添付資料 6：活動実績

添付資料 6-1：新旧 NAVTTC 認証基準

OLD

Government of Pakistan

Ministry of Education, Training & Standards in Higher Education

NAVTTC

National Vocational & Technical Training Commission

ACCREDITATION MANUAL

TECHNICAL& VOCATIONAL STREAM

Published by TVET Reform Support Programme (TRSP)

Performance Area 5: Effectiveness of Teaching Learning Process					
Srl.	Indicators	Category			Weightage
		Critical	Essential	Optional	150
5.1	The institute provides weekly time tables for the/all program(s)	√			20
5.2	Lesson plans are provided for the/all program(s)	√			20
	Lesson plans include the learning outcomes of the lesson and the course.		√		10
5.3	The institute has a policy to introduce competency-based learning		√		10
	Lesson plans reflect a competency based approach to teaching			√	
5.4	The institute ensures that training delivery is carried out according to time tables		√		10
5.5	The institutes monitors the students' learning progress	√			20
5.6	Students practical workbooks, tasks etc. are checked regularly	√			20
5.7	The institutes integrates industrial practice into the teaching (e.g. through regular visits to relevant industries, visits from employers and/or representatives of the labour market, etc.) and maintains adequate records	√			20
5.8	The institute keeps proper records of students' achievements		√		10
5.9	Results of trainee projects are recorded and displayed	√			10
5.10	Academic and other achievements and distinctions are publicly displayed			√	
					150

Performance Area 7: Job Market Linkages					
Srl.	Indicators	Category			Weightage
		Critical	Essential	Optional	150
7.1	The institute has established links with the labour market	√			30
7.2	The institute maintains an active exchange with representatives of industry	√			30
7.3	Representatives of industry take part in relevant institute's meetings		√		10
7.4	Representatives of (local) industry participate in institute functions			√	
7.5	The institute regularly invites guest speakers from industry		√		10
7.6	The institute maintains record of job trainings	√			30
7.7	The institute maintains record of job placements	√			20
7.8	New programs are developed by a cooperation of industry and institute		√		20
					150

NEW

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ACCREDITATION MANUAL

TECHNICAL& VOCATIONAL STREAM

(Institutional Accreditation)

Published by TVET Reform Support Programme (TRSP)

August 2018

Criteria for Vertical (Program) Assessment within Institutional Accreditation					
Srl.	Indicators	Category			
		Critical	Essential	Optional	
2.7	Adequate resources for the program are allocated for the duration of the accreditation period, esp. with respect to training material budget	√			10
3.1	Faculty teaching in the program are adequately qualified and curricula compliant	√			20
3.2	The program has an adequate student-teacher ratio that facilitates good teaching-learning conditions: a) in theoretical courses b) in lab / practical courses	√			10
3.3	There is an even teaching load among teachers in the program.	√			10
3.5	Teachers in the program have attained additional qualification in the last two years	√			15
4.1a	The institute maintains an adequate training infrastructure ➢ Classrooms are properly equipped (with regard to their function)	√			10
b	➢ Labs / workshops are available, in good shape and adequate for the programs	√			10
c	➢ Training equipment / machinery is adequate in terms of numbers and state of repair	√			10
d	➢ Training consumables are sufficiently available	√			10
e	➢ The library provides sufficient copies of relevant books and other media.		√		10
4.3	ICT resources are available for the students in the program (if applicable to the program)		√		10
4.7	Adequate health and safety measures for the program are implemented	√			20
5.2	Lesson plans are provided for the program	√			10
5.4	The institute monitors the students' learning progress	√			20
5.5	Students practical workbooks, tasks etc. are checked regularly	√			10
5.6	The institutes integrates industrial practice into the program (e.g. through regular visits to relevant industries, visits from employers and/or representatives of the labour market, etc.) and maintains adequate records	√			10
5.7	The institute keeps proper records of students' achievements	√			10
5.8	Students' projects, achievements and distinctions are recorded and displayed	√			10
10.2	Teachers teaching in CBT programs are certified CBT-teachers	√			10
10.3	The institute has certified assessors for formative assessments	√			10
10.4	Labs are equipped according to the requirements of the CBT programs	√			10
10.5	The institute has laid down a schedule for CBT courses		√		10
	Total Marks				**255**

Performance Area 5: Effectiveness of Teaching Learning Process					
Srl.	Indicators	Category			Weightage
		Critical	Essential	Optional	100
5.1	The institute has a policy to implement notified curriculum of National/Provincial mandated body and provides weekly time tables for all the program(s)	√			20
5.2	Lesson plans are provided for all program(s)	√			10
5.3	The institute has a policy to introduce competency-based learning		√		10
5.4	The institute monitors the students' learning progress	√			20
5.5	Students practical workbooks, tasks etc. are checked regularly	√			10
5.6	The institutes integrates industrial practice into the teaching (e.g. through regular visits to relevant industries, visits from employers and/or representatives of the labour market, etc.) and maintains adequate records	√			10
5.7	The institute keeps proper records of students' achievements		√		10
5.8	Students' projects, achievements and distinctions are recorded and displayed		√		10
					100

Performance Area 7: Job Market Linkages					
Srl.	Indicators	Category			Weightage
		Critical	Essential	Optional	100
7.1	The institute has established links with the labour market	√			20
7.2	The institute maintains an active exchange with representatives of industry		√		20
7.3	The institute regularly invites guest speakers from industry		√		15
7.4	The institute maintains record of job trainings	√			20
7.5	The institute maintains record of job placements		√		15
7.6	New programs are developed by a cooperation of industry and institute		√		10
					100

添付資料 6-2：Training Management Cycle Manual Ver.2

TRAINING MANAGEMENT CYCLE MANUAL

VERSION 2

2017 October

THE PROJECT FOR STRENGTHENING DAE IN MECHANICAL TECHNOLOGY AT GOVERNMENT COLLEGES OF TECHNOLOGY IN PUNJAB PROVINCE IN THE ISLAMIC REPUBLIC OF PAKISTAN

GOVERNMENT OF PUNJAB
TECHNICAL EDUCATION & VOCATIONAL TRAINING AUTHORITY
(TEVTA)

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

CONTENTS

Ⅰ. Introduction

Pakistan National level of Technical Vocational Education and Training (TVET) development strategy is shown in "National Skills Strategy".

The Strategy aims to transform TVET system to strengthen competitiveness in the global market. It aims to develop capacities required for industrial and economic development.

Therefore, the recruitment needs of enterprises diversify and advance, so the TEVT role is becoming important day by day.
The most important in the TEVT is to establish process especially developing human resources from identifying the company's human resources needs.
And the process is required to improve continually as a one of the cycle.

In the Punjab province of Pakistan, TEVTA is the only one organization which promotes TVET.
TEVTA possesses the results which have met the political requirements for various TVET from the industrial sectors.

On the other hand, Government Colleges of Technology (GCTs) are the one of the TVET institutes in developing human resources which are equipped with technical capacity for the industrial sector.

Therefore, JICA has created "Training Management Cycle Manual" aims to establish human resources development process for TEVTA in the project from 2008.
In addition, JICA creates a new "TMC Manual" which can be used for human resource development process for all GCT in Punjab province in the project starting in 2016.

Ⅱ. Necessity of the training management in GCT

It's important to respond accurately to the ability of the human resources from the industrial sector in the implementation of effective TVET.
Therefore, GCT as TVET institution should solve problems and challenges for aim to ensure and improve the reliability and quality of TVET.
It's necessary to do proper management and operation at each stage of TVET so that GCT could expect the following effect.

1) Can identify human resources needs from the industrial sector accurately.
2) Can set up the TVET courses corresponding to changes in local economic and employment situation.
3) TVET curriculum is reconsidered flexibly.
4) TVET can be shifted to a systematic work from an individual.
5) The reliability and the quality of TVET improve, and it'll be effective and efficient.
6) The role of the GCT as TVET institution is clarified.
7) It's possible to give a security and a reliability of GCT to the participants.

Ⅲ. What is the Management Cycle?

Appropriate management and operation of TVET can be applied to the "PDCA cycle" as a flow from the human resources needs of the industry to evaluation and improvement of the training.

Figure 1 and 2 shows a relation among PDCA cycle and a general educational training. In addition, GCT as TVET institution should clarify the issues in the TVET process, and shall take measures to resolve it.

Therefore, GCT is required to back up the attitude of staffs in systematic for the problem-solving.

Table 1 shows "PDCA cycle and TVET basic process in GCT"

Figure 1: "The Cycle of Educational Training"

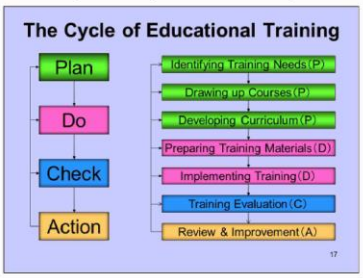


Figure 2 "The Concepts of Management Cycle"

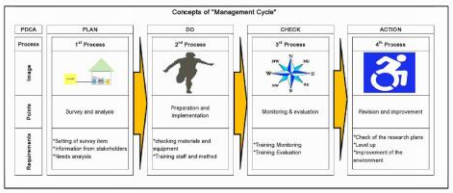


Table 1: PDCA cycle and TVET basic process in GCT

PDCA cycle	TVET basic process in GCT
Plan	1) Identifying human resources needs from the industrial sector 2) Training subject development or set-up 3) Curriculum development or revision 4) Preparation of facility and machinery
Do	1) Preparation of training materials 2) Implementation of training (theory and practice)
Check	1) Evaluation of training contents 2) Evaluation of training level 3) Participant achievement test 4) Evaluation whole of training course and subject
Action	1) Improvement of identifying human resources needs 2) Improvement of course and subject 3) Improvement of curriculum 4) Improvement of training contents and method 5) Revision of training material 6) Revision of evaluation method

Ⅳ. Basic Procedure of Management Cycle in GCT

GCT will further strengthen a collaboration with companies by industrial linkage, such as improving the curriculum that matched the industry needs and increasing employment opportunities for graduates.

For that purpose, activities according to the training management cycle are required as shown in Table 1.

From the next section, chapters will be explained according to the flow of TVET in GCT.

Chapter 1

Identifying Human Resources Needs

1. Identifying industrial trends
2. Identifying human resources needs
   1) Survey main points, contents & details
   2) Survey method
   3) Survey plan
   4) Survey Implementation
3. Needs Analysis and Report

The contents of TVET are requested to reflect the human resources needs from the community.
Therefore, accurate identifying of human resources needs from the industrial sector and the related organizations is needed.
Main activities of the identifying the human resource needs and details are as follows.
GCT will be required to effort better TVET program to train desired person.
Table 2 is shown "Main activities of the identifying the human resource needs and details"

Table 2: Activity of the identifying the human resource needs

No	Activity
1	Identifying industrial trends
2	Identifying the human resource needs
3	Needs analysis

1 . Identifying industrial trends

It's necessary to identify the reality of the economy, the employment situation and the industrial trend.
Therefore, it's useful to get industrial trend information of the community area from various released material and report from each related stakeholders as below.

1) Collection of industrial statistic data
2) Collection of industrial policy data
3) Hearing from industrial association and Chamber of commerce and industry
4) Visiting the companies

Hearing from the industrial association and the chamber of commerce is a very meaningful thing to get an industrial trend in community area, so GCT should hold a meeting periodically.
Moreover, the instructors of GCT should increase a chance of the company visit.
It's a meaningful thing that they learn the realistic production activity and the necessary technological skill in a production site.
Further, it's necessary to esteem the following item to look for the trend of the industrial sectors (enterprises).

Table 3: Identifying industrial trends

Identifying industrial trends	i) Development in new field ii) Introduction of new technology iii) Change of line iv) Promotion of entering other market v) Change of management policy vi) New employment plane

2. Identifying human resources needs

It's necessary to identify human resources needs at least once every year, GCT can use it for revises of TVET contents.
The examples of Identifying human resources needs are as below.

1) TNA (Training Needs Assessment)
2) Industrial linkage survey
3) Questionnaire from GCT graduates

A lot of direct opinion from the enterprises is obtained, so Identifying human resources needs will be important data of GCT operation and management.
The identifying of the human resource needs should be considered the following items.

Table 4: The identifying of the human resource needs

The identifying of the human resource needs	1) Survey main points, contents or details 2) Survey method 3) Survey plan 4) Survey Implementation

1) Survey main points, contents or details

The main points of the survey contents are as follows, and detailed items of survey items are determined from these.

Table 5: Survey Main Points

Survey main points	i) Employ adoption No. and field ii) Technical innovation iii) Required employee ability iv) Facility & Machinery v) Accepting GCT internship vi) Training for employees vii) Request or expectation to GCT viii) Others

An example of survey contents or details in Training Needs Assessment (TNA) is shown on the table 6.
JICA recommend to make survey item with this example and use it as basic data of human resources needs.

Table 6: "Example of TNA Contents & details"

TNA Cotents			
No.	**Survey Details**	**No.**	**Survey Details**
1	Date of Survey	13	Adoption of engineers
2	Company name	14	Adoption level
3	Industrial field	15	Training for employees
4	Location	16	Internship from GCT
5	Date of foundation	17	No. of GCT graduates
6	Representative	18	Adoption of GCT graduates
7	Interviewer	19	Comments of GCT curriculum
8	Main Products	20	Attendance for GCT seminar
9	Number of employees (officer engineer)	21	Lecturer from company
10	Main production equipment (machine name,type,year)	22	OJT for GCT instructors
11	Necessary technique and skill	23	GCT seminar for company
12	Technical problem	24	Others

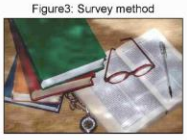
2) Survey method

There are 3 kinds of survey method in TNA and Industrial Linkage survey, and something suitable is selected from those.
And also, it's possible to use a combination of these.

Table 7: Survey method

Survey method	i) Document survey ii) Questionnaire survey iii) Interview survey

Figure3: Survey method



1) Document survey

2) Questionnaire survey

3) Interview survey

3) Survey plan

GCT Should decide about the next item as a plan of the TNA and Industrial Linkage survey.
When working an enough plan and survey, it's necessary to know that a good result is obtained.

Table 8: Survey plan

Survey plan	i) Survey period ii) Surveyor iii) Survey target iv) Budget

4) Survey Implementation

Also, GCT should decide the next item when implement the TNA and Industrial Linkage survey
An example of a TNA questionnaire is shown on the table10.
In addition, questionnaire of industrial linkage surveys emphasize the item on strengthening of the collaboration between GCT and industrial sector (Table11).

Table 9: Survey Implementation

Survey Implementation	i) Implementation date ii) Implementation Person iii) Decision of question iv) Preparation of data material v) Questionnaire sheet making vi) Collection of questionnaire sheet vii) Classifying questionnaire sheet

Graduate's opinion is also helpful.
It's also necessary to take up request to GCT from them for a questionnaire in the half of year or 1 year later after graduation.
Opinion collection has the following methods.
· Mail questionnaire and replies· Available by registered questionnaires and interviews
· Visit to the enterprise surveys and interviews

Figure 4: Preparing Graduate's Questionnaire

Table 10: "Example of TNA sheet"

TRAINING NEEDS ASSESSMENT

The date of survey		(d/m/y)	Interviewers			
Company						
Industrial Classification						
Location						
Date of foundation		(d/m/y)	Representative person			
Main Products	1		2		3	
Numbers of employees	White-collar workers		Engineering workers			
Main Production Equipment(s) (Machinery and Equipment, Model, Year, Number(s))						
Machinery and Equipment	Year	Number	Machinery and Equipment	Year	Number	
Could you write necessary(or deficient) technique(s) and acquirement(s)?						
Do you have confront technical problems? If yes, Please write the details of the problems.						
Technician's adoption and numbers of them		Yes	Numbers:		No	
What kind of field(s) and level(s) would you like to adopt?						
The methods of education and training for employees.						
Would you like to accept introduction of Internship from GCT?		Yes	No			
Could you write condition(s) if yes?						
How many GCT's graduates have you ever adopt?	Yes	No	Numbers:			
Could you explain their specialized fields if yes?						
Would you like to adopt GCT's graduates?		Yes	No			
Could you explain adopt specialized fields that you want and numbers of graduates if yes?						
Please write your request(s) and expectations to GCT.						

Table 11: "Example of Industrial Linkage Survey Sheet"

INDUSTRIAL LINKAGE SURVEY

ISO certification [9000s] [14000s]

Main customers:

Annual sales (Rs.)	2011	2012	2013	2014	2015

Participation to Technical Trainings:

	Course	Period	Number of participants
2011			
2012			
2013			
2014			
2015			

Plan from 2016:

Do you have any technical alliance with Government Colleges of Technology (GCTs), or have you ever introduced technology from GCTs?

(Circle Yes or No.) Yes No

Future plan of your company

Annual Sales Rs. Planned number of employment per year

[Engineers] [Technicians]

The plans of introduction of machinery and equipment

Name/Model	Year	number	Name/Model	Year	number

Cooperation with GCTs

How do you evaluate the graduates of GCTs?

Strong points:

Points that needs improvements:

Opinions on the GCTs' curriculum:

Possibility of use the GCTs' resource on your company's training:

Intent to participate in the recruitment seminars of GCTs: Yes, we do have. No, we don't have.

Are you interested in the seminars by GCTs to the enterprises?

Can your company dispatch lecturers to GCTs?

Can your company accepts interns from GCTs?

Interviewer's Impression:

3. Needs Analysis and Report

It's important to analyze and organize TNA Industrial Linkage survey and the graduate questionnaires, they give the development of TVET and management of CGT in the future. Therefore, the analysis of needs and organize of survey results are performed by the next procedure.

Table 12: Needs Analysis

Needs Analysis and Report	i) Collection of data ii) Analyzing of whole data iii) Analyzing of training needs from industry (company) iv) Organizing educational training challenges v) Checking of training duty, ability and level vi) Making a survey report

The indication of the result of analysis can be understood by everyone using following chart and graph.

It's important to share the information about the arrangement of the analysis of the survey results and training challenges to the stakeholders.

Because, they can be utilized as basic material of the next survey activities.

Figure 5: Example Graph

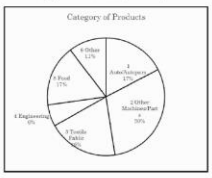


Figure 6: Example Graph

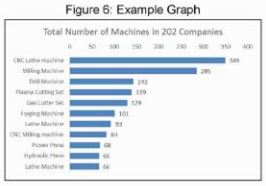


Figure 7: Sharing of the information

Figure 8: Example of Survey Report (Summary)

EXECUTIVE SUMMARY OF THE SURVEYS

Baseline survey, Training Needs Assessment (TNA) and Industrial Linkage Survey

Introduction:

Three surveys were done in the Project for Strengthening DAE in Mechanical Technology in Punjab Province in the Islamic Republic of Pakistan (hereinafter, "Project").

(1) Baseline Survey,
(2) Training Needs Assessment (hereinafter, "TNA")
(3) Industrial Linkage Survey

The method and the schedule of the survey is as follows.

(1) Method: Questionnaire to 13 colleges (Baseline survey) and 202 enterprises (TNA and Industrial Linkage Survey).
(2) Schedule: Asked principals of 13 colleges on 10 March 2016. Then each college collected data from inside and enterprises around the college.
(3) The project team summarized, analyzed the data.

Data source:

(1) Colleges: 13 colleges that are the target of the Project
(2) Instructors: 196 instructors participated in the survey
(3) Enterprises: 202 enterprises participated in the survey.

Findings:

The result shows that the size of the colleges varies a lot. The annual budget varies from 14 million to 218 million PKR. Also, number of students of students is from 50 to 1,100.

The ages and experience of instructors show some problem. 41% of the instructors are over 50 years old. 33% of the instructors has experience of 5 years or less. These data show that continuity of knowledge and skills is a big challenge.

The self evaluation of skills and knowledge of instructors shows that they think that their knowledge and skills is low on WEDM, Machining Center and CAD is low and high on Lathe and Metal Work Machining.

The survey to the enterprises shows that enterprises wants graduates with practical skills and discipline, and hope the curriculum of GCTs to be more practical, to be update and to focus on discipline. The enterprises have interests in the relation with GCTs, 78% of the enterprises have willing to accept interns and 71% have the capability to accept.

Conclusion & Recommendations:

The result of the surveys shows the importance of practical skills, especially new technology, and discipline and the challenges of sustainability. These points of view are recommended in the training management cycle, curriculum revisions, equipment procurement and the master trainings and training of trainers. Also, the enhancement of industrial linkage such as internship is in line with the industrial sector's expectation.

Chapter 2

Course Subjects and Curriculum Revision

1. Revision of training final goal

1) Clarification of the vocational duties and functions
2) Clarification of vocational ethics and the attitude
3) Reconsideration of qualification

2. Revision of training objectives and level of course subjects

1) Subject objective level
2) Training time
3) Instructor in charge
4) Training place and equipment
5) Instruction method

3. Revision of the curriculum of course subjects

1) Revise items
2) Reference
3) Members
4) Points of discussion
5) Procedure

It's necessary to reconsider the technological capability and the level of the human resources needs from the community and the industrial sector on TVET in GCTs from a result of TNA and the industrial linkage survey.
Therefore, setting of a subject and the curriculum in a course will be reconsidered by the next procedure.
The reconsideration of a subject and the curriculum will be advanced by master trainers of each subject.
Master Trainers are instructed about the critical item of the respective steps from a Japanese expert.

Table 13: Course Subjects and Curriculum Revision

No.	Activity
1	Revision of training final goal
2	Revision of training objectives and level of course subjects
3	Revision of the curriculum of course subjects
4	Revision of training method

1. Revision of training final goal

It is necessary to reconsider what kind of ability a student should learn after an end of training.
In detail of the training final goal are the following 3 items.

Table 14: Revision of training final goal

Revision of training final goal	1) Clarification of the vocational duties and functions 2) Clarification of vocational ethics and the attitude 3) Reconsideration of qualification

1) Clarification of the vocational duties and functions

This should be stipulated the necessary role of employment and entrepreneurship expected after an end of training.

(Example)

"A graduate can do production management, machinery management, materials and process of operation management as a supervisor in a production site of an enterprise."

2) Clarification of vocational ethics and the attitude

This should be stipulated the norms, the behavior and the cooperation in carrying out their duties
It means attitude and activity of reporting, communication, consultation and emphasis of safety within an enterprise.

(Example)

"A graduate can find the way of problem solving when there was a defect on the management by reporting it to a boss and seeking an instruction as well as asking an opinion from a site workers."

3) Reconsideration of qualification

This should be consider the future qualifications as well as giving of qualification of DAE.

(Example)

"Due to the globalization of the company, GCT should aim the improvement of English

ability to the student."

Figure 9: Discussion for Problem solving

2. Revision of training objectives and level of course subjects

It's necessary to reconsider the training final goal, the level and time of the subject which require to train the technique and skill, related knowledge composed the vocational duty and the function.

Table 15: Revision of training objectives and level of course subjects

Revision of training objectives and level of course subjects	1) Subject objective level 2) Training time 3) Instructor in charge 4) Training place and equipment 5) Instruction method

(Example) Subjects are classified as follows.

Table 16: Subject Classification

	Classification	Subject Name (Example)
Couse Subject	Basic theory	Basic Engineering Drawing, Basic CAD etc.
	Basic workshop (Practice)	Workshop Practice, Metrology etc.
	Applied theory	Applied Mechanics Applied Thermodynamics, etc.
	Applied workshop (Practice)	CAD/CAM CNC Machines etc.

1) Subject objective level

The standard of the arrival goal of each subject shows the degree of acquisition of the technic and skill, the related knowledge and the attitude.

They are the items which are checked and estimated specifically after training.

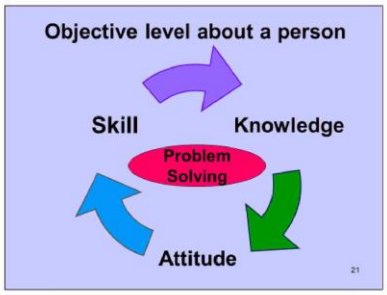
The basic ability of the followings are desired to execute vocational work in particular.

