to develop skills in professions. To know principles and technical teaching duties for adult

No.	Subject	Credits	Content of subject
			education. To know activity oriented teaching methods for adult education/training, and various interactive processes in group working for adult education/training
6	Production Lines and Voc. Education	1	To train professional talents with practice ability for the first line of production, service, and description of professional post ability are more in line with the actual need of the market and society. To train students how to use school-enterprise cooperation to enrich and enhance the vocational teachers, strengthen the teacher development, improve the education quality. Finally through teaching of staff construction
7	Teaching Practice	2	To rehearse theoretical and practical teaching in the department concerned and within the group of classmates. To gain more competence in preparing and teaching students' own specialization. In this matter students would select their specialization for the rehearsal of the teaching methodology to be used in future.
8	Teaching Media	4	To learn, understand, distinguish, apply, develop and maintain various learning-teaching media in accordance with teaching contents. To know the meaning, significance and function of the learning-teaching media starting with simple to modern models e.g. using computers for faster communication. **Content:** **Theory** 1. Introduction to the understanding of media 2. Meaning of symbols and signs 3. Differences between media, tools and projectors 4. Media classification according to various characteristics 5. Meaning of media in learning-teaching methods 6. Uses of languages and learning-teaching media **Practices** 1. Create teaching media (transparences) for your specialization 2. Review the use of Microsoft Word 3. Review the use of Microsoft Excel 4. Use Power Point in the teaching preparation
	Practice in Industry	1	Practical training is an important part of a vocational

No.	Subject	Credits	Content of subject
	and Vocational School		education system. The theory of teaching sciences indicates that when being carried out in society, vocational colleges or industries would enable vocational teachers to gain more knowledge and competences. Furthermore, practical training would enable students to adapt to real work and future colleagues. **Content:** Teaching auditing Students will appraise classes and follow various functions and duties in vocational and technical colleges to gather and gain competences in teaching. Rehearse theoretical teaching To let students be familiarized with the rules and principles of teaching, and to rehearse theoretical teaching in vocational or technical colleges. This should be carried out with advics and suggestions of supervisors to prepare students to undertake their duties in the future better. Rehearse practical teaching To let students be familiarized with the rules and principles of teaching, and to rehearse practical teaching in vocational or technical colleges. This should be carried out with advice and suggestions of supervisors to prepare students to undertake their duties in the future better. - In the last week students will summarize their practical training and submit the report to the parties concerned.
	Final Paper(6 weeks)	4	To know and understand the science of research writing, to prove original and sources and other problems. To know how to find information and various approaches are parts of research writing. To be able to reference various literatures, summarize and elaborate information obtained from other sources. **Content:** Contents and title given by the units concerned, students themselves or by other parties must be involved with sciences for vocational education, specialization and training that are in line with the country's socio-economy.
	Optional subjects	**2**	
1	Special Problem of Vocational Education	2	To learn and understand the meaning and significance of the development and maintain learning-teaching media in accordance with the teaching content.

No.	Subject	Credits	Content of subject
			To know the meaning, significance and function of learning-teaching media for distance learning that uses computer networks for information and data communication. **Prerequisite**: 361TM321 1. Planning learning-teaching media for students' own specialization 2. Create contents of students' specialization to be posted in Website 3. Design Website

Annex 4: The curricula for VTE Mechanical Engineering and Electrial Engineering at Indonesia University of Education

1 Introduction to the curriculum of vocational teacher training in Electrical Engineering

1.1 Training Objectives (general objectives, specific objectives)

The general objective of Electrical Engineering Education is to produce undergraduates who are able to master technology within the field of electrical engineering and are capable of being professional teachers in the field of electro technology.

The specific objectives are:

a. To produce graduates who are experts in the field of electrical engineering education by having theory and practical skills, as well as research capabilities to develop professionalism in their field.

b. To produce graduates who are able to develop their knowledge by working with other institutions, both nationally and internationally.

c. To produce graduates who are able to teach professionally in the field of electrical engineering in secondary vocational schools (SMK: Sekolah Menengah Kejuruan) and be able to be instructors within the field of electrical engineering in companies or in training centres.

1.2 Duration of studies (standard duration)

The standard duration of a bachelor programme (S.1 : Strata 1) is 4 years, but it is also possible to complete the study programme within only 3.5 years if a student is very bright, works very hard, and has met all the requirements for graduation. The longest possible study duration is 5 years for this programme.

1.3 Structure and contents of the study programme

The study programme of Electrical Engineering Education is made up of 60 subjects (lectures, courses, etc.) grouped in 7 study areas:

a. The group of general subjects (General knowledge) includes 7 subjects worth 14 credits

b. The group of Faculty Expertise Subjects (Compulsory Subjects) includes 3 subjects worth 6 credits

c. The group of the study programme's expertise subjects (Compulsory Subjects) includes 33 subjects.

d. The group of a concentration's elective expertise subjects (Optional Subjects) contains 13 subjects.

e. The group of basic profession subjects (pedagogical knowledge) includes 5 subjects

f. The group of Expertise Subjects of the profession's study field (Pedagogical knowledge) is made up of 4 subjects

g. The group of Professional Training Subjects contains only 1 subject worth 4 credits

Details on the study areas and the respective subjects are given in the detailed curriculum structures of Electrical Engineering Education bellow.

1.4 Enrollment

Students in Electrical Engineering Education come either from general high school or from secondary vocational school. To be accepted into the study programme they have to pass a number of selection steps and test/ examinations, which among others include a pre-selection based on data of their achievements in school (scores of the national school leaving examination), academic exams, a physical test, an interest and aptitude test, and.

1.5 Training process and graduation requirements

According to UPI regulations for academic subjects, each semester last 16 weeks and includes 14 weeks of face-to-face (classroom teaching) sessions as well as 2 weeks for the midterm exams and the end of the semester exams. Each course carries between 2 and 4 credits.

1. For lectures and seminars 1 credit is defined based on the weekly workload for three kinds of activities as follows:
    a. For Students:
        i. 50 minutes (1 teaching hour) face to face event scheduled by lecturers, for example in the form of a lecture.
        ii. 60 minutes of structured academic activities, i.e. work initiated by lecturers, which is not scheduled for a specific time, for example in the form of homework assignments.
        iii. 60 minutes of independent learning activities, such as literature study.
    b. For Lecturers:
        i. 50 minutes face to face teaching with students;
        ii. 60 minutes of structured academic planning and evaluation
        iii. 60-minutes lecture material development.
2. For laboratory work, field work, and research 1 credit is defined as equivalent

a. For laboratory work, weekly scheduled experimental activities in the laboratory is 3 x 60 minutes, and plus 60 minutes structured academic activities.

b. For field work, 1 credit is equivalent to 4 x 60 minutes workload per week for one semester.

c. For research work / thesis writing 1 credit is assumed to be equivalent to a workload of 3 x 60 minutes a day for 25 days.

1.6 Assessment

Students have to sit tests for individual courses as well as the final programme examination. For each course (subject) there are a compulsory mid-semester exam and a final exam, as well as other examination and test assigments which are given by the lecturer wo teaches the subject. Mid-term and final tests follow set out in the University's evaluation system. The final programme examination at the end of the study programme includes writing a final paper (Skripsi) and defending the paper in front of an examination board. Upon successfully passing the final programme examination the graduate is awarded a bachelor degree (S1: Strata 1).

1.7 The Curriculum

1. The curriculum of UPI's bachelor programme in Electrical Engineering Education is structured in 6 sudy areas.
    a. General Courses (MKU) aim at developing the personality aspect of the students as individuals and members of the community;
    b. Expertise Subjects (MKK) aim at developing students' ability in mastering subject area/discipline-related skills;
    c. Expertise Subjects courses are further divided into Faculty Expertise Subjects and Study Programme Expertise Subjects.
    d. The major part of the Study Programme Expertise Subjects (MKK) are mandatory (77 credits) and some are elective (16 credits);
    e. Profession Courses (MKP) aim to develop educational professional competences.
    f. The final paper (Skripsi) is the final project (paper) which is intended to develop the students' abilities in scientific work and research.
2. The volume of individual courses (subjects) ranges from 2 to 4 credits (for the definition of a credit see above), except for the final paper which carries a value of 6 credits.
3. The complete bachelor programme carries 144 to 150 credits with the following components:
    a. General Courses (MKU) with 14 credits
    b. Expertise Subjects with 100 -106 credits

c. Pedagogical subjects with 30 credits

d. Professional Teacher Training Programme with 4 credits. This is an internship programme in a vocational school for one semester, in which students have to act as teacher, prepare and deliver teaching lessons, evaluate students' activities in class room, etc..

1.7.1 Curriculum Structure of Electrical Engineering Education

The S1 or bachelor programme in Electrical Engineering Education (PTE : Pendidikan Teknik Elektro) is designed to be studied within eight semesters and comprises a total of 150 credits, including General Subjects (14 credits), Expertise Subjects (106 credits), Profession Basic Subjects (12 credits), and Profession expertise Subjects (14 credits) and Profession Training Subjects (4). This curriculum refers to the national curriculum of Electrical Engineering and complemented by a number of local elements that constitute 3 concentrations/majors, namely Electric Power Technical Education (PTTE / Pendidikan Teknik Tenaga Elektrik)), Industrial Electronics Technical Education (PTEI / Pendidikan Teknik Elektronika Industri), and Telecommunication Technical Education (PTTK / Pendidikan Teknik Telekomunikasi) at the Department of Electrical Engineering Education, Faculty of Vocational and Technology Education, Indonesia University of Education (UPI) .

Curriculum Structure of Electrical Engineering Education:

General Subjects	14 credits
Expertise Subject (Skills Subjects)	93 credits
Elective subjects	13 credits
Profession Basic subjects	12 credits
Profession Expertise Subjects	14 credits
Profession Training Subjects	4 credits

The details of the curriculum which is designed for 8 semesters (4 years), are the following:

No.	Code	Subject	Credits	Semester							
				I	II	III	IV	V	VI	VII	VIII
I.	**Groups of General Subjects**										
1		Religion Education	2								
2		Citizenship Education	2								
3		Indonesian Language	2		x						
4		PLSBT	2			x					
5		Religion Educational Seminar	2		x						
6		Sport and Physical Education	2								
7		Real Work Lecture	2						x		
II.	**Groups of Faculty Expertise Subjects**										
1	TK100	English Language	2	x							

No.	Code	Subject	Credits	Semester							
				I	II	III	IV	V	VI	VII	VIII
2	TK102	Introductory of Vocational and Technological Education	2			x					
3	TK101	Basic Mathematics	2	x							
III.	**Groups of Expertise Subjects on Study Programme**										
	A. Together Semester (semester 1 – semester 3)										
1	EL 100	Basic Physics I	3	x							
2	EL 101	Fundamental of Electrical Engineering	3	x							
3	EL 102	Electrical Design Basis	2	x							
4	EL 106	Energy and Conversion	2			x					
5	EL 103	Engineering Mathematics I	3		x						
6	EL 104	Basic Physics II	3		x						
7	EL 105	Electric Circuit I	3		x						
8	EL 106	Basic Computer and Programming	3								
9	EL 202	Engineering Mathematics II	3			x					
1	EL 203	Material Physics	2			x					
11	EL 204	Probability and Statistics	3			x					
12	EL 205	Electric Circuit II	3			x					
	B. Selection Path for Telecommunication Technical Education										
13	EL 201	Measurement Methods	2				x				
14	EL 206	Industrial management	2				x				
15	EL 207	Electromagnetic Field I	3				x				
16	EL 301	Telecommunication Networks	3						x		
17	EL 208	Signals and Systems	2				x				
18	EL 209	Fundamental of Electronic	3				x				
19	EL 210	Digital Technique	3				x				
20	EL 211	Electrical Basic Practicum	2				x				
21	EL 302	Linear System Synthesis	2					x			
22	EL 303	Microprocessor System	2					x			
23	EL 305	Electromagnetic Field IIB	2					x			
24	EL 314	Control Systems	3					x			
25	EL 306	Digital Signal Processing	3					x			
26	EL 307	Telecommunication Engineering Labs I	2					x			
27	EL 401	Transmission Line	2							x	
28	EL 408	Telecommunication Engineering Labs II	2						x		

No.	Code	Subject	Credits	Semester							
				I	II	III	IV	V	VI	VII	VIII
29	EL 402	Telecommunication electronics	2					x			
30	EL 510	Telecommunication Engineering Labs III	2							x	
31	EL 509	Industrial Practices	2							x	
32	EL 60	Final project	4							x	
33	EL 601	Education Thesis	6								x
34	EL 602	Final Examination									X
	C. Selection Path for Industrial Electronic Technical Education										
35	EL 206	Industrial management	2				x				
36	EL 207	Electromagnetic Field I	3				x				
37	EL 200	Numerical Analysis	2				x				
38	EL 208	Signals and Systems	2				x				
39	EL 209	Electronic Fundamental	3				x				
40	EL 210	Digital Technique	3				x				
41	EL 211	Electrical Fundamental Practicum	2				x				
42	EL 310	Power Electronics	2					x			
43	EL 314	Control Systems	3					x			
44	EL 311	Electronics Measurement	2					x			
45	EL 312	Advanced Electronics	3					x			
46	EL 313	Advanced Digital Technique	2					x			
47	EL 308	Industrial Electronic Engineering Labs I	2					x			
48	EL 303	Microprocessor System	2					x			
49	EL 411	Electronic System Design	3						x		
5	EL 409	Industrial Electronic Engineering Labs II	2						x		
51	EL 402	Telecommunication electronics	2						x		
52	EL 511	Industrial Electronic Engineering Labs III	2							x	
53	EL 509	Industrial Attachment	2							x	
54	EL 60	Final project	4							x	
55	EL 601	Education Thesis	6								x
56	EL 602	Final Examination									X
	D. Selection Path on Electric Power Technical Education										
57	EL 21	Measurement Methods	2				x				
58	EL 206	Industrial management	2				x				
59	EL 27	Electromagnetic Field I	3				x				

No.	Code	Subject	Credits	Semester							
				I	II	III	IV	V	VI	VII	VIII
60	EL 200	Numerical Analysis	2					x			
61	EL 208	Signals and Systems	2				x				
62	EL 209	Electronic Fundamental	3				x				
63	EL 315	Electric Machinery I	3					x			
64	EL 211	Electric Fundamental Practicum	2				x				
65	EL 310	Power Electronics	2					x			
66	EL 314	Control Systems	3					x			
67	EL 304	Electromagnetic Field IIA	2					x			
68	EL 316	Electrical Installation Technique	3				x				
69	EL 303	Microprocessor System	2					x			
70	EL 39	Electrical Power Engineering Labs I	2					x			
71	EL 417	Electric Machinery II	3						x		
72	EL 410	Electrical Power Engineering Labs II	2						x		
73	EL 418	Power System Analysis	3							x	
74	EL 512	Electrical Power Engineering Labs III	2							x	
75	EL 509	Industrial Attachment	2							x	
76	EL 600	Final project	4							x	
77	EL 601	Education Thesis	6								x
78	EL 602	Final Examination									X
IV	**Group of Expertise Subjects for Concentration Selection**										
	A. Selection Path for Telecommunication Technical Education										
1	EL 403	Analog Communication System	3						x		
2	EL 404	Digital Communication Systems	3						x		
3	EL 405	Traffic Engineering	3						x		
4	EL 406	Antenna and Propagation	2						x		
5	EL 407	Transmission Line	2						x		
6	EL 501	Satelit and Terestrial System Design	2						x		
7	EL 502	Data Communication	2							x	
8	EL 503	Multimedia Information System	2							x	
9	EL 504	Planning Computer-aided	2							x	
1	EL 505	Project handling Technique	2							x	
11	EL 506	Telephone and Switching Digital	2							x	
12	EL 507	Wireless System for fixed and mobile	2							x	

No.	Code	Subject	Credits	Semester							
				I	II	III	IV	V	VI	VII	VIII
13	EL 508	Entrepreneurship	2							x	
	B. Selection Path for Industrial Electronic Technical Education										
14	EL 502	Data Communication	2						x		
15	EL 517	Information Technology	2						x		
16	EL 508	Entrepreneurship	2						x		
17	EL 512	Introduction to Robotics	2						x		
18	EL 513	Biomedical Electronic	2							x	
19	EL 514	Digital Control System	2							x	
20	EL 515	Computer System Architecture	2							x	
21	EL 516	Intelligent Instrumentation Systems	2							x	
	C. Selection Path for Electric Power Technical Education										
22	EL 520	Electrical Power Plant	2						x		
23	EL 521	Engineering Economics	2						x		
24	EL 522	Power System Stability and Reliability	2						x		
25	EL 523	Power Transmission and substation	2						x		
26	EL 508	Entrepreneurship	2						x		
27	EL 524	Computer Application on Electric Power System	2							x	
28	EL 525	Electric Drive Control	2							x	
29	EL 526	Industrial Measurement & Instrumentation	2						x		
30	EL 527	Electric Machineries Design	2							x	
31	EL 528	Introduction to Artificial Intelligent	2							x	
32	EL 529	Over Voltage Protection	2							x	
33	EL 530	Insulation Technology	2							x	
34	EL 531	Power System Operation	2							x	
V.	**Groups of Profession Basic Subjects**										
1		Educational Foundation	2	x							
2		Development Of Learners	2		x						
3		Guidance And Counseling	2		x						
4		Curriculum And Learning	3			x					
5		Processing Education	3				x				
VI.	**Groups of Expertise Subjects for study field Profession**										
1	PL 30	Teaching And Learning	4					x			

No.	Code	Subject	Credits	Semester							
				I	II	III	IV	V	VI	VII	VIII
		Strategies									
2	PL 301	Evaluation Of Education	4						X		
3	PL 501	Planning Of Teaching	3							x	
4	PL 500	Educational Research	3						x		
VII.	**Groups of Profession and Training Subjects**										
1	PL 600	Field Experience Programme	4								X
TOTAL CREDITS			**150**	20	2	2	2	2	2	2	1

1.7.2. Description

No.	Code	Subject	Credits	Descriptions
I.	**Groups of General Subjects** *(MKU / Kelompok Mata Kuliah Umum (MKU)*			
1	KU 100	Religion Education	2	This is discussed in the lecture material Methodology Understanding of Islam; People, Religion and Islam: Al-Quran Understanding and went; Hadith as a Source of Islamic teachings; Ijtihad In Sources and Methodology of Islamic Law; Tauhidullah: Living with the Presence of God; Remembrance, prayer and ruling; Love, Morals, and Amal Salih; Amar Ma'ruf Nahyi Munkar and Jihad;-stream flow of theology in the Islamic concept of education in Islam; Concept educator in a private form of Islam, and family as the core vehicle realization of education.
2	KU 105	Citizenship Education	2	This lecture discusses the essence of PKN (foundation of philosophical, historical, Vision, Mission, Goals, Competence Centre), dynamics of the National State, and the philosophy of Pancasila as the State Association, Berkonstitusi Awareness, Rights and Duties of Man base, awareness of democracy, geopolitics and geostrategi Indonesia , Politics and the National Strategy, the Local Development

No.	Code	Subject	Credits	Descriptions
				Framework Homeland
3	KU 106	Indonesian Language	2	This course is a personal development course in the Indonesian language. After following this course students are expected to be able to (1) use Indonesian to enrich the mind, ideas, and have a scientific attitude to the various forms of scientific work quality (qualified objectivity, coherence, cohesion, effectiveness, efficiency, and communicative), (2) edited by critically analyze and refine scientific papers based on the results of edits; (3) use of language proficiency in Indonesia to develop themselves throughout their lifetime. Lectures are held by the communicative approach and contextually through technical discussions, exercises, and presentations.
4	KU 107	PLSBT	2	This lecture discusses human in a social context or humans as social beings who reveal individual development starting within the family unit, from that unit up to a wider audience. in the main it explores the role of values, moral, and legal, social interaction, social groups, social processes of social change and development. It also discusses problems of human problems in the context of culture, science technology and human interaction with the environment.
5	KU 300	Religion Educational Seminar (Seminar Pendidikan Agama)	2	Grammar; structure; composition; writing; etc.
6	KU 108	Sport and Physical Education (Pendidikan Jasmani Dan Olahraga)	2	Health Sports (Sports Medicine) discusses all aspects of medical and sports ranging from aspects of anatomical, physiological, sports psychological health,

No.	Code	Subject	Credits	Descriptions
				governance nutrition, aklimasisasi, competitive sports injury prevention, treatment at injury, recovery of the Fisk after recovering from injury and the degree of one or more P3K on sports injuries, sport on children, on women's sport, sports the elderly, rehabilitation, massage.
7	KU 400	Real Work Lecture (KKN / Kuliah Kerja Nyata)	2	
II.	Groups of Faculty Expertise Subjects (MKK / Kelompok Mata Kuliah Keahlian Fakultas			
8	TK100	English Language	2	Introduced a few phrases and usage, the term mathematics and geometry, electrical and electronics terms. Do exercises on how to read text books and translate them.
9	TK102	Introductory of Vocational and Technological Education	2	This covers the basics of vocational education, vocational education models, examples of vocational learning.
1	TK101	Basic Mathematics	2	The concepts covered include: Introduction, functions, limits, derivatives, use, integral, and use of integral.
III.	**Groups of Expertise Subjects on Study Programme**			
	A. Semester Bersama (semester 1 – semester 3)			
11	EL 100	Basic Physics I	3	Vector. Uniform rectilinear motion. Uniformly accelerated motion. Uniform circular motion. Effort and energy. Transverse and longitudinal waves. Sound waves. Light waves. Lenses and optical instruments. Thermodynamics.
12	EL 101	Fundamental of Electrical Engineering	3	Introduction to Electrical Engineering. Fundamentals of electric circuits. Response to a series of back and forth in steady state conditions. Introduction to the system. Basic electronics. Basic semiconductor electronic components. Introduction to network analysis. Basic digital electronics and microprocessors. OP-Amp amplifier.