Using the three of ability, graduates can solve the various problems on the work, and they look for the productivity, the efficiency, development and improvement in the production site of the enterprise.

Table 17: Ability and Classification

Ability	Classification
Having an enough knowledge about the work	knowledge
Having a certain technic and skill about the work	Technic and Skill
Having a sincere posture, attitude and preparation on the work	Attitude

Figure 10: "Objective level about a person
(Relation among knowledge, skill and attitude)"



It's necessary to decide the measure levels of the arrival standard to check and estimate.
It's possible to express them as shown in the next table.

Table 18: Subject objective level

Rank	Objective Level	Technic & Skill	Knowledge	Attitude
A	Important practice, theory, attitude	Can do it correctly and efficiently	Can know and explain it certainly and efficiently	Can do it aggressively
B	General practice, theory, attitude	Can do it correctly and generally	Can know it certainly and generally	Can do it positively
C	Related practice, theory, attitude	Can do it generally	Can know it generally	Can do it interestedly

Table 19: Subject objective level (Example)

Course subject name	Automotive Electricity
Subject objective level	The students to be able to get the following levels after the training. 1. Can know and explain Ohm's law, Fleming's law certainly and efficiently. 2. Can know and explain Automobile electricity diagram certainly and efficiently. 3. Can check and repair the lighting circuits correctly and efficiently. 4. Can check and repair charging system correctly and generally. 5. Can check and repair starting system correctly and efficiently. 6. Can do their theme aggressively

2) Training time

It means to be reviewed for the following three items.

Table 20: Training time

Training time	i) Starting date ii) Training duration iii) Total training hours

3) Instructors in charge

It means to review the all instructors in charge for the each subjects.

The following documents are needed to provide.

Table 21: Instructors in charge

Instructors in charge	i) List of Instructors in charge ii) Outside Lecturer iii) Curriculum Vitae

4) Training place and equipment

It means to review classroom supplies and workshop equipment.

Table 22: Training place and equipment

Training place and equipment	i) Classroom Blackboard, Chair, Desk, Light, Chart, Screen ii) Workshop Blackboard, Tools, Equipment, Machinery

5) Instruction method

Roughly classify, it has lesson in a classroom and a practice in a workshop.

An important one is to take the method to understand easy for a student.

The items as below summarize in one table as course subject plan.

The example is shown in the table 22 as below.

Table 23: Instruction method

Instruction method	i) Conversion to the practical instruction utilizing the actual technique ii) Utilization of new kinds of practice technique (work study and case study) iii) Conversion to practicing instruction by a problem solving iv) Utilization of the outside lecturer from an enterprise v) Utilization of an internship

Table 24: Course Subject Plan (Example)

Item	Contents
Course Subject name	Automotive Electricity (Practice)
Subject objective level	The students to be able to get the following levels after the training. 1. Can know and explain Ohm's law, Fleming's law certainly and efficiently. 2. Can know and explain Automobile electricity diagram certainly and efficiently. 3. Can check and repair the lighting circuits correctly and efficiently. 4. Can check and repair charging system correctly and generally. 5. Can check and repair starting system correctly and efficiently.
Training hours	40hours, First year, The second semester
Instructor in charge	Engr. Muhamad Usman, Lecturer from SUZUKI Motors
Training place	Lecture room No.45 Automobile Workshop 1
Instruction Method	1. Theory about Ohm's law, Fleming's law, etc. 2. Theory about automobile electricity diagram. 3. Demonstration of checking and repairing the lighting circuits from instructors. 4. Practice for each participants 5. Inspection of check-point 6. Demonstration of checking and repairing charging system from instructor. 7. Practice for each participants 8. Inspection of check-point 9. Demonstration of check and repair starting system from instructor. 10. Practice for each participants 11. Inspection of check-point 12. Confirmation

3. Revision of the course subjects curriculum

Consideration of the existing curriculum is the first purpose about a revise of each subject. It's necessary to understand a critical item of instruction, so master trainer who had advanced from a Japanese expert takes the leading part.

Table 25: Revision of the course subjects curriculum

Revision of the course subjects curriculum	1) Revise items 2) Reference 3) Members 4) Points of discussion 5) Procedure

1) Revise items

The next item will be revised along with the existing syllabus and curriculum.

Table 26: Revise items

Revise items	i) Title (Course contents) ii) Description (Detail of contents) iii) Training Hours iv) Instructional Objectives v) Others

2) Reference

The reference materials are as follows.

Table 27: Reference

Reference	i) "Syllabus for D.A.E. Mechanical Technology" ii) "Curriculum for D.A.E. Mechanical Technology" iii) Report of TNA iv) Report of Industrial linkage survey v) Master Training plan

3) Members

Master trainers of GCT-RR, GCT-FSD and several GCT instructors of each subject are chosen as the key members. The curriculum department of TEVTA will be a secretariat.

Table 28: Members

Members	i) TEVTA Curriculum department ii) Master trainers iii) GCT instructors in charge

4) Points of discussion

The following items should be considered with the references.

Table 29: Points of discussion

Points of discussion	i) Adding new technology items ii) Revision of proper technical terms iii) Elimination of the low item of the necessity iv) Unification of the items overlapping v) Resetting of training time in appropriate vi) Adjustment of the training level of the contents vii) Other related point

5) Procedure

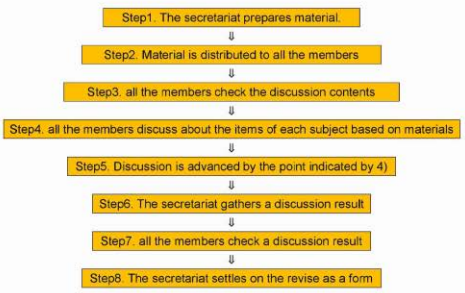


Table 30: Curriculum Revision Example
("Industrial Planning & Production Method")

Ch	Present		New	
1	Industrial planning 1.1 Need of industrial planning 1.2 Phases of industrial planning	3 hrs	Industrial planning 1.1 Need of industrial planning 1.2 Phases of industrial planning	3
2	Site selection for industry 2.1 Economical and technical factors considering while selecting factory site	2	**Site selection** 2.1 Economical and technical factors considering while selecting factory site	2
3	Plant layout 3.1 Definition 3.2 Objectives 3.3 Types 3.4 Criteria for a good layout 3.5 Advantages of a good layout 3.6 Preparing a layout	4	**Layout** **3.1 Introduction to layout** **3.2 Types of layout** **3.3 Good layout** **3.4 Preparation of a layout**	4
4	Production Methods 4.1 Introduction to production 4.2 Important types of production	3	Production Methods 4.1 Introduction to production **4.2 Types of production** **4.3 New trend of types of production**	3
5	Job Analysis 5.1 Motion study 5.2 Time study	6	Job Analysis 5.1 Motion study 5.2 Time study	**5**
6	Production planning and control 6.1 Production planning 6.2 Production control	4	Production planning and control 6.1 Production planning 6.2 Production control **6.3 Improvement of productivity**	4
7	Quality assurance 7.1 Inspection 7.2 Quality control	2	Quality assurance 7.1 Inspection **7.2 Quality control (Quality management)** **7.3 Quality control circle**	**3**
8	Maintenance 8.1 Responsibility of maintenance department 8.2 Types of maintenance 8.3 Comparison of different types of maintenance 8.4 Replacement studies	4	Maintenance 8.1 Responsibility of maintenance department 8.2 Types of maintenance **8.3 Total productive maintenance**	4
9	Cost determination and control 9.1 Cost calculation of industrial product 9.2 Cost control	2	Cost determination and control 9.1 Cost calculation of industrial product 9.2 Cost control	2
10	Store operation in industry 10.1 Receipt of store items 10.2 Records of store 10.3 Issue of store items	2	**Store operation** **10.1 Receipt of store items** **10.2 Issue of store items**	2

Remark : **Red & underline** parts are revised items.

Chapter 3

Training Preparation

1. Training Schedule

   1) Annual Training Schedule
   2) Period Training Schedule
   3) Timetable

2. Training Budget Plan

3. Training Facility and Machinery Plan

It's necessary to make a training implementation plan for preparations of TVET.
This is the necessary drafting item for the training time management and the budget control of the TVET.

Table 31: Activity of the training preparation

No	Activity
1	Training Schedule
2	Training Budget Plan
3	Training Facility and Machinery Plan

1. Training Schedule

An annual or a period schedule and daily or a weekly timetable are included in the training schedule.

Table 32: Training Schedule

Training Schedule	i) Annual Training Schedule ii) Period Training Schedule iii) Timetable

An example of period training schedule and timetable are shown as next tables.

Table 33: "Example of Training schedule"

Training Schedule (Example)				1st month					2nd month				3rd month			
	Subject	Hours	Instructor	1	2	3	4	5	6	7	8	9	10	11	12	13
Word & Excel Basic	opening & saving	12		1	11											
	Editing text	24			8	16										
	tables	24				3	19	2								
	graphics	24						17	7							
	preparation for printing	24							12	12						
	Total	108		1	19	19	19	19	19	12						
Excel Advance	sheet formatting	12								5	7					
	functions	24									10	14				
	insert charts	12										3	9			
	data manipulations	24											8	16		
	printing	12												1	11	
	Total	84								5	17	17	17	17	11	
Others	Safety & security	12		1	1	1	1	1	1	1	1	1	1	1	1	
	Starting Business	12								2	2	2	2	2	2	
	Final Evaluation	4													4	
	Opening & Closing ceremony	4		2											2	
	Total	32		3	1	1	1	1	1	3	3	3	3	3	9	
	G. Total	224		4	20	20	20	20	20	20	20	20	20	20	20	

Table 34: "Example of Weekly Timetable"

Weekly Timetable					
TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
7:00~8:00	ELECTRICAL PRINCIPLES	EFI ENGINE	SENSOR	ACTUATOR	ENGINE DIAGNOSIS
	M. Tahir	Tayuub	M. Tahir	M. Tahir	Tayuub
8:00~8:10	Short Break				
8:10~9:10	PRACTICE	EFI ENGINE	SENSOR	ACTUATOR	ENGINE DIAGNOSIS
	Usman F.	Tayuub	M. Tahir	M. Tahir	Tayuub
9:10~9:20	Break				
9:20~10:20	PRACTICE	PRACTICE	PRACTICE	PRACTICE	PRACTICE
	Usman F.	M. Ali	M. Ali	Usman F.	Usman F.
10:20~10:40	Short Break				
10:40~11:40	PRACTICE	PRACTICE	PRACTICE	PRACTICE	PRACTICE
	Usman F.	M. Ali	M. Ali	Usman F.	Usman F.
11:40~11:50	Break / PRAY TIME				
11:50~12:50	PRACTICE	PRACTICE	PRACTICE	PRACTICE	PRACTICE
	Usman F.	M. Ali	M. Ali	Usman F.	Usman F.
12:50~13:00	MEETING & REPORTING				

2. Training Budget Plan

It is necessary to decide about a rough estimate of the budget or the expenses of the consumption machinery and educational materials cost beforehand.
About this format and how to request, it needs to conform to the systen of TEVTA and GCT.

3. Training Facility and Machinery Plan

A management list for the training facility and machinery plan is prepared about the training equipment, machinery and materials.
Machinery and materials are prepared in order to train the each subject of GCT.
The next items are listed of training facility and machinery plan.

Tabele 35: Training Facility and Machinery Plan

Training Facility and Machinery Plan	i) Name of Machinery ii) Existing Quantity iii) Specification iv) Maker (Manufacturer) v) Type of Machinery vi) Supplier vii) Supplied year viii) Condition ix) Remarks

The example of training facility and machinery plan is shown as the table.

Table 36: "Example of List of Facility and Machinery Plan"

No	Equipment	Photo	Quantity	Unit	Manufacture	Model/Type	Origin	Supplier
(1-1)	Ultrasonic flaw detector with standard accessories		1	sets	(A&D Company, Limited	IAD-321EX	Japan	Technology Links
(1-2)	Magnetic particle testing equipment with standard accessories		1	sets	(DENSHIJIKI INDUSTRY CO.,LTD) Eishin Kagaku Co., Ltd	Handymagna A-1 S-35LC	Japan	Technology Links
(1-3)	Heat treatment Furnace with standard accessories		1	sets	Nabertherm GmbH	N 7/H	Germany	Technology Links
(1-4)	Specimen Mounting Press with standard accessories		1	sets	ASLi	XQ-2B	China	Technology Links
(1-5)	Metallurgical Microscope with standard accessories		1	sets	Meiji Techno	EZN-13/PKL-2	Japan	Technology Links
(1-6)	Maintenance and Repair Tool kit		1	sets	TONE co., LTD	TTSX950	Japan	Technology Links

Chapter 4

Training Implementation

1. Training Material Plan
2. Lesson Plan
3. Subject Evaluation Plan
4. How to proceed with training
   1) Reconfirmation of guidance plan
   2) Relationship between practical skills and departments
   3) Improvement of teaching methods
   4) Thorough safety and health
5. Confirmation of learning level and follow-up
   1) Self-Evaluation by students
   2) Judgment of Self Evaluation by instructor
   3) Follow up and employment support

Regarding the implementation of training, it is necessary to clarify the outcome and constantly review the training content and implementation method in order to achieve the specific goal of getting students' DAE qualifications and employment or self-employed for companies.
Since it is the individual instructor that is greatly involved in the implementation of training, it is necessary to improve students' knowledge and skills comprehensively in cooperation with creative ingenuity and guidance for coaching guidance.
Major efforts on implementation of training are as shown in the table below.

Table 37: Activity of the Training Implementation

No	Activity
1	Training Material Plan
2	Lesson Plan
3	Subject Evaluation Plan
4	How to proceed with training
5	Confirmation of learning level and follow-up

1. Training Material Plan

Preparations and using of teaching materials are necessary work by education and training.
There are two types of teaching materials.
They are a standardized commercially materials and made by instructors.
How to use utilizing the characteristics of each for students ' understanding is required.
Since there are a classroom lesson and workshop practice in TVET, so selection of effective teaching materials is necessary to each.
The table shows the kind of training material.

Table 38: Training Material

Training Material	i) Reference for theory ii) Reference for practice iii) Job assignment sheet iv) Job breakdown sheet v) Audio visual vi) Others

It is good to select text from "Recommended Textbooks" described in "Curriculum for DAE in Mechanical Technology" and use other necessary materials for the lesson.
In general, there are many kinds of textbooks in teaching materials, but there are also other media that can be used as teaching materials, so if GCT has something that will help students to understand, they should be used.
For example, Catalogue and Pamphlet are also useful media.
In the table, examples of "Job assignment sheet" and "Job breakdown sheet" are shown, but since these can be created even by instructors, it is good to be able to teach the main points of creation from Japanese experts and use them for practical skills.
When creating, it is important to make particular attention so that work can be carried out safely.
For audiovisual teaching materials, it is necessary to recognize its effectiveness and usefulness. And also Real · Model, Cut · Model, Chart, Slide, VTR are effective.
For Internet teaching materials, use it in accordance with the terms of TEVTA.

Table 39: "Example of Job assignment sheet"

Job assignment sheet (Flash Board)

Sheet No.1

Task: Assemble a flash board as follow.
Material: Timber, Plywood, Glue
Machine & Tools: Circle cutter, Hand sand tool, Wood bench, Hammer, Steel scale
Training Time: 6 hours

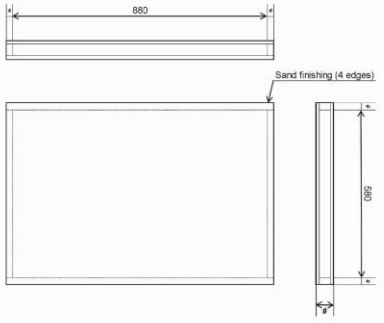


Table 40: "Example of Job Breakdown Sheet"

No. 1

Job Breakdown Sheet

Task: Finishing of flash board
Tools & Materials plywood, timber, board bench, circle cutter machine, hand sand tool

Main Steps	Important, safety Points	Remarks(Graphics)
1. Set flash boards on the bench	Put them into same direction	After finish pasting
2. Set bolts on the bench	3 bolts in left and right side	
3. Tighten the bolts with nuts	Set bolts with same force not to slip off the flash board	
4. Take out flash boards from the bench		
5. Cut extra parts with circle cutter machine	Use a gauge not to cut too match	
6. Finish edges of flash board with hand sand tool	Horizontally	

2. Lesson Plan

When teaching units of curriculum, it is important to prepare class scenarios in advance. The scenario for advancing this lesson is the Lesson Plan.

Items to be described in the Lesson Plan are as follows, and the purpose and important items of the lesson, the order of the lessons and the necessary time are assumed in advance, so that they can be instructed effectively within the specified class hours. It is one of the teaching material.

In addition, the Lesson Plan has no fixed format, it can be created independently by the instructor so that it can be used easily by himself / her ingenuity.

An example is shown in the table for reference.

Table 41: Lesson Plan

Lesson Plan	i) Training Task ii) Main Theme iii) Training Date iv) Training Place v) Trainer vi) Training Course vii) No. of trainee viii) Objective of Study ix) Classification (Instruction Stage) x) Training time xi) Point of instruction xii) Instruction materials and method

Table 42: "Example of Lesson Plan"

LESSON PLAN
(Example)

Training Task : Finishing of flash board **Main Theme** (1) Flash board bench work (2) Circle cutter work (3) Hand sand tool work	**Date:** 2016/09/18 **Place:** Carpentry workshop **Trainer:** **Course:** Carpentry **No. of trainee:** 10

Objective of Study: How to finish flash board

Classification (Instruction Stage)	Time	Point of instruction	Instruction materials or method
Introduction	10	Attendance Explanation of task objective Attention of safety	Attendance record Job sheet no. 1
Demonstration (Presentation)	20	How to use flash board bench How to assemble flash board How to use circle cutter How to finish flash board	Job breakdown sheet no.1
Practice (Application)	80	Flash board bench practice Flash board assemble practice Circle cutter practice Flash board finishing practice	Direct instruction to the trainees
Confirmation	10	Review of practice Comments Explanation of the next work	Job sheet no.2
	Total 120		

Method to evaluate comprehension
By next assignment (Assemble of wood rocker)

Training materials to be used
Timber 30*10*2000mm:100 piece
Plywood 900*1800*2mm:20 piece

3. Subject Evaluation Plan

In the evaluation of subjects, it is important to measure the theoretical understanding degree of the students and the degree of technical acquisition and to make them effective as guidance.

There are paper test practice test, Self-evaluation, etc. as types of tests, and it is good to use properly according to their characteristics.

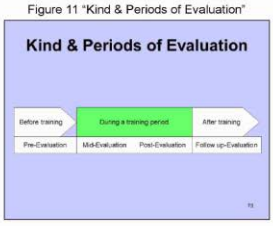
Although the subject examination during the training period is carried out on a regular basis, an evaluation plan that takes the exams before and after training into consideration is necessary.

The relationship between the time and type of evaluation is as shown in the table.

Table 43: Subject Evaluation Plan

Subject Evaluation Plan	i) Monthly- Evaluation ii) Quarter- Evaluation iii) Final- Evaluation iv) Follow-up Evaluation

Figure 11 "Kind & Periods of Evaluation"

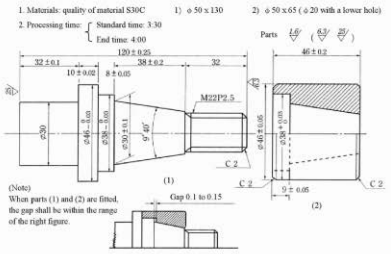


The following figure is an example of a practical test.

Figure 12: "Example of Practical Test"

Assignments of the Test in the Practical Skills for the Machining Department

Produce the parts (1) and (2), as shown in the drawing below, and fit them exactly.
Make the thread of screws as short as possible.



The items of evaluation should be accuracy (dimension accuracy), finishing, work time, and work attitudes, and marks are allocated. It is preferable to set 100 points for the total points. If there are many judgment locations such as dimension accuracy, it is possible to set 150 points or 200 points.

The allotment of marks for evaluation items differs depending on the intention of questions. If dimensions are crucial, allocate high points to accuracy. When focus is placed on finishing, allocate high points to it.

For the example of the assignments for the machining department, we allocate marks as follows:

Total points: 150 points	Dimension accuracy	60
	Finishing	60
	Work time	15
	Work attitudes	15

4. How to proceed with training

Before teaching, the instructor must explain the relationship between the training content and actual work, the level to be achieved, matters concerning safety, etc. without fail.

By doing so, students can understand the importance of the goals to be learned and the contents of the training, and can motivate and motivate the lesson.

Also note the following items.

Table 44: How to proceed with training

How to proceed with training	1) Reconfirmation of guidance plan 2) Relationship between practical skills and departments 3) Improvement of teaching methods 4) Thorough safety and health

1) Reconfirmation of guidance plan

The original teaching plan should always be revised.

Knowledge, skills and skills that students should acquire are becoming sophisticated and diversified, and it is necessary to review the order of guidance, training subjects, teaching materials, etc. so that they can respond flexibly to such changes.

For that purpose, it is requested that the guidance plan be constantly reviewed so that it can be instructed effectively and systematically.

2) Relationship between department and practical skill

The granting of relevant knowledge necessary for occupation is called a department, and the granting of work technologies and skills incidental thereto is called practical skill.

It is not about practicing only the work done at the practice ground, or classroom lecture in the classroom.

Therefore, it is necessary to have guidance at the practice ground and classroom with always having the relevance of both.

Therefore, in practical training, visualization of instruction contents (presentation of real objects and use of audiovisual teaching materials) should be done to clarify the relevance to the theory learned in the department.

3) Improvement of teaching methods

In order to improve the effect of training within a certain time, improvement of teaching method is always necessary.

For that reason, the instructor shall endeavor to improve the following items.

(1) How to explain in accordance with the guidance plan
(2) Method of teaching practical skills
(3) How to use teaching materials
(4) Setting assignment

4) Thorough safety and health

It is important to improve awareness about safety and health and the environment throughout the GCT.

To that end, it is necessary for everyone to have awareness that "safety first" and "education and training are established on safety and sanitation", and it is necessary to ensure the following items thoroughly.

(1) Guidance on safety and health work: thorough work to eliminate unsafe work and proper tools, machines, transport
(2) Thorough disaster prevention measures: clothing, protective equipment, safety equipment, safety posters, safety passage, etc.
(3) Thorough implementation of 5S (organization, arrangement, cleaning, cleanliness, discipline)
(4) Voluntary inspection before work

Figure 13: "Health and Safety Poster"

5. Confirmation of Acquisition Level

Confirmation of degree of mastery at GCT can be confirmed by regular test conducted twice a year and final examination for acquisition of DAE, but in normal training, confirmation work should be performed to ascertain whether the student understood or mastered it is necessary.

In other words, it is necessary to confirm whether the arrival level has reached the preset arrival level for each subject of the subject in a relatively short cycle.

In this confirmation, it is good to take the method shown in the following table.

Table 45: Confirmation of Acquisition Level

Confirmation of Acquisition Level	1) Self-Evaluation by students 2) Judgment of Self Evaluation by instructor 3) Follow up and employment support

1) Self-Evaluation

For each item that received objective examination and guidance differently, it evaluates by themselves.

The evaluation levels and examples of the evaluation levels are shown in the following table.

Table 46: Self-Evaluation Contents

Level	Self-Evaluation Contents
1	Not yet get any knowledge and skills. Can't do it if having a help from other people.
2	Get a few knowledge and skill. Can do it if having a help from other people.
3	Get a general knowledge and skill. Can do it by looking through the reference book oneself.
4	Get a major knowledge and skill. Can do it by oneself more than 60%.
5	Get enough knowledge and certain skill. Can do it by oneself more than 80%.

2) Judgment of Self Evaluation by instructor

This judgment is to judge the result obtained by self-evaluation against the level to be reached, and generally the following criteria are used.

Table 47: Judgment of Self Evaluation by instructor

Judgment reference	Judgment contents
A	Level has been reached
B	Level has been almost reached
C	Level has not been reached

Although this depends on the objectives of the subjects, for example, if the self-evaluation is Level 3, it can be determined that the acquisition level is generally satisfied with the determination criterion as B.