No.	Code	Subject	Credits	Descriptions
13	EL 102	Electrical Design Basis	2	
14	EL 106	Energy and Conversion	2	Understanding of energy, energy consumption, energy sources. The introduction of power system equipment, transmission and distribution of electrical energy. Utilization of electrical energy. Basic electric power, all kinds of electric motors, electric generators. Hydropower base. Thermic power / steam. Otto and diesel cycle. Cycle gas turbines and combined cycles. With conventional power generation. Patterns and the availability of national and world energy consumption.
15	EL 103	Engineering Mathematics I	3	Ordinary Differential Equations, Laplace transform, matrix and determinants, Linear Systems of Equations, Complex Numbers, Taylor series, Fourier series
16	EL 104	Basic Physics II	3	Electrostatics. Electrical circuit elements. Direct current. Magnetic field. Induced emf. Current and voltage back and forth. Theory of relativity and atomic models. Nuclear physics.
17	EL 105	Electric Circuit I	3	Fundamentals of electrical circuit analysis, electrical circuit components, law-legal electric circuit, simplifying the circuit, the method of settlement of the circuit, circuit theorems, waveform, sinusoidal waveform, forced response, the average price and price effective, meter readings, calculations single phase power, and dual analogue.
18	EL 106	Basic Computer and Programming	3	This course discusses the computer system (software, hardware and brain ware), basic programming, programme design techniques, know specific programming languages (Pascal, C, etc..), And analyzing the results.

No.	Code	Subject	Credits	Descriptions
19	EL 202	Engineering Mathematics II	3	This course discusses the basic mathematical concepts to be applied to engineering problems mainly related to electrical engineering which involve complex numbers, infinite series, systems of linear equations and matrices, determinants, partial differential and integral folding.
2	EL 203	Material Physics	2	Classification of materials. Conductor materials. Superconducting materials. Semiconductor materials. Insulator material. Dielectric material. Polar and non polar materials. Magnetic materials. Materials for special purposes. The means of making electrical equipment.
21	EL 204	Probability and Statistics	3	Definition of random variables, probability distribution, mathematical expectations of order I and II, permutations, combinations, probability distribution 2 variables, parameters and statistics of the difference between the 2 variables, estemasi values, hypothesis testing and statistical depiction
22	EL 205	Electric Circuit II	3	Three-phase, three-phase power measurement system, frequency response, transformers, circuit pole 4, a series of first order, second order circuits, excitation at natural frequency, operational amplifier.
	B. Selection Path for Telecommunication Technical Education *(Jalur Pilihan Pendidikan Teknik Telekomunikasi / PTTK)*			
23	EL 201	Measurement Methods	2	Unit and scale. Standards and calibration. Errors and statistical analysis of data. Basic measuring tools. Various kinds of meter. Instrument electronics. Measurement of electrical quantities.
24	EL 206	Industrial management	2	Basic understanding and development management, process management, principles of work organization. Aspects

No.	Code	Subject	Credits	Descriptions
				of human resources, product development related to the strategic dimensions of technology. The basics of the evaluation of investment plans, preparation of financial flows, the concept of time value of money, relationships various factors of interest. The determination of production costs, the analysis points recoup the economic analysis with consideration of risk. Project management/production, project planning/production, project scheduling/production, network basics, CPM, and PERT analysis.
25	EL 207	Electromagnetic Field I	3	Introduction to Mathematical Theory of Field (coordinate systems, gradient, divergence curl; integral Gauss: Stokes integral), Coloumb interaction style, line style of the flux and Gauss's law, Divergence, electric potential, capacitance and capacitors, Ampere's Law, Faraday's Law, Henry's Law, and inductor inductance, Maxwell's equations of electricity and magnetism
26	EL 301	Telecommunication Networks	3	Development of telecommunications networks. Network architecture. Transmission media: copper, fibre, radio frequency. Non-digital technology and digital switching. Telecommunications terminal equipment: telephone, facsimile, multimedia terminals. Planning of telecommunication networks: Topology, numbering, routing, signaling. Introduction to data communications. IP networks, Frame relay and ATM. Network management.
27	EL 208	Signals and Systems	2	Introduction to Signals, Introduction to System, Differential and Diferensi system, System State, Theory of Decomposition and Fourier series, Laplace transform and

No.	Code	Subject	Credits	Descriptions
				Z, some applications
28	EL 209	Fundamental of Electronics	3	This discusses the introduction of a system that includes system engineering, block diagrams, feedback circuits, transfer functions, block diagram algebra, Bode diagram; cathode ray tube (CRT), a semiconductor diode, transistor-transistor and the introduction of IC manufacturing process, transistor-transistor , amplifier-amplifier; that includes theory, equations, calculations, analysis, and design.
29	EL 210	Digital Technique	3	Number system and linear codes. Boolean algebra. The concept of logic, logic gates. Minimization function. Karnaugh Map. Design a combinational circuit. Adder, multivibrator, registers, memory, converter. Synchronous sequential circuits. Introduction to asynchronous sequential circuits
30	EL 211	Electrical Basic Practicum	2	Basic Physics of Electrical Engineering Series of Electric Circuits II Electricity I Method of Measurement
31	EL 302	Linear System Synthesis	2	Basic circuit synthesis, method of approach Butterworth, Chebychev, Bessel, Frequency Transformation, Synthesis of analogue filters that are passive, passive analogue filter synthesis.
32	EL 303	Microprocessor System	2	Interface with digital devices, interface with analog device, interface with high voltage devices, Analogue to Digital Converter, Digital to Analogue Converter Basic. Basis, parts, and the workings of the microprocessor; micro-processor technology and development.; Microprocessor 8 bit, 16 bit and 32 bit; microprocessor system components and interfaces, bebarapa range of microprocessor systems and applications.
33	EL	Electromagnetic Field IIB	2	Changed the field and Maxwell equations.

No.	Code	Subject	Credits	Descriptions
	305			Transfer law. The use of the press. Maxwell on the propagation of waves, skin effect, pointing vector, reflection, SWR, the polarization of the wave. Wave propagation on transmission lines. Wave propagation in the waveguide, the TE mode, TM mode.
34	EL 314	Control Systems	3	Definition and control system elements. Categories of control system. Control system applications. The mathematical model. Analysis of the characteristics of the control system. Root Locus technique. Nyquist plot and stability criteria Niquist. Control system design. The use of MATLAB in the analysis of control systems. The types of controllers in the industry.
35	EL 306	Digital Signal Processing	3	Discrete time systems. Transformation Z. Planning an analogue filter. Planning a digital filter. Realization of digital filters. Discrete Fourier transform.
36	EL 307	Telecommunication Engineering Labs I	2	Digital Techniques Electronics Telecommunications Network
37	EL 401	Transmission Line	2	The introduction of the channel construction of two parallel wires, coaxial, microstrip, the optical fibre. Channel parameters, the primary constants, loop impedance, parallel capacitance, skin effect, the channel equation. Homogeneous channel, the concept of reflection and standing waves. Disability channel. Imposition of telephone cable, optimum and maximum power transfer, good cross-channel measurements. / 4.λOpen channel and a short connecting channels, channels with any cover, transformer Smith shart, SWR. Single stub, double stub.

No.	Code	Subject	Credits	Descriptions
38	EL 408	Telecommunication Engineering Labs II	2	Digital Signal Processing Control System Analogue Communications System Digital Communications System
39	EL 402	Telecommunication electronics	2	High frequency amplifier: S parameter, strengthening, stability, low noise amplifier, power amplifier class. Mixer: characteristics, the types of mixer diode, transistor mixer types. High Frequency Filter: filter types, Butterworth filter, filter Tchebyscheff. High frequency oscillators: oscillation conditions, a variety of oscillator circuit, a negative resistance oscillator. Frequency Synthesizers: phase locked loop, fractional division N PLL synthesis, direct digital syntesis.
40	EL 510	Telecommunication Engineering Labs III	2	Basic Transmission Line System Microprocessor Antennas and propagation of Electronics Telecommunications Transmission System
41	EL 509	Industrial Practices	2	
42	EL 60	Final project	4	
43	EL 601	Education Thesis	6	
44	EL 602	Final Examination		
	C. Selection Path for Industrial Electronic Technical Education			
45	EL 206	Industrial management	2	Basic understanding and development management, process management, principles of work organization. Aspects of human resources, product development related to the strategic dimensions of technology. The basics of the evaluation of investment plans, preparation of financial flows, the concept of time value of money, relationships various factors of interest. The determination of production costs, the analysis points recoup the

No.	Code	Subject	Credits	Descriptions
				economic analysis with consideration of risk. Project management/production, project planning production, project scheduling/production, network basics, CPM, and PERT analysis.
46	EL 207	Electromagnetic Field I	3	Introduction to Mathematical Theory of Field (coordinate systems, gradient, divergence curl; integral Gauss: Stokes integral), Coloumb interaction style, line style of the flux and Gauss's law, Divergence, electric potential, capacitance and capacitors, Ampere's Law, Faraday's Law, Henry's Law , and inductor inductance, Maxwell's equations of electricity and magnetism
47	EL 20	Numerical Analysis	2	Introduction. Computer calculations and calculation errors. Systems of Linear Equations. Interpolation. Numerical integration. Linear Least Squares regression. Non-Linear Equations. Ordinary Differential Equations.
48	EL 208	Signals and Systems	2	Introduction About Signals, Introduction About System, Differential and Diferensi system, System State, Theory of Decomposition and Fourier series, Laplace transform and Z, a few applications
49	EL 209	Fundamental of Electronic	3	This discusses the introduction of a system that includes system engineering, block diagrams, feedback circuits, transfer functions, block diagram algebra, Bode diagram; cathode ray tube (CRT), a semiconductor diode, transistor-transistor and the introduction of IC manufacturing process, transistor-transistor , amplifier-amplifier; that includes theory, equations, calculations, analysis, and design.
50	EL 210	Digital Technique	3	Number system and linear codes. Boolean algebra. The concept of logic, logic gates.

No.	Code	Subject	Credits	Descriptions
				Minimization function. Karnaugh Map. Design a combinational circuit. Adder, multivibrator, registers, memory, converter. Synchronous sequential circuits. Introduction to asynchronous sequential circuits
51	EL 211	Electrical Fundamental Practicum	2	Basic Physics of Electrical Engineering Series of Electric Circuits II Electricity I Method of Measurement
52	EL 310	Power Electronics	2	Components of the semi-conductor, pelbagi converters and its application, the system pelbagi rectifier, inverter, DC choper, etc., how the anatomical characteristics and how they control.
53	EL 314	Control Systems	3	Definition and control system elements. Categories of control system. Control system applications. The mathematical model. Analysis of the characteristics of the control system. Root Locus technique. Nyquist plot and stability criteria Niquist. Control system design. The use of MATLAB in the analysis of control systems. The types of controllers in the industry.
54	EL 311	Electronics Measurement	2	And measurement errors, measurement systems, measurement standards, instruments of direct current pointer, pointer instruments alternating current, principles and applications of the potentiometer, the application of DC and AC bridge circuit, oscilloscope, electronic instruments for measuring voltage, current, and resistance and other parameters , instrument for waveform analysis.
55	EL 312	Advanced Electronics	3	MOS transistor technology: making the rules and layout of MOS transistors, MOS transistor models. Large signal models, small signal models, SPICE parameter.

No.	Code	Subject	Credits	Descriptions
				Amplifier is simple: the transconductance amplifier, voltage amplifier with active load, source follower amplifier, differential amplifier. Current source, current mirror, voltage operational amplifier. Model and characteristics. Operational voltage amplifier design.
56	EL 313	Advanced Digital Technique	2	Characteristics of digital devices, System Numbers, Boolean Algebra, Minimization, Synchronous sequential circuit, Introduction to Asynchronous circuit.
57	EL 308	Industrial Electronic Engineering Labs I	2	Electronics Digital Techniques Prerequisites: Courses related
58	EL 303	Microprocessor System	2	Interface with digital devices, interface with analog device, the interface with high voltage devices, Analogue to Digital Converter, Digital to Analogue Converter Basic. Basis, parts, and the workings of the microprocessor; micro-processor technology and development.; Microprocessor 8 bit, 16 bit and 32 bit; microprocessor system components and interfaces, bebarapa range of microprocessor systems and applications.
59	EL 411	Electronic System Design	3	The design methodology; Description of VHDL; behavioral level circuit models; design of the architecture, design of the circuit; implementation techniques.
6	EL 409	Industrial Electronic Engineering Labs II	2	Advanced electronic control systems Digital Techniques Advanced Sensor and transducer
61	EL 402	Telecommunication electronics	2	High frequency amplifier: S parameter, strengthening, stability, low noise amplifier, power amplifier class. Mixer: characteristics, the types of mixer diode, transistor mixer types. High Frequency Filter: filter types, Butterworth filter, filter

No.	Code	Subject	Credits	Descriptions
				Tchebyscheff. High frequency oscillators: oscillation conditions, a variety of oscillator circuit, a negative resistance oscillator. Frequency Synthesizers: phase locked loop, fractional division N PLL synthesis, direct digital syntesis.
62	EL 511	Industrial Electronic Engineering Labs III	2	Microprocessor System Design system Elka Power Electronics System instrumentation
63	EL 509	Industrial Attachment	2	
64	EL 60	Final project	4	
65	EL 601	Education Thesis	6	
66	EL 602	Final Examination		
	D. Selection Path on Electric Power Technical Education *(Pendidikan Teknik Tenaga Elektrik /PTTE)*			
67	EL 201	Measurement Methods	2	Unit and scale. Standards and calibration. Errors and statistical analysis of data. Basic measuring tools. Various kinds of meters. Instrument electronics. Measurement of electrical quantities.
68	EL 206	Industrial management	2	Basic understanding and development management, process management, principles of work organization. Aspects of human resources, product development related to the strategic dimensions of technology. The basics of the evaluation of investment plans, preparation of financial flows, the concept of time value of money, relationships various factors of interest. The determination of production costs, the analysis points recoup the economic analysis with consideration of risk. Project management/production, project planning/production, project scheduling/production, network basics, CPM, and PERT analysis.

No.	Code	Subject	Credits	Descriptions
69	EL 207	Electromagnetic Field I	3	Introduction to Mathematical Theory of Field (coordinate systems, gradient, divergence curl; integral Gauss: Stokes integral), Coloumb interaction style, line style of the flux and Gauss's law, Divergence, electric potential, capacitance and capacitors, Ampere's Law, Faraday's Law, Henry's Law , and inductor inductance, Maxwell's equations of electricity and magnetism
70	EL 200	Numerical Analysis	2	Introduction. Computer calculations and calculation errors. Systems of Linear Equations. Interpolation. Numerical integration. Linear Least Squares regression. Non-Linear Equations. Ordinary Differential Equations.
71	EI 473	Systems Engineering	2	Some basic understanding of the concept of systems and frameworks. The basis of the design process. Basics of systems analysis methodology, several alternatives and decision-making models in the engineering trade-off study. Miraculous economic evaluation models, optimization in design and operations, including reliability, concepts and control techniques. Some pre-requisites to the issue of operational feasibility; design reliability; can be operated, managed, supported, and economically viable. Management including project management system engineering: systems engineering planning, organization, direction and control, and management interface with consumers.
72	EL 208	Signals and Systems	2	Introduction About Signals, Introduction About System, Differential and Diferensi system, System State, Theory of Decomposition and Fourier series, Laplace transform and Z, a few

No.	Code	Subject	Credits	Descriptions
				applications
73	EL 209	Electronic Fundamental	3	This lecture discusses the introduction of a system that includes system engineering, block diagrams, feedback circuits, transfer functions, block diagram algebra, Bode diagram; cathode ray tube (CRT), a semiconductor diode, transistor-transistor and the introduction of IC manufacturing process, transistor-transistor , amplifier-amplifier; that includes theory, equations, calculations, analysis, and design.
74	EL 315	Electric Machinery I	3	The working principle of transformer, circuit and substitute equations, work characteristics, voltage regulation, parallel work, group of vectors, construction, classification of power transformers, current transformers, electromechanical energy conversion concepts, direct current engines, construction machinery direct current, motor step.
75	EL 211	Electric Fundamental Practicum	2	Basic Physics of Electrical Engineering Series of Electric Circuits II Electricity I Method of Measurement
76	EL 310	Power Electronics	2	Components of the semi-conductor, pelbagi converters and its application, the system pelbagi rectifier, inverter, DC choper, etc., how the anatomical characteristics and how they control.
77	EL 314	Control Systems	3	Definition and control system elements. Categories of control system. Control system applications. The mathematical model. Analysis of the characteristics of the control system. Root Locus technique. Nyquist plot and stability criteria Niquist. Control system design. The use of MATLAB in the analysis of control systems. The types of controllers in the industry.
78	EL	Electromagnetic Field IIA	2	This discusses Maxwell equations for

No.	Code	Subject	Credits	Descriptions
	304			electromagnetic fields, the use of electromagnetic wave phenomena in various media, the characteristics of electromagnetic waves, and its use in Communication Technology and Power Engineering.
79	EL 316	Electrical Installation Technique	3	Standardization and electrical installation requirements. Low voltage, medium and high. Equipment and materials in electrical installations. Loads in the installation. Circuit for the equipment and components. General provisions in the planning of electrical installations. Luminasi calculations on the room (the building), certain objects and paths. Calculation of the number of points of light in a room. Technique placement of the light point. Engineering division of a group of power distribution in the PHB. Calculation/planning the installation of capacitors. Planning the installation of the building/buildings. Perencaanaan installation of sports field. Perencaanaan power installations (electrical machinery). Mechanical installation of lightning rods.
80	EL 303	Microprocessor System	2	Interface with digital devices, interface with analog device, the interface with high voltage devices, analogue to Digital Converter, Digital to analogue Converter Basic. Basis, parts, and the workings of the microprocessor; micro-processor technology and development.; Microprocessor 8 bit, 16 bit and 32 bit; microprocessor system components and interfaces, bebarapa range of microprocessor systems and applications.
81	EL 309	Electrical Power Engineering Labs I	2	Cable splicing techniques, installation of electrical installations, memasangan power tools, installation Starting of

No.	Code	Subject	Credits	Descriptions
				electrical machines (holding self-control; forward reverse; star-delta)
82	EL 417	Electric Machinery II	3	Emf The three-phase asynchronous machines, synchronous generator characteristics, arch V, snag pole, polar cylinders in work settings, distributed windings, the onset field of play, building asynchronous machine, the generation of moments, moment-rotation curve, a single phase machine.
83	EL 410	Electrical Power Engineering Labs II	2	The use of electrical measuring instruments; calibration of electrical measuring instruments; manufacture of small transformers and test characteristics.
84	EL 418	Power System Analysis	3	Power system problems, Representation of power systems, reduction of Jala-nets, power flow analysis, economic operation of power systems, short circuit analysis, stability of power systems, symmetrical components.
85	EL 512	Electrical Power Engineering Labs III	2	Practice of electric power installations (electrical machinery); Practice kerakateristik measuring electrical machines, Practice PLC (programmable logic controller).
86	EL 509	Industrial Attachment	2	
87	EL 600	Final project	4	
88	EL 601	Education Thesis	6	
89	EL 602	Final Examination		
IV.	**Group of Expertise Subjects for Concentration Selection** *(Kelompok Mata Kuliah Keahlian / MKK) Pilihan Konsentrasi*			
	A. Selection Path for Telecommunication Technical Education *(Jalur Pilihan Pendidikan Teknik Telekomunikasi /PTTK)*			
90	EL 403	Analog Communication System	3	Element model and electronic communication system, communication