In addition, if the judgment criterion is C, it is important to instruct them to raise to standard B by repair etc.

3) Follow up and employment support

For students who are slow to learn and students who have not passed the regular exam, it is necessary to follow up guidance according to their degree.

Basically, they encourage themselves to self-study, focusing on subjects and items that are lacking in understanding, and will try to improve the level of the students.

Also, at 3 years, it is necessary to support employment for students who wish to find employment, such as visiting companies by collaborating with the employment support office.

Chapter 5

Evaluation and Improvement

1. Evaluation and improvement of DAE course

2. Evaluation and improvement from graduates and employer

Evaluation at TMC is to gather necessary information at all steps from Identifying Human Resources Needs mentioned in Chapter 1 to Training Implementation of Chapter 4, evaluate them, arrange the problems, analyze the cause and interpret the cause. Also, it is an improvement to organize other methods derived from the analysis of their evaluation and cause, and make use of it in the next plan.
Evaluations include those conducted inside the GCT and those that consolidate external opinions such as companies.
The main items of this evaluation and improvement are listed in the table below.

Table 48: Activity of the Evaluation and Improvement

No	Activity
1	Evaluation and improvement of DAE course
2	Evaluation and improvement from graduates and employer suggestion

1. Evaluation and improvement of DAE course

The following table shows worthy evaluations in education and training activities at GCT.
Since these evaluations can be evaluated inside the GCT, they are items that can be handled on a daily basis.

Table 49: Evaluation of DAE course (internal evaluation)

Evaluation of DAE course (internal evaluation)	i) Number of applicants (rate) ii) Promotion & Number of graduates (rate) iii) Student grades (Results of the final test during the period) v) Self-assessment of trainee vi) Student impression / opinion

With regard to the following items that can be numerically analyzed among them, improvement can be aimed for by setting specific numerical targets.
Examples are shown in the following table 14.

Table 50: "Example of Internal Evaluation"

Item	Target value	Current value	Improvement item
i) Number of applicants (% of previous year)	Number (%)	Number (%)	(i) Thorough publicity (ii) Visit to high school (iii) Publication of GCT (iv) Other (Utilization of media, etc.)
ii) Number of enrolled students (% of previous year)	Number (%)	Number (%)	
iii) Promotion & Number of graduates (rate)	Number (%)	Number (%)	
iv) Student grades	Average point	Average point	(i) Increase attendance rate (ii) Thorough motivation for learning (iii) Confirmation and improvement of teaching methods (iv) Expansion of instructor training (v) Other (Introduction of corporate visits etc.)

2. Evaluation and improvement from graduates and employer

These evaluations are evaluations obtained from the outside of the GCT, and it is necessary to investigate regularly. Therefore, it is necessary to devise these investigations beforehand in GCT's annual business plan, analyze external evaluations, and make use of it in the next task.

Table 51: Evaluation and improvement from graduates and employer

Evaluation and improvement (External evaluation)	i) Evaluation from graduates ii) Evaluation for employer iii) Evaluation of Industry to GCT (Opinion / Request) iv) Social evaluation of GCT

To that end, it is necessary to evaluate and improve the following items.

Table 52: "Example of External Evaluation"

Item	Evaluation Item	Improvement Item
i) Evaluation from graduates	Contents of teaching while in school and similarities / differences on the site etc.	(i) Improvement of guidance contents (ii) Aptitude judgment of students (iii) Improvement of curriculum (iv) Thorough employment guidance (v) Introduction of company visits (vi) Accuracy of internship system (vii) Need for additional guidance (viii) Necessity of PR
ii) Evaluation from employer	Evaluation of graduates and characteristics, requests for GCT etc.	

V. Conclusion

Training management in the GCT is one of the most important items.
Training management consists of "Identifying the human resources needs of the industry", "Revising the curriculum", "Preparing for training", "Training implementation" and "Evaluation and improvement of training".

However, from "Identifying human resources needs of the industry" to "Evaluation and improvement of training" can be regarded as one flow.
And it is important to think that each stage is related to all items.

For this reason, attempts are being made in Japan to solve those problems by applying the PDCA management cycle frequently used in industry to training management.

Even in the JICA project, we intend to strengthen technical education management at GCTs and introduce this and aim to establish the Training Management Cycle (TMC).

This manual has been compiled to achieve the above objectives.
And, it focuses on items to be noted for each stage.
Also, it incorporates many cases, diagrams and photographs, so it is easy to understand.

There are some differences from the style used in each GCT, but please understand it as one example.

We hope this manual will help technical education in GCT.
Lastly, we thank the following people for their cooperation in creating this manual.

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Mr. Amjad Elahi	Chief Instructor GCT-RR Lahore	Focal Person of JICA GCT-RR
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Engr. Osamu Sasaki	Project Deputy Chief Advisor JICA	Working Group Member
Engr. Kuniaki Kato	Expert (Industrial Linkage) JICA	Working Group Member
Engr. Tadao Ishii	Expert (Metalwork Machining) JICA	Working Group Member

Attachment

Training Management Monitoring Check Sheet

Check Sheet No.1

Monitoring Check Sheet (Identifying Human Resources Needs)

Item	Detail	check
Survey main points	i) Employ, Adoption No. and field	
	ii) Technical innovation	
	iii) Required employee ability	
	iv) Facility & Machinery	
	v) Accepting GCT internship	
	vi) Training for employees	
	vii) Request or expectation to GCT	
Survey method	i) Document survey	
	ii) Questionnaire survey	
	iii) Interview survey	
Survey plan	i) Survey period	
	ii) Surveyor	
	iii) Survey target	
	iv) Budget	
Survey Implementation	i) Implementation date	
	ii) Implementation Person	
	iii) Decision of question	
	iv) Preparation of data material	
	v) Questionnaire sheet making	
	vi) Collection of questionnaire sheet	
	vii) Classifying questionnaire sheet	
Needs Analysis and Report	i) Collection of data	
	ii) Analyzing of whole data	
	iii) Analyzing of training needs from company	
	iv) Organizing educational training challenges	
	v) Checking of training duty, ability and level	
	vi) Making a survey report	

Check Sheet No.2

Monitoring check sheet (Course Subjects and Curriculum Revision)

Item	Detail	check
Subject objective level	i) Knowledge level	
	ii) Technic and Skill level	
	iii) Attitude level	
Training time	i) Starting date	
	ii) Training duration	
	iii) Total training hours	
Instructors in charge	i) List of Instructors in charge	
	ii) Outside Lecturer	
	iii) Curriculum Vitae	
Training place and equipment	i) Classroom	
	ii) Workshop	
Instruction method	i) Practical instruction utilizing the actual technique	
	ii) New kinds of practice technique (Work study and Case study etc.)	
	iii) Practicing instruction by a problem solving	
	iv) Outside lecturer from an enterprise	
	v) Internship training	

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Check Sheet No.3

Monitoring check sheet (Training Preparation)

Item	Detail	Check
Training Schedule	i) Annual Training Schedule	
	ii) Period Training Schedule	
	iii) Timetable	
Training Facility and Machinery Plan	i) Name of Machinery	
	ii) Existing Quantity	
	iii) Specification	
	iv) Maker (Manufacturer)	
	v) Type of Machinery	
	vi) Supplier	
	vii) Supplied year	
	viii) Condition	
	ix) Remarks	
Training Budget Plan	Training Budget Plan	

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Check Sheet No.4

Monitoring check sheet (Training Implementation)

Item	Detail	Check
Training Material	i) Reference for theory	
	ii) Reference for practice	
	iii) Job assignment sheet	
	iv) Job breakdown sheet	
	v) Audio visual	
Lesson Plan	i) Training Task	
	ii) Main Theme	
	iii) Training Date	
	iv) Training Place	
	v) Trainer	
	vi) Training Course	
	vii) No. of trainee	
	viii) Objective of Study	
	ix) Classification (Instruction Stage)	
	x) Training time	
	xi) Point of instruction	
	xii) Instruction materials and method	
Subject Evaluation Plan	i) Monthly- Evaluation	
	ii) Quarter- Evaluation	
	iii) Final- Evaluation	
	iv) Follow-up Evaluation	

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Check Sheet No.5

Monitoring check sheet (Evaluation and Improvement)

Item	Detail	Check
Evaluation of DAE course (internal evaluation)	i) Number of applicants (rate)	
	ii) Promotion & Number of graduates (rate)	
	iii) Student grades(Results of the final test)	
	v) Self-assessment of trainee	
	vi) Student impression / opinion	
Evaluation and improvement (External evaluation)	i) Evaluation from graduates	
	ii) Evaluation for employer	
	iii) Evaluation of Industry to GCT (Opinion / Request)	
	iv) Social evaluation of GCT	

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添付資料 6-3：調査結果報告書

添付資料 6-3-1：ベースライン調査

The Result of the Baseline Survey

I. Outline of the survey:

The survey was implemented as following procedure.
Period of Survey: March 2016
Source of Data: all the 13 colleges that are the targets of the project in Punjab Province, Pakistan,
List of colleges (hereinafter, GCTs) is as follows.

1. Govt. College of Technology, Railway Road, Lahore
2. Govt. College of Technology, Faisalabad
3. Govt. Staff Training College, Faisalabad
4. Govt. College of Technology, Gujranwala
5. Govt. Swedish Pakistani College of Technology, Gujrat
6. Govt. College of Technology, Jhelum
7. Govt. College of Technology, Layyah
8. Govt. College of Technology, Multan
9. Govt. College of Technology, Sangla Hill, District Nankana Sahib
10. Govt. College of Technology, Sahiwal
11. Govt. College of Technology, Sargodha
12. Govt. College of Technology, Sialkot
13. Govt. College of Technology, Bahawalpur

II. Outline of the Colleges

1. Date of establishment:

The dates of establishment of GCTs are shown in the table below. The dates are from 1884 to 2010. 7 out of 13 GCTs were established from 1961 to 1970.

Date of establishment	Number of GCTs
1884	1
1932	1
1961- 1970	7
1971-1980	1
1981-1990	1
1991-2000	1
2001-2010	1

2. Number of staff:

Number of staff is shown in the table below, which ranges from 3 of GCT Gujranwala to 192 of GCT Railway Road.

GCTs Name	No. of Staff	No. of instructors at Mechanical Department
GCT Railway Road	97+95=192	27
GCT Faisalabad	116	19
GSTC Faisalabad	88	7
GCT Gujranwala	3	3
GCT Gujrat	8	8
GCT Jhelum	32+32=64	7
GCT Layyah	132	15
GCT Multan	125	32
GCT Sangla Hill	10	10
GCT Sahiwal	91	2
GCT Sargodha	180	1
GCT Sialkot	70	19
GCT Bahawalpur	98	14

3. Number of courses:

The number of courses is shown in the table below.

No. of Courses	Number of GCTs
1-5	8
6-10	4
10-15	1

4. Courses of colleges:

The courses of colleges are shown in the table below.

	DAE Mechanical	DAE Electrical	Civil	DAE Auto & Diesel/Farm Machine	Electronics	Others
GCT Railway Road	1			1		3
GCT Faisalabad	1	1	1			4
GSTC Faisalabad	1	1	1			
GCT Gujranwala	1	1			1	1
GCT Gujrat	1	1		1	1	4
GCT Jhelum	1	1			1	1
GCT Layyah	1	1	1			
GCT Multan	1	1	1		1	2
GCT Sangla Hill	1	1		1		
GCT Sahiwal	1	1	1	1		1
GCT Sargodha	1	1	1		1	1
GCT Sialkot	1	1	1	1	1	8
GCT Bahawalpur	1	1	1		1	3

5. Course Duration:

The Course Duration of DAE is 3 years.

Course Duration	Number of GCTs
3-years (DAE)	13

6. Fixed Number of Students:

The fixed number of students is shown in the table below.

College's Name	No. of Students Morning + Evening	Comment
GCT Railway Road	1105	
GCT Faisalabad	143	
GSTC Faisalabad	189	
GCT Gujranwala	210	35 for each shift
GCT Gujrat	900	
GCT Jhelum	50	
GCT Layyah	450	
GCT Multan	100 Nos.	
GCT Sangla Hill	360	60 Students for each shift
GCT Sahiwal	360	60 Students for each shift
GCT Sargodha	128	
GCT Sialkot	1159	
GCT Bahawalpur	714	119 students for each section

7. Annual Budget

The annual budget of GCTs is shown in the table below. The budget include the salary of civil servants, TEVTA employees and non-salary costs. The budget varies from 14 million PKR to 218 million PKR.

Annual Budget (PKR)	Number of GCTs
- 50,000,000	3
50,000,001-100,000,000	5
100,000,001-150,000,000	3
150,000,001-200,000,000	1
200,000,001-	1

8. Daily Training Time:

The Daily training time is shown in the table below, which is from 5 hours 15 minutes to 8 hours.

Daily Training Time	Number of GCTs
5 hours 15 minutes	2
5 hours 30 minutes	2
5 hours 50 minutes	1
6 hours	5
7 hours	2
8 hours	1

9. Annual Training Time:

The annual training time of GCTs is 32 weeks for all the colleges.

Training time	Number of GCTs
32 weeks	13

10. Ratio of theory and practice training time:

The ratio of theory and practice is shown in the table below. At 12 colleges, more time is allocated on practice. Only at GCT Railway Road, more time is allocated on theory (Theory:Practice=3:2).

Ratio of theory and practice training time	Number of GCTs
1:2	5
1:3	2
3:2	1 (GCT Railway Road)
2:3	5

11. Recruitment method of the student:

The recruitment method of all GCTs is purely open merit.

Recruitment method	Number of GCTs
Purely open merit	13

12. Employment support to the students:

The employment support to the students of All GCTs is through placement officer.

Employment support	Number of GCTs
Placement cell	1
Through placement officer	12

13. Average score of the final test (the last year):

The average score of the final test (2015) is shown in table below.

GCTs Name	Average score of the final test	Comment
GCT Railway Road	91%	91% DAE and 90% BSc.Tech.
GCT Faisalabad	87.41%	
GSTC Faisalabad	81.7%	
GCT Gujranwala	90%	
GCT Gujrat	84%	
GCT Jhelum		2404 Marks
GCT Layyah	487	
GCT Multan	82%	
GCT Sangla Hill	53.8%	
GCT Sahiwal	78%	
GCT Sargodha	75%	
GCT Sialkot	85.33%	
GCT Bahawalpur	76.38	

14. Number (ratio) of applications / admissions (the last year):

The ratio of application/admission of colleges is shown in table below.

College Name	Number (ratio) of applications	Number of admissions	Comment
GCT Railway Road	1,965	1,109	Tech. 400:135
GCT Faisalabad	2,000	1,184	
GSTC Faisalabad	708	189	
GCT Gujranwala	280	70	
GCT Gujrat	1,409	810	Morning:390, Evening:420
GCT Jhelum	480	393	
GCT Layyah	607	591	
GCT Multan	1,395	749	
GCT Sangla Hill	120	80	
GCT Sahiwal	2,285	1,200	
GCT Sargodha	1,305	956	
GCT Sialkot	1,485	1,034	
GCT Bahawalpur	1,650	1,096	

15. Number (ratio) of graduates (the last year):

Number of graduates of 2015 is shown in the table below.

GCTs Name	Number (ratio) of graduates
GCT Railway Road	581/637
GCT Faisalabad	472 / 540
GSTC Faisalabad	122 / 128
GCT Gujranwala	35
GCT Gujrat	411
GCT Jhelum	90/157
GCT Layyah	132
GCT Multan	57
GCT Sangla Hill	21/39
GCT Sahiwal	510/722
GCT Sargodha	86/115
GCT Sialkot	144/188, 76.6%
GCT Bahawalpur	409/536

16. Number (ratio) of job offer (the last year):

Number of job offer of 2015 is shown in the table below.

GCTs Name	Number (ratio) of job offer
GCT Railway Road	105
GCT Faisalabad	70
GSTC Faisalabad	35 / 122
GCT Gujranwala	Almost every passed out doing some Job
GCT Gujrat	50%
GCT Jhelum	5%
GCT Layyah	25
GCT Multan	25
GCT Sangla Hill	
GCT Sahiwal	54
GCT Sargodha	54
GCT Sialkot	25/144
GCT Bahawalpur	50

17. Training method (ex, off-JT, OJT):

The training methods adopted by colleges are shown below.

Training Method	Number of colleges
Internship	9
On Job Training & Off job Training	3
Through TEVTA Training Wing	1

18. Trainer's training:

The measures of training of trainers are shown in the table below.

Trainer's training	Number of colleges
Through TEVTA	10
OJT	1
Revised in 2009	1
Other	1

19. Curriculum & Syllabus:

The curriculum and syllabus adopted by colleges are shown in the table below.

Curriculum & Syllabus	Number of colleges
PBTE	7
TEVTA/JICA	4
Other	2

20. Training materials:

The training materials are available at all the relevant colleges.

Training materials	Number of colleges
Available	13

21. Evaluation Test:

Evaluation test of GCTs is through Punjab Board of Technical education, Lahore.

Evaluation Test	Number of colleges
Through PBTE	8
Other	5

22. Facilities:

The facilities that colleges have are lab, workshop and library.

Facilities	Number of colleges
Lab, workshop, Library etc.	13

23. Equipment & tools:

The availability of equipment and tools at relevant colleges is shown in the table below. At 11 colleges, equipment and tools are available, while at one college 40% available and at one insufficient.

Equipment & tools	Number of colleges
Available	11
Available 40 %	1
Insufficient	1

24. Support from the other countries or organizations:

Support from other countries and organizations are shown in the table below. One college is supported by JICA, while others none.

Support from the other country or organization	Number of colleges
JICA	1
No	12

25. Problems about the college management:

Problems about the college management is shown in the table below. 10 out of 13 relevant colleges have no problems. 2 has the problem of insufficient machinery/equipment. 1 has a financial problem.

Problems about the college management	Number of colleges
No Problem/ Issue	10
Insufficient machinery/ Equipment's	2
Lack of security and financial Problem	1

26. List of Master Trainers:

The availability of list of master trainers is shown in the table below. At 4 colleges, master trainers are available, while at 9 not available.

Master Trainer	Number of colleges
Yes Available	4
Not Available	9

27. Student Date base:

The availability of student data base is shown in the table below. The student's data base is available at all the 13 colleges.

Student Date base	Number of colleges
Yes Available	13

28. Advertisement:

The method of advertisement of colleges is shown in the table below. At all the 13 colleges, the method of advertisement through electronic and print media for admission.

Advertisement	Number of colleges
Through electronic media and print media for Admission	13

29. Industrial cooperation campaign:

The situation of industrial cooperation campaign of colleges is shown in the table below.

Name of college	Industrial cooperation campaign
GCT Railway Road	70 approximately.
GCT Faisalabad	40 Approximately
GSTC Faisalabad	Visit of Industries
GCT Gujranwala	Through District Placement Officer
GCT Gujrat	Yes
GCT Jhelum	No
GCT Layyah	Lack of industrial cooperation
GCT Multan	OJT, Internship
GCT Sangla Hill	Through Institute Placement Officer
GCT Sahiwal	40% (Approx.)
GCT Sargodha	10
GCT Sialkot	Yes
GCT Bahawalpur	10-15 Approximately

30. Number of students who were supported job placement:

The number of students who were supported by job placement office is shown in the table below.

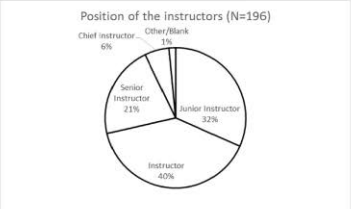
Name of college	No. of students who were supported job placement
GCT Railway Road	105
GCT Faisalabad	40 Approximately
GSTC Faisalabad	35
GCT Gujranwala	Almost all Students
GCT Gujrat	10%
GCT Jhelum	20%
GCT Layyah	
GCT Multan	8
GCT Sangla Hill	List available
GCT Sahiwal	50%
GCT Sargodha	30
GCT Sialkot	10%
GCT Bahawalpur	40 Approximately

IV. List of Instructors

196 instructors responded in this survey. The profile of the instructors are shown in the tables below.

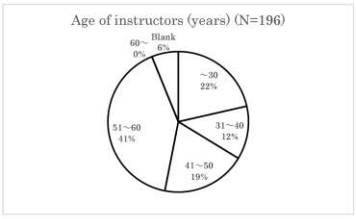
1. Positions of Instructors

Positions of instructors are shown the figure below.

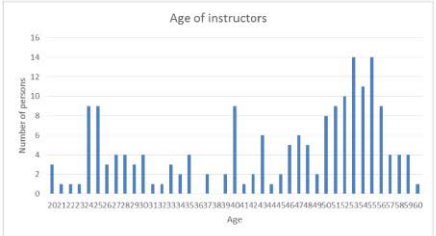


2. Age of instructors

Age of instructors is shown in the figure below. The percentage of instructors above 50 years old is 41%.

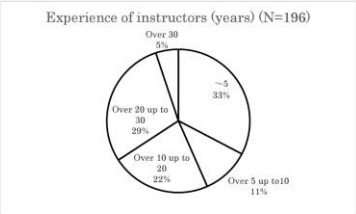


The age of instructors in detail is shown in the figure below, which shows that in five years, the colleges will lose from four to fourteen instructors each year since the retirement age is 60.

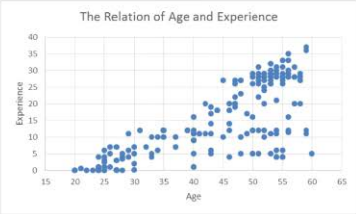


3. Experience of Instructors

The experience of instructors is shown in the figure below.

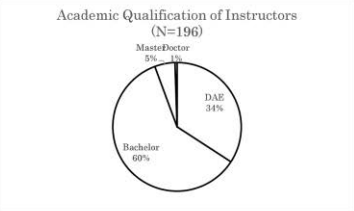


The relation of age and experience of instructors is shown in the figure below.



4. Academic Qualification of Instructors

The academic qualification of instructors is shown in the figure below.



V. Self-Evaluation

1. Data Source

Among the 196 instructors, 157 instructors (87%) participated in the survey. The participation per colleges is shown in the table below. At 7 colleges, all the instructors participated in the survey. On the other hand, at GCT Multan, 17 out of 32 instructors (53%) participated.

College	Number of Instructors	Number of participants	% of participation
GCT Railway Road	27	23	85%
GCT Faisalabad	19	19	100%
GSTC Faisalabad	7	7	100%
GCT Gujranwala	3	3	100%
GCT Gujrat	8	8	100%
GCT Jehlum	7	7	100%
GCT Layyah	15	10	67%
GCT Multan	32	17	53%
GCT Sangla Hill	10	10	100%
GCT Sahiwal	22	9	41%
GCT Sargodha	13	12	92%
GCT Sialkot	19	19	100%
GCT Bahawalpur	14	13	93%
TOTAL	196	157	80%

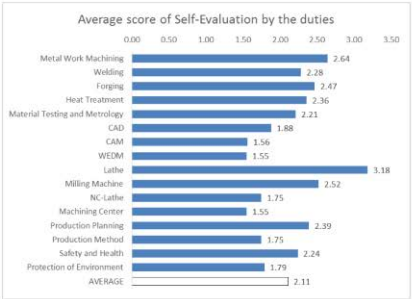
2. Self-Evaluation by the duties

Instructors evaluated their knowledge and skills using the scale below.

Level 1: don't have any knowledge and skills.
Level 2: have a few knowledge and skill.
Level 3: have a general knowledge and skills.
Level 4: have a major knowledge and skills.
Level 5: have enough knowledge and skills.

(1) Average score on the duties

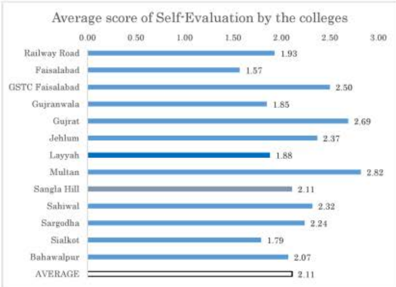
The average score on the duties is shown in the figure below.
The duties that the self-evaluation is low are CAD, CAM, WEDM, NC-Lathe and Machining Center.



(2) Average score by the colleges

The average scores by the colleges is shown in the figure below.

The average scores are high at GCT Multan, GCT Gujrat and GCTC Faisalabad and low at GCT Faisalabad. GCT Sialkot and GCT Gujranwala.



(3) Average on the duties by the colleges

Duty	AVERAGE	Railway Road	Faisalabad	GSTC Faisalabad	Gujranwala	Gujrat	Jehlum	Layyah	Multan	Sangla Hill	Sahiwal	Sargodha	Sialkot	Bahawalpur
Metal Work Machining	2.64	2.57	2.01	3.21	2.96	3.27	2.70	2.6	3.26	2.54	2.53	2.68	2.21	2.75
Welding	2.26	1.97	1.56	3	1.84	2.71	2.56	2.48	3.14	2.17	2.21	2.58	2.14	2.29
Forging	2.47	2.3	1.84	3.05	3	2.88	2.67	2.2	3	3.3	2.46	2.67	2.38	2.66
Heat Treatment	2.36	2.25	1.64	2.98	1.67	2.9	2.24	2.1	3.37	3.2	2.3	2.60	2.21	2.46
Material Testing and Metrology	2.21	2.22	1.61	2.98	1.44	3.17	2.19	2.02	2.99	1.90	2.22	2.46	1.85	2.31
CAD	1.88	1.67	1.51	1.82	2	3.26	2.04	1.56	2.38	2.13	2.38	1.98	1.53	1.33
CAM	1.66	1.3	1.2	1.61	1.25	2.41	1.56	1.28	2.15	1.66	1.87	1.52	1.28	1.52
WEDM	1.56	1.4	1.22	1.58	1.28	1.94	1.75	1.33	2.25	1.3	2.17	1.58	1.24	1.27
Lathe	3.18	2.96	2.59	4.4	3.22	4.25	3.84	2.77	3.75	3	3.04	3.53	2.67	3.01
Milling Machine	2.52	2.45	1.85	3.41	2.52	3.65	2.77	2.31	3.21	2.43	2.62	2.65	1.96	2.25
NC-Lathe	1.75	1.51	1.38	1.91	1.87	2.09	1.89	1.29	3.21	1.9	2.39	1.98	1.47	1.74
Machining Center	1.55	1.45	1.15	1.71	1.45	1.6	1.66	1.43	1.99	1.66	2.21	1.45	1.32	1.56
Production Planning	2.39	2.17	1.75	2.64	2.11	3.35	2.76	2.16	3.37	2.43	2.44	2.67	1.79	2.2
Production Method	1.75	1.62	1.25	1.68	1.56	2.43	1.95	1.52	2.54	1.74	2.19	1.78	1.41	1.58
Safety and Health	2.24	1.62	1.63	2.63	1.6	2.98	2.87	1.66	3.22	2.14	2.45	2.28	2.01	2.41
Protection of Environment	1.79	1.67	1.29	2.01	1.08	2.73	2.39	1.53	2.28	2.12	2.19	1.7	1.47	1.74
AVERAGE	2.11	1.93	1.57	2.5	1.85	2.69	2.37	1.88	2.82	2.11	2.32	2.24	1.79	2.07

The average of the self-evaluation is shown in the following table.

(4) Average score on the duties in detail, of grand total, at GCT Railway Road and GCT Faisalabad

Duty	No.	Ability	Grand Total	GCT Railway Road	GCT Faisalabad
1 Metal Work Maching	1-1	Theory of metal work machining	3.04	2.91	2.28
	1-2	Elements and processes of metal work machining	2.80	2.70	2.05
	1-3	Hand finishing, Drilling, Grinding	3.24	3.22	2.79
	1-4	Machine Design	2.69	2.96	2.32
	1-5	Tool and Mould Design	2.48	2.39	1.56
	1-6	Hydraulics and Hydraulic Machines	2.60	2.35	2.17
	1-7	Hob machine	2.00	1.91	1.26
	1-8	Maintenance of machine and tool	2.31	2.13	1.68
		Sub total	2.64	2.57	2.01
2 Welding	2-1	Characteristics of Welding Methods	2.77	2.62	2.05
	2-2	Arc Welding Machine (Tig , Mig)	2.36	2.22	1.79
	2-3	Procedure of Welding Operation	2.75	2.35	2.00
	2-4	Structure of Arc Welding Machine	2.51	2.13	1.74
	2-5	Maintenance of Arc Welding Machines	1.90	1.57	1.16
	2-6	Objectives and Methods of Defining Conditions for Arc Welding	2.24	1.83	1.47
	2-7	How to Define Conditions for Arc Welding Machine	2.22	1.78	1.58
	2-8	Quality Control of Arc Welding	2.20	1.83	1.47
	2-9	Procedure of Spot Welding	2.38	2.30	1.74
	2-10	Structure of Spot Welding Machine	2.16	1.87	1.53
	2-11	Maintenance of Spot Welding Machines	1.83	1.48	1.11
	2-12	Defining Condition of Spot Welding Machine	1.99	1.74	1.32
		Sub total	2.28	1.97	1.56
3 Forging	3-1	Types and features of forging, material, plating	2.44	2.30	1.95
	3-2	Processing of Plate Working, Structuring, Bending, Reforming	2.37	2.22	1.53
	3-3	Processing of Pressing, Cutting	2.61	2.39	2.05
		Sub total	2.47	2.30	1.84
4 Heart Treatment	4-1	Product function and materials	2.30	2.17	1.37
	4-2	Making heat-treatment sample	2.29	2.22	1.39
	4-3	Mold making	2.48	2.35	1.64
		Sub total	2.36	2.25	1.64
5 Material Testing and Metrology	5-1	Summary of material testing and metrology	2.56	2.81	1.74
	5-2	Tension test	2.48	2.65	2.11
	5-3	Hardness test (Rockwell test, Vickers test, Shore test)	2.56	2.57	2.05
	5-4	Structure examination	2.13	2.09	1.47
	5-5	Spark test	1.74	1.85	1.11
	5-6	Ultrasonic Test	1.80	1.74	1.21
		Sub total	2.21	2.22	1.61
6 CAD	6-1	Confirmation of the foundation of the CAD	1.92	1.70	1.53
	6-2	Confirmation of the drawing technique	2.10	1.91	1.79
	6-3	Structure of CAD data	1.78	1.57	1.47
	6-4	CAD database	1.71	1.52	1.26
		Sub total	1.88	1.67	1.51
7 CAM	7-1	CAD data and CAM data	1.70	1.30	1.37
	7-2	Data conversion	1.54	1.26	1.16
	7-3	D DXF data structure	1.39	1.22	1.05
	7-4	Simple NC data making technique	1.59	1.43	1.21
		Sub total	1.56	1.30	1.20
8 WEDM	8-1	Inspection of the processing precision	1.49	1.27	1.21
	8-2	Observation of cutting side	1.53	1.36	1.21
	8-3	Processing method	1.50	1.45	1.16
	8-4	Mold making	1.68	1.50	1.32
		Sub total	1.56	1.40	1.22
9 Lathe	9-1	Operation of lathe	3.29	3.13	2.89
	9-2	Stepping the outside diameter	3.38	3.17	2.89
	9-3	Cutting the inside diameter	3.13	2.91	2.21
	9-4	Taper machining	3.16	3.04	2.58
	9-5	Threading	2.95	2.74	2.37
	9-6	Knurling	3.17	2.76	2.58
		Sub total	3.18	2.96	2.59
10 Milling machine	10-1	Operation of milling machine	2.82	2.70	2.21
	10-2	Cubical milling	2.26	2.36	1.58
	10-3	Stepping by end mill	2.37	2.32	1.74
	10-4	Straight slot milling	2.40	2.59	1.74
	10-5	Slope machining by end mill	2.21	2.32	1.37
	10-6	Drilling	2.55	2.48	2.26
	10-7	Reaming	2.73	2.39	2.05
		Sub total	2.52	2.45	1.85

添付資料 6-3-2：研修ニーズ調査

The Result of the Training Needs Assessment (TNA)

Training Needs Assessment (TNA) was conducted as a part of the Project for Strengthening DAE in Mechanical Technology of Government Colleges of Technology in Punjab Province. TNA was conducted concurrently with Baseline Survey and Industrial Linkage Survey.
The purpose of the survey is to know the situation and the thoughts of companies of industrial sector in the relevant region in Punjab Province.

1. Outline of the assessment

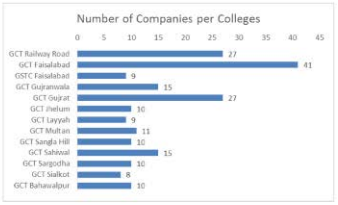
(1) Outline of the assessment

Data collection period:	March-April 2016
Target:	Companies selected by 13 GCTs
Method:	Questionnaire survey conducted by GCT instructors
Number of answering companies:	202

The Project team asked the principals of 13 GCTs conducting questionnaire at the meeting on 10 March 2016 at TEVTA.
The collected data was analyzed by the Project team.

(2) Number of companies surveyed per Colleges.

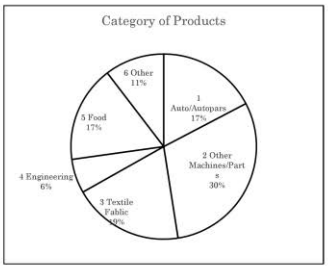
The number of companies that answered this questionnaire is 202 in total. The number of companies that each college collected data from is shown in the figure below:
GCT Faisalabad collected data from 41 companies, GCT Railway Road and GCT Gujat collected from 27 companies.
All other 10 colleges collected data from 8 to 15 companies.



2. Category of products of the companies surveyed

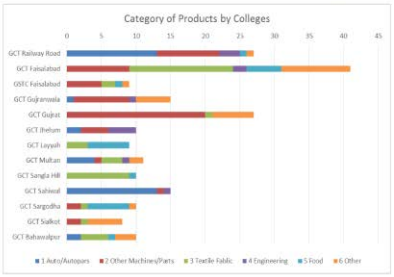
(1) Category of products of the companies surveyed

The category of products of the companies surveyed is shown in the figure below. Half of the companies are in the auto and other machine manufacturing.



(2) Categry of products by colleges

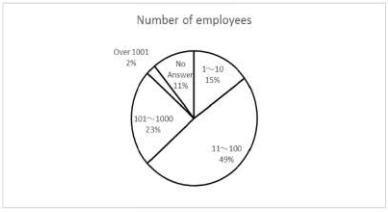
Category of products by colleges is shown in the figure below. Each college shows characteristics of its division. For example, GCT Railway Road collected data mainly from companies of auto parts and machines. On the other hand, GCT Faisalabad collected mainly from texitile companies.



3. Number of employees

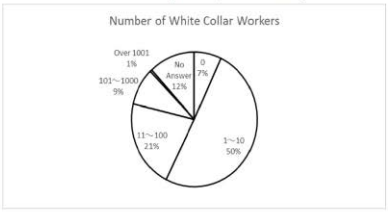
(1) Total number of employees

Number of employees of the companies surveyed is shown in the figure below. Almost 2/3 of the companies employs 100 or less employees.



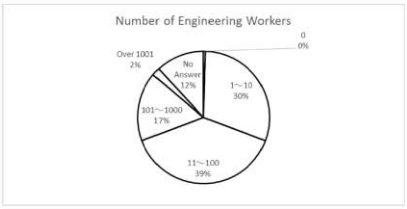
(2) Number of White Collar Workers

Number of white collar workers of the companies surveyed is shown in the figure below.

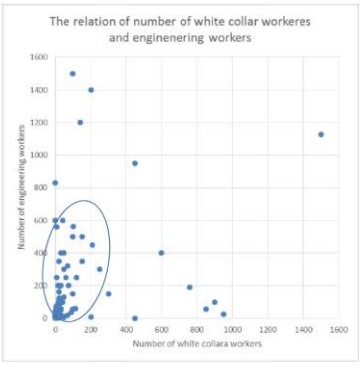


(3) Number of Engineering Workers

Number of engineering workers of the companies surveyed is shown in the figure below.



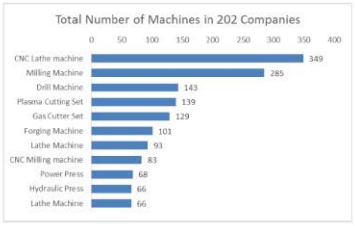
The scatter graph of number of white collar workers and engineering workers is shown below. The graph shows that in many companies there are more engineering workers than white collar workers.



4. Machines and equipment

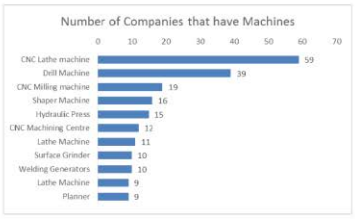
(1) Number of machines that 202 companies have

The number of the top 11 machines that the surveyed companies have is shown below.



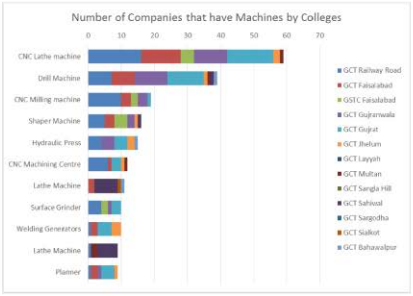
(2) Machines most companies have

Machines possessed by large number of companies are shown in the figure below. For example, CNC lathe machines are possessed by 59 out of 202 companies surveyed.



The figure above is analyzed further in the figure and table below. The number of the companies is divided by the colleges.

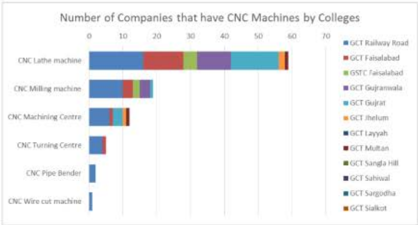
The figure shows the top 11 machines and the table shows all the machines.



	GCT Railway Road	GCT Faisalabad	GSTC Faisalabad	GCT Gujranwala	GCT Gujrat	GCT Jhelum	GCT Layyah	GCT Multan	GCT Sangla Hill	GCT Sahiwal	GCT Sargodha	GCT Sialkot	GCT Bahawalpur	Total
CNC Lathe machine	18	12	4	10	14	2	0	1	0	4	0	0	0	59
Drill Machine	7	4	0	10	1	1	0	1	0	1	0	0	1	39
CNC Milling machine	10	3	0	2	1	0	0	0	0	0	0	0	0	19
Shaper Machine	1	3	0	4	2	1	0	0	0	1	0	0	0	16
Hydraulic Press	0	2	0	2	4	2	0	0	0	0	0	0	0	15
CNC Machining Centre	0	1	0	0	0	1	0	1	0	0	0	0	0	12
Lathe Machine	0	2	0	0	0	0	0	0	0	0	1	0	1	11
Surface Grinder	4	3	0	1	2	0	0	0	0	0	0	0	0	10
Welding Generators	1	2	0	0	4	2	0	0	0	0	0	0	0	10
Lathe Machine	1	1	0	0	0	0	0	0	5	0	0	0	0	9
Planner	1	2	0	1	4	1	0	0	0	0	0	0	0	9
Milling Machine	0	0	0	0	0	0	0	1	0	1	0	0	0	8
Press Press	0	0	0	1	1	0	0	0	0	0	0	0	0	8
Injection Molding	1	0	0	1	4	0	0	1	0	0	0	0	0	7
Compressor	2	0	0	0	0	0	0	0	0	1	0	0	0	6
Grinding Machine	0	2	0	0	0	0	0	0	0	0	0	0	0	6
Overhead Crane	0	2	0	0	0	1	0	0	0	0	0	0	0	6
Boring Machine (Parts)	2	1	0	2	0	0	0	0	0	0	0	0	0	5
CNC Turning Centre	4	1	0	0	0	0	0	0	0	0	0	0	0	5
Core Grinder	0	0	0	0	0	0	0	0	0	0	0	0	1	5
Polishing Machine	0	3	0	0	0	1	0	0	0	1	0	0	0	5
Mechanical Press	2	0	0	1	0	0	0	0	0	0	0	0	1	4
Gas Cutter Set	2	2	0	0	0	0	0	0	0	0	0	0	0	4
Gear Shaper	0	1	0	0	0	0	0	0	0	0	0	0	0	4
Generator	1	2	0	0	0	0	0	1	0	0	0	0	0	4
Seal Welding Machine	1	2	0	0	0	0	0	0	0	0	0	0	0	3
Bending Machine	1	2	0	0	0	0	0	0	0	0	0	0	0	3
Cutting Machine	1	2	0	0	0	0	0	0	0	0	0	0	0	3
Drilling Machine	0	0	0	1	0	0	0	0	0	0	0	0	0	3
Hydraulic Jack	1	2	0	0	0	0	0	0	0	0	0	0	0	3
Plasma cutting machine	1	2	0	0	0	0	0	0	0	0	0	0	0	3
Shearing Machine	2	1	0	0	0	0	0	0	0	0	0	0	0	3
Spot welding machine	2	0	0	1	0	0	0	0	0	0	0	0	0	3
Arc Welding Machine	1	1	0	0	0	0	0	0	0	0	0	0	0	2
Band Saw	0	0	0	1	0	0	0	0	0	0	1	0	0	2
CNG Pipe Bender	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Conventional Machine	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Crank Shaft Grinder	0	0	0	1	0	0	0	0	0	0	0	1	0	2
Forging Machine	0	0	0	1	0	0	0	0	0	0	0	1	0	2
Handtool	0	0	0	1	0	0	0	0	0	0	0	1	0	2
Lever Machine	0	0	0	1	0	0	0	0	0	0	0	1	0	2
Molding Machine	1	1	0	0	0	0	0	0	0	0	0	0	0	2
Pipe Cutting Machine	1	1	0	0	0	0	0	0	0	0	0	0	0	2
Planks Sander Machine	0	0	0	1	0	0	0	0	0	0	0	1	0	2
Plasma Cutting Set	1	1	0	0	0	0	0	0	0	0	0	0	0	2
Pressure Die casting	1	0	0	0	1	0	0	0	0	0	0	0	0	2
Seamless Rolling Machine	1	1	0	0	0	0	0	0	0	0	0	0	0	2
Sheet cutt off Machine	0	0	0	1	0	0	0	0	0	0	0	1	0	2
TIG welder	1	1	0	0	0	0	0	0	0	0	0	0	0	2
Welding Transformers	1	1	0	0	0	0	0	0	0	0	0	0	0	2
Wire Cut Machine	2	0	0	0	0	0	0	0	0	0	0	0	0	2
CNC Wire cut machine	1	0	0	0	0	0	0	0	0	0	0	0	0	1
MIG welder	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Sand Mixer	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Sand Muller	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Surface Grinder	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Welding Robots	1	0	0	0	0	0	0	0	0	0	0	0	0	1

(3) CNC Machines

The figure and table below shows the number of colleges that have CNC machines.



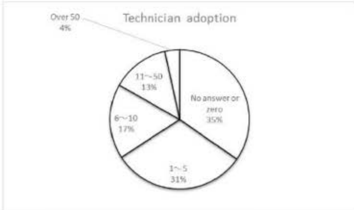
	GCT Railway Road	GCT Faisalabad	GSTC Faisalabad	GCT Gujranwala	GCT Gujrat	GCT Jhelum	GCT Layyah	GCT Multan	GCT Sangla Hill	GCT Sahiwal	GCT Sargodha	GCT Sialkot	GCT Bahawalpur	Total
CNC Lathe machine	16	12	4	10	14	2	0	1	0	0	0	0	0	59
CNC Milling machine	10	3	2	3	1	0	0	0	0	0	0	0	0	19
CNC Machining Centre	6	1	0	0	3	1	0	1	0	0	0	0	0	12
CNC Turning Centre	4	1	0	0	0	0	0	0	0	0	0	0	0	5
CNC Pipe Bender	2	0	0	0	0	0	0	0	0	0	0	0	0	2
CNC Wire cut machine	1	0	0	0	0	0	0	0	0	0	0	0	0	1

5. Employment

(1) Technician adoption

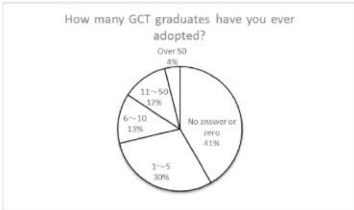
Technician adoption of the targeted companies is shown in the figure below.

In this questionnaire, it is hard to distinguish "zero" and "no answer". One third of the companies replied zero or no answer, one third from 1 to 5, and the remaining one third more than 5.



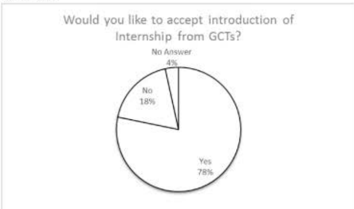
(2) Number of GCT graduates adopted

Number of GCT graduated adopted is shown in the figure below. In this question also it is hard to distinguish between "zero" and "no answer".



(3) Internship

The willingness to accept interns is shown in the figure below. As much as 78% of the companies replied "yes".



7. Sentence answers

(1) Could you write necessary (or deficient) technique(s) and acquirement(s)?

[Practical Training]
- Practical training should be increased.
- Weak in practical work
- On the job training in workshops
- Practical knowledge
- Lack of hands on practical experience

[Specific field]
- Deficient in machine maintenance.
- Addition of CNC operations
- Catia, Cutting speed, feed calculation, gear calculation
- Follow points of MECH Code –
  117, Important components of pipe fitting.
  141, Work permit system and its compliance, use of breathing apparatus.
  236, Latest welding techniques, Submerged Arc welding (SAW), Flux card Arc welding (SAW)
  323, Piping Isometrics
  362, Non destructive test may be enhanced
  Lecture from industrial expert should be increased.
- Welding, machining, turning, press working, CNC spg forming, carborizing
- Tolerance problem
- Tolerance & fits problems
- More skill is required in workshop and machines
- CNC & fabrication equipment
- Engineering drawing, welding inspection techniques
- Deficiency in machining shop

[Mindset, communication]
- Should mentally prepared for any work.
- Confidence level is poor, not good worker
- Respect of elders and senior persons, Quality, Inspection

(2) Do you have confront technical problems?
If yes, Please write the details of the problems.

- Drawing + Ideas + Requirements
- Drawing, Communication
- Management, Safety awareness
- Materials, primavera, project management, casting, more focus on practical.
- Pattern making, some casting defect
- Lack of mathematical and technical skills
- Thread inspection, Gear inspection, Master cam and solid work software.
- Hish rejection during Ni plating, process
- Marketing capabilities are not stable
- Casting of SS material, Leakage problem
- CNC & M/C's
- CNC Machines
- Lack of skilled technicians in the country

(3) What kind of field(s) and level(s) would you like to adopt?

[DAE, DAE mechanical]
- At least DAE or 2nd year apprenticeship.
- DAE
- DAE (Mech)
- DAE Mechanical

[Specific skills]
- DAE (Mech) + Machinist + Welder + Certificate holder regarding quality control
- SS Fabrication + machining
- Mechanical, Polymer
- Skilled labour, Quality control, Maching, Heat treatment
- Machining & fabrication
- Advance casting methods
- Manufacturing of pressure vessels under ASME
- CNC manufacturing & medal trades
- Mechanical Maint, Electrical Maint, Machining Turning, Spg forming, Die developement.
- Mechanical, Auto & Diesel, Electrical
- CNC Machines
- Totaly adopting CNC system

- CNC Machining
- Workshop practice and CNC
- Forging
- CNC, hydraulics, pneumatics, workshop practice, automation

[Other]
- Quality
- Please focus to change syllabus language, must be in English.
- Students should have more practical knowledge.

(4) The methods of education and training for employees.