No.	Code	Subject	Credits	Descriptions
				patterns, electromagnetic spectrum, bandwidth. Analogue base band signal transmission. Modulation techniques: amplitude modulation, frequency modulation, generation methods, methods of detection. Transmitter and receiver system. Television signals. FDM. Noise: the power spectral meeting, the transmission of noise through a linear system. Performance of analogue communication systems, the influence of noise in analogue modulation systems.
91	EL 404	Digital Communication Systems	3	Model and elements of digital communication systems. Information and channel capacity. Converting analogue signals into digital signals and vice versa. Digital base band signal transmission. Digital modulation. This type of interference on digital transmission. Signal detection in noisy environments. Synchronization. Spread spectrum communication system.
92	EL 45	Traffic Engineering	3	Magnitude and variations of traffic. The basic theory of traffic: state diagram. Poisson distribution, Erlang distribution, Erlang formula. Congestion. Binomial distribution. Traffic overflowing, the method of Wilkinson. Link system, routing. Pendimensian network. Network performance evaluation. Wait for the system. Forecasting.
93	EL 406	Antenna and Propagation	2	Propagation of electromagnetic waves, propagation path, the use of radio communications. Definitions and characteristics of the antenna, the source point, Friis law, the short dipole, the impedance and impedance trailer. Antenna arrangement. Various kinds of antenna and its characteristics. Antenna

No.	Code	Subject	Credits	Descriptions
				measurements.
94	EL 407	Transmission Line	2	Principle Transmission: Transmission of analogue, digital transmission. analogue transmission systems: a carrier wave system, system of channels, multiplexing, terminal device, the device channel, multiple channels, and operational planning. Digital Transmission Systems: PCM, DPCM, DM, TDM. Physical layer, data link layer. Flow control, Error Detection and sorrection Modem FSK, PSK, QAM, physical and coding transmission protocol.
95	EL 501	Satelit and Terestrial System Design	2	Basic radio link, the Freshnell, factor-factor that affects the relationship of nature. The reliability factor, fading, diversity. Planning the successor station. Development of satellite communication system. Space systems. Segment of the earth, the structure of the network. Modulation and multiplexing. Trajectory calculations. Multiple access.
96	EL 502	Data Communication	2	OSI. Layers. Error correction. Flow control. LAN, access methods, token. Internet, X 25, and stream virtual circuit. Addressing techniques.
97	EL 503	Multimedia Information System	2	What and why is multimedia, what multimedia system. Type and multimedia components. The use of multimedia. Standards and the technology behind multimedia. Multimedia architecture and the pros and cons. Signal characteristics, signal processing and system standards in multimedia. Analysis and design.
98	EL 504	Planning Computer-aided	2	Know the design. Design in the field of electrical technology, electronics, telecommunications engineering. Systematically target system design and the features (characteristics) the relevant

No.	Code	Subject	Credits	Descriptions
				system. Know and review a variety of system design software available. These features range keelektroan system design software, advantages and disadvantages. The selection of one or more software for system design and selection of one or more cases of the system to be designed. Evaluation and testing techniques. Benchmarking of a system specification and design results.
99	EL 505	Project handling Technique	2	Orientation of projects in the field. Scale projects and programmes of the project. Organize a project. Planning, control, scheduling, financing, directing and evaluation and performance improvement projects. The introduction and application of tools: Software and hardware in handling the project.
10	EL 506	Telephone and Switching Digital	2	The use of digital signal for voice transmission. The use of digital switching in telephone networks. Principles, techniques, and development of digital transmission and switching in digital networks.
101	EL 507	Wireless System for fixed and mobile	2	Perkenbangan non-wire communications systems. Of communication. Mobile communications. Gelombamg and propagation characteristics. Damping. Cellular systems. Frequency reuse. Tues Control and switching systems. Modulation system is used.
102	EL 508	Entrepreneurship	2	The role of enterprise in society. Enterprise model, the type of business. Entrepreneurial behavior. Identification of new business opportunities, the process of starting a new business. Organization. Manage marketing activities, managing the company's financial, human resource management, managing production

No.	Code	Subject	Credits	Descriptions
				activities. Competition and industry. Development company. Direction of business development in the future.
103	EI 353	Sensor and Transducer	3	Electronics-based measurement system, red-out, trnasmisi, measurement data processing, static and dynamic characteristics and performance of the transducer, selection criteria, range of transducers (sensors, actuators, smart transducers, transducer-based micro-electronics).
104	EI 354	Mechatronics	2	Mechatronics, sensors and transducers, signal conditioners, measurement systems; pneumatic and hydraulic actuation systems, mechanical, electrical; a model system, the dynamic response, transfer function, closed loop control, microprocessor, PLC, communication systems, and mechatronics design.
	B. Selection Path for Industrial Electronic Technical Education *(Jalur Pilihan Pendidikan Teknik Elektronika Industri /PTEI)*			
105	EL 502	Data Communication	2	OSI. Layers. Error correction. Flow control. LAN, access methods, token. Internet, X 25, and stream virtual circuit. Addressing techniques.
106	EL 517	Information Technology (Teknologi Informasi)	2	Communications Technology data. Storage technology. User interface technology. Information acquisition system. Information processing systems (computers, Work station, Special Real time computer), the distribution system of information storage, performance, applications.
107	EL 508	Entrepreneurship	2	The role of enterprise in society. Enterprise model, the type of business. Entrepreneurial behavior. Identification of new business opportunities, the process of starting a new business. Organization. Manage marketing activities, managing

No.	Code	Subject	Credits	Descriptions
				the company's financial, human resource management, managing production activities. Competition and industry. Development company. Direction of business development in the future.
108	EL 512	Introduction to Robotics	2	Robot kinematic equations. Inverse kinematic solution. Robot dynamics equations with Lograng-Euler formulation, Newton Euler. Trajoktori planning.
109	EL 513	Biomedical Electronic (Elektronika Biomedika)	2	Basics of biomedical electronics, medical procedures. -Dasa basic medical electronics equipment. Bio-electric potential. Transducer and biomedical sensors. Operational amplifier and biomedical amplifier. Patient safety issues, electrical shock and microshock macroshock. Pengaaman tools and safety programme. The use of microprocessors and PC systems in the biomedical field.
11	EL 514	Digital Control System	2	Introduction. Digital Control Systems. Control issues. Disdrete-Time System and the a-Transform. Sampling and Reconstruction. Open Loop Discrete Time Systems. Closed Loop System. Characteristics of System Response Time. The stability analysis techniques. Interpretation of Frequency Response. Digital controller design.
111	EL 515	Computer System Architecture	2	The basic concept of computer system architecture. Mikrooperasi and transfers between registers. Design and computer organization, design of the control unit. Hirdwired and mikroprogramme. CPU and control programme. Stack, an interrupt status bit. RISC and CISC architectures. Computer arithmetic. Pipeline and vector processing. Organization of I / O: mode of transfer,

No.	Code	Subject	Credits	Descriptions
				priority interrupt, DMA, the processor I / O, serial and parallel communication. Organization of memory: the memory hierarchy, main memory, secondary memory, associative memory, cache memory, virtual memory.
112	EL 516	Intelligent Instrumentation Systems	2	The basic concept of the instrumentation system.: Sensors, processors, actuators, displays. Berkecerdasan artificial systems: an expert system, learning system, fuzzy system. The use of artificial intelligence in the system instrumentation: smart sensors, intelligent processor, actuator intelligent, smart communications systems, controlling active and intelligent manufacturing systems.
113	EK 463	Digital communication systems	3	Model and elements of digital communication systems. Information and channel capacity. Converting analog signals into digital signals and vice versa. Digital base band signal transmission. Digital modulation. This type of interference on digital transmission. Signal detection in noisy environments. Synchronization. Spread spectrum communication system.
	C. Selection Path for Electric Power Technical Education *(Jalur Pilihan Pendidikan Teknik Tenaga Elektrik /PTTE)*			
114	EL 520	Electrical Power Plant	2	Type of generation, construction, transmission, distribution, measurement, protection, AVR. Design, site selection, environmental aspects, cost calculation, the energy storage.
115	EL 521	Engineering Economics	2	Understanding of Engineering Economics Target engineering-economic studies Intangible factors and the factors considered in engineering economy Engineering and economic planning processes

No.	Code	Subject	Credits	Descriptions
116	EL 522	Power System Stability and Reliability	2	Introductory course material covers system reliability, maintenance, and the addition of units in the system as well as qualitative analysis kwantitaif system reliability calculation
117	EL 523	Power Transmission and substation	2	Transmission power: aspects of electric power distribution, power line components, transmission line parameters. Insulators, a ground wire, conductor configuration problems, structural and architectural interests of transmission. Substations: The type and rating of major equipment, substation support equipment, power system grounding, and transformer busbar protection system, power breaker equipment.
118	EL 508	Entrepreneurship	2	The role of enterprise in society. Enterprise model, the type of business. Entrepreneurial behavior. Identification of new business opportunities, the process of starting a new business. Organization. Manage marketing activities, managing the company's financial, human resource management, managing production activities. Competition and industry. Development company. Direction of business development in the future.
119	EL 524	Computer Application on Electric Power System	2	Technology-based power control system SCADA: basic functions, system software, system hardware configuration, the man-machine interface, SCADA systems, energy management system, distribution management system, customer automation, facility control center, a data communication system. Computer methods in power system analysis: basic principles, the equivalent circuit of the generator, transformer and per-unit system, the equivalent circuit, the

No.	Code	Subject	Credits	Descriptions
				parameters and performance of the transmission system, power flow analysis, analysis of disorders of balance, symmetrical components and the analysis of disorders of balance, stability .
120	EL 525	Electric Drive Control	2	Type of construction-type motor, an electric winding installation, operation control system of direct current motors, asynchronous, synchronous electronic, Motor Panel, install the motor, the motor and switching the safety component, in terms of size and setting selection.
121	EL 526	Industrial Measurement & Instrumentation	2	Classification and characteristics of the instruments, signal conditioning, conversion of non-electrical quantities into electrical systems, sensors and transducers, measurement of non electrical quantities, Basics of telemetry
122	EL 527	Electric Machineries Design	2	Recognition and understanding of the design, characteristics of small and very small motors, linear motors larger motors, Standard Specifications and Use of Motor
123	EL 528	Introduction to Artificial Intelligent	2	Development of Artificial Intelligence Technology This type of Artificial Intelligence Algorithms Artificial Intelligence Technology Excellence
124	EL 529	Over Voltage Protection	2	
125	EL 530	Insulation Technology	2	Development of the insulation of electrical equipment. Dielectric polarization, the types of polarization, the conduction current and the shift in isolation, polarization by space charge. Dielectric losses in insulation. Vacuum dielectric strength, dielectric strength of insulating gas, liquid insulation dielectric strength, dielectric strength of solid insulation.

No.	Code	Subject	Credits	Descriptions
				Dielectric diagnostics on the equipment.
126	EL 531	Power System Operation	2	In this lecture covered the basic concepts of operating electric power systems, modeling and simulation of economic dispatch.
127	ET 362	High Voltage Techniques	3	Definition of electric field, the magnitude and the basic equation, the calculation of the electric field, the mechanism of electricity through the gas, electricity transparent mechanisms in liquid and solid. Generation of high voltage, high voltage measurement, high voltage testing.
V.	**Groups of Basic Subjects (Kelompok Mata Kuliah Dasar Profesi /MKDP)**			
128	KD 300	Educational Foundation	2	In this lecture discussed the concept of the foundation and cornerstone of education, the concepthumans, the concept of education, philosophical foundations of education, psychological foundation educational, sociological and atrofologis foundation of education, education, the foundationhistorical education, and the juridical basis of education.
129	KD 301	Development Of Learners	2	1.orientation course 2. Insight into the psychological basis of education and professional education (the teaching profession, competence of teachers, professional teacher, problems and challenges of the future teachers) 3. The concept of the behavior of individuals (definition, types, theories, and the role of behavioral mechanisms education for behavior change) 4. The concept of individual development (understanding, principles, phase, direction and tasks development) 5. The process of cognitive development and language (including the

No.	Code	Subject	Credits	Descriptions
				understanding, characteristics, theories, issues and efforts to develop cognitive-language) 6. Social and moral development of individuals (including the understanding, characteristics, theories, problems and efforts in social and moral development) 7. The process of emotional development, personality, and of religious (including definition, characteristics, theories, problems and emotional aspects of development efforts, personality, religious) 8. Adolescent development and the Problem 9. Midterms 10. Students in learning psychological attributes (intelligence, aptitude and interest) 11. Psychological attributes of students in learning (motivation, attitudes, habits, and perception) 12. Observation of dynamic behavior of learners (projects) 13. Observation of dynamic behavior of learners (projects) 14. Presentation of project reports 15. End of semester exams
13	KD 302	Guidance And Counseling	2	The lecture discusses the concept of guidance and counseling includes understanding. Principles, and functions of guidance and counseling; guidance and counseling approaches include curative, and developmental; foundation of guidance and counseling psychology includes foundation, philosophical, religious, social, cultural, pedagogical basis and foundation of science and technology strategies and techniques of

No.	Code	Subject	Credits	Descriptions
				guidance and counseling ; the types of guidance and counseling services; the basics of understanding learners; learning-based guidance and counseling, and implementation of remedial teaching in diagnosis and subjects to which it aspires later.
131	KD 303	Curriculum And Learning	3	This course examines various theoretical and practical aspects related to curriculum and learning curriculum subjects related to art. This course serves to equip students with insight into the candidates' education and understanding of the concepts and practices related to curriculum and learning and can apply them in the learning process.
132	KD 304	Processing Education	3	Introduction Insights Management Association, Management Education Unit Education, Educational Leadership, Supervision of Education, Education Information Systems / Management, Curriculum Management, Management of Students, Personnel Management, Management of Educational Finance, Infrastructure Management, Relationship Management, and Public School Classroom Management.
VI.	**Groups of Expertise Subjects for study field Profession** *(Study Field Kelompok Mata Kuliah Keahlian Profesi /MKKP) Bidang Studi*			
133	PL 300	Teaching And Learning Strategies	4	This course examines and analyzes the nature and where the learning strategy, identifying various external factors, efforts to organize the learning of effective, efficient and directional aim to achieve optimal learning outcomes. Analyze the variables in the taxonomy of learning (learning objectives and characteristics of the study area, the constraints, the characteristics of the learner. Strtegi

No.	Code	Subject	Credits	Descriptions
				organizational learning, strategic learning delivery, learning management strategy).
134	PL 301	Evaluation Of Education	4	This course aims to provide professional skills for prospective student teachers PKN on a test basis, measurement and evaluation of educational and developmental assessment of children as human beings and citizens of a global life science and technology literacy.
135	PL 501	Planning Of Teaching	3	GBPP analyze curriculum and variations of this model lesson plans, syllabi and scenarios make learning-oriented field conditions, and simulate the PBM in small classes, and conducted observations on learning problems in school (outside of class time)
136	PL 500	Educational Research	3	Discusses the research, science, and knowledge of scientific research and scientific truth; the types of research; planning studies, and draft reports study.
VII.	**Groups of Profession and Training Subjects** *(Kelompok Mata Kuliah Latihan Profesi /MKLP)*			
137	PL 600	Field Experience Programme	4	In the Professional Training Programme (PLP) is a student (praktikan) studied directly in the school life, a way to interact with all members of the school both in the classroom or outside the classroom. Exercise Programme Profession conducted on the level of SMA / SMK. Activities undertaken by the students include: preliminary activities (orientation and adaptation), activities development (core training), and culminating activities (reporting and exams).

No.	Code	Subject	Credits	Descriptions
1		Calculus I	3	System of Real Numbers, Functions, Limit

No.	Code	Subject	Credits	Descriptions
				and continuity functions, derivatives and Uses, Integral and its use.
2		Calculus II	3	Partial derivatives, multiple integrals, transformation of coordinates, vector calculus, line integrals and surface integrals.
3		Technical Drawing	2	The introduction of drawing tools. Standardization of Fig. Geometry technique. AutoCad programming, use of Protel, Visio.
4		Computer Basics	2	Development and generation of computers. Computer hardware: the computer system configurations, the main processing unit, memory, the flow of information within a computer, input and output units. Computer software: operating systems, programming languages, compilers, software applications, introduction to computer networks, UNIX operating system.
5		Basic Programming	2	Programming algorithm: the concept of data types, sequence structure, record structure, the structure set, sequential file structures, dynamic structures, sorting, recursive algorithm. Programming: Pascal language, the language C.
6		Electronics	3	Amplifier bipolar transistor and FET amplifiers. Bias circuit, the signal model of large and small signals. Differential amplifier and amplifier rise with bipolar and FET transistors. Types of feedback and the feedback amplifier. Effect of feedback on amplifier characteristics. Operational amplifier and power amplifier. The power amplifier output stage distarsi. Wideband amplifier and power supply.
7		Basic Microprocessor System	2	Interface with digital devices, interface with analogue device, the interface with

No.	Code	Subject	Credits	Descriptions
				high voltage devices, Analogue to Digital Converter, Digital to Analogue Converter Basic. Basis, parts, and the workings of the microprocessor; micro-processor technology and development.; Microprocessor 8 bit, 16 bit and 32 bit; microprocessor system components and interfaces.
8		Synthesis of Linear Systems	2	Basic circuit synthesis, method of approach Butterworth, Chebychev, Bessel, Frequency Transformation, Synthesis of analog filters are passive, passive analogue filter synthesis.
9		Instrumentation System	3	Introduction. Sensors as well as aspects of the design and application. Pongkondisi signals as well as aspects of the design and application. Actuators. Analog and Digital Controllers.
10		Power Distribution System	3	Classification of Network Distribution Systems, Architecture distribution substation topology and configuration, modeling and working characteristics of the components in the distribution system for the analysis of power flow and short circuit problems, disorders of balance, Performance of air delivery channels and ground wires. Analysis of load characteristics, matrisial analysis, tissue distribution, job analysis for radial distribution network, reactive power compensation and voltage regulation of distribution networks, safety equipment and protection systems of distribution networks, the introduction of distribution SCADA system.
11		Sistem Protection	2	More voltage and current disturbances lebihpada power systems, principles of protection against overvoltage and insulation coordination in power systems,

No.	Code	Subject	Credits	Descriptions
				working principle-rele rele rele protection and coordination.
12		Application of Power Electronics Technology	2	UPS inverter emergency ystem resonance lamp (induction leating), static reactive power compensation, Harmonie Conditioners, PWM Rectifier, Power supply Special.
13		Power Cable Technology	2	The main characteristics of the power cable and its comparison to the conductivity of air, cable construction and electrical loading, mechanical and thermik in isolation, through the mechanism of the electrically insulating, dielectric losses as a function of voltage, the insulation on the cable, paper, oil, gas tap, the polymer; determination of the ability of the power distribution, power cord with a large conductivity, calculation of these losses, the forces acting on the cable, peenentuan fault location, direct current cables, standardization.
14		Instrumentation and Control for Power System	2	The role and development of instrumentation and control system. Components, control system specification standards. Kind of transducer, measuring transformers.
15		Aircraft Transportation System	2	The concept of electric trains. Electric train engine. Energy conversion. The concept of electrical automation train. Traction system. Motor generator system. Electrification of illumination. Protection. Generator electrical system. Traction. Analysis of railway electricity.

1.8 Laboratory / workshop Facilities

Department of Electrical Engineering Education in running the activity of teaching learning process is completed by laboratory for student practices, and also used for research by lecturers. Today Electrical Engineering Education has 9 laboratories, as seen on table 2 below:

Table 1.1: List of laboratories and workshops for Electrical Engineering Education

Major	Laboratories and workshops	Number
Electrical Engineering	Electrical Machines Lab	1
	Electrical High Voltage Lab	1
	Electrical Installation Lab	1
	Electrical Measurement Lab	1
	Basic Lab	1
	Telecommunication Lab	1
	Industrial technical lab	1
	Computer and Automation Lab	1
Total		9

Industrial Practices:

As a teacher for vocational education, the student should carry out practices in industry for three months (internship within related industry). The objectives of this activity is to ensure students know what is going on industry, students are demanded to do activities as employees, and thus gain great experience of the industry and it working. Students can do internship activities in: Textile industries, Aircraft industri (PT. DI : Perusahaan Terbatas Dirgantara Indonesia), State Electric company (PT. PLN: Perusahaan Terbatas Perusahaan Listrik Negara), etc.

2 Introduction to the curriculum of vocational teacher training in Mechanical Engineering Education

2.1 Training Objectives (general objectives, detailed objectives)

The general objective of Mechanical Engineering Education is to produce undergraduates capable of mastering technology within the field of mechanical engineering that can also be professional teachers in the field of mechanical technology.
The detailed objectives are:

a. To produce graduates that are experts in the field of mechanical engineering education possessing the theory and practical skills, equipped with research capabilities for developing professionalism in their field.

b. To produce graduates able to develop their knowledge by working with other institutions, both nationally and internationally.

c. To produce graduates who can teach professionally in the field of Mechanical engineering at secondary vocational schools (SMK: Sekolah Menengah Kejuruan) and that can work as instructors in the field of mechanical engineering in companies or in training centers.

2.2 Duration of studies (standard duration)

The standard duration of a bachelor programme (S.1 : Strata 1) is 4 years, but it is possible to complete the study programme within only 3.5 years if a student is very bright, works very hard, and meets all the requirements for graduation. The longest possible study duration is 5 years for this programme.

2.3 Curriculum Structure and contents of the study programme

The study programme of Mechanical Engineering Education specially Concentration of Production and Construction is made up of 82 subjects (lectures, courses, etc.) worth 150 credits total, grouped in 7 study areas:

a. The group of general subjects (General knowledge) includes 7 subjects worth 14 credits.

b. The group of Faculty Skill Subjects (Compulsory Subjects) includes 3 subjects worth 6 credits.

c. The group of the Study Programme's Skill Subjects (Compulsory Subjects) includes 4 subjects worth 86 credits.

d. The group of a concentration's elective subjects (Optional Subjects) contains 16 subjects, student take 16 credits.

e. The group of profession basic subjects (pedagogical knowledge) includes 5 subjects, worth 12 credits.

f. The group of profession Skill Subjects is made up of 5 subjects worth 12 cerdits.

g. The group of Professional Training Subjects contains only 1 subject worth 4 credits.

Details on the study areas and the respective subjects are given in the detailed curriculum structures of Mechanical Engineering Education below.

2.4 Enrollment

Students in Mechanical Engineering Education come either from general high school or from secondary vocational school. For being accepted into the study programme they have to pass a number of selection steps and test/examinations, which include a pre-selection based on data on their achievements in school (scores of national school leaving examination), academic exams, a physical test, an interest and aptitude test, and.

2.5 Training process and graduation requirements

According to UPI regulations for academic subjects, each semester lasts 16 weeks and includes 14 weeks of face-to-face (classroom teaching) sessions as well as 2 weeks for the midterm exams and the end of the semester exams. Each course carries between 2 and 4 credits.

(1) For lectures and seminars 1 credit is defined based on the weekly workload for three kinds of activities as follows:

c. For Students:

i. 50 minutes (1 teaching hour) face to face event scheduled by lecturers, for example in the form of a lecture.

ii. 60 minutes of structured academic activities, i.e. work initiated by lecturers, not scheduled for a specific time e.g. in the form of homework assignments.

iii. 60 minutes of independent learning activities, such as literature study.

d. For Lecturers:

iv. 50 minutes face to face teaching with students;

v. 60 minutes of structured academic planning and evaluation

vi. 60 minutes lecture material development.

(2) For laboratory work, field work, and research 1 credit is defined as equalling

d. For laboratory work, weekly scheduled experimental activities in the laboratory are 3 x 60 minutes, plus 60 minutes structured academic activities.

e. For field work, 1 credit equals 4 x 60 minutes workload per week per semester.

f. For research work/thesis writing 1 credit is equals a workload of 3 x 60 minutes a day for 25 days.

2.6 Assessment

Students have to sit tests for individual courses as well as the final programme examination. For each course (subject) there are a compulsory mid-semester exams and a final exam, as well as other examination and test assigments given by the lecturer teachign the subject. Mid-term and final tests follow set out in the university's evaluation system. The final programme examination at the end of the study programme includes writing a final paper (Skripsi) and defending the paper before an examination board. Upon passing the final programme examination the graduate is awarded a bachelor degree (S1: Strata 1).

2.7 The Curriculum

(1) The curriculum of UPI's bachelor programme in Mechanical Engineering Education is structured in 6 study areas.

a. General Courses (MKU) aim at developing aspects of students' personality as individuals and members of the community;

b. Skill Subjects (MKK) aim at developing students' ability in mastering subject area/discipline-related skills;

c. Skill Subjects courses are further divided into Faculty Skill Subjects and Study programme skill subjects.

d. The major part of the Study Programme Skill Subjects (MKK) are mandatory (86 credits) and some are elective (16 credits);

e. Profession Courses (MKP) aim to develop educational professional competences.

f. The final paper (Skripsi) is the final project (paper) intended to develop the students' abilities in scientific work and research.

(2) The volume of individual courses (subjects) ranges from 2 to 4 credits (for the definition of a credit see above), except for the final paper which carries a value of 6 credits.

(3) The complete bachelor programme carries 144 to 150credits with the following components:

a. General Courses (MKU) with 14 credits

b. Skill Subjects with 1 -106 credits

c. Pedagogical subjects with 30 credits

d. Professional Teacher Training Programme with 4 credits. This is an internship programme in a vocational school for one semester, in which students have to act as a

teacher, prepare and deliver teaching lessons, evaluate students' activities in class room, etc..

2.7.1 Curriculum Structure of Mechanical Engineering Education

Concentration: PRODUCTION AND DESIGN EDUCATION

General Subjects	14 credits
Skills (expertise) Subjects	92 credits
Elective subjects	16 credits
Profession Basic subjects	12 credits
Professions Skill Subjects	12 credits
Profession Training Subjects	4 credits

No.	Code	Subject	CRT	Semester							
				1	2	3	4	5	6	7	8
		A. GENERAL SUBJECTS									
1	KU18	Physical and Sports Education	2	2							
2	KU 1	Islamic Education	2		2						
3	KU11	Protestant Religious Education	2								
4	KU12	Catholic Religious Education	2								
5	KU13	Hindu Religious Education	2								
6	KU14	Buddhist Religious Education	2								
7	KU16	Indonesian Education	2		2						
8	KU15	Citizenship Education	2			2					
9	KU17	PLSBT (Environ, Social, Culture, and Technology)	2					2			
10	KU 3	Seminar on Islamic Education	2						2		
11	KU31	Protestant Religious Education Seminar	2								
12	KU32	Catholic Religious Education Seminar	2								
13	KU33	Hindu Religious Education Seminar	2								
14	KU34	Buddhism Education Seminar	2								
15	KU401	Field Work	2						2		
		Total Credits	**14**	**2**	**4**	**2**		**2**	**4**		
		B. SKILLS SUBJECT (MKK)									
		Faculty Subjects									

No.	Code	Subject	CRT	Semester							
				1	2	3	4	5	6	7	8
16	TK3	Basic Mathematics	2	2							
17	TK31	English	2	2							
18	TK32	Studies of Technical and Vocational Education	2	2							
	0	**Total Credits**	**6**	**6**							
		Concentration Subjects									
19	PP11	Physics I	2	2							
20	PP1101	Chemical Engineering	2	2							
21	PP112	Entrepreneurship	2	2							
22	PP21	Engineering Drawings	2	2							
23	PP2101	Materials Engineering I	2	2							
24	PP212	Computer Programming	2	2							
25	PP22	Physics II	2		2						
26	PP22001	Metal Fabrication	3		3						
27	PP222	Electrical and Electronics Engineering	2		2						
28	PP320	Engineering Mathematics I	2		2						
29	PP321	Engineering Thermodynamics	2		2						
30	PP130	Engineering Mechanics I	2			2					
31	PP330	Energy Conversion	2			2					
32	PP331	Heat Transfer	2			2					
33	PP332	Machine Elements I	3			3					
34	PP333	Fluid Mechanics	2			2					
35	PP334	Applied Statistics	2			2					
36	PP335	Kinematics and Dynamics	2			2					
37	PP141	Quality Management	2				2				
38	PP142	Materials Engineering II	2				2				
39	PP240	Mechanical Maintenance	2				2				
40	PP241	Metal Grafting	3				3				
41	PP340	Engineering Mathematics II	2				2				
42	PP341	Machine Elements II	2				2				
43	PP342	Engineering Mechanics II	2				2				
44	PP25	Corrosion Engineering	2					2			
45	PP251	Metal Forming	2					2			
46	PP252	Metal Casting	2					2			
47	PP253	Machining Techniques	2					2			
48	PP350	Pump and Compressor	2					2			

No.	Code	Subject	CRT	Semester							
				1	2	3	4	5	6	7	8
49	PP450	Automation	2					2			
50	PP451	Auto CAD Drafting and Drawing	2					2			
51	PP160	Human Resource Management	2						2		
52	PP170	Mover Tool Materials and Warehousing	2							2	
53	PP171	Production Management	2							2	
54	PP370	Boiler and Turbine	2							2	
55	PP570	Final Project	3							3	
56	PP480	Industrial Attachment	2								2
57	PP598	Final Examination	0								0
58	PP599	Education Thesis (Skripsi)	6								6
		Total Credits	**86**	**12**	**11**	**15**	**15**	**14**	**2**	**9**	**8**
		Elective Subjects									
59	PP460	Special Machining	4						4		
60	PP461	Making Tools	4						4		
61	PP462	Advanced Metal Casting	4						4		
62	PP260	Metal Coating	4						4		
63	PP360	Machine Design	4						4		
64	PP361	English For Academic	4						4		
65	PP362	Industrial Engineering	4						4		
66	PP363	Information Technology	4						4		
67	PP364	Mechanical Vibration	4						4		
68	PP463	Mechanical Welding (TIG and MIG)	4						4		
69	PP470	Advance Metal Forming	4							4	
70	PP471	CNC	4							4	
71	PP472	Drawing Plan	4							4	
72	PP473	Simulation Design Process	4							4	
73	PP474	Industrial Automation	4							4	
74	PP371	Construction Maintenance	4							4	
		Total Credits	**16**	**0**	**0**	**0**	**0**	**0**	**8**	**8**	**0**
		C. PROFESSIONS SUBJECTS (MKP)									
		a. PROFESSIONS BASIC SUBJECTS (MKDP)									
75	KD3	Education Fundamentals	2		2						
76	KD301	Development of Students	2		2						

No.	Code	Subject	CRT	Semester							
				1	2	3	4	5	6	7	8
77	KD302	Guidance and Counseling	3				3				
80	KD303	Curriculum and Learning	3			3					
81	KD304	Management Education	2				2				
		Total Credits	**12**	**0**	**4**	**3**	**5**	**0**	**0**	**0**	**0**
		b. PROFESSIONS SKILLS SUBJECTS (MKKP)									
83	PP50	Teching and Learning Process	2					2			
84	PP501	Learning Evaluation	2					2			
85	PP502	Planning Teaching	2							2	
86	PP503	Learning Media	3						3		
87	PP504	Educational Research Methods	3						3		
		Total Credits	**12**	**0**	**0**	**0**	**0**	**4**	**6**	**2**	
		c. PROFESSIONS TRAINING SUBJECTS (MKLP)									
88	PP590	Field Experience Programme	4								4
		Total Credits	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**
		TOTAL CREDITS	**15**	**2**	**19**	**2**	**2**	**2**	**2**	**19**	**12**

2.7.2 Description

No.	Code	Subject	Credits	Descriptions
A. GENERAL SUBJECTS				
1	KU108	Physical and Sports Education	2	Health Sports (Sports Medicine) discusses all aspects of medical and sports ranging from aspects of anatomical, physiological, sports psychology health, governance nutrition, aklimasisasi, competitive sports injury prevention, treatment of injury, recovery of the Fisk after recovering from injury and the degree of one or more P3K on sports injuries, sport for children, women's sport, sports for the elderly, rehabilitation, massage.
2	KU 100	Islamic Education	2	This is discussed in the lecture material Methodology Understanding of Islam;

No.	Code	Subject	Credits	Descriptions
				People, Religion and Islam: Al-Quran Understanding and went; Hadith as a Source of Islamic teachings; Ijtihad in Sources and Methodology of Islamic Law; Tauhidullah: Living with the Presence of God; Remembrance, prayer and Ruling; Love, Morals, and Amal Salih; Amar Ma'ruf Nahyi Munkar and Jihad;-stream flow of theology in the Islamic concept of education in Islam; Concept educator in a private form of Islam, and family as the core vehicle realization of education.
3	KU101	Protestant Religious Education	2	
4	KU102	Catholic Religious Education	2	
5	KU103	Hindu Religious Education	2	
6	KU104	Buddhist Religious Education	2	
7	KU106	Indonesian Language	2	This course is a personal development courses Indonesian language. After following this course students are expected to be able to (1) use Indonesian to enrich the mind, ideas, have a scientific attitude to thevarious forms of scientific work quality (qualified objectivity, coherence, cohesion, effectiveness, efficiency, and communicative), (2) edited by critically analyze and refine scientific papers based on the results of edits; (3) use of language proficiency in Indonesia to develop the individual over a lifetime. Lectures are held by the communicative approach and Contextual through technical discussions, exercises, and

No.	Code	Subject	Credits	Descriptions
				presentations.
8	KU105	Citizenship Education	2	Discusses the essence of PKN (foundation of philosophical, historical, Vision, Mission, Goals, Competence Centre), Dynamics of the National State, and the philosophy of Pancasila as the State Association, Berkonstitusi Awareness, Rights and Duties of Man base, awareness of democracy, geopolitics and geostrategi Indonesia , Politics and the National Strategy, the Local Development Framework Homeland
9	KU107	PLSBT (Envirm, Social, Culture, and Tech Education)	2	Discusses about the man in the social context or humans as social beings who reveal individual development startedof the family unit, the unit up to a wider audience. in the main this subject matter explores the role of values, moral, and legal, social interaction, social groups, social processes of social change and development. It also discusses human problems in the context of culture, science technology and art, and human interaction with the environment.
10	KU 300	Seminar on Islamic Education	2	
11	KU301	Protestant Religious Education Seminar	2	
12	KU302	Catholic Religious Education Seminar	2	
13	KU303	Hindu Religious Education Seminar	2	
14	KU304	Buddhism Education Seminar	2	
15	KU401	Real Work Lecture (Kuliah Kerja Nyata)	2	
TOTAL CREDITS			**14**	
B. SKILLS SUBJECTS				
16	TK300	Basic Mathematics	2	After following this course students are

No.	Code	Subject	Credits	Descriptions
				expected to implement/apply the rules, formulas, and mathematical concepts in machine engineering. Contents of this course is essentially reviewed materials ever given in high school/vocational school that aims to equalize the perception and the ability of students from high school and vocational school in mathematics. Discussed in this lecture: The set of concepts, functions, equations, inequalities, inequality, the limit (limit on all limit functions, limit theorems, limit the indeterminate form (00/, ∞/∞, etc.), in the infinite limit, limit on the transcendent function, continuity), derivative / differential (derivative terms, the derivative function algebra, derivatives trigonometric functions, inverse function derivative, chain rule, derivatives of high degree, implicit derivatives, derivatives and approximation), use of derivatives (maximum and minimum, monotonicity and concavity, derivative applications in the field of mechanical engineering), and the function of two variables or more, the derivative on the function of two variables or more.
17	TK301	English	2	Grammar; structure; composition; writing; etc. Do exercises how to read text books and translate them.
18	TK320	Studies of Technical and Vocational Education	2	This subject is the Subject Areas Faculty (MKKF), mandatory for all students. This course is designed to give students knowledge and form attitudes in assessing the scope of technological and vocational education (PTK) in various aspects both at home and abroad. After following this course students have the knowledge to analyze, and have the

No.	Code	Subject	Credits	Descriptions
				right attitudes toward the implementation of PTK. In this lecture material related to the implementation of PTK is given. PTK includes a review of the philosophical and historical development of PTK, PTK implementation models, the implementation of PTK in Indonesia, the implementation of PTK in some countries, curriculum and learning PTK, PTK organizing relations with the business world and world industry (Dudi), career planning and development in the PTK. PTK implementation of comparative studies in several countries.
19	PP110	Physics I	2	This course discusses the concepts of physics on the scale, and unit vectors, particle kinematics, particle dynamics, effort and energy, impulse and momentum, rigid body and the rolling motion and elasticity.
20	PP111	Chemical Engineering	2	Completion of this course students are expected to have an insight into the basic chemistry, stoichiometric, equations of chemical reactions, the periodic system of elements, thermochemical, electrolytic, and electrochemical, and chemical applications in the field of mechanical engineering.
21	PP112	Entrepreneurship	2	This course is designed to provide skills and mastery of the student's behavior that characterize a successful entrepreneur, methods and structures associated with changes in business environment, the characteristics of resources and build networks to accelerate the development of business and to know and master of business

No.	Code	Subject	Credits	Descriptions
				management new.
22	PP210	Engineering Drawings	2	Completion of this course students should be able to explain the concepts of image, implementation and evaluation of an automotive engine working drawings in accordance with the demands of technological development. It discusses: standardization, basic painting, perspective drawing, projection, cutting, measuring, tolerance, signs of progress, connection systems, gears and springs, stacking images automotive, and electrical systems.
23	PP211	Materials Engineering I	2	This course is designed to give students the ability and mastery of fundamental material properties of the various factors and internal factors that shape the nature of the material, study the phases present in the material.
24	PP212	Computer Programming	2	After following this course students are expected of students are expected to implement / apply the pascal programming concepts in the course machine engineering, and can use it as a tool for analyzing the final task. Discussed in this lecture: Introduction to Computers (History of computer development, use of computers, computer parts, functions and usefulness of computer, operating system, the Setup files, introduction to computer applications), Turbo Pascal and programming, introduction of the programme, programming language , Steps in programming, flow chart (Flow Chart), Pascal and Turbo Pascal, Turbo Pascal on a basic element, character, words, identifiers, data types, constants, variables (types of numeric variables,

No.	Code	Subject	Credits	Descriptions
				variable assignment, Operator and mathematical operations, output and insert operations, Boolean expressions and compound statements, type Boolean, Boolean operators, order processing, compound statement, 5. IF and Case Statements, If simple, IF Else, If nested, If with AND and OR, Case complete, is optional, 6. Repetition Process, iterative process, For to, For down, For nesting, While, Repeat, Functions and Procedures, Creating a function of the programme, Creating a Data Array procedure Type, 2-dimensional array, 3-dimensional array, data type The set, Operations between sets, set as a parameter, Record Data Types, Declaration Record, Record in the record, statement with, Array record.
25	PP220	Physics II	2	This course discusses the concepts of the physics of waves, static electricity, dynamic electricity, magnetism, electromagnetic impact, and an alternating current .
26	PP221	Metal Fabrication	3	This course is a basic engineering course mandatory for all students. After following this course students are expected to have guided the response level psychomotor skills in basic practices of metal fabrication. Discusses the theories of measurement techniques, the formation of metal using hand tools, grinding tools, sheet metal connecting, welding, and safety. The course also provides training or practice in: the use of measuring tools, the establishment of the workpiece using hand tools, grinding tools, sheet metal connecting, welding, and safety.
27	PP222	Electrical and Electronics	2	This course is a basic skills course in the

No.	Code	Subject	Credits	Descriptions
		Engineering		electrical field of mechanical engineering. After following this course students can understand basic theory and practice particularly of electricity generators and electric motors and transformers, basic electronics, especially semiconductor diodes and transistors, and basic logic circuits.
28	PP320	Engineering Mathematics I	2	After following this course students are expected to implement/apply the rules, formulas, and mathematical concepts in a subject machine engineering. It discusses: integral (i.e an integral, indefinite integral and definite integral, integral with the substitution, the integral on trigonometric functions, integral with the rationalizing substitution, partial integral, rational integral functions, improper integrals), Application of integral (search area flat field, the volume of objects in the field, turn the volume object, the length of the curve on the field, the surface area of play, work, fluid force, moment, center of mass. integral in polar coordinates), The function of two variables or more (partial derivatives, limits on the function 2 or more variables, the derivative on the function of two variables or more, the application of the derivative function of two variables or more), Integral lipat2, 3 fold integral, integral folding applications 2 and 3, the determinant (third-order determinant and more, the properties of determinants, the simultaneous equations with three or more variables); matrix (the matrix operations, Gaussian elimination method, the search for the inverse matrix, Eigen values and Eigen