[On the job training]
- In house training
- In-house on job training
- Attachment with senior workers
- On job training
- On job training
- On job training for quality control, production through webinars
- On job trainings

[Off the job training]
-Training from HONDA Car as our valued customer.
- 3 Months training within the company
- Two weeks training in each section before job start
- Self training center at IKAN site under TEVTA
- One week training on specific job before strating the job
- Internal on job training

[Content of training]
- Moral value should be introduced.
- Improvement in the technical knowledge & skills.
- Safety + Fire fighting + Safety on height work.
- Safety, Fire fighting, Fibre glass technologies
- Machinist, CNC operator, DAE (Mechanical)
- Orientation, Quality training, Safety training

- Industrial information
- Orientation, importance of M/C's
- Improve of machines orientation
- Technical & soft skills both

(4) Could you write condition(s) (of accepting interns) if yes?

[Attitude]
- Any type of work have to do.
- They should work (with this organization) with us.
- Professional attitude towards job
- Willing and hardworking
- Professional attitude towards job

[Without salary]
- Without salary for two weeks
-Without salary

[Timing/duration]
- Period of internship should be conveyed to us timely and should be decided by mutual understanding.
- 5 students must follow company timing.

[Other]
- Students are used to work on small machines & small jobs, It becomes problematic for them to work on heavy machinery.
- Internee should be belonging to the surrounded of Shahdarah.
- Practical implementation of specific project within the duration of internship.
- On approval
- If space is available
- If space is available

(6) Could you explain their specialized fields (of GCT graduate have the company adopted) if yes?

[General or mechanical]
- Mechanical 03

- DAE graduates in Mech. 04 Not at least.
- Mechanical 01
- Mechanical 02 DAE
- Must have practical experience
- DAE/B.Tech Mechanical approximately 15–20 years

[Specific skills]
- Specialized in quality control, designing and surface treatment.
- Casting
- Foundry
-Quality, Production, 05
- Production and meating, 5
- Fabrication & welding
- Fabrication supervisors, Production supervisors
- CNC machines
- New techniques like CNC machines
- Knowledge of CNC milling machine, Lathe machine
- CNC M/C's mechanical forging presses, maintenance
- Welding, CNC

[Other]
- 20/year
- If space is available

(9) Please write your request(s) and expectations to GCT.

[Internship]
- At least 6 industries should be visited during 3 years course.
- Development in practical skill needed. Internee should work with us at least two or three years.
- 5/6 months internship.

[Practical in general]
- More practical knowledge.
- Practically strong
- Students should have more practical knowledge.

- Promote more technical knowledge.
- More practical work
- Promote more practical work
- More practical skills

[Skills]
- Student lacks in maintenance.
- Training should be given in consumer's products manufacturing industry.
- Specialized training in CNC machines.
- Improve skills in workshops and maintenance, management skills
- Should have fabrication & modern welding techniques in their CV.

[Mind/Communication]
- Specialized graduates should be produced+ work ethics should be improved.
- The graduates should respect others grooming of students/graduates w-v-t industrial needs
-Must have theoretical knowledge and motivated to stay for job.
- There must be good communication skills, management skills, practical knowledge must be good and confidence level must be high.

[Other]
- The skilling ratio of GCT qualify is much high than private.
- Promote practicals, adopt urdu language for proper awareness.

添付資料 6-4：改善計画

Improvement Plan for DAE Mechanical Technology of GCTs in The Eastern Part of Punjab Province

(Draft)

June 2019

The Project for Strengthening DAE in Mechanical Technology at Government Colleges of Technology in Punjab Province in The Islamic Republic of Pakistan

Government of Punjab
Technical Education & Vocational Training Authority
(TEVTA)

Japan International Cooperation Agency
(JICA)

Contents

Ⅰ. Introduction

JICA has been providing technical cooperation to the Government College of Technology Railway Road (GCT RR) and Faisalabad (GCT FSD) in the project for strengthening DAE (Diploma of Associate Engineering) in mechanical technology at government colleges of technology in Punjab province from 2016.

Both GCT RR and GCT FSD are GCTs that form the core of Punjab State as CoE (Center of Excellence).

And they have a large role for the training of trainers to 11 GCTs.

Therefore, this improvement plan was created for the purpose of spreading out these results to other 11 GCTs.

Ⅱ. Achievement target

Following the circumstances that led to the CoE of both GCTs, various means of improvement and items used by the project were to be released in this plan.

Furthermore, the improvement plan incorporates the activities conducted for two GCTs and the activities judged to be implemented by GCT independently.

This enabled all 13 GCTs to take advantage of this improvement plan.

As a result, the ultimate goal is to make the training management, facility equipment management and industrial linkage of 13 GCTs to be same level.

Ⅲ. Time to achieve the target

The following items are set in the improvement plan.

For these items, the arrival time at the 11 GCTs is set as shown in the table below.

Improvement item (outline)	Time of arrival
Training Needs Survey Relations	December 2019
Training Management Relations	December 2019
Master Training and Training of Trainers Relations	November 2019
Facility / Equipment Management Relations	January 2020
Industrial Linkage relations	December 2019
Students and graduates, Placement relations	December 2019

Ⅳ. Technique for achievement target

Each improvement item uses a concise and rational method to achieve the target.

Among the items to be improved, the method used by JICA technical cooperation for GCT RR and GCT FSD is included.

For example, training management is characterized by using the most efficient method such as the PDCA management cycle.

In addition, the proposal is made for each topic of improvement, and it is expressed in diagrams or tables.

Ⅴ. Improvement item

The improvement items (1 to 15) are as follows.

Improvement item

1. Improvement of Industrial Trends and Training Needs Survey and Analysis
2. Improvement of Curriculum Revision
3. Improvement on Preparation for Training
4. Improvement on Training Implementation
5. Improvement on Evaluation of Training
6. Improvement on Teaching Methods
7. Improvement on Instructor Training Plan
8. Improvement on Equipment Management
9. Improvement on Facilities
10. Improvement on Educational Facilities Environment
11. Improvement on Industrial Linkage
12. Improvement on Employment Support
13. Improvement on Student Administration
14. Improvement on Graduate Administration
15. Other Improvements

Ⅵ. Improvement subject

The Improvement subjects [1-1 to 15-1] are as follow.

However, the numbers in ( ) indicate page numbers.

Improvement Proposal

Improvement item : 1. Improvement of Research and Analysis of Industrial Trends and Training Needs
Improvement subject : 1-1. Identifying industrial trends

The GCT project will make the following improvement proposals on the above subject.

■Current status	Although the GCT is identifying the trend of the industry with IMC etc., its scope is limited.
■Problems (core of problem)	There is no established method for identifying the actual situation of regional economic and employment and industrial trends other than IMC.
■Specific contents of improvement proposals	It is necessary to obtain various kinds of materials and reports from industrial organizations and chambers of commerce. And also to identify local industrial trends based on hearings.
■Required Expenses and Time	Expenditures are low because various public reports are free or low price.
■Expected Effects	In order to develop human resources who can play an active part in local industry, it is important to identify industrial trends along with establishing relations with industrial organizations. Identifying the industrial trends in the local aria is also greatly related to human resource development, as well as training itself.
■Important Points	Pay attention to the placement office and instructors in charge.
■Reference material	Industrial trends should identify the following items.

Trend in the industrial sectors	i) Development in new field ii) Introduction of new technology iii) Change of product line iv) Promotion of entering other market v) Change of management policy vi) New employment plane

Improvement Proposal

Improvement item: 1. Improvement of Research and Analysis of Industrial Trends and Training Needs
Improvement subject: 1-2. Setting of training needs survey items

The GCT project will make the following improvement proposals on the above subject.

■Current status	Since various survey led by JPT in 2016, the GCT has not carried out any survey independently. Adjusting for implementation in 2019.
■Problems (core of problem)	The GCT has not carried out a survey independently, it has not experienced the setting of survey items.
■ Specific contents of improvement proposals	It is necessary to bridge the difference between the contents of the current training in GCT and the contents expected by the industry. It is necessary to set concrete and effective survey items in order to accurately capture it.
■ Required Expenses and Time	Since the discussion on the survey item setting is carried out within the GCT, no expenses are required. Time for discussion is necessary.
■ Expected Effects	If the GCT can grasp the direction of the industry accurately, GCT can use of them in future education and training. In addition, personnel expected by the industry is produced from GCT.
■ Important Points	Be careful not to make the survey abstract. Study items will be discussed fully within the GCT to make it concrete and effective.
■ Reference material	See examples of the following survey items.

TNA Cotents			
No.	Survey Details	No.	Survey Details
1	Date of Survey	13	Adoption of engineers
2	Company name	14	Adoption level
3	Industrial field	15	Training for employees
4	Location	16	Internship from GCT
5	Date of foundation	17	No. of GCT graduates
6	Representative	18	Adoption of GCT graduates
7	Interviewer	19	Comments of GCT curriculum
8	Main Products	20	Attendance for GCT seminar
9	Number of employees (officer engineer)	21	Lecturer from company
10	Main production equipment (machine name,type,year)	22	OJT for GCT instructors
11	Necessary technique and skill	23	GCT seminar for company
12	Technical problem	24	Others

Improvement Proposal

Improvement item: 1. Improvement of Research and Analysis of Industrial Trends and Training Needs
Improvement subject: 1-3. Needs survey method

The GCT project will make the following improvement proposals on the above subject.

■Current status	Since various survey led by JPT in 2016, the GCT has not carried out any survey independently. Adjusting for implementation in 2019.
■Problems (core of problem)	It should be implemented while considering merits such as documents and interview survey.
■ Specific contents of improvement proposals	1-2. According to "Setting of training needs survey items", it needs to divide questionnaire survey, document survey and interview survey for each item.
■ Required Expenses and Time	It takes some time to decide the survey method.
■ Expected Effects	Survey result for each item becomes more concrete and systematic.
■ Important Points	In the questionnaire and interview survey, since there is interpersonal relationship, 4W1H (when, where, who (with who), what, how) is important.
■ Reference material	See the figure below.

Survey method	**ⅰ) Document survey** **ⅱ) Questionnaire survey** **ⅲ) Interview survey**

1) Document survey 2) Questionnaire survey 3) Interview survey

Improvement Proposal

Improvement item: 1. Improvement of Research and Analysis of Industrial Trends and Training Needs
Improvement subject: 1-4. Survey Plan

The GCT project will make the following improvement proposals on the above subject.

■Current status	Since various survey led by JPT in 2016, the GCT has not carried out any survey independently. Adjusting for implementation in 2019.
■Problems (core of problem)	When conducting a survey such as TNA, it is necessary to systematically planning, implementation and analysis.
■ Specific contents of improvement proposals	It is necessary to conduct a survey after preparing the survey plan and the implementation plan.
■ Required Expenses and Time	It takes a time to prepare the survey plan and the implementation plan.
■ Expected Effects	It is necessary to know that good results can be obtained if a plan is sufficient.
■ Important Points	It needs to appoint a person in charge. Also it needs to organize the survey team and implement.
■ Reference material	See the survey plan and implement plan items

Survey plan	**ⅰ) Survey period** **ⅱ) Surveyor** **ⅲ) Survey target** **ⅳ) Budget**

Survey Implementation Plan	**ⅰ) Implementation date** **ⅱ) Implementation Person** **ⅲ) Decision to ask question** **ⅳ) Preparation of data material** **ⅴ) Questionnaire sheet making** **ⅵ) Collection of questionnaire sheet** **ⅶ) Classifying questionnaire sheet**

Improvement Proposal

Improvement item: 1. Improvement of Research and Analysis of Industrial Trends and Training Needs
Improvement subject: 1-5. Survey Sheet Preparing

The GCT project will make the following improvement proposals on the above subject.

■Current status	Since various survey led by JPT in 2016, the GCT has not carried out any survey independently. Adjusting for implementation in 2019.
■Problems (core of problem)	In conducting the survey, it should be prepared a sheet covering the contents of "1-2. Setting of the training needs survey item".
■ Specific contents of improvement proposals	Attention is required especially for preparing the questionnaire survey table. In order to make it easier for companies to respond, it is necessary to make one questionnaire and to keep the question concise.
■ Required Expenses and Time	Slight cost and time are required for printing the number of sheets
■ Expected Effects	There is little burden on companies' answers, which helps improve the collection rate.
■ Important Points	In preparing the survey form, work should be carried out while listening to opinions of several people regardless of individual judgment.
■ Reference material	See example questionnaire in the next.

TRAINING NEEDS ASSESSMENT

The date of survey		(d/m/y)	Interviewers		
Company					
Industrial Classification					
Location					
Date of foundation		(d/m/y)	Representative person		
Main Products	1		2		3
Numbers of employees	White-collar workers		Engineering workers		
Main Production Equipment(s) (Machinery and Equipment, Model, Year, Number(s))					
Machinery and Equipment	Year	Number	Machinery and Equipment	Year	Number
Could you write necessary(or deficient) technique(s) and acquirement(s)?					
Do you have confront technical problems? If yes, Please write the details of the problems.					
Technician's adoption and numbers of them		Yes	Numbers:		No
What kind of field(s) and level(s) would you like to adopt?					
The methods of education and training for employees.					
Would you like to accept introduction of Internship from GCT?		Yes	No		
Could you write condition(s) if yes?					
How many GCT's graduates have you ever adopt?		Yes	No	Numbers:	
Could you explain their specialized fields if yes?					
Would you like to adopt GCT's graduates?		Yes	No		
Could you explain adopt specialized fields that you want and numbers of graduates if yes?					
Please write your request(s) and expectations to GCT.					

Improvement Proposal

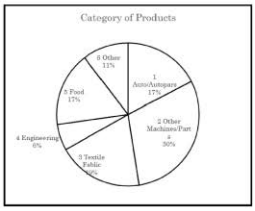
Improvement item: 1. Improvement of Research and Analysis of Industrial Trends and Training Needs

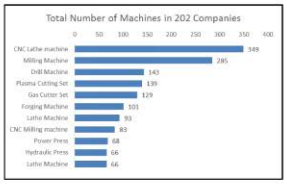
Improvement subject: 1-6. Survey analysis

The GCT project will make the following improvement proposals on the above subject.

■Current status	Since various survey led by JPT in 2016, the GCT has not carried out any survey independently. Adjusting for implementation in 2019.
■Problems (core of problem)	It is unknown how the GCT will conduct analysis of the survey results. Such analysis of data and needs are obtained from it.
■ Specific contents of improvement proposals	It's necessary to analyze and summarize needs according to the procedure as shown in the table below. Also, to display the analysis result, it can be used any graph or table as below to devise it so that everyone can understand it.
■ Required Expenses and Time	It takes considerable time and effort to consolidate and analyze the results outcome.
■ Expected Effects	Analysis of the needs from TNA, graduate questionnaire and summary of the results are important for the development of TVET in the future and management of CGT.
■ Important Points	Knowledge of software such as Excel is necessary for input work of data aggregation and graph creation.
■ Reference material	See the table, pie chart and graph below

Analysis and organizing survey results	i) Collection of data ii) Analyzing of whole data iii) Analyzing of training needs from industry (company) iv) Organizing educational training challenges v) Checking of training duty, ability and level





Improvement Proposal

Improvement item: 2. Improvement of Curriculum Revision

Improvement subject: 2-1. Curriculum revision proposal

The GCT project will make the following improvement proposals on the above subject.

■Current status	The TEVTA curriculum revision committee is inviting guidance every year to suggest proposals for curriculum revision of subjects, but the number is small.
■Problems (core of problem)	Proposals can not be made because instructors are lacking understanding of industry trends and latest technologies.
■ Specific contents of improvement proposals	Instructor needs to propose curriculum and syllabus for each subject against knowledge gained through MT and ToT. Also, the GCT should identify latest industry trends to conduct TNA at least once every three years, and disclose their contents to instructors.
■ Required Expenses and Time	It takes some time to organize the proposed items. Expenses are unnecessary for regular work of the instructor.
■ Expected Effects	The revision of the curriculum leads to improvements in the technological awareness of students, strengthening of guidance activities by instructors, and attracting GCT's evaluation.
■ Important Points	It is necessary to present in advance what to suggest and how to propose the curriculum.
■ Reference material	Refer to the tables below for details on the proposal for review and their main points.

Revise items	i) Title (Course contents) ii) Description (Detail of contents) iii) Training Hours iv) Instructional Objectives

Points of consideration	i) Adding new technology items ii) Revision of proper technical terms iii) Elimination of the low item of the necessity iv) Unification of the items overlapping v) Resetting of training time inappropriate vi) Adjustment of the training level of the contents vii) Other related point

Improvement Proposal

Improvement item: 2. Improvement of Curriculum Revision

Improvement subject: 2-2. Example of curriculum revision

The GCT project will make the following improvement proposals on the above subject.

■**Current status**	The TEVTA curriculum revision committee is inviting guidance every year to suggest proposals for curriculum revision of subjects, but the number is small.
■**Problems (core of problem)**	The TEVTA side needs to prepare so as to unify formats so that instructors can propose revised revision.
■ **Specific contents of improvement proposals**	TEVTA should prepare a form that every instructor can see at a glance which item of the curriculum is to be revised. This makes it easier for proposals to be revised by them.
■ **Required Expenses and Time**	It takes few time to prepare the form and enter revised item of the curriculum for each subject.
■ **Expected Effects**	With regard to the revision of the curriculum, the instructor's interest will rise and better education and training can be implemented.
■ **Important Points**	Not particularly.
■ **Reference material**	See next page. The bolded shading is the revised items.

Example of curriculum revision

Ch	Present		New	
1	Industrial planning 1.1 Need of industrial planning 1.2 Phases of industrial planning	3 hrs	Industrial planning 1.1 Need of industrial planning 1.2 Phases of industrial planning	3
2	Site selection for industry 2.1 Economical and technical factors considering while selecting factory site	2	**Site selection** 2.1 Economical and technical factors considering while selecting factory site	2
3	Plant layout 3.1 Definition 3.2 Objectives 3.3 Types 3.4 Criteria for a good layout 3.5 Advantages of a good layout 3.6 Preparing a layout	4	**Layout** **3.1 Introduction to layout** **3.2 Types of layout** **3.3 Good layout** **3.4 Preparation of a layout**	4
4	Production Methods 4.1 Introduction to production 4.2 Important types of production	3	Production Methods 4.1 Introduction to production **4.2 Types of production** **4.3 New trend of types of production**	3
5	Job Analysis 5.1 Motion study 5.2 Time study	6	Job Analysis 5.1 Motion study 5.2 Time study	**5**
6	Production planning and control 6.1 Production planning 6.2 Production control	4	Production planning and control 6.1 Production planning 6.2 Production control **6.3 Improvement of productivity**	4
7	Quality assurance 7.1 Inspection 7.2 Quality control	2	Quality assurance 7.1 Inspection **7.2 Quality control (Quality management)** **7.3 Quality control circle**	**3**
8	Maintenance 8.1 Responsibility of maintenance department 8.2 Types of maintenance 8.3 Comparison of different types of maintenance 8.4 Replacement studies	4	Maintenance 8.1 Responsibility of maintenance department 8.2 Types of maintenance **8.3 Total productive maintenance**	4
9	Cost determination and control 9.1 Cost calculation of industrial product 9.2 Cost control	2	Cost determination and control 9.1 Cost calculation of industrial product 9.2 Cost control	2
10	Store operation in industry 10.1 Receipt of store items 10.2 Records of store 10.3 Issue of store items	2	**Store operation** **10.1 Receipt of store items** **10.2 Issue of store items**	2

Improvement Proposal

Improvement item: 3. Improvement on Preparation for Training

Improvement subject: 3-1. Preparation of lesson plan

The GCT project will make the following improvement proposals on the above subject.

■**Current status**	There are few instructors preparing teaching procedures and teaching materials in conducting classes.
■**Problems (core of problem)**	It is necessary to prepare lesson plans in advance, such as the content and order to be taught, the necessary time, teaching materials, etc.
■ **Specific contents of improvement proposals**	Utilize lesson plans that contain the contents of teaching, its order, necessary time, materials to be prepared, etc.
■ **Required Expenses and Time**	The time to prepare a lesson plan is generally less than 30 minutes in one lesson.
■ **Expected Effects**	· The content to be taught is introduced and the teaching elimination disappears · Instruction order can be fixed, and necessary time can be secured. · Teaching materials can be prepared in advance.
■ **Important Points**	In order to understand the experience of preparing the lesson plan, training is necessary for preparation method.
■ **Reference material**	See an example of lesson plan.

Lesson Plan (Example)

Task: Introduction & Importance of Safety **Theme:** ・Identify the importance of safety. ・What is an accident. ・Hazards not observing safety.	**Date:** **Place:** Conference Room **Trainer:**
Prepared by:	**Course:** Health Safety & Environment (Mech. 141) **Number of trainees:** 20

Classification (Instruction stage)	Time	Point of Instruction	Instruction Tool or Method
Introduction	05	Attendance Daily Life: example of accidents & Cause of accidents	Attendance Register Picture
Presentation	25	What is safety? Importance of safety. What is accident? Causes of accidents. Hazards not observing accidents.	Videos Multimedia
Application	10	Enlist Accidents not observing traffic rules.	
Confirmation	05	Review of lecture Questions Explain First Aid	
Method to evaluate comprehension Make assignment on "Enlist accidents not observing safety rules in workshops".			
Materials to be used White Board, Multimedia, Videos.			

Improvement Proposal

Improvement item: 4. Improvement on Training Implementation

Improvement subject: 4-1. Utilization and sharing of the teaching materials created in the project

The GCT project will make the following improvement proposals on the above subject.

■Current status	The following teaching materials related to the revised curriculum were targeted for monitoring in the project and these project products in consultation with TEVTA. 1. Health Safety and Environment 2. Applied Thermodynamics 3. Machine Design 4. Hydraulics and Hydraulic Machine 5. Material Testing and Heat treatment
■Problems (core of problem)	1. How should these teaching materials be used as project products? 2. These teaching materials are taken into a specific organization or person, and there is a concern that these materials will be buried somewhere without being known to the public.
■ Specific contents of improvement proposals	1. To organize the completed teaching materials by field. 2. The completed teaching materials should be saved not only on paper but also as electronic documents. For example, the electronic document is saved as a "cloud document" using a "cloud" such as Dropbox, One Drive, or iCloud.
■ Required Expenses and Time	1. Internet environment construction cost 2. Charge for the capacity of electronic documents
■ Expected Effects	1. As long as a teacher under GCT, anyone can view the cloud documents anytime, anywhere, and share information. 2. Teachers should be able to use the cloud documents directly as teaching materials for students. 3. Cloud documents make it easy to correct and add content,

	so teachers always get updated content. 4. Cloud documents will last forever as products of the project.
■ Important Points	1. Who should be the main administrator of "cloud documents" and which organization will be placed? 2. About operation method of security management of "cloud document". 3. Even a teacher under GCT needs a password. 4. Reading of "cloud documents" is possible, but in principle writing is prohibited. The designated specific person can add or correct the content of the cloud document or update the cloud document. 5. If there is any reference material in the cloud document, we need to specify the quoted source list.
■ Reference material	1． Dropbox 2． One Drive 3． iCloud

Improvement Proposal

Improvement item: 5. Improvement on Evaluation of Education and Training

Improvement subject: 5-1 Utilization of internal evaluation items of DAE course

The GCT project will make the following improvement proposals on the above subject.

■Current status	Various numerical data on students from admission to graduation are prepared in DEA course. Although TEVTA Web Portal is utilized, some of them still have not been sorted out because they are filled in with paper documents.
■Problems (core of problem)	Advancement of students and in-campus test data is saved in paper documents, and the goal values from admission to promotion and graduation are not targeted.
■ Specific contents of improvement proposals	The number of applicants, the number of enrollees, the number of grades / graduates, the results, student self-evaluation, student opinion and impressions are unified with management in the form of Excel, electronic media etc. For items that can be analyzed in the next fiscal year ranging from enrollment to promotion and graduation, specify concrete numerical targets to improve and make it an index of academic management.
■ Required Expenses and Time	It takes some time to decide the input method by Excel etc. and appoint an administrator.
■ Expected Effects	Student management is unified, and it is effective to be utilized for academic management, learning guidance, and employment guidance.
■ Important Points	Because dealing with personal information by electronic medium, let a person familiar with it be identified as administrator.