No.	Code	Subject	Credits	Descriptions
				vectors) in the field and vector geometry (plane curves, the field vector, vector-valued function, motion along the curve, the curvature and acceleration) and the geometry of the space vectors (vectors in 3 dimensional space, velocity and acceleration, curvature, surface in three dimensions rooms, tubes and spherical coordinates, Calculus vector (vector fields, line integrals, freedom footprint, Green's theorem in the field, surface integrals, divergence theorem of Gauss); Linear programme(linear programme applications); Introduction to numerical methods (Taylor approximation of functions, error estimation, Numerical integration, equations numerically solution, the fixed point method); series infinite (infinite sequence, the series infinity, the integral test on the positive series, operating in a power series, Taylor series and Mc. Laurin).
29	PP321	Engineering Thermodynamics	2	This course discusses the concepts of nature and the law of thermodynamics founded on the gas law, temperature and heat, kinetic theory of gases, the first law of thermodynamics, the process of gas, differential equations of thermodynamics, the second law of thermodynamics, thermodynamics cycles, application of the laws of thermodynamics in the field of mechanical engineering and thermodynamics law to zero.
30	PP130	Engineering Mechanics I	2	This course is designed to provide students with skills and mastery of the analysis of style, balance and determination of the power of engine construction. These include the strength calculation of the power of order,

No.	Code	Subject	Credits	Descriptions
				statically indeterminate conditions, construction of the deflection force and torque.
31	PP330	Energy Conversion	2	After following this course of learning, students can understand the concept of the principle of energy conversion, energy sources, energy utilization, conventional energy conversion machinery and the machinery of non-conventional energy conversion.
32	PP331	Heat Transfer	2	This course discusses the concepts of heat transfer : conduction, convection and radiation, condensation and boiling heat transfer, heat exchangers and heat transfer as special topic.
33	PP332	Machine Elements I	3	This course is a course of Expertise programme S-1, curricular goals aim at students being able to analyze the strength of the structure/component machining while learning objectives to develop insight, knowledge, and analytical skills of those taking S-1 Technical Education Programmes machines in the machining technology: Analysis of the load, the basic principles of machine elements, design of static power, connection, shaft, bearings, springs.
34	PP333	Fluid Mechanics	2	This course discusses the concepts of fluid mechanics include propersi fluid, fluid kinematics, fluid statics, fluid dynamics, viscous flow, and losses in the drainage of fluid.
35	PP334	Applied Statistics	2	
36	PP335	Kinematics and Dynamics	2	After this course students can comprehend the concepts of kinematics and dynamics, and apply them to engineering design. It discusses the basic concepts of dynamics: kinematics and dynamics; Speed and acceleration:

No.	Code	Subject	Credits	Descriptions
				relative motion, kinematic diagram, the application of equations relative velocity and acceleration; equivalent mechanism; Dynamics: static force in the machine, the force of inertia, dynamic analysis, balancing masses spinning, balancing back and mass back in one area; Gyroscope.
37	PP141	Quality Management	2	This course is designed to provide the skill and mastery for a quality management system to increase competitiveness. It involves the factors affecting productivity and quality, model competition, and competition strategies.
38	PP142	Materials Engineering II	2	This course is designed to provide students with the ability to decide on the selection of material to apply to environmental technology, owned by studying the nature of the material and how to test it and how to process the material into finished material processing.
39	PP240	Mechanical Maintenance	2	This course is designed make students capable of planning, organizing, implementing, and controlling the implementation of the maintenance of production facilities to obtain the system of effective and efficient maintenance.
40	PP241	Metal Grafting	3	After following this course students are expected to have attained the response level of psychomotoric skills in metal joining. It discusses theories on the basics of connecting metal, other types of metal splicing techniques, analysis of the strengths of each type of connection of the metal. It also provides training or practice in: connecting metal by welding, soldering, brazing adhesive, connection bolts nuts, rivet, and

No.	Code	Subject	Credits	Descriptions
				shrinkage connections (hot and cold) and safety aspects.
41	PP340	Engineering Mathematics II	2	After following this course students are expected to implement/apply the rules, formulae, and mathematical concepts in machine engineering. It discusses: complex Numbers, Differential Equations (PD) the order of 1 (Settlement by direct integration, completion of the separation of variables, homogeneous equations by substitution, integration by a factor of linear equations, linear first-order equation, Equation Bernoulli, with an exact differential equation) , PD-order 2 (Without the dependent variable / independent variable, Linear homogeneous with a coefficient fixed, non-homogeneous Linear fixed coefficient), higher-order PD (Linear homogeneous with fixed coefficients, Linear not homogeneous with fixed coefficients, Linear homogeneous with special functions) , Ricatti PD, PD Napire, application of Differential Equations, and Forier series.
42	PP341	Machine Elements II	2	This course is designed to make students capable to deal with the failure experienced by elements of the machine, planning machine including element power transmission belts, pulleys, clutches, coupling and braking. And selecting materials to be used in applying it to environmental technology.
43	PP342	Engineering Mechanics II	2	This course is designed to provide skills and mastery of students on the determination of the power of engine construction involving strength calculation of the power of order, statically indeterminate conditions,

No.	Code	Subject	Credits	Descriptions
				construction of the deflection force and torque.
44	PP250	Corrosion Engineering	2	Students should gain an insight into basic concepts of electrochemical kinetics of corrosion, passivation, types of corrosion, metallurgical structures which may cause corrosion and corrosion control and prevention techniques.
45	PP251	Metal Forming	2	Upon completion students should be able to explain the fundamentals of metal forming, metal bulk deformation process and sheet metal work in the working state of hot/cold working and plastic; in terms of: the concept of process, analysis techniques, the starting materials, tools formation/printing, design considering, making job choices, implementation and inspection of products and the final settlement. It also examines matters of materials and processing developments in vocational and industrial products in Indonesia.
46	PP252	Metal Casting	2	Students will be able to explain the techniques of metal, base metal casting and mold casting process expendable in terms of: the concept of process, analysis techniques, the starting materials, tools formation/printing, design consideration, deciding on job options, the application of the product and inspection, and final settlement. It also examines matters of materials and processing developments in vocational and industrial products in Indonesia.
47	PP253	Machining Techniques	2	This course is a practical course in continuation/strengthening/deepening of course machining, with the aim of improving the operational capability of machining processes for the

No.	Code	Subject	Credits	Descriptions
				concentration of production and design students to enable competencies required when teaching at Vocational High School of Technology. Course material consists of a lathe practice, frais practice, scraf practice, practice of sharpening a chisel/knife grinder tool wear.
48	PP350	Pump and Compressor	2	
49	PP450	Automation	2	Students expected to gain competence in basic design of control systems for industrial automation. It discusses the concept of automation in industrial controls, pneumatic and hydraulic systems.
50	PP451	Auto CAD Drafting and Drawing	2	This course is designed to give students the ability and mastery of 2D and 3D drawing of a single object or assembling using AutoCad programme.
51	PP160	Human Resource Management	2	This course is designed to provide skills and mastery of students about the human resource management and human behavior (as individuals or in groups) in the context of the organization and be able to establish the human resource management programmes in an integrated and planned manner, so as to improve organizational performance (productivity).
52	PP170	Mover Tool Materials and Warehousing	2	
53	PP171	Production Management	2	This course is designed to enable students to take the steps for systematic analysis and design/improvement of the production process, as a basis to plan, implementation and control of production factors (materials, labour, machinery, and equipment) to obtain system integrated production to achieve

No.	Code	Subject	Credits	Descriptions
				maximum productivity of the organization/industry/enterprise.
54	PP370	Boiler and Turbine	2	
55	PP570	Final Project	3	This course groups Automotive Engineering Expertise. Upon completion students will be able to undertake the scientific work of the final project: planning, analysis, testing or stimulation studies on the automotive unit in accordance with the demands of technological development. The lecture discusses: explanation of the characteristics of the final task, procedure writing and the final seminar.
56	PP48	Industrial Attachment	2	
57	PP598	Final Examination		
58	PP599	Education Thesis (Skripsi)	6	
TOTAL CREDITS			**92**	
C.ELECTIVE SUBJECTS				
59	PP460	Special Machining	4	Upon completion students gain an insight into the fundamentals of specific machining technology, Electro Discharge Machining, Various kinds of implementation of the EDM process, the formation process of plastics and composite materials, the manufacturing techniques of rubber, plastics and rubber machining process.
60	PP461	Making Tools	4	Upon completion students gain an an insight into knowledge of techniques for the manufacture of tooling materials, basics of designing cutting tools machining materials, the main elements of the machining process, machining process design tools, design tools-press work pieces (press working), Design of dies (forming), manufacture of tooling design projects.
61	PP462	Advanced Metal Casting	4	Completion of this course students should be able to explain the processing

No.	Code	Subject	Credits	Descriptions
				of metal casting and permanent mold castings product design considerations, as well as surface treatment of castings, including in terms of: the concept of process, analysis techniques, the starting materials, tools formation/printing, design considering, making job choices, application of the product and inspection, and final settlement. This course also examines matters of materials and processing developments in vocational and industrial products in Indonesia.
62	PP26	Metal Coating	4	Upon completion students gain an insight into the basic concepts of coating, surface treatment prior to coating, the coating process, the types of coatings, coating and testing.
63	PP360	Mechanical Design	4	
64	PP361	English For Academic	4	
65	PP362	Industrial Engineering	4	Upon completion students aquire competence in the design of control systems with the application Programmable Logic Controller (PLC). It teaches industrial automation control concepts, introduction to PLC, Signals and signal processing, logic operations, the components of a PLC, programming methods, programming languages, timer and counter functions, and programming of sequential movements.
66	PP363	Information Technology	4	This course discusses the basics of information technology, computer utilization, and application of information technology in learning.
67	PP364	Mechanical Vibration	4	
68	PP463	Mechanical Welding (TIG and MIG)	4	
69	PP470	Advance Metal Forming	4	Completion of this course students should be able to explain the processing

No.	Code	Subject	Credits	Descriptions
				of particle/metal and ceramic powders, glass pempadatan process, the process of formation of plastic, rubber processing technology and the process of formation of polymer matrix composites in terms of: the concept of process, analysis techniques, the starting materials, tools formation/printing, pertinbangan design, making job selection, implementation and inspection of products, as well as the final settlement.
70	PP471	CNC	4	This course involves advanced technical drawing and machining techniques. Students will be able to make a work piece using a lathe and CNC milling machines. It teaches basic foundations includeing Basic Hardware CNC, CNC Tooling and Contol System. Additionally, discusses the basics of CNC pemrogramam well as programming exercises (Turning and Milling). It also presents knowledge and skills to design products with the help of CAD CAM technology.
71	PP472	Drawing Plan	4	This course is designed to give students the ability and mastery of 2D and 3D drawing of a single object or assembling using AutoCad programme.
72	PP473	Simulation Design Process	4	Upon completion students will have gained an insight into the Engineering Enterprise, process design, problem solving and decision making, Modeling and Simulation, Materials Selection, Interaction of Materials - The manufacturing process - Design, Cost Calculations, Project Planning, sources of information, Communicating design , project design and component manufacturing production machinery or

No.	Code	Subject	Credits	Descriptions
				construction.
73	PP474	Industrial Automation	4	Upon completion students will have competence in the basic design of control systems for industrial automation. It also teaches the concept of automation in industrial controls, pneumatic systems, electropneumatics systems, hydraulic systems, electrohydraulic system, PLC introduction, methods and programming languages, application timer and counter functions, and programming of sequential movements.
74	PP371	Construction Maintenance	4	Upon completion students will have competence in types of body damage to the ship construction and environmental consequences, as well as construction and maintenance of the vessel body.
TOTAL CREDITS			**16**	
D.PROFESSIONS BASIC SUBJECTS				
75	KD300	Education Fundamentals	2	
76	KD301	Development of Students	2	
77	KD302	Guidance and Counseling	3	
78	KD303	Curriculum and Learning	3	
79	KD304	Management Education	2	
TOTAL CREDITS			**12**	
E.PROFESSIONS SKILLS SUBJECTS				
8	PP5	Teching and Learning Process	2	Students understand and can apply learning strategies related to teaching basic skills to open and close the lesson, give reinforcement, taking a variety, of questions, explaining and leading small group discussions, managing the classroom, small groups and individual teaching, learning methods and evaluate learning.
81	PP501	Learning Evaluation	2	This course is the Professional Skills courses (MKKP) S-1 programme of Mechanical Engineering Education FPTK UPI, curricular goal is to have

No.	Code	Subject	Credits	Descriptions
				students regarding the evaluation of learning and competence goal instruction to develop insight, knowledge, skills and analytical skills as well as S-1 Student Education Programmes Machine learning techniques in the evaluation, which includes: concept evaluation of Education, and Usability evaluation of Educational Objectives: Principal objective evaluation; Education Evaluation Procedures; approach evaluation: Forms and Tools evaluation of Learning; Processing Score study abroad test Results: Assessing the Quality evaluation Tool.
82	PP52	Planning Teaching	2	This course is the Professional Skills courses (MKKP) S-1 programme of Mechanical Engineering Education FPTK UPI, curricular goal is to enable students to plan teaching competence, and goal instruction to develop insight, knowledge, skills and analytical skills as well as S-1 Student Programmes Engineering education in the planning of teaching, which include: concept design of learning: vocational Curriculum Analysis: Preparation of material Design for Learning Theory: Learning Design for the Preparation of material Practices: Use of Competency Assessment Instrument (IPKG) for the Design of Learning: Using Teacher Competency Assessment Instrument (IPKG) for Performance Based Design teaching learning-teaching has been Created.
83	PP53	Learning Media	3	This course is the Professional Skills courses (MKKP) S-1 programme of Mechanical Engineering Education FPTK UPI, curricular goal is to have

No.	Code	Subject	Credits	Descriptions
				students learning about media competence, and goal instruction is to develop insight, knowledge, skills and analytical skills as well as S-1 Student Programmes Engineering education in instructional media, which include: the theoretical foundation of the use of media; the characteristics of educational media; functions and benefits of educational media; usefulness of educational media in the PBM; type and characteristics of the media, media selection; development of educational media; utilization of educational media; Equipment media education: media evaluation.
84	PP54	Educational Research Methods	3	Teaches the basic concepts of educational research and its application to arrange research proposals, analyze problems, theoretical and conceptual framework, hypothesis, applying sampling technique, research instruments , reports and analyze data and research. Theory lectures are: Basics of the other research methodologies, elements, processes and scarce educational research, variables and paradigms of research, measurement scale, theoretical framework/theoretical study, framework thought, hypotheses and research questions and sample populations, sampling techniques, research instruments, the validity, reliability, quantitative data analysis.
TOTAL CREDITS			**12**	
F.PROFESSIONS TRAINING SUBJECTS				
85	PP59	Field Experience Programme	4	This course is the Professional Practice course (MKLP) S-1 programme of Mechanical Engineering Education FPTK UPI, curricular goals is that

No.	Code	Subject	Credits	Descriptions
				students (interns) gain factual educational experience in the field, for the formation of professional education personnel. Experience may include: knowledge (cognitive), skills (psychomotor), and work attitudes (apektif) in the profession as an educator to apply them in providing education and teaching, both at school and outside school with full responsibility. For the purpose of instructional analysis is to develop insight, knowledge, skills and analytical skills as well as S-1 student of Mechanical Engineering in the Department of Education: through knowledge of the social, physical, administrative, and academic training of school places; to implement a range of basic skills teacher training/education in comprehensive and integrated approach in a real situation; to draw lessons from experience and penghayatannya, which is reflected in everyday behavior. Implementation of the course using a "direct cases in the training school". Work to be done by the students intern "are: (1) Orientation and Adaptation, (2) The core exercises, the teachers' practice field preparing lesson plans at least 8 (eight) pieces and the appearance of at least 16 times, while for the field of educational practice include: implementing flag raising ceremony, library services, picket teachers, extra curricular activities, guidance counseling, (3) Testing and Reporting. Phase control of students assessed through: The RPP last assessment; Value appearance last assessment; Personal Social Value: The value of

No.	Code	Subject	Credits	Descriptions
				extra-curricular activities; The Individual Report; Value Test (RPP and Appearance).
TOTAL CREDITS			**4**	
TOTAL			**15**	

2.8 Facilities

Table 2.1: List of laboratories and workshops for Mechanical Engineering Education

Major	Laboratories and workshops	Number
Mechanical Engineering	Physics Lab	1
	Automotive Lab	1
	Photo Lab	1
	Lab Materials	1
	Computer Lab	1
	Refrigeration and Air Lab Procedures	1
	Production Lab	1
	Welding Lab	1
	Chemistry Lab	1
	Casting Lab	1
	Lab Automation	1
	CNC Lab	1
	Design Lab	1
Total	13	

Annex 5: The curricula for VTE in Mechanical Engineering and Electrical Engineering at Tongji University

1 Introduction to the curricula of vocational teacher training in Mechanical Engineering

1.1 Training objectives (general objectives, detailed objectives)

The professional training to meet the modernization needs of the twenty-first century, the all-round development of physical and moral energy, setting the basic knowledge and skills of mechanical engineering, vocational education teaching theory and practice in a compound of senior personnel

1.2 Training duration (standard duration): 4 years

1.3 The amount of knowledge for the whole course

The graduates are involved in teaching, management and research work of the vocational school, as well as in the development and management of human resources in the corporate human resource management department

Graduates should acquire the knowledge and ability of

Basic theoretical knowledge in the humanities and social sciences and natural sciences

Mastering technologies such as mechanical, electrical, electronic, mechanical vocational school teachers required basic knowledge and expertise

Mastering basic education and vocational education science, psychology, social sciences and labor science

Being able to use the skills independent of various forms of teacher education teaching process

Preliminary development of instructional media and teaching process innovation capability

1.4 Enrollee: High school graduates

1.5 Process of training and graduation condition: Completing all courses required for graduation thesis defence

1.6 Assessment: Based on course grades and performance in school during evaluation

1.7 The curriculum

- General knowledge: 91.5 credits
- Pedagogical knowledge: 16 credits
- Professional knowledge: 94 credits

Among which:

- Basic knowledge: 26 credits
- Specialized knowledge: 30 credits
- Internship: 21 credits
- Graduation paper: 17 credits

1.7.1 General knowledge

No	Subject	Credits	Content of subject
	Compulsory subjects	**81.5**	
1	PE	4	Students select four sports to train, in four semesters.
2	German	28	Learn basic knowledge of German
3	Military Theory	3	The main theme of the course is national defence education. through military theory learning, students master basic military skills and military theory, increase national defence awareness,national security awareness, and strengthen organization, discipline, promote patriotism, collectivism and revolutionary heroism, to inspire confidence and courage to overcome difficulties, train hard, establish a hard-working spirit a correct outlook on life and values and comprehensively improve the overall quality of training for the People's Liberation Army Reserve soldiers and reserve officers training to set a solid foundation.
4	Basic Knowledge of Computer	2.5	University computer-based content: basic knowledge of computer, operating system, Windows XP systems, Word 2003, Excel 2003, PowerPoint2003, computer network, Internet, multimedia technology, web design, information security.
5	C C + + Programming	2.5	C + + programming main contents of C + +

No	Subject	Credits	Content of subject
			programming, C + + language based , the establishment of the basic application, the dialogue and common controls, menus, toolbars and status bar, frame windows, documents and views, database programming.
6	Chinese History	2	History of China including from the Opium War of 1840 to May Fourth Movement at 1919, the eight years of changing and the history of national democratic revolution in modern China brewing, preparation and leadership of the old bourgeois democratic revolution, the outbreak of the May Fourth Movement of 1919 to 1949 establishment of the PRC, an earth-shaking three decades, and the history of Chinese proletariat and its vanguard leadership of the CPC and the democratic revolution since the 1949 founding of the PRC. These are the brilliant achievements of fifty years, the Chinese people of all nationalities under the leadership of the Chinese Communist Party socialist revolution, construction and reform of the history of three stages.
7	Morality and legal basis	3	Morality and the legal basis including university life and the development of life how to stay healthy and establish harmonious interpersonal relationships and create a wonderful value of life, promote the national spirit and patriotic traditions. Moral self-cultivation, observe social ethics, family virtue and ethics, and enhance legal awareness and establish the rule of law, the spirit of our Constitution and legal system.
8	Mao Zedong Thought, Deng Xiaoping Theory and "Three Represents" Important Thought	6	Mao Zedong Thought, Deng Xiaoping Theory and "Three Represents" Important Thought incuding communist Party of China the basic principles of Marxism with China's reality of the historical process , reflect Marxism in China's three major theoretical achievements, to help students master the system Mao Zedong Thought, Deng Xiaoping Theory and "Three Represents" the basic principles of a firm under the leadership of the party's socialist road with