Evaluation items of internal evaluation of DAE course

Evaluation of DAE course (internal evaluation)	1) Number or rate of applicants 2) Number or rate of entrants 3) Number or rate of advancement and graduates 4) Student grades (Results of the period test and graduation test) 5) Self-assessment of trainee 6) Student impression / opinion

Improvement items by setting specific numerical targets.

Contents	Target value	Status value	Improvement item
1) Number of applicants (% of previous year)	Number or Percentage	Number or Percentage	(1) Publicity (2) Visit to high school (3) Publication of GCT (4) Other (Utilization of media, etc.)
2) Number of enrolled students (% of previous year)	Number or Percentage	Number or Percentage	
3) Advancement · Number of graduates (rate)	Number or Percentage	Number or Percentage	
4) Student grades	Average	Average	(1) Increase attendance rate (2) Motivation for learning (3) Confirmation and improvement of teaching methods (4) Expansion of instructor's training (5) Other (Company visit etc.)

Improvement Proposal

Improvement item: 5. Improvement on Evaluation of Education and Training

Improvement subject: 5-2. Utilization of external evaluation items of DAE course

The GCT project will make the following improvement proposals on the above subject.

■**Current status**	There is little activity to analyze opinions from the outside and use it as an evaluation of the DAE course. Recently IMC has been held and there is a movement to incorporate corporate opinion into school activities.
■**Problems (core of problem)**	GCT has little opportunity to investigate externals, especially graduates and industry, what they expect of the DAE course. For this reason, there are outdated guidance contents, lack of contact with companies, lack of public relations and so on.
■ **Specific contents of improvement proposals**	GCT periodically conducts surveys and corporate visits and analyzes them. Along with evaluation from graduates, incorporate graduates from employment companies and requests for GCT.
■ **Required Expenses and Time**	Constructing an annual plan has little time constraints.
■ **Expected Effects**	External evaluation can be used for CGT management such as revision of guidance contents, student proper judgment, curriculum review, employment guidance etc.
■ **Important Points**	The GCT routinely has the point of contact with outside companies and making graduate management appropriate.
■ **Reference material**	For the external evaluation items of graduates and employment companies, see the table below.

Evaluation items of external evaluation of DAE course

Evaluation of DAE course (External evaluation)	1) Evaluation from graduates 2) Evaluation for employment company 3) Evaluation of Industry to GCT (Opinion and Request) 4) Social evaluation of GCT

Improvement items by graduates and employ company

External Evaluation	Evaluation Item	Improvement Item
1) Evaluation from graduates	Similarities / Differences on contents of GCT and work site	(1) Improvement of instruction contents (2) Aptitude judgment of students
2) Evaluation from employ company	Evaluation of graduates and characteristics, requests for GCT etc.	(3) Improvement of curriculum (4) Employment guidance (5) Company visit (6) Accuracy of internship system (7) Need for additional guidance (8) Necessity of Public Relations

Improvement Proposal

Improvement item: 6. Improvement on Teaching Method

Improvement subject: 6-1. Improvement of training method in Mech.141 Health Safety and Environment

The GCT project will make the following improvement proposals on the above subject.

■**Current status**	Associated with curriculum revision in Safety Health and Environment, there is a need for teaching materials that cover the contents of the three items shown in the following subjects.
■**Problems (core of problem)**	The points to be strengthened are as follows. (1) Establishment of a sustainable safety management system (2) Realization of safe workplace by 5S promotion (3) Specific knowledge of handling and storage methods of combustible substances
■ **Specific contents of improvement proposals**	Prepare a text that has been developed separately for the above three points. (1) Provide an executable manual for establishing a sustainable safety management system. * Provide basic knowledge about disasters and hazards, and provide guidelines for taking correct action to prevent recurrence. * Identify the contents and implementation method of hazard prediction training (KYT) as a concrete tool and hazard training as specific means to avoid and prevent hazards by risk management. (2) Show the importance of 5S to create a safe workplace and the implementation procedure to develop its activities. (3) Provide information on basic concepts and specific methods of handling flammable materials.
■ **Required Expenses and Time**	(1) Necessary expenses: None (2) Time: Preparation period for preparing teaching materials and transferring technology through MT and ToT.

■ **Expected Effects**	(1) It is not only the acquisition of knowledge, but the way for graduates to practice and teach in a company becomes clear. (2) It can be used daily as a manual, and can be trained repeatedly based on it.
■ **Important Points**	It is desirable that the subject (1) and (2) be treated as a common theme that all students should acquire. And the subject (3) is specifically strengthened in response to the needs.
■ **Reference material**	(1) Establishing "Sustainably Safe and Healthy Environment" (2) 5S Guidebook for "Step by step implementation" (3) Handling and Storage of "Flammable materials"

Improvement Proposal

Improvement item: 6. Improvement on Teaching Method

Improvement subject: 6-2. Improvement of training method in Industrial Planning and Production Method

The GCT project will make the following improvement proposals on the above subject.

■**Current status**	In the Industrial Planning and Production Method, the part related to Planning has been mostly improved as a result of the project activities so far. However, the parts related to Production Method are not fully covered.
■**Problems (core of problem)**	It hardly includes the improvement of quality and productivity, which is the basis of the basic activities of the manufacturing industry. Specifically, there is no description of the necessity or procedure of improvement concerning Q (quality), C (cost) and D (delivery date) which are the main elements of added value.
■ **Specific contents of improvement proposals**	We will clarify the mechanism of production and introduce 5S activities as an infrastructure for "visualizing" the process, and introduce methods and systems for productivity improvement and quality improvement. Especially, we introduce TQM (Total Quality Management), TPM (Total Productive Maintenance), TPS (Toyota Production System, Just in Time) and cost reduction methods as a Japanese-style KAIZEN system. Introduce as many specific cases as possible in the company to promote student understanding.
■ **Required Expenses and Time**	(1) Necessary expenses: None (2) Time: Prepare teaching materials in the work of experts in japan and transfer technology through MT and ToT.
■ **Expected Effects**	(1) GCT can respond to the needs of companies (training of problem-solving ability of graduates). (2) GCT students can acquire practical knowledge and methods.

■ **Important Points**	(1) First of all, define the system of the whole technology, and then let students understand the positional relationship of Kaizen's infrastructure, systems and tools after grasping the whole picture. (2) In addition, make them understand the basic way of thinking and practicing about TQM, TPM and JIT, which are the core of Japanese-style manufacturing. (3) Introduce specific examples to promote understanding.
■ **Reference material**	"Introduction to Production management"

Improvement Proposal

Improvement item: 6. Improvement on Teaching Method

Improvement subject: 6-3. Enhancement of practical training in Mech. 312 Hydraulics and Hydraulic machine

The GCT project will make the following improvement proposals on the above subject.

■**Current status**	In GCT RR and GCT FSD, the equipment is substantial and practical training using this equipment is important but there seem some difficulties in proper implementation due to lack of adequate experience of instructors.
■**Problems (core of problem)**	Lack of skill of practical training of instructors.
■ **Specific contents of improvement proposals**	Training method is clarified by organizing the training contents and procedures for each training equipment and write it as a document, and to conduct the training accordingly.
■ **Required Expenses and Time**	Not particularly
■ **Expected Effects**	Enhancement of practical training ability of instructor
■ **Important Points**	Reference to the manual of each equipment will be useful.
■ **Reference material**	Examples used in the master training are shown in the following pages.

Example

Hydraulics and hydraulic machine

Practice 1　centrifugal pump system

1. Preparation
   - 1.1 centrifugal pump apparatus
   - 1.2 manual
   - 1.3 cold water

2. Safety instructions
   - 2.1 electrocute
   - 2.2 hot surface
   - 2.3 rotating components

3. Understanding of machine components and their function by observation
   - 3.1 support frame
   - 3.2 reservoir
   - 3.3 centrifugal pump unit
   - 3.4 control unit
   - 3.5 electrical cabinet
   - 3.6 low pressure supply pipes
   - 3.7 low pressure outlet pipes
   - 3.8 low pressure inlet valve
   - 3.9 low pressure outlet control valve
   - 3.10 pressure relief valve
   - 3.11 flow sensor（flow meter）・F1
   - 3.12 inlet pressure sensor ・P1
   - 3.13 outlet pressure sensor ・P2

4. Setting （installation）
   - 4.1 Fill the reservoir with clean cold water
     - Close drain valve and open pipe
     - Fill reservoir to reach 75mm from top
     - Cover reservoir with lid
     - After priming, check float level sensor that it remains fully submerged in water, if not add water
   - 4.2 Connect electric supply
     - Connect main plug to 230V electric supply
     - Check illumination of display on control panel

5. Priming ・ system idling run
   - 5.1 Turn on main switch
     - Turn on switch of cabinet
     - Observe welcome massage and initial screen on display
   - 5.2 Open all valves between reservoir and pump
   - 5.3 Press "select" box on control panel until "centrifugal pump" is shown
   - 5.4 Press "enter"
   - 5.5 Press "select" until "speed" is displayed
   - 5.6 Increase speed of "pump 1" until display indicates 100° by pushing " ↑ "

   - 5.7 Observe water flow
   - 5.8 Press "select" to read all sensor values
   - 5.9 Press "exit" to stop pump working

6. Exercise
   - 6.1 Prime the system as above
   - 6.2 Set pump speed at 100%
   - 6.3 Press "select" key to read those parameters, and record them
     Motor speed, flow rate, inlet pressure, outlet pressure, motor torque
   - 6.4 Gradually close outlet valve until getting 90 % of original flow rate
   - 6.5 Read and record those parameters
   - 6.6 Close outlet valve farther to get flow rate of
     80 %, 70 % , 60 % , 50 % , 40 % , 30 % , 20 % 10 % , 0 % of original flow rate
   - 6.7 Read and record those parameters at each flow rate
   - 6.8 Press "exit" to stop pump working

7. Result calculation
   - 7.1 summarize recorded data on sheet A
   - 7.2 calculate and summarize characteristic figures
   - 7.3 plot graphs of
     Total head, mechanical power, and overall efficiency, against flowrate

Sheet A

	Pin	Pout	F	T	N	t	ρ
	kN/m^2	kN/m^2	L /min	Nm	RPM	℃	Kg/m^3
Original							
90%							
80%							
70%							
60%							
50%							

40%							
30%							
20%							
10%							
0%							

Sheet B

	Q	Hs	Hc	Hv	Ht	Pm	Ph	Eo
	M^3/s	m	m	m	m	watts	watts	%
Original								
90%								
80%								
70%								
60%								
50%								
40%								
30%								
20%								
10%								
0%								

Improvement Proposal

Improvement item: 6. Improvement on Teaching Method

Improvement subject : 6-4. Enhancement of practical training in Mech. 323 Applied Thermodynamics

The GCT project will make the following improvement proposals on the above subject.

■Current status	In GCT RR and GCT FSD, the equipment is substantial and practical training using this equipment is important but there seems to be some difficulties in proper implementation due to lack of adequate experience of instructors.
■Problems (core of problem)	Lack of skill of practical training of instructors
■Specific contents of improvement proposals	To clarify the training method by organizing the training contents and procedures for each training equipment and write it as a document, and to conduct the training accordingly.
■Required expenses and time	Not particularly
■Expected effects	Enhancement of practical training ability of instructor
■Important Points	Reference to the manual of each equipment will be useful.
■Reference material	Not particularly Examples used in the master training are shown in the following pages.

Example

Applied Thermodynamics

Practice 7, 8 Compressor test unit

Actions

8. Safety instructions
   - electrocute
   - hot surface
   - rotating components
   - hot gas blow
   - noise

9. Understanding of machine components and their function

   Compressor module
   - compressor
   - motor
   - start and stop switch
   - safety valve
   - pressure gauge for outlet
   - dynamometer set
   - pressure gauge inlet
   - inlet air receiver tank
   - air inlet and orifice
   - air inlet control valve
   - outlet air receiver tank
   - outlet control valve
   - discharge pipe

   Control console
   - main switch
   - circuit breaker
   - tachometer
   - orifice manometer
   - ammeter
   - volt meter
   - temperature indicator

   - temperature selector switch
   - thermocouple socket

10. Installation
   - High speed air flow from compressed air must be considered at installation of main unit.
   - Black tube of orifice plate right side is connected to orifice plate manometer inlet pipe at right side, and Left side of plate to inlet pipe left.
   - Red colored liquid must be filled at zero mark on the adjustable scale.
   - Connection of compressor tachometer to be done.
   - Connect 2 thermocouple plugs from main body is connected to 2 thermocouple sockets of console,
     1 more couple plug with loose end to 3rd socket.
   - Connect power supply cable from main unit to socket 13 at console.
   - Keep start / stop switch in position off by pushing down red button.
   - Voltage label on the machine must match local supply power.
   - Keep the main switch on console at off position.

11. Test running as part of setting
   - Turn on main switch
   - Check if those are OK
     Digital display working
     Free swing of compressor motor
     Release of dynamometer adjuster
     Full swing of motor cradle counterclockwise
     Compressor oil level
     Full open of inlet control valve, and outlet control valve
   - To start compressor, pull up red button
   - Check air flow out
   - Check tachometer and manometer working
   - Turn of start / stop switch to end test run.

12. Operation
   12.1 check if inlet and outlet valve are open
   12.2 adjust orifice plate manometer scale to zero
   12.3 check no load on dynamometer load indicator
   12.4 adjust zero position of spring balancer (load gauge)

   12.5 pull up red button of start / stop switch to start compressor idle running
   12.6 to adjust the compressor dynamometer, pull up adjuster 20 so that motor cradle come to horizontal position
   12.7 to set discharge pressure to planed value
      - shut air outlet control valve fully
      - observe rise of pressure
      - when the pressure reach planned value at gauge, open air outlet control valve slowly to get stabilized pressure. This is controlled state of compressor running
   12.8 take read of indicators of tachometer, thermometer, manometer, load gauge

Improvement Proposal

Improvement item: 6. Improvement on Teaching Methods

Improvement subject: 6-5. Enhancement of practical training in Mech.343 Machine design

The GCT project will make the following improvement proposals on the above subject.

■**Current status**	Machine design training is dominated by theory lectures on mechanical strength design, with less emphasis on knowledge skills about specific industrial product design procedures.
■**Problems (core of problem)**	Lack of training on specific product design procedures.
■ **Specific contents of improvement proposals**	It is expected that this curriculum revision will add an understanding of the product design procedure, it is to conduct desk design training to promote this understanding. The training takes simple products and simulates the procedure from product planning to conceptual design strength calculation on the desk.
■ **Required Expenses and Time**	Not particularly
■ **Expected Effects**	Better understanding of the design steps set up in the curriculum.
■ **Important Points**	Not particularly
■ **Reference material**	Examples used in the master training are shown in the following pages.

Example

Machine Design

Practice 1 planning of school chair - requirement & rough sketch of product

1. Planning

1.1 Assumption

- You are designer employed by some manufacturing company.
- You are not specialist of specific product, but you have general knowledge and know-how of furniture product planning and design.

1.2 order

Your boss ordered you to draft planning paper of school chair
Key words of his idea were,
Made up of wood,
All GCTs in Punjab as main customer
Planning should be made basing on your consideration, but it should be reasonable enough
to convince your colleague.

1.3 Drafting

You are to draft paper of requirement & rough sketch of product

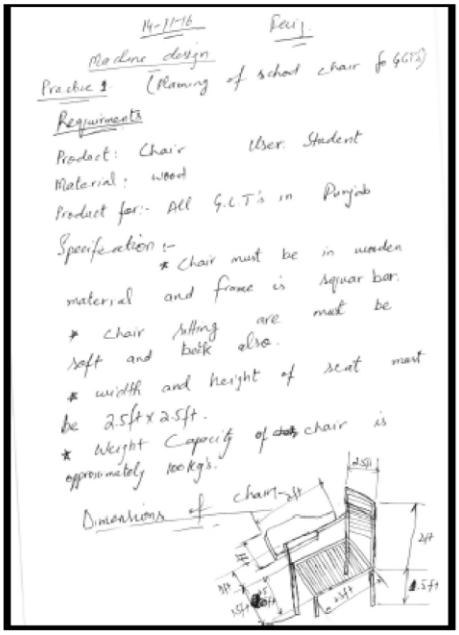
- Amount should be 1 ～3 page in text, extra picture pages acceptable.
- Style of document do not matter.

1.4 presentation

You are to present your paper to your colleague and take some question
You are to listen to presentation of your colleague.

1.5 integration

One member plays the role of coordinator during discussion.
Remaining members to have discussion to integrate each drafted idea to one



Practice 2 concept design of school chair - data collection

2.1 Aim

To acquire necessary reference data to design the product

a. bench marking

to study the character and specification of most typical and major product in the market

- - structure, mechanism and dimension
- - material, finish, and coloring
- - weight
- - price
- - reputation and evaluation from general customer
- - other requirement item

b. collection of designing data

to collect every data relating to design

- - dimensions of human body
- - property of expected material
- - supplier and standard size of expected material

2.2 Action

a. Observation and survey of bench mark

- As current product is available in GCT, it can be sample as bench mark. Other sample piece for bench mark is welcome.
- you are to make observations of those samples and to draft report paper
- At least major structure and dimension must be reported.
- Any measuring tools can be used

b. collection of designing data

to collect every data related to design from web site and market and report

- - dimensions of human body
- - property of expected material
- - supplier and standard size of expected material

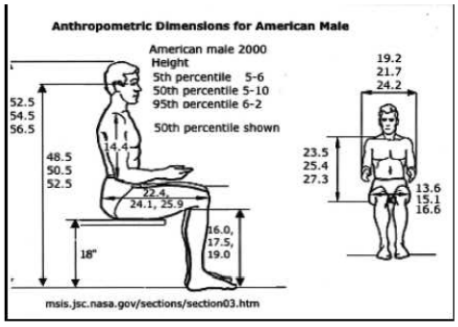
2.3 presentation

You are to present your report paper to your colleague and take some question
You are to listen to presentation of your colleague.

2.4 integration

one member plays role of coordinator of discussion.

Remaining member to have discussion to integrate each drafted idea to one.



Practice 3 concept design of school chair - design

3.1 Aim

To establish concrete idea of product

- product concept -- description of product character
- to define core items of design
- to calculate strength of structure
- to calculate performance of function and mechanism

3.2 Action

Base on preceding idea and information,

c. You are to list out product concept and core items of design

d. You are to make strength calculation of one of core items < sitting surface flat bar > on an assumption of

- -- human weight load would be at center of only on single bar
- -- dynamic factor would be 4 against static load
- -- section size of bar W x H as you designed (other than 60 x 20)
- -- length of bar L as you designed
- -- human weight w as per your survey
- -- material strength if you have no other information σ = 14 kgf / mm2

3.3 presentation

You are to present your report paper to your colleague and take some question

You are to listen to presentation of your colleague and ask question.

(b) Strength calculation of sitting surface flat bar:

→ Human weight acts at centre of my own single bar = 70 kg-f

→ Dynamic factor = 4 x static cond.

→ Section size of bar W x H = 43 x 20 mm

→ Length of bar = 430 mm

→ Material strength = 30 kgf/mm²

1. Calculation of bending moment at centre of bar

$M = w \times L/2 = 70 \times \frac{430}{2} = 15,050$ Kg-mm

2. Calculation of modulus of section

For rectangle section $Z = W \times H^2/6$

$Z = \frac{43 \times (20)^2}{6} = 2866.66\ mm^3$

3. Calculation of edge stress (Maximum bending stress)

$\sigma_e = \frac{M}{Z} = \frac{15050}{2866.66} = 5.25$ Kg/mm²

4. Comparison of allowable stress vs expected stress

Allowable Strength = 30 kg f/mm²

Expected stress with dynamic factor = 5.25 x 4 = 21 kg/mm²

Practice 4 cost estimation of school chair .

4.1 Aim

To establish concrete idea of product cost

4.2 condition of estimation

- scope of estimation -- manufacturing cost
- Material price as per separate sheet
- labor rate and others are,

direct labor

-- wood machining 650 RPK/ hr

-- assembling and painting 550 RPK /hr

indirect labor

-- wood machining 300 RPK/ hr

-- assembling and painting 300 RPK /hr

indirect materials

-- lacquer paint and thinner 3.5 RPK / pc

other indirect cost -- machine depreciation

-- wood machining 2000 RPK/ hr

-- assembling and painting 1150 RPK /hr

others would be by your own information

4.3 Action

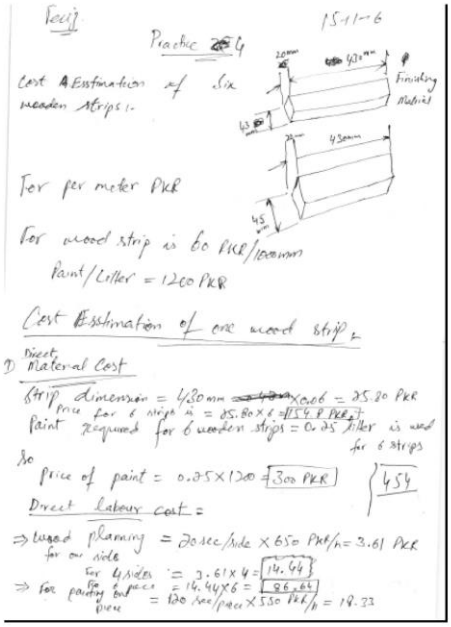
Base on preceding idea and information,

you are to list out product cost estimation of each element

4.4 presentation

You are to present your report paper to your colleague and take some question

You are to listen to presentation of your colleague.



Practice 5 detail design of school chair

4.1 Aim

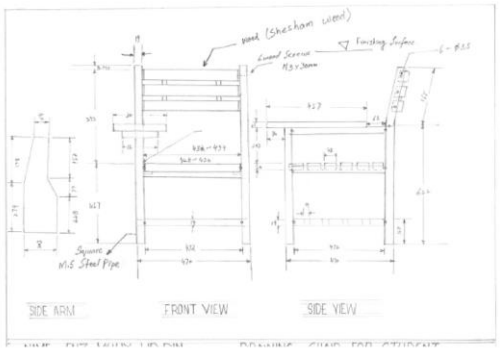
To define details of product – school chair, which enables actual production

4.2 Action

Base on preceding idea and information of your practice,
you are to draw sketch drawing of whole product and one of its major parts, in which all necessary structure, dimension and tolerance must be shown.

4.3 presentation

You are to present your report paper to your colleague and take some question
You are to listen to presentation of your colleague.



Improvement Proposal

Improvement item: 6. Improvement on Teaching Methods

Improvement subject: 6-6. About shifting from large group to small group in teaching of practice

The GCT project will make the following improvement proposals on the above subject.

■Current status	In teaching practice, it is generally a system of teaching in a large group of students.
■Problems (core of problem)	Training equipment in the GCT-RR and GCT-FSD have been installed in line with the curriculum by the JICA-GCT project about training equipment owned by each GCT. However, in all GCT schools, training equipment is generally not enough. And at GCT, there is also the problem of aging training equipment. Therefore teaching of practice in a large group of students tends to be biased towards the theoretical field. There may be a large number of students in charge of one teacher, and we may think that the number of training equipment necessary for the number of students is necessary. There seems to be a difference in the type and number of training equipment owned by each GCT, but are that training equipment currently being used effectively? In a current condition, the training only consumes its planned time, and the content of the teaching in the training may not be linked to the improvement of students' substantial understanding and proficiency level.
■ Specific contents of improvement proposals	For example, if different training equipment is installed with A, B, and C in a class of 30 students, rather than 30 students working on each training equipment at once, how about organizing three groups as a group of 10 students? As three groups, place the teacher in each group and give teaching of practice using each training equipment. Students will rotate three times to learn each equipment. If a student receives teaching in a small group, understanding

	and proficiency levels will be greatly improved compared to the past, rather than learning one equipment with 30 students. We would like to list the following improvement proposals to create such an environment. 1. Increase the number of teachers 2. Hiring assistant teachers for practice 3. Hiring as a temporary external lecturer from companies related to practical tasks
■ Required Expenses and Time	1. Personnel expenses necessary for hiring new teachers, assistant teachers for practice and temporary external teachers. 2. In the above example, in the case of placement of one teacher, the assigned time for teachers is three times longer than before.
■ Expected Effects	1. We can effectively utilize existing training equipment. 2. Teachers may increase their assigned time, but they can give students dense teaching. Therefore students also improve their understanding and proficiency levels.
■ Important Points	1. We think that the placement of teachers for each group is desirable. In the case of placement of one teacher, it may be considered that the time for self-study of the student may increase. However, it is possible if we consider the following two points. 1. To prepare appropriate practical tasks. 2. To take measures for accident prevention with training equipment and adequate safety.
■ Reference material	Non

Improvement Proposal

Improvement item: 6. Improvement on Teaching Methods

Improvement subject: 6-7. About teaching method united with practice and theory

The GCT project will make the following improvement proposals on the above subject.

■Current status	Teaching of practical and theory are performed separately.
■Problems (core of problem)	1. The graduate with DAE qualification must have at least capable persons who can support an engineer at the site of a place of employment. Therefore capable persons who have practical theory and skills are necessary. In order to bring up such capable persons at GCT, it is extremely important to perform teaching methods that are united with practice and theory to them. When they are employed in the mechanical industry, they should surely be evaluated as a practical engineer or mid-level engineers from the employer side. 2. In a current condition, the training only consumes its planned time, and the content of the teaching in the training may not be linked to the improvement of students' substantial understanding and proficiency levels.
■ Specific contents of improvement proposals	1. To perform the teaching, there is need to *unite practice and theory.* Since there is a relation by safety depending on the content, two or more teacher systems may be needed. 2. If only one teacher needs to perform the training, a teacher can teach theory. However If one teacher performs practice, it is necessary to devise a teaching method. In that case, he needs to explain a practice task to all students in large group. For example, the following measures can be considered. If all students in large group need to use A, B, or C training equipment in a practice task, first, a teacher will explain these three types of training equipment. Then a teacher divides the student into three groups and

	place each group on the A, B, C training equipment. A teacher will set the appropriate time for the student to master each training equipment and make them rotate each equipment while paying attention to safety. *3. I*n the case of placement of one teacher, training time and the amount of work may increase. However, as training can be focused on practice, it is possible to reduce the details of theory in the curriculum. Therefore it has the merit of being able to increase practical training time for us.
■ Required Expenses and Time	1. In order to perform the teaching united with practice and theory, more than one teacher system is required. Therefore we need to consider the personnel expenses necessary for hiring new teachers, assistant teachers for practice and temporary external teachers.
■ Expected Effects	1. The teaching methods united practice and theory can reduce the number of classrooms and moving time of students in the school. 2. As training is focused on practice, we can reduce the details of theory in the curriculum. Therefore we can increase practice time and can develop practical capable persons who can make use of what they have learned in practice at the site of a place of employment.
■ Important Points	1. We would like to have a teacher placement for each group. However, in the case of placement of one teacher, it may be considered that the time for self-study of students may increase, so the following two points should be considered. (a) To prepare appropriate practical tasks. (b) To take measures for accident prevention with practical equipment and adequate safety.
■ Reference material	Non

Improvement Proposal

Improvement item: 6. Improvement on Teaching Methods

Improvement title: 6-8. Practical instruction by company's engineer

The GCT project will make the following improvement proposals on the above topics.

Current status	In practical instruction, it is practical instruction only from the instructor in charge of practical skill training.
Problem (core of problem)	1. As one faculty member is in charge, it seems that they are not able to give sufficient explanation and guidance 2. Many machines are out of order and few machines can operate. Also there are few tools and practical training does not proceed. Power outages occur frequently. With one faculty member, it is impossible for all students to achieve sufficient safety. For this reason, it seems that there are many practical training centered on explanation. 3. I think that only the digestion of the planning time is carried out and it has not led to a substantial understanding of students and improvement of proficiency degree. 4. There is no time or opportunity for teachers to look at the state of the latest technology, machining conditions, learn from them.
Specific contents of improvement proposal	For the purpose of creating an environment for improving technical skills of students as well as instructors, we suggest the following improvement proposals. 1. Hiring practical skill training instructors 2. In order to learn the latest technology and practical efforts at enterprises, we request short-term practical instruction by engineers from enterprises.
Required Expenses Time	1. Employment of technical assistant teachers, personnel expenses related to temporary external lecturer hiring. 2. Expenditure materials expenses such as tools and expendable teaching materials purchase costs.

Expected effect	1. This can effectively utilize existing equipment. 2. Not only the instructor but also the students' technical skill level is improved and the job motivation for employment is smooth. 3. We can provide students with a dense instruction. 4. Seminars for companies can be implemented.
Important Points	Companies that require guidance must have a working environment (such as 5S) in the factory. And it is desirable that the instructor who will be dispatched be a field engineer or in a leadership position.
Reference material	Non

Improvement Proposal

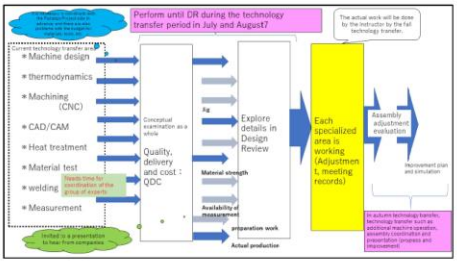
Improvement item: 6. Improvement on Teaching Methods

Improvement subject: 6-9 To enhancement of practical training from actual production activity with all instructors

The GCT project will make the following improvement proposals on the above subject.

■Current status	Despite the expectation of training practical workers (who can understand techniques and skills), purpose of practical workers training is not sufficient. Furthermore, since the level of technical and technical support to companies in GCT does not seem to be a sufficient level. It is desirable to have a state in which companies and GCT mutually benefit each other. However, the present circumstances, it seems that industry- college collaboration of job placement request is a major factor. GCT seems to need continuity of human resource development support for companies.
■Problems (core of problem)	1. Priority is given to obtaining the DAE exam (subject exam), and training has not been sufficiently conducted. 2. It seems that the relationship between the subjects has not been coordinated with production activities in a company where everyone works. 3. The concept of "total optimization" that supports actual manufacturing is difficult in individual subject instruction. 4. There is no motivation to relate individual subjects.
■ Specific contents of improvement proposals	Creating a relationship between subjects by "making something unique" in a group of instructors, we will also seek education and training by meeting new corporate needs. * By conducting a series of functional development of products to basic experiments, design, manufacture, use, and maintenance, the relationship with the entire manufacturing will be clarified for each subject, and understanding will be deepened.

	* The problem is to help the industry- college collaboration by receiving from the company if possible.
■ Required Expenses and Time	1. Training time for instructors (summer vacation) 2. Cost of teaching materials for "Making things"
■ Expected Effects	1. It can be used effectively without leaving existing practical equipment. 2. There is an opportunity to seek "education and training" on the company sense of the instructor. 3. By building a network with instructors' companies, it is possible to build the actual industry-academia collaboration and achieve real-time acquisition of company needs.
■ Important Points	1. The instructor needs to be aware of the current situation. It is difficult without everyone having the same vector. 2. Support from related instructors for parts related to electricity and electronics.
■ Reference material	See the figure below



Improvement Proposal

Improvement item: 6. Improvement on Teaching Methods

Improvement subject: 6-10. Securing training time in consignment production from a company

The GCT project will make the following improvement proposals on the above subject.

■Current status	Despite expectation of training of practical worker (who can understand techniques and skills), practical techniques and skills is neglected.
■Problems (core of problem)	1. Priority is given to obtaining the DAE exam (subject exam), and practical training has not been sufficiently conducted. 2.5. If we have enough training for 50 people, we will need a lot of training materials and budget. 3. It is difficult to prepare practical training materials (texts). Because the amount of printing is large. 4. There are many busy instructors in charge of teaching classes. It is difficult to prepare for practical training (prototype and procedure).
■ Specific contents of improvement proposals	Consignment production from a company * At first glance learning seems to be a mere task rather than preparation for production, and it seems to be difficult. As an advantage ・ Training environment becomes more practical ・ Exclusion of teaching material expenses ・ Some training income ・ Corporate training in the school ・ We can learn QDC such as production control of working level, quality control ・ Cooperation between instructors' companies is tight. As a problem point ・ Risk of defective product, delivery date etc.

	・ Order adjustment during periods such as summer vacation
■ **Required Expenses and Time**	1. Development of new companies 2. Purchase of tools and measuring instruments with orders 3. Vehicles for delivery etc.
■ **Expected Effects**	1. It can be used effectively without leaving existing practical equipment. 2. The ability of students to improve their immediate work skills and to provide them with a smooth job motivation. 3. Practical acquisition of teaching skills of teachers and QDC in companies.
■ **Important Points**	1. It can be used effectively without leaving existing practical equipment. 2 Honestly, there are many difficult aspects. Therefore, it is desirable that it be implemented after practicing the actual work in the "Product manufacturing problem training" by the instructor of improvement plan 2. The reason seems to be that at present, it is difficult to assess the degree of difficulty of outsourcing from a company.
■ **Reference material**	non

Improvement Proposal

Improvement item: 7. Improvement on Instructor Training Plan

Improvement subject: 7-1. Master training continuation plan

The GCT project will make the following improvement proposals on the above subject.

■**Current status**	Training of instructors from GCT RR (as from previous project) and GCT FSD (as from current) to maintain and enhance the capacity have been conducted by holding master training regularly. It has been used as a base of ToT targeting 11 GCTs instructors in the eastern part of the province. Since there is no other instructor training program at both GCTs, continuation of the above functions after the project is worried.
■**Problems (core of problem)**	Maintaining the master trainer system becomes difficult in the future.
■ **Specific contents of improvement proposals**	To continue training similar to current master training after project completion details are shown in the attachment.
■ **Required Expenses and Time**	185,000 PKR / year Details are shown in the attachment.
■ **Expected Effects**	Instructors of the GCT RR and the GCT FSD who have reached the capacity as a master trainer in the current project can maintain the same ability and can further improve even after change of times and personnel change. By this action, separately proposed ToT would become feasible, thus it will be possible to maintain and improve the capacity of 11 GCT instructors in the eastern part of the state.
■ **Important Points**	Not particularly
■ **Reference material**	Not particularly

Attachment

Continuation of Master Training

1. Purpose
By continuing to carry out instructor training equivalent to the master training conducted in the JICA Project, it contributes to maintain and improve the instructors' abilities of the GCT RR and GCT FSD mechanical departments after the project completion,, and enables continuation of (ToT) training of instructors in 11 GCT Mechanical Department in the eastern part of the province .

2. Responsible person in charge
TEVTA Training Manager will be responsible
In addition, one person from each college will be assigned as a person in charge of execution who will assist the responsible person.

3. Timing of implementation
Master training should be held once a year between June and August, while student training is off.

4. Target instructor
instructors in mechanical department of GCT RR and GCT FSD should be appointed by each college

5. Subject
It should be decided by responsible person in charge, but in principle it would be the 16 subjects of the current master training

6. Venue
All subjects are divided into 2 even groups and distributed both to GCT RR and GCT FSD, for those subjects training are implemented at both colleges respectively

7. Trainer
Under the direction of the responsible person, several instructors who excels in subject

knowledge, practical skills, and leadership ability are selected among the instructors of both colleges
The designated trainers examine the details of the training content, prepare the teaching materials, and execute the training
At the time of project completion, the candidate is recommended from the project based on the result of the master training
In addition, in the nomination of the trainer for each subject, it is the principle to nominate those who is working in the training venue.

8. Content of training
The person in charge of execution instructs the trainers on the setting of content every year, but it is desirable to select from the following viewpoints
- ・Of the teaching details set in the curriculum, learn the items that should be re-recognized as a master trainer with lectures and practical skills
- ・Learn about specific procedures and handling of training using training equipment
- ・Knowledges and skills related to use and application in industry, including direct interaction with company's site and human resources
- ・Understand and acquire instructional skills
- ・To learn the key points to plan and implement ToT as a master trainer

9. Training hours
For each year, 3-day training per subject per training course

10. Budget
Cost of training to be borne by TEVTA
Both the trainer (instructors) and the trainees (instructors) who participate in the course are within normal working hours, other estimated yearly expenses are as follows

- Travel expenses 25,000 PKR (25person x 1,000PKR)
- accommodation 150,000 PKR (25person x 2nights x 3,000PKR)
- Utility costs of venue included in facility operation costs
- Teaching materials 10,000 PKR
- Total 185,000PKR

11. Evaluation
To evaluate the following items for the training results
- Evaluation of overall outcome in the trainee by the trainer

- Feedback on general training content by trainee
- Attendance

12. Implementation procedure
- Each year, the responsible person gives instructions on planning the training to the person in charge of execution End of march
- The person in charge of execution formulates the implementation program and coordinates with related parties End of April
- The designated trainer sets the details of training content and prepares teaching materials End of June
- The person in charge of execution prepares draft of notice for holding the event information, responsible person issues the notice to the concerned June 15
- ToT to be implemented under management of person in charge of execution July ～August
- The person in charge of execution summarize the training results and report it to the responsible person End of August

13. Notes

Improvement Proposal

Improvement item: 7. Improvement on Instructor Training Plan

Improvement subject: 7-2. ToT Continuation plan

The GCT project will make the following improvement proposals on the above subject.

■Current status	In order to extend the results of the master training of GCT RR (from the previous project) and GCT FSD (from current) instructors, project has planned and supported capacity improvement training ToT for to 11 GCT instructors in the eastern part of the state. On the other hand, it is presumed that there is no other instructor training program in 11 GCT, and the continuation of the above functions is threatened after the project is over.
■Problems (core of problem)	Implementation of ToT training will be difficult in the future.
■ Specific contents of improvement proposals	After the end of the project, the training corresponding to the current ToT to be continued by 2 colleges. Details are shown in the attachment.
■ Required Expenses and Time	1,108,240 PKR / year Details are shown in the attachment.
■ Expected Effects	Continuation of improving the ability of 11GCTs instructors in the eastern part of the province.
■ Important Points	not particularly
■ Reference material	not particularly

Attachment

Continuation of ToT

1. Purpose
By continuing instructor training similar to the ToT, which has been implemented within the framework of the JICA Project, capacity of the 11GCTs Mechanical Department instructors in the eastern part of the province will be retrained and enhanced.

2. Responsible person in charge
TEVTA Training Manager will be responsible
In addition, one person from each college will be assigned as a person in charge of execution who will assist the responsible person.

3. Timing of implementation
ToT should be held once a year between June and August, while student training is off, as a set with master training. Following the master training timing.

4. Target instructor
Of instructors in mechanical department of 11 GCTs in the eastern part of the province, those who are appointed by each college, in principle, one instructor for each subject from each college.

5. Subject
To be designated by the responsible person in charge, and shall be the same as the master training course prior to this training

6. Venue
To be held at the same place as master training for each subject

7. Trainer
Under the direction of the Responsible Person, one of the master trainer instructors at both GCT RR and GCT FSD will be appointed as appropriate trainer.
The designated trainer examines the details of the training content, prepares the

teaching materials, and executes the training
In addition, in the nomination of the trainer for each subject, it is the principle to nominate those who are from the training venue.

8. Content of training
The trainer selects a training topic from the following viewpoint, referring to the 11GCT's opinion heard in advance after consultation with the person in charge
- ・Practical training using equipment that is in the tendency of lack of training knowledge and skills
- ・Knowledges and skills related to use and application in industry , including direct interaction with company's site and human resources
- ・Matters relating to curriculum revision
- ・Knowledge and skills related to emerging technologies and methods in industry and education

9. Training hours
For each year, 3-day training per subject per training course

10. Budget
Cost of training to be borne by TEVTA
Both the trainer (instructors) and the trainees (instructors) who participate in the course are within normal working hours, other estimated yearly expenses are as follows
- Travel 254,440 PKR （16subject x 11colleges x 1person x 80% x 1,800PKR）
- Accommodation 844,800 PKR （16subjects x 11colleges x 1person x 80% x 2nights x 3,000PKR）
- Utility costs of venue included in facility operation costs
- Teaching materials 10,000 PKR
- total 1,108,240 PKR

11. Evaluation
To evaluate the following items for the training results
- Evaluation of overall outcome in the trainee by the trainer
- Feedback on general training content by trainee
- Attendance

12. Implementation procedure
- Each year, the responsible person gives instructions on planning the training to the

person in charge of execution End of march

- The person in charge of execution formulates the implementation program and coordinates with related parties End of April
- The designated trainer sets the details of training content and prepares teaching materials End of June
- The person in charge of execution prepares draft of notice for holding the event information, responsible person issues the notice to the concerned. June 15
- ToT to be implemented under management of person in charge of execution July ～August
- The person in charge of execution summarize the training results and report it to the responsible person End of August

13. Notes

Improvement Proposal

Improvement item : 7. Improvement on Instructor Training Plan

Improvement subject : 7-3. Implementation of factory tour

The GCT project will make the following improvement proposals on the above subject.

■Current status	Since instructors are concentrating on student instruction ordinary, there is a tendency for fewer points of contact with the industry. Therefore, there are few opportunities to visit the production sites, and utilize them for student instruction.
■Problems (core of problem)	Since there are many items to learn technical contents of the field of work from the production site, it is necessary to instruct and relate them to students directly.
■Specific contents of improvement proposals	HOD will mainly create a plan to visit production sites at least several times a year. And also to consider it as part of the instructor training during the summer vacation.
■Required Expenses and Time	From the viewpoint of cost savings, gathering and dissolving at the site. The observation time is about 2 to 3 hours.
■Expected Effects	The instructor can understand which part of the industry is being taught, or the technical position at the production site. And they can make use of it in future lesson.
■Important Points	It is important to have contact with company ordinary.
■Reference material	Report of Company Visit attached below.

Report of Company Visit

Report by:
Date:

Title of Training	Instructor training	
	Auto company visit	
Date/Time		
Venue	・・・Limited Company aa Plant 26-27km, Lahore-aa Road	Meeting room , Plant work shops
Host	Mr.____, head of corporate affairs	
Method	a + b + c (a : presentation, b : QA, c : plant tour)	
Textbook/Material	-	
Participants	All instructor of GCT-	
Objective of the training	To learn and acquire specific knowledge and information concerning his subjects in current charge, in addition to general idea of plant operation	
Time schedule		
Output / Usage	All become familiar with modern Japanese auto manufacturing operation. This will be used as background knowledge in future training.	
Observation/Notices	The participants are very impressed to be there.	

Improvement Proposal

Improvement item: 8. Improvement on Equipment Management

Improvement subject: 8-1. Management System at Equipment Planning

The GCT project will make the following improvement proposals on the above subject.

■Current status	・ The entire equipment plan for the project is divided into the burden on the donor agency who is called JICA and the burden on the counterpart agency who is called as the C/P. ・The classified equipment will be finalized and approved by each responsible agencies and the procurement work will be executed.
■Problems (core of problem)	・It takes about one year or more for the approval official procedures of the C/P.
■ Specific contents of improvement proposals	It is necessary bellowing tasks. ・the C/P get internal consensus among related organizations. ・The C/P takes care of the contents of equipment plan and consideration of operation cost. ・The C/P helps make procedure for the PC-1 applications smoothly. ・The C/P discloses from official bidding notice procedures at media to bidding ceremony. ・The C/P will chose an adequate contractor and they will sign in the contract for equipment delivery.
■ Required Expenses and Time	・Expense is unnecessary ・The C/P will provide time frame on the intergovernmental consultation.
■ Expected Effects	・The entire equipment plan will be approved at the same time according to the plan. ・ The C/P smoothly proceeds to bid selection for suppliers, procurement and installation management.

	・Ultimately, project goals can be achieved.
■ Important Points	・Consensus must be made between JICA and the C/P in advance.
■ Reference material	・ Such as equipment Plan, equipment estimation sheet, biding notice of notification, Minutes of discussion about exportation, etc.

Improvement Proposal

Improvement item: 8. Improvement on Equipment Management

Improvement subject: 8-2. Management system at Equipment Procurement

The GCT project will make the following improvement proposals on the above subject.

■Current status	・ The final design of equipment for the C/P is carrying out for acceptance inspection by the GCT-FSD supervisor in charge before the shipment. ・The C/P is responsible for the local equipment supply.
■Problems (core of problem)	・ The equipment on the local portion is delegated to delivery to the local contractor, and the C / P shares only work progress reports. ・It means that the C/P has left its responsibility to the local contractors.
■ Specific contents of improvement proposals	・The C/P ought to consult and to clarify the contents, supply schedule, and supply methods among instructors, contractors etc.
■ Required Expenses and Time	・Expense might be unnecessary ・The C/P will provide time frame on the intergovernmental consultation.
■ Expected Effects	・The contractors must be to share information with C/P at the time of procurement and installation work. ・Eventually, the C/P will be able to prevent delivery delay of procurement supplier, equipment rejection etc.
■ Important Points	・ Regarding equipment of the donor and items procured by the local portion, conduct pre-shipment inspection of the equipment, immigration procedure for goods from third country so on. ・Delivery inspection is an important activity to be done at the installation point by the C/P with the donor agency or consultant.

■ Reference material	・Pre-shipment inspection certificate (when necessary), equipment specifications, shipping documents, acceptance import certificate, etc.

Improvement Proposal

Improvement item: 8. Improvement on Equipment Management

Improvement subject: 8-3. Management at Equipment Installation

The GCT project will make the following improvement proposals on the above subject.

■Current status	・ The installation, initial operation, and handing over inspection for newly equipment will be confirmed by the C/P with the donor or consultant firm. ・Equipment of C/P portion will be managed and inspected by herself.
■Problems (core of problem)	as same as 8-2 the management at equipment procurement
■ Specific contents of improvement proposals	as same as 8-2 the management at equipment procurement
■ Required Expenses and Time	as same as 8-2 the management at equipment procurement
■ Expected Effects	It is necessary that the C/P and the contractor share information about installation work of equipment with each other. ・Schedule for installation work is necessary, therefore, C/P should inform the contractor in advance to prevent late delivery and problems.
■ Important Points	・The working content, time schedule and installation method should be thoroughly followed by the C/P. ・Before installation of equipment, the C/P will thoroughly share information to prevent operation methods, maintenance methods, and delays in service start.
■ Reference material	・Installation check, operation check, initial training guidance, and invoice, etc.

Improvement Proposal

Improvement item: 8. Improvement on Equipment Management

Improvement subject: 8-4 Maintenance after Equipment Delivery

The GCT project will make the following improvement proposals on the above subject.

■Current status	・ Newly installed equipment will be maintained and managed in the equipment registration rule of the C/P (as inventory sheet) or maintenance system and its manual by the C/P after Supplier' s guarantee is expired. ・The C/P did not set up a maintenance team in the C/P, and at least new management system and its manual under prepare now.
■Problems (core of problem)	・Especially, GCT-FSD college of the C/P has not been established any management system.
■ Specific contents of improvement proposals	・Newly installed equipment must be managed under new management system and it manual at the GCT-FSD.
■ Required Expenses and Time	・It is necessary to apply for budget such as maintenance cost or spare-parts and consumable material to the C/P for management expenditures. ・It is necessary incorporating those cost into the college's annual budget.
■ Expected Effects	・ It is desirable to share with all GCTs in the model version of the management manual. ・ The management system shall regularly check the results of equipment diagnosis. ・Defects, breakdown, parts replacement and annual management costs for newly installed equipment will be became clear. ・It will be easier to apply for equipment renewal, parts and consumables to the C/P.
■ Important Points	・To obtain consensus between the materials and equipment management, each class instructor

	discusses with HOD and send to principal for approval.
■ Reference material	・Existing inventory list

Improvement Proposal

Improvement item: 8. Improvement on Equipment Management

Improvement subject: 8-5. Maintenance management training to instructors

The GCT project will make the following improvement proposals on the above subject.

■Current status	・ The instructors of the subjects and the department carry out maintenance management based on the department chief.
■Problems (core of problem)	・The operation manual uses a copy of the original provided by the supplier. ・ The C/P has many mechanic engineers and proper management manual.
■ Specific contents of improvement proposals	・ Especially, there are OS software updates for precision equipment (CNC equipment etc.), so we will carry out pipelines with support from manufacturers and suppliers. In addition, other new training equipment will be implemented under the following management system. ・ Conduct regular diagnosis ・ Replacement of parts and consumables ・ Procurement of parts and consumables ・ Inventory check
■ Required Expenses and Time	・Expenses are unnecessary. ・Working Group needs time to carry out management manual editing and updating work.
■ Expected Effects	・ This model version shall be come as "the management manual" that will be used commonly by all of GCTs after take in internal agreement.
■ Important Points	・ The management manual and management system should get agreement from each department. ・It is necessary to make a lectures of maintenance and management to instructors.