No	Subject	Credits	Content of subject
			Chinese characteristics, ideals and beliefs.
9	Introduction to basic principles of Marxism	3	Introduction to basic principles of Marxism content: the basic principles of Marxism is about the liberation of the proletariat and human science, the nature of the material world and its development, understand and transform the world, social structure, law of social development and historical subject, the formation of capitalism and the nature of the development process of capitalism, the establishment and development of the socialist system, communism is the noblest of social ideals and so on.
10	Higher Mathematics	10	As a science and engineering undergraduate mathematics students in the basic course training programme, learning in other subjects for the future lay the basis, the basis for analysis. Through the study, requiring learners to access the system functions of one variable calculus, multi-function calculus (including vector algebra and analytic geometry), ordinary differential equations, series of basic knowledge, theory and methods.Requires learners to master the relevant content of the basic concepts, basic theory and methods, with more skilled computing and analytical skills, spatial imagination and abstract mathematical models of the initial capacity for further expansion of study follow-up courses and lay the necessary mathematical knowledge basis.
11	Linear Algebra	3	Linear algebra, including linear equations, matrices, vector space, linear space.
12	Mechanical Drawing	7	Include mechanical drawing, descriptive geometry, drawing foundation, engineering drawings, and computer graphics.
13	General Physics	6	General Physics include: mechanical, mechanical vibration and mechanical waves, thermodynamics and statistical physics, wave optics, electromagnetism and so on the basis of modern physics. mechanical, mechanical vibration and mechanical waves, thermodynamics and statistical physics, wave

No	Subject	Credits	Content of subject
			optics, electromagnetism and so on the basis of modern physics.
14	General Physics Lab	1.5	Physics experiments including the determination of thin lens focal length, michelson interferometer and the use of the regulation, grating diffraction experiment, observation and analysis of polarization, electrostatic field painted, voltammetry resistor, use of the oscilloscope.
	Optional subjects	**10**	
	Total	**91.5**	

1.7.2 Professional knowledge

No.	Subject	Credits	Content of subject
	Compulsory subjects		
	Basic knowledge		
1	Mechanical Design	3	This course studies the following specific content: General part - basic machinery and parts design principles, design and calculation theory, material selection, structural requirements, and the friction, wear, lubrication and other basic knowledge. Connected parts - threaded connection, keys, splines and non-key connection, pin connection, riveting, welding, bonding and interference connection; Transmission parts - screw drive, belt drive, chain drive, gear drive, worm drive and friction wheel drive, etc.; Shaft parts - bearings, roller bearings, shaft couplings and clutches, and so on; Other parts - springs, frame, and box, gear and transmission, etc.;
2	Interchangeability and Technical Measurement	2	This book systematically discusses the "interchangeability and measured" basic knowledge, analysis describes the tolerance and co-ordination of the new standards, describes the basic principle measured, reflecting the

No.	Subject	Credits	Content of subject
			number of new testing technology. The main content includes introduction, hole and shaft limits and fits, the basis of length measurement, shape and position tolerances and testing, surface roughness and testing, smooth limit gauge, rolling bearing tolerances and fits, size chain, with the cone of tolerance and testing, Thread tolerance and testing, key and spline tolerance and cooperation, involute cylindrical gears and detection.
3	Mechanical principles	3	Mechanical principles including graphic composition of the body, motion, force and friction force of the machine's dynamic analysis, common body design and mechanical analysis of continuously variable transmission organizations.
4	Engineering Materials	2	Teaching mission and purpose is to make students to master the engineering materials used basic theories and knowledge, to master the types of commonly used engineering materials, composition, microstructure, properties and modification methods to have a reasonable selection of the initial capacity of commonly used engineering materials , and the establishment of common engineering materials, components, technology, organizational structure and the relationship between performance and its variation, as well as learn other related courses in mechanical design and manufacturing work to lay the necessary foundation.
5	Electrical Engineering (Electrical Technology)	3	Electrical technology including four parts of the basis of the circuit motor and control, electrical power measurement and Safe use of electricity.
6	Electrical Engineering (Electronics)	3	Electronics includes semiconductor devices, integrated circuits, the common basic power electronic circuits.
7	Forms of energy and its use	2	The course covers: energy, meaning, classification and historical evolution of China's energy situation, problems and countermeasures

No.	Subject	Credits	Content of subject
			of China's new energy and renewable energy situation and prospects.
8	Theoretical Mechanics	4	According to a gradual understanding of the law and the scientific system, theoretical mechanics can be divided into statics, kinematics and dynamics of three parts.
9	Mechanics of materials	4	Mechanics of materials include: two parts of Statics and Mechanics of Materials.
	Specialized knowledge		
1	Machinery manufacturing technology	3	Machinery manufacturing technology is a "typical working process of machining parts, " the main line, used to wear the development and implementation of technical rules, organic integration of metal cutting the basic knowledge and basic knowledge of jigs and fixtures commonly used, and the construction of a comprehensive curriculum . Course covers the structure and selection of commonly used tool, machining process planning, a typical part of the preparation process, the quality of machining, mechanical assembly process, common fixture design methods.
2	Sensing and Measurement Technology	2	This object of study is mechanical engineering and design of experiments, control, and operation of monitoring and other projects related to the amount of physical quantity measurement and measurement device and system performance, Including the measurement methods of the amount of physical and other works, tests commonly used in sensors, signal conditioning circuits and recording, display equipment works, the basic characteristics measuring device evaluation method, test signal analysis and processing.
3	The basis of molding technology	2	Contents: 1, clarify basic theoretical problems of the material forming the design, Including the material forming the thermal process, the metal solidification theory, forming the basis of the

No.	Subject	Credits	Content of subject
			physical and mechanical, and related surface forming, powder metallurgy and plastic forming the theoretical basis. 2, Introduce the solidification forming, plastic forming, welding forming, shaping and strengthening the surface, ceramic forming and powder metallurgy, forming and other processes shaping methods, technical points and related technology and equipment and molds.
4	Automatic Control Theory	2	The main research projects are in the state of the movement of the system and the possibility to change this law of motion and methods, and establish and reveal the system structure, parameters, behavior and performance between the established and quantitative relationships. Typically, the problem of movement of the system as analysis of issues, the possibility of changing the movement of the problems and methods of synthesis problems, the former are a recognized system - a transformation system.
5	Machine Control	2	Content: the strong electricity content of drive motor, control electrical appliances, electric drive, relay - contactor control, programmable controllers, power electronics technology, detection technology, DC opportunistic system, AC servo system, servo systems, stepper motor servo system.
6	Fluid mechanics and fluid power	3	Contents: 1, hydraulic fluid foundation 2, hydraulic pumps and hydraulic motors 3, the hydraulic cylinder 4, hydraulic control valves 5, hydraulic assist device 6, the basic circuit of hydraulic
7	Modern pneumatic technology	2	Contents: 1, describes the working principle of various pneumatic components and symbols 2, describes the working principle of pneumatic circuit used

No.	Subject	Credits	Content of subject
			Requirements: master the working principle of pneumatic components and how to use and adapt to situations; can design a simple pneumatic circuit.
8	Professional Foreign Language	2	Contents: analysis of computer, energy, medicine and health, ecology, automotive, transportation, science knowledge, technology and economic and scientific invention and German space technology and other related articles, by learning to master some of the German terminology, exercise professional literature reading comprehension.
9	Programmemable Controller	3	Contents: 1, understanding the basic structure of Siemens plc 2, master the basic programming instructions 3, grasp basic programming 4, for analog operation
1	Design methodology	20	Contents: 1, familiarity with the design process model 2, familiarity with the logical steps to solve the problem 3, the master principle of design - functional analysis and design method 4, master evaluation and decision making.
11	Comprehensive Experiment	2	1, the structure of three-phase asynchronous motor and control 2, three-phase asynchronous motor mechanical characteristic curve 3, single-phase motor starting 4, pneumatic technology theory 5, pneumatic experimental operation 6, the theoretical basis for electronic pneumatics 7, electronic pneumatic experimental operation
12	Manufacturing equipment and system control	2	Contents: 1 Overview of CNC machine tools 2 NC programming 3, computer numerical control devices 4, Servo System

No.	Subject	Credits	Content of subject
			5, numerical control machine tool structure, mechanical transmission 6, numerical control machine tool exchange device.
13	Machinery and equipment design	3	Contents: 1, metal-cutting machine tool design 2, the design of jigs and fixtures 3, the design of industrial robots 4, material handling equipment design
	Internship		
1	Course Design of Mechanical Design	3	Design a reducer
2	Course Design of Mechanical Principle	1	Design a mechanical model
3	Military Training	2	Military Training
4	School awareness training	1	A visit to the vocational schools
5	Enterprise awareness training	1	A visit to the Enterprise
6	Factory practices	3	Factory practices
7	Curriculum design or practice	2	Design a robot
8	Vocational school teaching practice	8	Vocational school teaching practice
	Graduation paper		
	Total	**94**	

1.7.3 Pedagogical knowledge

No	Subject	Credits	Content of subject
	Compulsory subjects		
1	Career Development Overview	2	The main teaching of this course is a comprehensive discussion of the contents caused by occupational appear, rise, development, and die, not only from the engineering point of view, but also as social, political, legal, economic, cultural, religious, geographical, climatic and other factors, so students understand the characteristics of

No	Subject	Credits	Content of subject
			vocational and occupational classification structure; Through the discussion of the phenomenon of career change, to understand the social, economic, cultural, scientific and technological progress on career development and vocational and technical education requirements; for the corresponding industries (such as machinery manufacturing) job content, work objects, operating tools, production equipment, labor and environmental characteristics of the analysis; for the corresponding industries (such as machinery manufacturing) job content, work objects, operating tools, production equipment, labor and environmental characteristics of the analysis, students of vocational trades and positions contained in the duties, tasks and the required knowledge, Skills and capacity of analysis and research. Therefore, the course is vocational and technical education teacher training is core content.
2	Vocational Education	2	The main content of this course are: 1, vocational education and economic development; 2, professional relationships with other systems; 3, vocational education and the relationship between human development; 4, the personnel structure and goals of vocational education; 5, the vocational education system and security system; 6, ethics, and campus culture; 7, vocational teacher training; 8, general education in vocational education; 9, secondary vocational education; 10, higher vocational education; 11 Rural Vocational Education; 12, vocational guidance and counseling.
3	Vocational Education	2	The purpose of this course is to enable students

No	Subject	Credits	Content of subject
	Psychology		to study vocational education in psychology, some of the basic concepts, theories, and middle school students in vocational education contexts based on fundamental psychological law, students analyze and grasp the context of vocational education learners. Psychological, and vocational education can take advantage of the basic principles of psychology to effectively organize and implement educational activities, establish the correct teaching philosophy.
4	Behavior-oriented approach	2	Behaviour-oriented approach to positive changes in student behavior as the ultimate goal of teaching, teaching through a variety of autonomous problem-solving and teaching style in the general form ofcognitive, social, emotional and other aspects of multi-dimensional personality. Through this course, to learn about the application of behavior-oriented teaching methods: the project of teaching, simulation, performance. case studies, role-playing. Organizational form of teaching based on the nature of learning tasks that can be changed flexibly.
5	Professional Pedagogy	3	Contents: mechanical engineering definition of professional teaching Mechanical engineering programme theory of teaching The design development process R & D center and modern design tools and methods Field of mechanical engineering professional development trend of teaching e.g. the text to guide teaching
6	Teaching techniques and instructional media development	3	content: Preliminary study using a variety of multimedia audio software Preliminary study using a variety of multimedia video software Preliminary study using a variety of modeling software Independently complete a full Multimedia

No	Subject	Credits	Content of subject
			Software
7	Labor and Education	2	Learning content: The relationship between economy and science and technology, scientific advances impact on the socio-economic, labor, employment and unemployment, occupational and professional ethics, learning new ideas, self, mental models, team learning, systems thinking
	Total	**16**	

1.8 Facilities for vocational teacher training in Mechanical Engineering Metalworking the internship factories, Mechanics of Materials Laboratory, Physics Laboratory, laboratory, plc control room

2 Introduction to vocational teacher training in Electrical Engineering

2.1 Training objectives *(general objectives, detailed objectives)*

The professional training is adapted to the needs of socio-economic and technological development, the coordinated development of knowledge, ability, personality, having solid electronic technology, information systems and vocational education theoretical knowledge, broad knowledge, practical ability, and collection of electronic information technology expertise skills, vocational education theory and method in one. For training senior personnel with the innovative spirit of wide range and composite vocational education.

2.2 Training duration (standard duration): 4 years

2.3 The amount of knowledge for the whole course:

- Having the basic theoretical knowledge of the humanities and social sciences and natural sciences required by Electronic and Information Engineering vocational school teachers.
- Mastering the basis of the theory of knowledge and expertise in electronics, communications, computer network systems and equipment
- Having a strong electronics and information technology practical ability and engineering skills
- Mastering the basic knowledge of vocational education, education, psychology, labour science
- Being able to use the vocational education theories and methods of effective organization of professional teaching process
- Having comprehensive application of the better foreign language skills and strong computer skills
- Understanding the field of electronic information science and vocational education in the field of literature search, data query News
- Having better learning ability and ability to innovate
- Having a strong ability to adapt, both engaged in teaching, management and research work of the vocational schools of electronic information professional direction, also involved in the related professional human resource development, vocational training and technical work in the enterprise

2.4 Enrollee: High school graduates

2.5 Process of training and graduation condition

Completing the course requirements by the thesis

2.6 Assessment

Based on assessment of the students' course grades and performance during the school

2.7 The curriculum

General knowledge:	84.5	credits
Pedagogical knowledge:	18.5	credits
Professional knowledge:	95	credits
Among which:		
- Basic knowledge:	34	credits
- Specialized knowledge:	20	credits
- Internship:	24	credits
- Graduation paper:	17	credits

2.7.1 General knowledge

No.	Subject	Credits	Content of subject
	Compulsory subjects	**84.5**	
1	Situation and Policies	2	2 credits for the course, the curriculum includes the teaching content of ideological and moral education, mental health education, targeted to develop education for the students personality, at the same time through the education of the campus culture and technological innovation, the volunteer spirit of education, career planning education and other content, combined with a certain amount of internal and external social practice that focuses on training students' comprehensive ability.
2	Chinese History	2	History of China from Opium War of 1840 to May Fourth Movement at 1919, eight years of change and the history of national democratic revolution in modern China brewing, preparation and leadership of the old bourgeois democratic revolution, the outbreak of the May Fourth Movement of 1919 to 1949 establishment of the PRC, its earth-shaking three decades, and the history of Chinese proletariat and its vanguard leadership of the

No.	Subject	Credits	Content of subject
			CPC and the democratic revolution since the 1949 founding of the PRC. These are the brilliant achievements of fifty years, the Chinese people of all nationalities under the leadership of the Chinese Communist Party socialist revolution, construction and reform of the history of three stages.
3	Morality and legal basis	3	Morality and the legal basis including university life and the development of life to remain healthy and establish harmonious interpersonal relationships, and create the wonderful value of life, promote the national spirit and patriotic traditions, and moral self-cultivation, observe social ethics, family virtue and ethics, and enhance legal awareness and establish the rule of law, the spirit of our Constitution and legal system.
4	Mao Zedong Thought, Deng Xiaoping Theory and "Three Represents" Important Thought	6	Mao Zedong Thought, Deng Xiaoping Theory and "Three Represents" Important Thought incuding communist Party of China the basic principles of Marxism with China's reality of the historical process, reflect Marxism in China's three major theoretical achievements, to help students master the system of Mao Zedong Thought, Deng Xiaoping Theory and "Three Represents" the basic principles of a firm under the leadership of the party's socialist road with Chinese characteristics, ideals and beliefs.
5	Introduction to basic principles of Marxism	3	Introduction to basic principles of Marxism content: the basic principles of Marxism is about the liberation of the proletariat and human science, the nature of the material world and its development, understand and transform the world, social structure, law of social development and historical subject, the formation of capitalism and the nature of the development process of capitalism, the establishment and development of the socialist system, communism being the noblest of social

No.	Subject	Credits	Content of subject
			ideals and so on.
6	Military Theory	1	The main theme of the course is national defense education. through military theory learning,students master basic military skills and military theory, increase national defense awareness,national security awareness, and strengthen organization, discipline, promote patriotism, collectivism and revolutionary heroism. To inspire confidence and courage to overcome difficulties,train hard, hard-working spirit. To establish a correct outlook on life and values.and comprehensively improve the overall quality of training for the People's Liberation Army Reserve soldiers and reserve officers training setting a solid foundation.
7	PE	4	Students select four sports to train, in four semesters.
8	German	28	Learn basic knowledge of German
9	Basic Knowledge of Computer	2.5	University computer-based content: basic knowledge of computer, operating system, Windows XP systems, Word 2003, Excel 2003, PowerPoint2003, computer network, Internet, multimedia technology, web design, information security.
1	C C + + Programming	2.5	C + + programming main contents of C + + programming, C + + language based , The establishment of the basic application, the dialogue and common controls, menus, toolbars and status bar, frame windows, documents and views, database programming.
11	Higher Mathematics	10	As science and engineering undergraduate mathematics students in the basic course training programme, learning in other subjects for the future set the basis for analysis. The study requires learners to access the system functions of one variable calculus, multi-function calculus (including vector algebra and analytic geometry), ordinary differential equations, series of basic knowledge, theory and methods.Requires

No.	Subject	Credits	Content of subject
			learners to master the relevant content of the basic concepts, basic theory and methods, with more skilled computing and analytical skills, spatial imagination and abstract mathematical models of the initial capacity for further expansion of study follow-up courses and lay the necessary mathematical knowledge basis.
12	General Physics	7	General Physics include: mechanical, mechanical vibration and mechanical waves, thermodynamics and statistical physics, wave optics, electromagnetism and so on - the basis of modern physics. mechanical, mechanical vibration and mechanical waves, thermodynamics and statistical physics, wave optics, electromagnetism and so on the basis of modern physics.
13	General Physics Lab	1.5	Physics experiments including the determination of thin lens focal length, michelson interferometer and the use of the regulation, grating diffraction experiment, observation and analysis of polarization, electrostatic field painted, voltammetry resistor, use of the oscilloscope.
14	Linear Algebra	3	Linear algebra, including linear equations, matrices, vector space, linear space.
15	Probability Theory and Mathematical Statistics	3	Through the learning of the course, the students have to understand the basic concepts of probability theory and mathematical statistics and basic methods. Master the method used in the calculation of the probability of random events, be familiar with and master the distribution of the random variable and its calculation, master discrete random variable and its distribution law of the concept and its calculation, to grasp the concept of continuous random variables and their density function and its calculation . The common digital master random variable characteristics of the concept. Understand and grasp the concept of convergence in

No.	Subject	Credits	Content of subject
			probability, to master the law of large numbers and their central limit theorem and its applications. Understand and master the basic concepts of mathematical statistics, familiarity with the commonly used statistics and sampling distributions, familiarity with and to master parameters point estimates and confidence intervals method to grasp the concept of hypothesis testing and test methods common parameters.
16	Complex function and integral transform	3	Include the plural and complex function, analytic functions, complex function of integral, series, residue and its applications, conformal mapping, Fourier transform, Laplace transform
17	Mechanical Drawing	3	Include mechanical drawing, descriptive geometry, drawing foundation, engineering drawings, and computer graphics.

2.7.2 Professional knowledge

No.	Subject	Credits	Content of subject
	Compulsory subjects	**34**	
1	Circuit Theory	4	By taking this course, that students master the basic concepts of circuit theory, the fundamental theorem of the circuit, the basic analysis method and preliminary experimental skills
2	Circuit experiment	1	1.Institute of access to the professional manual, understand the basic knowledge of the circuit components; 2. Electrical equipment, correct use of common electronic devices; 3. Schematic wiring, check lines to exclude simple experimental circuit fault; 4. Independent experimental operation, observe the experimental phenomena accurate reading of the experimental data, mapping experiments wave Shape and curves;

No.	Subject	Credits	Content of subject
			5. Can gradually learn to determine the experimental programme, the design of the experiment; 6. Computer simulation of the experimental circuit, parameter selecting and implemented in hardware. 7. Collation, analysis and processing of the experimental data, drawing experiment chart and write coherent content Ends Whole and in the form of standardized experimental reports.
3	Analog Electronic Technology	4	Learning through the curriculum, so that students get basic knowledge of the technical aspects of analogue electronics, basic theory and basic skills, should grasp the analytical methods commonly used in electronic devices, analogue circuits and its system and preliminary analogue circuit design capabilities for in-depth study follow-updigital electronic technology, high-frequency electronic circuits (or communication electronics) and Electric Information professional to lay the foundation
4	Digital electronic technology	3	1. Mastering the basic laws and theorems of the algebra of logic, and understanding of the gate and trigger logic functions, features, and to master the methods of analysis and design of combinational logic circuits and sequential logic circuits. 2. Correct understanding of the integrated gate structure and working principle works commonly integrated logic devices, semiconductor memory works, 555 timer works, A/D and D/A converter works.
5	Electronic Technology Experiment	1	1. Institute of access to the professional manual to understand the basic knowledge of electronic components; 2. Electrical equipment, correct use common electronic devices; 3. Being able to read a basic circuit diagram,

No.	Subject	Credits	Content of subject
			schematic wiring, check the line and rule out simple experiments circuit fault; 4. Independent experimental operation, observing the experimental phenomena, an accurate reading of the experimental data, mapping experiment waveforms and curves; 5. Can gradually learn to determine the experimental programme, the design of the experiment, according to the actual situation of reasonable selection of components constitute the system circuit; 6. Computer simulation of the experimental circuit, parameter selecting and implemented in hardware. 7. Collation, analysis and processing of the experimental data, drawing experiment chart and write coherent, content integrity, seeking truth from facts, theoretical analysis or unique insights, fluent text and form of standardized experimental reports.
6	Signals and Systems	4	The course is a study of the basic theory of systems analysis courses. By teaching the students should have the system concepts and the transfer of information (signal) processing functions, and the time domain, frequency domain intrinsically linked with distinction clear. The task of this course is the study of linear time-invariant (LTI) system the basic theory and methods, to lay the foundation for further study of the theory of communications, control, signal processing
7	Automatic Control Theory B	2	1. Enable students to master the basic concept of the automatic control system. 2. Learning how to establish and to simplify the mathematical model of the automatic control system. 3.An automatic control system time-domain analysis, root locus analysis and frequency characteristics analysis. 4.Llearning automatic control system based on

No.	Subject	Credits	Content of subject
			this general method of synthesis and correction. 5.Being able to use MATLAB analysis and calculation of the relevant issues.
8	Principles of communication systems	4	1. Mastering the basic components of the communication system works. 2 mastering to evaluate the performance of the various systems and their basic analysis method. 3 About the technology used for improving the performance of various communication systems. Lay the necessary foundation for the study of the design of various communication systems
9	Software technology	3	1. Grasping the thinking of the basic data structures and algorithms; 2. Grasp the basic principles of operating systems and resource management methods; 3. Grasping the basic concepts and basic operation of the database; 4.Understanding of the software development process and project management methodology;
10	Microcomputer Principle and Interface Technology	4	This course Intel 0x86 series CPU and Intel, Free scale, Microchip's family of microcontrollers (MCU) based on principle explain computer interface technology. Enable students to master the basic structure and working principle of the micro-computer, and establish the overall concept of the computer, students with microcomputer hardware systems analysis, interface design, assembly language and integrated development and application capabilities
11	Information Theory	2	This course is based on classroom lectures and homework practice, supplemented by the necessary internship teaching this course should meet the following basic requirements: Understanding the basic concepts of information theory, source entropy; Understanding the source and channel coding

No.	Subject	Credits	Content of subject
			theorem of information theory; Mastering signal source entropy calculation; Mastering lossless source coding (Shannon code, the Fenno code, Huffman code); Master limited the common encodings law distortion source; Learning several channel error coding and password coding theory and methods.
12	Digital Signal Processing	3	1.Mastering the basic concepts of the discrete-time signal and system, the system increases the characteristics of linear and non-shift change constraints, to describe the system of differential equations and their solution discrete convolution. 2 mastering the z transform its domain of convergence, z concept and method of the inverse transform, nature. 3, grasping the relationship between the discrete Fourier transform for an export, nature, and other transformations, as well as to improve the method of the discrete Fourier transform computing speed - FFT implementation of ideas and IFFT. 4.Familiarity with the principle of the digital filter structure and related design method, based on the actual application requirements select FIR or IIR digital filter structure, the design of the relevant parameters.
	Specialized knowledge	8	
13	Signal detection and valuation	3	1. Mastering basic statistical characteristics of the random process. 2 mastering signal detection theory, and the realization of the principle and system performance. 3. understanding the signal estimation theory and implementation methods and system performance, and lay the necessary foundation for the study of random signal processing system.
14	Computer communication network	3	Requiring students to understand the origin and development of the computer network, to

No.	Subject	Credits	Content of subject
			grasp the basic principles of computer networks, architecture, master the OSI seven-layer model and the functions of each, to master the basic theoretical knowledge of the data link layer and related technology master IP address, IP protocol knowledge, understanding routing protocol works, understanding the transport layer TCP, UDP protocol works, the Internet application layer protocols and technologies.
15	Embedded Systems	2	Understanding the concept and development of embedded systems; mastering ARM7 architecture, instruction set and LPC2000 family of ARM microcontrollers structural principle; learning how to design embedded systems, including hardware design, embedded operating system transplant, and the establishment of softwaredevelopment platform and embedded system development platform applications
	Optional subjects	Select at least 12 credits	
1	Methods of mathematical physics	2	Mastering vibration equation, the diffusion equation and the Laplace equation solution, understanding the simple nature of Bessel functions and Legendre polynomials and their applications in mathematical physics equations.
2	Electromagnetic Fields and Waves	3	Clarifying the basic concepts of the electromagnetic field, the basic laws and fundamental analysis and calculation methods, learning to use the field view, the analysis of electromagnetic phenomena.
3	High-frequency electronic circuits	3	High-frequency electronic circuits the purpose of the course is to enable students to have the ability to analyse and design high-frequency electronic circuits, nonlinear analysis and design of electronic circuits, flexible use of existing components to achieve a variety of

No.	Subject	Credits	Content of subject
			high-frequency electronic circuitmaster the realization method of the automatic gain and phase control circuit.
4	Modern information and communication technology	2	1, modern information technology involved in cutting-edge ideas and new technology, such as wavelet transform, virtual laboratory technology, display technology, multimedia technology, data compression technology, state-of-the-art development platform 2.New theory of new technologies in the new concept of modern communication technology, such as Beyond 3G/4G (the future of wireless and mobile communications technology), the Next Generarion Network (NGN new generation network), modern communication system design EDA software, broadband wireless communication technologies, sensor network technology, EDA simulation software platform, etc.
5	Digital Speech Processing	2	Through the study, the students should master basic voice signal time domain and frequency domain characteristics, the basic analysis of the speech signal and voice signal compression encoding the basic principles and methods, as well as a number of practical speech coding technology and standards.
6	Principles of wireless communication	2	For wireless communication of basic characteristics and development trend of this course, students master the mobile radio propagation characteristics (including large-scale path loss, small-scale fading and multipath effects), mobile radio modulation technology, equalization, diversity andchannel coding and the like.
7	Digital Image Processing	2	Through this course, students master basic image processing theory, concepts, methods, and technologies. Including an image of the mathematical model, the basic transformation, image enhancement, compression, segmentation, description of the contents.

No.	Subject	Credits	Content of subject
			With the experiment, so students can use high-level language C or Java, to achieve some of the basic algorithms
8	Mobile communication system	2	Learning through the curriculum, so that students understand the basic characteristics and development trend of mobile communication, master cellular network technology, GSM and its enhanced mobile communication system, code division multiple access and IS-95 mobile communication system, the third generation mobile communication system enhancement technology (including CDMA2001x, WCDMA and TD-SCDMA), as well as the future development of wireless mobile communication augmentation systems (IMT-2000, IMT-Advanced system).
9	Programmemable logic device	2	Enabling students to master the programmable logic device (PLD), structural systems, design methods, in particular, is to enable students to master the use of the hardware description language VHDL hardware circuit design in the PLD with EDA platform
1	Sensor technology	20	Providing students with basic knowledge of signal detection and signal conversion, basic theory and application methods to cultivate the ability of the student organization of scientific experiments, analysis of the error data processing
11	Imaging technology and TV	30.	Through this course of learning, to enable students to understand the source of the image information, imaging methods and imaging equipment structure, principle and TV image information acquisition, processing, transmission, storage, reproduce, basic image information system design knowledge and capabilities
12	Professional German	20.	

2.7.3 Pedagogical knowledge

No	Subject	Credits	Content of subject
	Compulsory subjects	**14.5**	
1	Introduction to Vocational Science (electric)	2	Understanding of occupation, occupation definitions, characteristics. Several social and career development during the state. Factors that affect career development. Occupational classification and comparison of country classification. The general characteristics of the electrical and electronic related professional development role. Occupational analysis. Vocational training, job description. Occupation of the relevant laws and regulations. New energy in the form of, and between the electric power and other energy conversion characteristics. Vocational training institutions and their mode.
2	Vocational Education	2	The main themes of this course are: 1. vocational education and economic development; 2. professional relationships with other systems; 3. vocational education and the relationship between human development; 4. the personnel structure and goals of vocational education; 5. the vocational education system and security system; 6. ethics, and campus culture; 7. vocational teacher training; 8. general education in vocational education; 9. secondary vocational education; 10. higher vocational education; 11. rural vocational education; 12. vocational guidance and counseling.
3	Vocational Education Psychology	2	The purpose of this course is to enable students to study vocational education in psychology, some of the basic concepts, theories, and middle school students in vocational education contexts based on fundamental psychological law, students analyze and grasp the context of vocational education learners Psychological, and vocational education can take advantage of the basic principles of

No	Subject	Credits	Content of subject
			psychology to effectively organize and implement educational activities, establish the correct teaching philosophy.
4	Teaching techniques and instructional media development	3	Content: Preliminary study using a variety of multimedia audio software Preliminary study using a variety of multimedia video software Preliminary study using a variety of modeling software Independently complete full multimedia software
6	Professional Pedagogy (Electronic)	3	The course includes theory of general education, professional teaching theory with professional teaching on the relationship; electrical technology development and occupational characteristics; teaching skills; electrical technology development; professional course curriculum strategies; specialized courses of instruction strategies; educational evaluation. Which major courses taught strategies for teaching points, including instructional design, teaching methods, teaching media content.
6	Integrative Experiment (electric)	1.5	Motor and drag the part of the main contents of the structure of the three-phase asynchronous motor, starter, basic control, mechanical characteristic curve, single-phase motor starting. Pneumatic and electronic pneumatic part is divided into two blocks of the theoretical and experimental, the main content of the experimental part of the simple single-acting cylinder, double-acting cylinder control, throttle control, delay control, logic control, stroke control, pressure control, multi-cylinder control. The difference between the two is a pneumatic control technology pneumatic components, electronic pneumatic technology uses electrical components and solenoid valve control.
7	Multimedia technology and equipment applications	3	To grasp the basic concepts of multimedia, multimedia technology, the history and characteristics of the development of multimedia systems, multimedia media classification, the basic

No	Subject	Credits	Content of subject
			architecture of multimedia applications, multimedia application system classification. Media forms its representation. Audio, video, image, animation, and so on. Hypermedia. Estimate of the size of the media storage. General steps for the development of multimedia applications.
	Optional subjects	**Select at least 4 credits**	
9	Introduction to Education	2	The course content includes concepts and basic principles of educational technology and computer-assisted instruction, multimedia courseware design and development of methods and procedures used soft-and hardware tools to collect and produce Multimedia courseware text, audio, images, animation and video clips.demo type of design and production, interactive type and web-based multimedia courseware, multimedia courseware evaluation criteria. Both theoretical knowledge in the course elaborated another operation of the process of training, with a teaching experiment on machine operation, focus on linking theory with practice, emphasis on cultivating students' applications, the design of actual capacity and the development of modern teaching media.
10	Instructional design activities guidance	2	1. Lesson to provide case studies and a full statement of the reasons; 2. according to the specified logical basis for student activities, teaching activities with reasons; 3. Instructional design activities guidance integrated use of instructional theory, learning theory and clearly aware of the theoretical basis behind (students) ability.
11	Labor and Education	2	Learning content: The relationship between economy and science and technology, scientific advances impact on the socio-economic, labour, employment and unemployment, occupational and professional ethics, learning new ideas, self, mental models, team learning, systems thinking

No	Subject	Credits	Content of subject
12	Behavior-oriented approach	2	Behaviour-oriented approach to positive changes in student behaviour as the ultimate goal of teaching, teaching through a variety of autonomous problem-solving style and teaching style of the common shape cognitive, social, emotional and other aspects of multi-dimensional personality. Through this course, learn about the application of behaviour-oriented teaching methods: the project of teaching, simulation, performance. case studies, role-playing. Organizational form of teaching based on the nature of learning tasks can be flexibly change.
13	The Germany vocational eduation (German)	2	From this course, students should grasp the ideological system of the German dual system of vocational education, the institutional framework, the school system, management system, teaching features a more systematic understanding of the German dual system of our initial contact phenomenon in the field of vocational education and issues a preliminary comparative analysis.
	Internship	24	
1	Military Training	2	
2	Metalworking Practice	3	
3	Schools' Practice	1	
4	Companies recognize Practice	1	
5	Curriculum design of electronic circuits	2	
6	Vocational skills certificate examination	1	
7	Internship	4	
8	Vocational schools teaching practice	8	
9	Innovation capayity expansion projects	2	
	Graduation paper	17	

2.8 Facilities for vocational teacher training in Electrical Engineering

Metalworking the internship factories, physics Laboratory, laboratory, plc control room and so on.

Annex 6: Comparison of curcicula in Mechanical Engineering and Electrical Engineering

1 Comparison of curricula in Mechanical Engineering

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
I. General knowledge	**20**	**I. General knowledge**	**14**	**I. General knowledge**	**17**	**I. General knowledge**	**91.5**	**I. General knowledge**	**28**
				Compulsory subjects	**13**	**Compulsory subjects**	**81.5**		
Lao Study I	2	Physical and Sports Education	2	Professional education	2	PE	4	Introduction to Informatics	2
Philosophy	2	Islamic Education	2	Teaching management	2	German	28	General English I	2
Lao Study II	2	Protestant Religious Education	2	Specialized teaching methodology	2	Military Theory	3	General English II	2
Mathematic I	3	Catholic Religious Education	2	Teaching skills	3	Basic Knowledge of Computer	2.5	Technical English	2
Mathematic II	3	Hindu Religious Education	2	Practicum	4	C C++ Programming	2.5	Physics I	2
General English I	2	Buddhist Religious Education	2	**Elective subjects**	**4**	Chinese History	2	Physics II	3
General English II	2	Indonesian Education	2	Research methodology	2	Morality and legal basis	3	Mathematics I	2
General Psychology	2	Citizenship Education	2	Development of vocational teaching curriculum	2	Mao Zedong Thought, Deng Xiaoping Theory and "Three Represents" Important Thought	6	Mathematics II	2
National defense	1	PLSBT (Envirm, Social, Culture, and Technology)	2	Measurement and assessment in teaching	2	Introduction to basic principles of Marxism	3	Mathematics III	2
Workshop Training I	1	Seminar on Islamic Education	2	Pedagogical communication	2	Higher Mathematics	1	Engineering Mathematics	3

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
		Protestant Religious Education Seminar	2	Teaching technology	2	Linear Algebra	3	Probability And Statistics	2
		Catholic Religious Education Seminar	2			Mechanical Drawing	7	Psychology	2
		Hindu Religious Education Seminar	2			General Physics	6	Introduction to Economics	2
		Buddhism Education Seminar	2			General Physics Lab	1.5		
		Field Work	2			**Optional subjects**	**10**		
II. Professional knowledge		**II. Professional knowledge**	**92**	**II. Professional knowledge**		**II. Professional knowledge**	**56**	**II. Professional knowledge**	
Compulsory subjects		***Faculty Subjects***	*6*	**Basic knowledge**	*26*	***Basic knowledge***	*26*	**Basic knowledge**	**29**
Basic Professional Subjects	**42**	Basic Mathematics	2	*Compulsory subjects*	*24*	Mechanical Design	3	***Compulsory subjects***	*27*
Physic I	2	English	2	Graphics – Technical drawing	3	Interchangeability and Technical Measurement	2	Graphic and Technical Drawings 1	2
Physic II	2	Studies of Technical and Vocational Education	2	Heating Technique	2	Mechanical principles	3	Graphic and Technical Drawings 2	1
Introduction to Informatics	3	***Concentration Subjects***	*85*	Mechanics 1	3	Engineering Materials	2	Heat Transfer	2
General Chemistry	3	Physics I	2	Mechanics 2	2	Electrical Engineering (Electrical Technology)	3	Mechanics I	3
English Technic I	2	Chemical Engineering	2	Engineering material 1	2	Electrical Engineering (Electronics)	3	Mechanics II	2
English Technic II	2	Entrepreneurship	2	Engineering material 2	2	Forms of energy and its use	2	Engineering material 1	2

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
Introduction to economy and accounting	3	Engineering Drawings	2	Metal technology	2	Theoretical Mechanics	4	Engineering material 2	2
Engineering Mathematic I	3	Materials Engineering I	2	Tolerance – Measurement technique	2	Mechanics of materials	4	Metal processing	2
Engineering Mathematic II	3	Computer Programming	2	Machine principle and part	3	***Specialized knowledge***	***31***	Tolerance and Measurement Technique	2
Advance Statistics	2	Physics II	2	Part course project	1	Machinery manufacturing technology	3	Mechanical design	2
Theory Mechanics I –Statics	3	Metal Fabrication	3	Electric-electronic technique	2	Sensing and Measurement Technology	2	Mechanical design Project	1
Theory Mechanics II - Dynamics	3	Electrical and Electronics Engineering	2	*Elective subjects*	*2*	The basis of molding technology	2	Electric-electronic technique	2
Engineering Drawing I	3	Engineering Mathematics I	2	Technical oscillation	*2*	Automatic Control Theory	2	Fluid Mechanics	2
Engineering Drawing II	3	Engineering Thermodynamics	2	Computer Aided Designing and Drawing	2	Machine Control	2	Strength of Material	2
Fluid Mechanics I	2	Engineering Mechanics I	2	Industrial economics and quality administration	*2*	Fluid mechanics and fluid power	3	***Elective Subject***	***2***
Fundamentals of Electrical Engineering	2	Energy Conversion	2	**Specialized knowledge**	*24*	Modern pneumatic technology	2	Computer Aided Designing and Drawing	2
Workshop Training II	1	Heat Transfer	2	*Compulsory subjects*	*20*	Professional Foreign Language	2	Industrial Economics and Quality	2

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
								Management	
Core Professional Subject	**51**	Machine Elements I	3	Metal cutting principles	3	Programmemable Controller	3	**Specialized knowledge**	**26**
Thermodynamics I	2	Fluid Mechanics	2	General metal cutting machine	2	Design methodology	2	***Compulsory subjects***	*24*
Strength of Materials I	3	Applied Statistics	2	Hydroneumatic transmission in industrial machine	2	Comprehensive Experiment	2	Metal Cutting Principle	3
Fundamentals of Machine Component Design I	3	Kinematics and Dynamics	2	Mechanical Manufacturing Technology and fixture	4	Manufacturing equipment and system control	2	General Metal Cutting Machines	2
Workshop Training III	1	Quality Management	2	Mechanical Manufacturing Technology course project	1	Machinery and equipment design	3	Manufacturing processing and Fixture	4
Strength of Materials II	2	Materials Engineering II	2	CNC technology	2			Manufacturing processing project	1
Mechanical Laboratory I	2	Mechanical Maintenance	2	Unconventional processing methods	3			CNC Technology	2
Mechanical Laboratory II	2	Metal Grafting	3	CNC machine and industrial robot	3			Unconventional processing methods	3
Engineering Materials II	2	Engineering Mathematics II	2	CAD/CAM-CNC technology	2			CNC machine and industrial robotics	3
Fundamentals of Machine Component Design II	3	Machine Elements II	2	*Elective subject*	*2*			Industry Safety and Maintenance	2
Design Project	1	Engineering Mechanics II	2	Mold manufacturing	2			Mold Manufacturing	2

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
				technology				Technology	
Heat Transfer 1	2	Corrosion Engineering	2	Automatic controlling	2			Automatic Controlling	2
Heat Transfer 2	3	Metal Forming	2					***Elective Subject***	*2*
IC Engines	3	Metal Casting	2					Experimental method and Data Processing	2
Fluid Mechanics II	2	Machining Techniques	2					CAD/CAM-CNC Technology	2
Engineering Materials I	2	Pump and Compressor	2						
Manufacturing Processes I	2	Automation	2						
Manufacturing Processes II	3	Auto CAD Drafting and Drawing	2						
Engineering Measurements	3	Human Resource Management	2						
Thermodynamics II	3	Mover Tool Materials and Warehousing	2						
Industrial Safety and Maintenance	2	Production Management	2						
Electro technic and Electronic	3	Boiler and Turbine	2						
Electrical Machine	2	Final Project	3						
Elective subjects		Industrial Attachment	2						
Optional Energy	**21**								
Power Plant Engineering	2	Education Thesis (Skripsi)	6						
Gas Dynamics	3	***Elective Subjects***	16						
Refrigeration	3	Special Machining	4						
Thermal	2	Making Tools	4						

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	Credits	Subjects	Credits	Subjects	Credits	Subjects	Credits	Subjects	Credits
Engineering									
Energy Conversion	2	Advanced Metal Casting	4						
Non - Conventional energy	2	Metal Coating	4						
Energy Management in Buildings	2	Machine Design	4						
Energy Management in Industrial	2	English For Academic	4						
Air conditioning	3	Industrial Engineering	4						
Optional applied mechanic	**20**	Information Technology	4						
Construction Equipment	3	Mechanical Vibration	4						
Elasticity, Plasticity	3	Mechanical Welding (TIG and MIG)	4						
Design and Analysis of Experiments	2	Advance Metal Forming	4						
Engineering Design	3	CNC	4						
Electrical Engine and Electronic System Service	2	Drawing Plan	4						
Engineering Piping System	3	Simulation Design Process	4						
Computer Applications in Mechanical	1	Industrial Automation	4						

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
Engineering II									
Special Topics in Mechanical Engineering	2	Construction Maintenance	4						
Agricultural Machinery	2								
Materials and Productions	**18**								
Advanced Manufacturing Processes	2								
Polymer Engineering	3								
Plastic Production and Mold Design	3								
Industrial Robotics	2								
Quality Management	2								
Engineering Economy	2								
Operational Research	2								
Quality Management and Control	2								
III. Pedagogical subjects		**III. Pedagogical subjects**		**III. Pedagogical subjects**	**17**	**III. Pedagogical subjects**		**III. Pedagogical subjects**	**21**
Compulsory subjects		**a. PROFESSIONS BASIC SUBJECTS**	**12**	**Compulsory subjects**	**13**	Career Development Overview	2	***Compulsory subjects***	***19***

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
		(MKDP)							
Basic Course		Education Fundamentals	2	Professional education	2	Vocational Education	2	General Vocational Education	2
General Vocational Pedagogies	2	Development of Students	2	Teaching management	2	Vocational Education Psychology	2	Psychology of Learning and Teaching	2
Didactics of Vocational Education	2	Guidance and Counseling	3	Specialized teaching methodology	2	Behavior-oriented approach	2	Research Methodology	2
Psychology of Learning and Teaching	2	Curriculum and Learning	3	Teaching skills	3	Professional Pedagogy	3	Vocational Curriculum Development	2
Strategies and Methodology	2	Management Education	2	Practicum	4	Teaching techniques and instructional media development	3	Teaching Skill	3
Core Course		**b. PROFESSIONS SKILLS SUBJECTS (MKKP)**	**12**	**Elective subjects**	**4**	Labor and Education	2	Teaching Media	2
Subject oriented Didactics	4	Teching and Leaming Process	2	Research methodology	2			Practice in Vocational School	4
Methods of Social Sciences	1	Learning Evaluation	2	Development of vocational teaching curriculum	2			Teaching Measurement and Evaluation	2
Theory of Curricula	1	Planning Teaching	2	Measurement and assessment in teaching	2			***Elective Subject***	***2***
Interaction and Communication	2	Learning Media	3	Pedagogical communication	2			Teaching Methodology	2
Adult and Further Education	2	Educational Research Methods	3	Teaching technology	2			Professional Didactic	2
Production Lines	1								

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
and Voc. Education									
Teaching Practice	2	**c. PROFESSIONS TRAINING SUBJECTS (MKLP)**	4						
Teaching Media	4	Field Experience Programme	4						
Practice in Industry and Vocational School	1								
Final Paper(6 weeks)	4								
Optional subjects	**2**								
Special Problem of Vocational Education	2								
				IV. Internship	**18**	**IV. Internship**	**21**	**IV. Internship**	**25**
				Compulsory subjects	*16*	Course Design of Mechanical Design	3	Technical Internship in workshop/Lab	16
				Handwork cutting practice	1	Course Design of Mechanical Principle	1	Technical Internship in Factories	2
				Basic lathing practice	4	Military Training	2	Teaching internship in Vocational Institutions	4
				Advanced lathing practice	3	School awareness training	1		
				Basic milling-planing practice	3	Enterprise awareness training	1		
				Advanced milling-planing practice	2	Factory practices	3		
				CNC practice	3	Curriculum design or	2		

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
						practice			
				Elective subjects	*2*	Vocational school teaching practice	8		
				Internship	2				
				Grinding practice	2				

2 Comparison of curricula in Electrical Engineering

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
I. General knowledge	**20**	**I. Groups of General Subjects** (MKU / Kelompok Mata Kuliah Umum (MKU)	**14**	**I. General knowledge**	**51**	**I. General knowledge**	**84.5**	**I. General knowledge**	**3**
Compulsory subjects	**2**	Religion Education (Pendidikan Agama)	2	**Compulsory subjects**	**44**	**Compulsory subjects**	**84.5**	Introduction to Informatics	2
Lao Study I	2	Citizenship Education (Pendidikan Kewarganegaraan)	2	Basic principles of Marxism-Leninism	5	Situation and Policies	2	General English I	2
Philosophy	2	Indonesian Language (Bahasa Indonesia)	2	Hochiminh Ideology	2	Chinese History	2	General English II	2
Lao Study II	2	PLSBT	2	Revolution ways of the Communist Party of Vietnam	3	Morality and legal basis	3	Technical English	2
Mathematic I	3	Religion Educational	2	Introduction to	3	Mao Zedong Thought,	6	Physics I	2

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
		Seminar (Seminar Pendidikan Agama)		Informatics		Deng Xiaoping Theory and "Three Represents" Important Thought			
Mathematic II	3	Sport and Physical Education (Pendidikan Jasmani Dan Olahraga)	2	English	5	Introduction to basic principles of Marxism	3	Physics II	3
General English I	2	Real Work Lecture (KKN/ Kuliah Kerja Nyata)	2	English for Electrical Engineering	2	Military Theory	1	Mathematics I	2
General English II	2	**II. Groups of Faculty Expertise Subjects (MKK / Kelompok Mata Kuliah Keahlian Fakultas**	**6**	General physics 1	2	PE	4	Mathematics II	2
General Psychology	2	English Language	2	General physics 2	3	German	28	Mathematics III	2
Technical defense	1	Introductory of Vocational and Technological Education	2	General chemistry	2	Basic Knowledge of Computer	2.5	Engineering Mathematics	3
Workshop Training I	1	Basic Mathematics	2	Advanced mathematics 1	2	C C++ Programming	2.5	Probability And Statistics	2
Elective subjects		**III. Groups of Expertise Subjects on Study Programme**		Advanced mathematics 2	2	Higher Mathematics	10	Psychology	2
II. Professional knowledge		**A. Together Semester (semester 1 – semester 3)**	33	Advanced mathematics 3	2	General Physics	7	Introduction to Economics	2

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
Compulsory subjects	**92**	Basic Physics I	3	Special subject mathematics 1	2	General Physics Lab	1.5	Engineering Drawing	2
Basic Professional Subjects	**30**	Fundamental of Electrical Engineering	3	General laws	2	Linear Algebra	3	**II. Professional knowledge**	**52**
Physic I	2	Electrical Design Basis	2	National defence	4	Probability Theory and Mathematical Statistics	3	***Basic Knowledge***	***34***
Physic II	2	Energy and Conversion	2	Physical education 1,2	3	Complex function and integral transform	3	Electrical circuit 1	3
Introduction to Informatics	2	Engineering Mathematics I	3	**Optional subjects**	**7**	Mechanical Drawing	3	Electrical circuit 2	3
General Chemistry	2	Basic Physics II	3	Special subject mathematics 2	2	**II. Professional knowledge**		Electronic 1	2
Technical English I	1	Electric Circuit I	3	Special subject mathematics 3	2	**Compulsory subjects**	**34**	Electronic 2	3
Technical English II	1	Basic Computer and Programming	3	Formal logic	2	Circuit Theory	4	Electrical Measurement and instrumentation	2
Introduction to economy and accounting	3	Engineering Mathematics II	3	Professional psychology	2	Circuit experiment	1	Digital Technique	3
Engineering Mathematic I	3	Material Physics	2	Introduction to economics	2	Analog Electronic Technology	4	Power Electronic	2

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
Engineering Mathematic II	3	Probability and Statistics	3	Introduction to sociology	2	Digital electronic technology	3	Electromagnetic field	
Advance Statistics	3	Electric Circuit II	3	Physical education 3	1	Electronic Technology Experiment	1	Electric Machine 1	3
Engineering Mechanics	3	**B. Selection Path for Telecommunication Technical Education (Jalur Pilihan Pendidikan Teknik Telekomunikasi / PTTK)**	**54**	Physical education 4	1	Signals and Systems	4	Electric Machine 2	3
Engineering Drawing	2	Measurement Methods	2	**II. Professional knowledge**	**78**	Automatic Control Theory B	2	Electric drives	2
Fluid Mechanics	2	Industrial management	2	**Basic knowledge**	**30**	Principles of communication systems	4	Electronic-Electrical Materials	2
Workshop Training II	1	Electromagnetic Field I	3	***Compulsory subjects***	*26*	Software technology	3	Automatic Controlling Systems	3
Core Professional Subject	**59**	Telecommunication Networks	3	Electrical circuit 1	2	Microcomputer Principle and Interface Technology	4	Microprocessor	2
Electrical engineering materials	2	Signals and Systems	2	Electrical circuit 2	2	Information Theory	2	Project 1	1
Electrical measurement and	3	Fundamental of Electronic	3	Basic electronic 1	2	Digital Signal Processing	3	***Specialized knowledge***	***18***

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
instrumentation									
Electronics 1	3	Digital Technique	3	Basic electronic 2	2	**Specialized knowledge**	**8**	Electrical installation technique	3
Electronics 2	3	Electrical Basic Practicum	2	Electrical measurement and measuring equipment	2	Signal detection and valuation	3	Power system analysis	3
Circuit theory I	3	Linear System Synthesis	2	Digital techniques	2	Computer communication network	3	Power system protection	3
Circuit theory II	3	Microprocessor System	2	Micro-processing	2	Embedded Systems	2	Power station & substation	2
Automatic controls	3	Electromagnetic Field IIB	2	Data transmission techniques	2	**Optional subjects**	Select at least 12 credits	Power transmission	2
Electromagnetic field theory	3	Control Systems	3	Sensor measurement	2	Methods of mathematical physics	2	SCADA	2
Electromechanical energy conversionl	3	Digital Signal Processing	3	Automatic controlling system	2	Electromagnetic Fields and Waves	3	Programming control	2
Electromechanical energy conversion 2	3	Telecommunication Engineering Labs I	2	Electric machine 1	2	High-frequency electronic circuits	3	Project 2	1
Digital electronics	3	Transmission Line	2	Electric machine 2	2	Modern information and communication technology	2	**III. Pedagogical knowledge**	**21**
Power electronics	3	Telecommunication Engineering Labs II	2	Electricity transmission	2	Digital Speech Processing	2	***Compulsory subjects***	**19**

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
Power system analysis 1	3	Telecommunication electronics	2	**Optional subjects**	*4*	Principles of wireless communication	2	General Vocational education	2
Power system analysis 2	3	Telecommunication Engineering Labs III	2	Electrical safety	2	Digital Image Processing	2	Psychology of Learning and Teaching	2
Power system protection	3	Industrial Practices	2	Electrical-electronic materials	2	Mobile communication system	2	Research Methodology	2
Electric drives	3	Final project	4	Electrical instrument	2	Programmable logic device	2	Development Vocational Curriculum	2
Power system operation and control	3	Education Thesis	6	Electromagnetic field	2	Sensor technology	2	Teaching Skill	3
Mechanical calculation of transmission lines	3	Final Examination	0	Electronic power	2	Imaging technology and TV	3	Teaching Media	2
Renewable energy	3	**C. Selection Path for Industrial Electronic Technical Education** *(Pendidikan Teknik Elektronika Industri / PTEI)*	**54**	**Specialized knowledge**	**20**	Professional German	2	Practice in Vocational School	4
Design of electrical power system	3	Industrial management	2	***Compulsory subjects***	**16**	**III. Pedagogical knowledge**		Measurement And evaluation Teaching	2
Elective subjects	**3**	Electromagnetic Field I	3	Course project 1	1	**Compulsory subjects**	**14.5**	***Selective Subject***	*2*
Power system stability	3	Numerical Analysis	2	Course project 2	1	Introduction to Vocational Science	2	Teaching Methodology	2

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
						(electric)			
High voltage engineering	3	Signals and Systems	2	Electricity supply	2	Vocational Education	2	Professional Didactic	2
Illumination engineering	3	Electronic Fundamental	3	Electrical system	2	Vocational Education Psychology	2	**IV. Internship - Practice**	**22**
		Digital Technique	3	Programming control	2	Teaching techniques and instructional media development	3	***Technical Internship in workshop/Lab***	***16***
III. Pedagogical knowledge		Electrical Fundamental Practicum	2	Data collection and controlling system	2	Professional Pedagogy (Electronic)	3	Electrical measurement practice	1
Compulsory subjects	**32**	Power Electronics	2	Power station and substation	2	Integrative Experiment (electric)	1.5	Basic electricity practice	1
Basic Course		Control Systems	3	Computer aided design (CAD)	2	Multimedia technology and equipment applications	3.0	Basic electronic practice	2
General Vocational Pedagogies	2	Electronics Measurement	2	Automation of technological process	2	**Optional subjects**	**Select at least 4 credits**	Micro-processing practice	2
Didactics of Vocational Education	2	Advanced Electronics	3	***Optional subjects***	***4***	Introduction to Education	2	Programming control practice	2
Psychology of Learning and Teaching	2	Advanced Digital Technique	2	Protection and automation of industry	2	Instructional design activities guidance	2	Electronic power practice	1
Strategies and Methodology	2	Industrial Electronic Engineering Labs I	2	Protection of relays and automation	2	Labor and Education	2	Electric machine practice	2

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
Core Course		Microprocessor System	2	Heating and cooling technique	2	Behavior-oriented approach	2	Electricity supply and network analysis practice	3
Subject oriented Didactics	4	Electronic System Design	3	Calculation of repairing electric machine winding	2	The Germany vocational education (German)	2	Electricity transmission practice	2
Methods of Social Sciences	1	Industrial Electronic Engineering Labs II	2	**Internship – Practice**	**18**	**Internship**	**24**	***Technical Internship in Factories***	*2*
Theory of Curricula	1	Telecommunication electronics	2	***Compulsory subjects***	*18*	Military Training	2	***Teaching internship in Vocational Institutions***	*4*
Interaction and Communication	2	Industrial Electronic Engineering Labs III	2	Electrical measurement practice	1	Metalworking Practice	3		
Adult and Further Education	2	Industrial Attachment	2	Basic electricity practice	1	Schools' Practice	1		
Production Lines and Voc. Education	1	Final project	4	Basic electronic practice	2	Companies recognize Practice	1		
Teaching Practice	2	Education Thesis	6	Micro-processing practice	2	Curriculum design of electronic circuits	2		
Teaching Media	4	Final Examination	0	Programming control practice	2	Vocational skills certificate examination	1		
Practice in Industry and Vocational School	1	**D. Selection Path on Electric Power Technical Education** *(Pendidikan Teknik Tenaga Elektrik*	**55**	Electronic power practice	1	Internship	4		

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
		/PTTE)							
Final Paper(6 weeks)	4	Measurement Methods	2	Electric machine practice	2	Vocational schools teaching practice	8		
Optional subjects	**2**	Industrial management	2	Electricity supply and network analysis practice	3	Innovation capacity expansion projects			
Special Problem of Vocational Education	2	Electromagnetic Field I	3	Electricity transmission practice		Graduation paper	17		
		Numerical Analysis	2	Internship	2	**Total**	**198**		
Total	**144**	Signals and Systems	2	***Optional subjects***	*0*				
		Electronic Fundamental	3	**Graduation paper**	**10**				
		Electric Machinery I	3	*Optional subjects to replace graduation paper*					
		Electric Fundamental Practicum	2	Programming language	2				
		Power Electronics	2	Operating and controlling electricity system	2				
		Control Systems	3	Industrial mechatronics system	2				
		Electromagnetic Field IIA	2	Electricity manufacture engineering	2				

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
		Electrical Installation Technique	3	Electricity controlling equipment	2				
		Microprocessor System	2	Industrial robot	2				
		Electrical Power Engineering Labs I	2	Business administration	2				
		Electric Machinery II	3	Project management	2				
		Electrical Power Engineering Labs II	2	**II. Pedagogical knowledge**	**17**				
		Power System Analysis	3	**Compulsory subjects**	**13**				
		Electrical Power Engineering Labs III	2	Professional education	2				
		Industrial Attachment	2	Teaching management	2				
		Final project	4	Specialized teaching methodology	2				
		Education Thesis	6	Teaching skills	3				
		Final Examination	0	Practicum	4				
		IV. Group of Expertise Subjects for Concentration Selection *(Kelompok Mata Kuliah Keahlian / MKK) Pilihan Konsentrasi*		*Optional subjects*	*4*				
		A. Selection Path for Telecommunication Technical Education	**29**	Research methodology	2				

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	Credits	Subjects	Credits	Subjects	Credits	Subjects	Credits	Subjects	Credits
		(Jalur Pilihan Pendidikan Teknik Telekomunikasi /PTTK)							
		Analog Communication System	3	Development of vocational teaching curriculum	2				
		Digital Communication Systems	3	Measurement and assessment in teaching	2				
		Traffic Engineering	3	Pedagogical communication	2				
		Antenna and Propagation	2	Teaching technology	2				
		Transmission Line	2						
		Satelit and Terestrial System Design	2	**Total credits**	**146**				
		Data Communication	2						
		Multimedia Information System	2						
		Planning Computer-aided (Perancangan Berbantuan Komputer)	2						
		Project handling Technique (Teknik Penanganan Proyek)	2						
		Telephone and Switching Digital (Telepon Dan	2						

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	Credits	Subjects	Credits	Subjects	Credits	Subjects	Credits	Subjects	Credits
		Switching Digital)							
		Wireless System for fixed and mobile (Sistem Non Kawat Tetap & Bergerak)	2						
		Entrepreneurship	2						
		B. Selection Path for Industrial Electronic Technical Education *(Jalur Pilihan Pendidikan Teknik Elektronika* **Industri /PTEI)**	**16**						
		Data Communication	2						
		Information Technology (Teknologi Informasi)	2						
		Entrepreneurship	2						
		Introduction to Robotics	2						
		Biomedical Electronic (Elektronika Biomedika)	2						
		Digital Control System	2						
		Computer System Architecture	2						
		Intelligent Instrumentation Systems	2						
		C. Selection Path for Electric Power Technical	**29**						

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	Credits	Subjects	Credits	Subjects	Credits	Subjects	Credits	Subjects	Credits
		Education *(Jalur Pilihan Pendidikan Teknik Tenaga Elektrik /PTTE)*							
		Electrical Power Plant	2						
		Engineering Economics	2						
		Power System Stability and Reliability	2						
		Power Transmission and substation	2						
		Entrepreneurship	2						
		Computer Application on Electric Power System	2						
		Electric Drive Control	2						
		Industrial Measurement & Instrumentation	2						
		Electric Machineries Design	2						
		Introduction to Artificial Intelligent	2						
		Over Voltage Protection	2						
		Insulation Technology	2						
		Power System Operation	2						
		High Voltage Techniques	3						
		V. Groups of Profession Basic Subjects *(Kelompok*	**12**						

NUoL		UPI		NUTE		IBB		GROUP REMARKS	
Subjects	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**	**Subjects**	**Credits**
		Mata Kuliah Dasar Profesi /MKDP)							
		Educational Foundation	2						
		Development Of Learners	2						
		Guidance And Counseling	2						
		Curriculum And Learning	3						
		Processing Education	3						
		VI. Groups of Expertise Subjects for study field Profession *(Study Field Kelompok Mata Kuliah Keahlian Profesi /MKKP) Bidang Studi*	**14**						
		Teaching And Learning Strategies	4						
		Evaluation Of Education	4						
		Planning Of Teaching	3						
		Educational Research	3						
		VII. Groups of Profession and Training Subjects *(Kelompok Mata Kuliah Latihan Profesi /MKLP)*	**4**						
		Field Experience Programme	4						
Total credits	**144**	**Total credits**	**150**			**Total credits**	**146**	**Total credits**	**127**