■ Reference material	・Operation manual for newly installed equipment.

Improvement Proposal

Improvement item: 8. Improvement on Equipment Management

Improvement subject: 8-6. Establishment of maintenance system for provided equipment

The GCT project will make the following improvement proposals on the above subject.

■Current status	After providing equipment, lack of established maintenance system for equipment often invites poor performance of educational effect. The above situation is caused by breakdown and performance deterioration of equipment without executing its function which is expected.
■Problems (core of problem)	When teachers and students deal with equipment without the sense of maintenance, deterioration will be forced to grow. Because criteria of check and inspection are not designated, teachers and students cannot find a deterioration. When the sense to protect their equipment by themselves is lacking, they cannot find a sign of abnormality. Sources of dust and dirt are left without any countermeasure.
■ Specific contents of improvement proposals	Build up and operate a system that implements the following of "Autonomous Maintenance" as a part of "TPM (Total Productive Maintenance". （1） Initial cleaning （2） Countermeasure for source of contamination and difficult place to access （3） Preparing standards for inspection/ maintenance
■ Required Expenses and Time	（1）Necessary expenses: No special expenditure required （2）Time: Fit within the range that can be operated if it is systematically introduced at start-up and working hour
■ Expected Effects	(1) Improvement of educational effect by improving availability of equipment by prevention of failure.

	(2) As the awareness of maintenance has increased, graduates work as technicians at companies, giving operators the awareness of "protecting their own machines themselves", they will be able to train operators to ensure basic maintenance and inspection by themselves.
■ Important Points	(1) Ensure an environment in which the instructors who use the equipment can deliver leadership. (2) Follow the steps of procedure of autonomous maintenance and implement it. (3) Appropriately reflect the contents of the manual of equipment.
■ Reference material	"Guidance of Preventive Maintenance " (prepared for MT and ToT by JICA expert)

Improvement Proposal

Improvement item: 9. Improvement on Facilities

Improvement subject: 9-1. Rehabilitation of electricity supply facilities

The GCT project will make the following improvement proposals on the above subject.

■Current status	・There was no issues with facilities (such as installed position, situation, floor loading force and reinforcement measures, water and air piping, etc.) because in-charge or manager maintains the facilities every time. ・However, existing electricity supply system is inappropriate, and practical equipment has been experienced difficulty in training due to large fluctuations occurred depending on the time and training place.
■Problems (core of problem)	· Planned blackouts of 2-3 hours due to the dry season (supply shortage) are constantly affecting training. · Emergency blackouts due to rainy season (electricity leakage) occur frequently.
■ Specific contents of improvement proposals	・To make a schedule of sharing electricity supply by each department or class and recommend to obtain the self-electricity supply system. · To change electricity supply system to solar system or diesel generator supply system. · To obtain annual budget (as purchase of electricity, fuels).
■ Required Expenses and Time	・Considerable expense might be required for solar system or diesel generator system to keep its proper supply time. · It's necessary that JPT and Stakeholders to having opportunities to periodically exchange information of electricity supply and realize the expense of existing electricity supply.
■ Expected Effects	· Experiment and Practical training are conducted without electricity interrupting the training time, and it's possible to train industrial human resources capable of responding to adequate needs enough.

■ Important Points	· Rehabilitation plan to be developed based on facility environment aspect on consensus with C/P, Donors and Consultant firm.
■ Reference material	· For reference, information about other GCT's electricity supply facility or its maintenance program etc.

Improvement Proposal

Improvement item: 10. Improvement on Educational Facilities Environment

Improvement subject: 10-1.Promotion of 5S activity at GCTs lecture room, warehouse and workshop

The GCT project will make the following improvement proposals on the above subject.

■Current status	5S activity ("Sort", "Set in order", "Shine", "Standardize" and "Sustain") is an infrastructure of Safety and Health management in manufacturing industry and essential capacity building for an employee to work in his company comfortably. Students learn 5S through only lecture without any practice. As a result, learning environment in GCT shows poor performance in 5S implementation.
■Problems (core of problem)	Because students have not practiced 5S, they do not notice the necessity, even if the classroom, warehouse, work site are disturbed, they do not notice the necessity of 5S. Even if there is a problem, such problem does not become visible. Even when graduates enter the enterprise, the ability to practice 5S is not trained.
■ Specific contents of improvement proposals	1. Preparation: Decide a target site and duration to implement 5S activity 2. 5S Implementation: (1) Sort (Seiri in Japanese): Divide all items into "necessary items" and "unnecessary items" and then discard "unnecessary items". "Red tag" is put on the items in the grey zone, difficult items to divide, and is kept for certain period (one month or one week). If some item is used, it shows that the item is necessary, then red tag should be removed. If an item is kept with red tag on it, it shows that the item is not necessary, then the item should be discarded.

	(2)Set in order (Seiton in Japanese): To eliminate searching time, make visible for all items (a) exactly "right item" in (b) in the exactly "right place (address), (c) in exactly "right quantity" by using sign board. (3) Shine (Seisou in Japanese) : Clean and inspect Decide rules for cleaning and check and inspection including equipment (4) Standardize (Seiketsu in Japanese) Habit formation on the above 3S (Sort, Set in order and Shine) Design 5S check list and conduct regular patrol in the target work site (5) Sustain (Shitsuke in Japanese) Build up a system for sustaining 5S activity to encourage progress of continuous improvement through 5S competition and regular award to good practice
■ Required Expenses and Time	(1) Necessary expenses: office supplies expenses for the operation of the red card, paint purchase fee for the signboard operation, cleaning tool purchase cost (2) Time: 3 days of red tag operation, 3 days of signboard operation, cleaning 0.5 h / week plus alpha.
■ Expected Effects	(1) Space can be created by eliminating unnecessary items (2) Searching time can be reduced, and work efficiency can be increased (3) Learning environment can be improved and learning efficiency can be improved (4) Students acquire the ability to implement 5S
■ Important Points	(1) Initiate responsible and promotive organizations. (2) After deciding the model work site and implementing the pilot, deploy activity horizontally in order. (3) Perform regular monitoring. (4) Visualize changes by showing photos and quantification effects of Before / After.
■ Reference material	(1) 5S KAIZEN (ppt material prepared by Dr. S. Fujita) (2)Step by step 5S Implementation (Text book prepared by Malaysia Productivity Center)

Improvement Proposal

Improvement item: 11. Improvement on Industrial Linkage

Improvement subject: 11-1. Strengthening on the relationship with the IMC

The GCT project will make the following improvement proposals on the above subject.

■Current status	Under the consultation of the TEVTA, Institute Management Committee (IMG) which comprises local industries and GCTs was established in the respective GCTs, and then the industrial linkage between the two parties has been deepening.
■Problems (core of problem)	It is imperative to strengthen further the connection with local industries through the IMC.
■ Specific contents of improvement proposals	1. IMC meeting shall be held regularly. 2. Through the IMC, GCTs shall receive advices for the school management, and shall also establish a financial support from local industries. 3. Through the IMC, GCTs shall establish a system of requirement for the dispatch of engineers from industries and the acceptance of internship in industries.
■ Required Expenses and Time	IMC meeting is usually held at each GCT so that the necessary cost is expected a small sum. The invitation of the prospected participants shall be set to work about one month prior to the meeting.
■ Expected Effects	Strengthening on the industrial linkage would have a positive impact on expansion of the places of employment and internship.
■ Important Points	1. In case that the IMC has not yet been established in some GCTs, the GCTs shall set up it immediately. 2. In order to make full preparation for the activities, GCTs shall establish Job Placement Office (JPO)s and also assign Institute Placement Officer (IPO)s and Assistant Institute Placement Officer (AIPO)s inside their institutions.
■ Reference material	Minutes of Meeting at the IMC.

Improvement Proposal

Improvement item: 11. Improvement on Industrial Linkage

Improvement subject: 11-2. Holding the cooperative events with industries

The GCT project will make the following improvement proposals on the above subject.

■Current status	There are few GCTs which hold the cooperative events with industries such as a career day.
■Problems (core of problem)	Since there is a lack of interchange between GCT and local industries, employment ratio of the current students has not been increasing. The students, thus, have little interest in the industries.
■ Specific contents of improvement proposals	1. The following cooperative events shall be planned and implemented. 1) Career day 2) Visit to industries (Field trip to production sites) 3) Internship 4) Special lectures (Lecturers are invited from industries) 5) Skill competition (Judges are dispatched from industries) 6) Exhibitions (Trial products students made are exhibited, and industries are also invited to the exhibition) 2. Preparation meetings shall be held among the IMC, local industries and GCT.
■ Required Expenses and Time	Cooperative events such as career day are usually held at each GCT so that the necessary cost is expected to be a small sum. However, some events such as the visit to industries and invitation of external lecturers would require some expenditures.
■ Expected Effects	Strengthening on the industrial linkage would have a positive impact on expansion of the places of employment and internship, and it could be an opportunity for the current students to get more understanding of employment.

■ **Important Points**	Budgetary provision for the necessary costs such as transportation fees.
■ **Reference material**	Minutes of the past events carried out in the GCT-RR and FSD.

Improvement Proposal

Improvement item: 12. Improvement on Employment Support

Improvement subject: 12-1. Establishment of the JPO and improvement of working condition of IPOs and AIPOs

The GCT project will make the following improvement proposals on the above subject.

■**Current status**	JPOs have almost been established in the respective GCTs. However, in most cases, GCTs just assign the IPOs and AIPOs from their teachers, and only a few GCTs own an exclusive room and equipment for the JPO.
■**Problems (core of problem)**	Since the preparations of the JPOs have not yet been prepared in most of the GCTs and consequently the work condition for the IPOs and AIPOs can be evaluated as poor (e.g. no compensation for the necessary expenditure). The activities of the JPO is thus limited.
■ **Specific contents of improvement proposals**	1. Budget for the establishment of the JPOs and the development of facilities shall be secured. 2. Work condition of teaches who are assigned as the IPOs and AIPOs shall be improved. (e.g. Payment of remuneration for the additional task and the necessary expenditure such as telephone and transportation fees) 3. Public relations activities of the JPOs shall be strengthen in GTCs. 4. Publicity campaign towards outside (i.e. industries) shall be intensified. 5. Ultimately, it is desirable to post the full-time staff in the JPO.
■ **Required Expenses and Time**	A large increase of the additional budget shall be secured for the development of facilities in the JPOs (e.g. PC, internet and furniture) and improvement of working condition for the IPOs and AIPOs.
■ **Expected Effects**	The JPOs could be more active and could also serve to bridge between students and industries, which could lead to the improvement of employment ratio.

■ **Important Points**	As for the activities of the JPO, it is a quite important to take requirements from students and industries.
■ **Reference material**	Activity Record of the JPO, TEVTA Web Portal site

Improvement Proposal

Improvement item: 12. Improvement on Employment Support

Improvement subject: 12-2. Promotion towards the participating industries of the career day

The GCT project will make the following improvement proposals on the above subject.

■**Current status**	The number of participating industries in the career day at both of the GCT-RR and FSD is around 30. It is imperative to increase the participating industries for raising the employment ratio.
■**Problems (core of problem)**	Local industries' degree of recognition on the GCT and its career day is low.
■ **Specific contents of improvement proposals**	1. Promotion activities towards the local industries conducted by the IPOs and AIPOs shall be strengthened. 2. Promotion activities, through the IMC, towards the local industries shall be reinforced. 3. Public relations activities by means of flyers and publicity posters towards the local industries shall be intensified. 4. Not only the current students but also graduates who are seeking jobs are encouraged to join the career day. 5. Career day shall be carried out several times in a year.
■ **Required Expenses and Time**	Career day in general are held at each GCT so that the necessary cost is expected to be a small sum. However, promotion and public relations activities with a considerable preparation period will be indispensable to increase the participating industries.
■ **Expected Effects**	Industries and Students are able to contact directly at the career day and can also deepen mutual understanding. In addition, improvement of the employment ratio is expected.
■ **Important Points**	As for the selection of the participating industries, it is a quite important to take requirements from students.

■ **Reference material**	Activity Records of the JPO and IMC

Improvement Proposal

Improvement item: 13. Improvement on Student Administration

Improvement subject: 13-1. Regular updating of the data base in the TEVTA WEB PORTAL

The GCT project will make the following improvement proposals on the above subject.

■**Current status**	Regarding the information management on students, each GCT manages the personal information through the TEVTA Web Portal site.
■**Problems (core of problem)**	TEVTA Web Portal site, as a database, is not used as much as expected. In addition, the IPOs and AIPOs have difficulties in updating the database due to the time restriction.
■ **Specific contents of improvement proposals**	1. Facilities and equipment in the JPO at each GCT shall be developed. 2. IPOs and AIPOs shall be properly posted in each GCT. 3. A questionnaire survey targeting all the job applicants in the 3rd grade shall be conducted to accurately grasp the personal information, needs and requirements from student side. 4. The database shall be updated on a semi-annual basis. 5. Ultimately, it is desirable to post the full-time staff for the JPO.
■ **Required Expenses and Time**	A large increase of the additional budget shall be secured for the development of facilities in the JPOs (e.g. PC, internet and furniture) and improvement of working condition for the IPOs and AIPOs.
■ **Expected Effects**	Improvement of successful rate of the matching with industries and also employment rate can be expected by understanding the exact demand and needs on the employment from student side.
■ **Important Points**	Since the database contains personal information, the IPOs and AIPOs shall pay close attention not to leak the information.

■ **Reference material**	TEVTA Web Portal site

Improvement Proposal

Improvement item: 13. Improvement on Student Administration

Improvement subject: 13-2. Implementation of tutorial career counseling

The GCT project will make the following improvement proposals on the above subject.

■**Current status**	Students' usage rate of the JPO is around 20%, which can be recognized as low.
■**Problems (core of problem)**	Students lack information on employment, and on the contrary the JPOs do not understand the requirement and needs from students.
■ **Specific contents of improvement proposals**	1. IPOs and AIPOs shall conduct one-on-one interviews with all the applicants for job in the 3rd grade (10 minute-interview per student). 2. Counseling shall be provided in response to necessity, and IPOs and AIPOs shall accurately recognize the problems, requirements and needs from student sides. 3. Database shall be updated on a semi-annual basis. 4. Matching between students and industries shall be diligently executed. 5. Students are encouraged to register for the Skilled Labour Market Information System (SLMIS), a matching website managed by the TEVTA.
■ **Required Expenses and Time**	A large increase of the additional budget shall be secured for the development of facilities in the JPOs (e.g. PC, internet and furniture) and improvement of working condition for the IPOs and AIPOs.
■ **Expected Effects**	Improvement of successful rate of the matching with industries and also employment rate can be expected by understanding the exact demand and needs on the employment from student side.
■ **Important Points**	An efficient schedule shall be made out in order to alleviate the burden of IPOs and AIPOs.
■ **Reference material**	Activity Records of the JPO, TEVTA Web Portal site and SLIMS website

Improvement Proposal

Improvement item: 14. Improvement on Graduate Administration

Improvement subject: 14-1. Regular updating of the data base in the TEVTA WEB PORTAL

The GCT project will make the following improvement proposals on the above subject.

■**Current status**	As for the information management of graduates, each GCT manages the personal information through the TEVTA Web Portal site.
■**Problems (core of problem)**	TEVTA Web Portal site, as a database, is not used as much as expected. In addition, the IPOs and AIPOs have difficulties in updating the database since it is much more difficult for them to get in touch with graduates comparing with the current students.
■ **Specific contents of improvement proposals**	1. Facilities and equipment in the JPO at each GCT shall be developed. 2. IPOs and AIPOs shall be properly posted in each GCT. 3. A system that enables to contact with graduates via not only telephone but also e-mail and SNS shall be established. 4. The database shall be updated on a semi-annual basis. (up to 3 years after the graduation) 5. Ultimately, it is desirable to post the full-time staff in the JPO.
■ **Required Expenses and Time**	A large increase of the additional budget shall be secured for the development of facilities in the JPOs (e.g. PC, internet and furniture) and improvement of working condition for the IPOs and AIPOs.
■ **Expected Effects**	Improvement of successful rate of the matching with industries and also employment rate can be expected by understanding the exact demand and needs on the employment from student side.
■ **Important Points**	Since the database contains personal information, the IPOs and AIPOs shall pay close attention not to leak the

	information.
■ **Reference material**	Activity Records of the JPO and TEVTA Web Portal site

Improvement Proposal

Improvement item: 14. Improvement on Graduate Administration

Improvement subject: 14-2. Implementation of "Homecoming Day"

The GCT project will make the following improvement proposals on the above subject.

■**Current status**	After the graduation of GCTs, the connection between students and GCTs could be faded.
■**Problems (core of problem)**	The IPOs and AIPOs have difficulties in updating the database since it is much more difficult for them to get in touch with graduates comparing with the current students. In contrast, after graduation, graduates have less opportunities to consult with the IPOs and AIPOs in GCTs.
■ **Specific contents of improvement proposals**	1. Implementation of a homecoming day (once a year). 2. The latest personal information shall be obtained in order to update TEVTA Web Portal site. 3. The relationship between individuals (graduates) and GCT shall be intensified. 4. Job opportunities of the industries for which graduates work shall be procured. 5. The relationship between the current students and graduates shall be strengthened. 6. Students are encouraged to register for the SLMIS, a matching website managed by the TEVTA.
■ **Required Expenses and Time**	Overhead expenses are expected for the event, and depending on the contents, preparation period might be prolonged.
■ **Expected Effects**	Tightening the connection with the industries for which graduates work could lead to the improvement of the employment rate of the current students. In addition, the database of the TEVTA Web Portal will also be able to update since the latest personal information could be obtained from graduates.
■ **Important Points**	The date shall be determined in consideration of graduates' conveniences.

■ **Reference material**	Activity Records of the JPO, TEVTA Web Portal site and SLIMS site

Ⅷ. Conclusion

The total of 40 subjects presented by JICA were developed by Japanese experts familiar with each field.

Each subject is important for GCT located in the eastern part of Punjab, and it is no exaggeration to say that how to solve these will determine the future position of each GCT.

JICA will continuously present issues for improvement so that the technical education and vocational training conducted by GCT will become better.

We hope the improvement plan will help technical education in DAE mechanical technology of GCTs.

Lastly, we thank the following people for their cooperation in creating the plan.

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Dr. Iftikhar Hussain shah	Principal GCT-Faisalabad	Working Group Member
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Engr. Hideo Sonoda	Expert(Industrial Planning) JICA	Working Group Member
Engr. Kenichiro Sugiya	Expert(Industrial Linkage) JICA	Working Group Member
Engr. Kunio Nishihara	Expert(CNC) JICA	Working Group Member
Engr. Senji Oyabu	Expert(Material Testing) JICA	Working Group Member
Engr. Kuniaki Kowatari	Expert(CAD/CAM) JICA	Working Group Member
Engr. Yukio Utsumi	Expert(Equipment Planning) JICA	Working Group Member
Engr. Masami Tsuyuki	Expert(Equip. Procurement) JICA	Working Group Member

Comments of 13 GCTs for improvement plan for
DAE Mechanical Technology of GCTs in
The Eastern Part of Punjab Province
(Summary)

01/07/2019
JICA GCT Project

1. Lab Machinery required for proper practical training.
2. Renovation of existing Labs and Classrooms is highly required to improve the learning environment.
3. Renovation of labs and class rooms is required to achieve the targets as per curriculum.
4. Training refresher courses may be arranged for teaching staff to meet new innovations and technology.
5. Advanced Teacher's Training must be provided as per revised curriculum to meet the need of Industry in the best interest of the nation.
6. Practical Training must be provided to Lab Staff as per latest Industrial trends.
7. A post of Institute placement officer along with his supporting staff may be created for linkage between institute and industry for proper on job training and facilitation of pass outs for placement.

Working Group Meeting Discussion Points

09. July. 2019

- Noor Asif Noor requested that GCT Multan should be centre of Excellence.
- GCT RR principal also requested to JICA project team for continue Working of industrial linkage.
- Placement manager informed that 20 placement officers' already placed in different colleges and he also requested that IPO should be linked with DPO, and then placement work will be effectively.
- GCT RR senior instructor Mr. Razzaq khan requested that the duration of internship should be less instead of six months.
- DGM Ops-1 replied that this point is already in discussion in TEVTA and very soon it will be finalized.
- Engr. Iftekhar Hussain Shah, GCT Faisalabad principal explained that with the help of JICA project team GCT Faisalabad is working on Industrial Linkage and already created a Job Placement office in GCT Faisalabad and now we are getting a very good result.
- DGM Academic and DGM Ops-1 agree for the improvement plan and they told that they will start work for improvement plan.

09 July 2019

Working Group Meeting Memo

The Project for Strengthening DAE in Mechanical Technology at Government Colleges of Technology in Punjab Province in the Islamic Republic of Pakistan

1. Date, Place:

   09 July 2019, Tuesday, 15:00 ～16:30 P.M

   TEVTA Conference Room.

2. Attendants:

[JICA Project team]

1	Engr. Noboru KAKISU	Chief Advisor
2	Engr. Osamu SASAKI	Deputy Chief Advisor
3	Engr. Tadao ISHII	Master Training In-Charge
4	Mr. USMAN Tufail (Record)	Assistant (JICA Project)

[TEVTA]

1	Mr. SHUJAT Ali Khan	Deputy General Manager (Operation-1)
2	Mr. MUAZ Saleem	Deputy General Manager (Academic)
3	Engr. Syed WAQAR	Manager (Curriculum)
4	Engr. EZAZ Haider	Manager (Technical Operation – I)
5	Mr. HUSSAIN Akhter	Assistant Manager (Placement)
6	Mr. KASHIF Rasheed	Deputy Manager (Placement)
7	Mr. MSHTAQ Ahmed	Assistant Manager (Training)

[GCTs]

1	Dr. Syed Iftikhar Hussain Shah	Principal GCT Faisalabad
2	Mr. Tariq Mahmood	Principal GCT Railway Road Lahore
3	Mr. Noor Asif Noor	HOD Mechanical Technology GCT-FSD
4	Mr. Muhammad Razzaq Khan	Focal person JICA Project GCT-RR

Contents:

- Mr. SHUJAT Ali welcomed Working Group (GW) Meeting members.
- Engr. KAKISU explained the agenda of the meeting.
- Engr. SASAKI explained "improvement Plan for DAE Mechanical Technology at GCTs in the Eastern Part of Punjab Province "and approved by the WG members.
- Engr. ISHII explained the Master Training Program Concept for 2019, ToT Training in July to August 2019, and Draft certificate for Master Trainers and approved by WG members.

19/7/19

Mr. Noboru KAKISU
Chief Advisor
JICA Project

Mr. SHUJAT Ali Khan
Deputy General Manager
(Operation-1)
TEVTA

添付資料 6-5：改訂カリキュラム

CURRICULUM REVISION PROPOSAL

Revised by GCT Project JICA

2017 October

THE PROJECT FOR STRENGTHENING DAE IN MECHANICAL TECHNOLOGY AT GOVERNMENT COLLEGES OF TECHNOLOGY IN PUNJAB PROVINCE
IN THE ISLAMIC REPUBLIC OF PAKISTAN

GOVERNMENT OF PUNJAB
TECHNICAL EDUCATION & VOCATIONAL TRAINING AUTHORITY
(TEVTA)

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

MT-141
HEALTH SAFTY AND ENVIRONMENT

Draft
2017

Revised by GCT Project JICA

Red color: Contents added or delete

MT-141 HEALTH SAFETY AND ENVIRONMENT

Total Contact Hours	T	P	C
Theory:32Hrs	1	0	1

Pre-requisites: None

AIMS: At the end of this course, the students will be able to:-

1. Adopt safety standards, codes, rules, etc., to be desired in Mechanical Workshop / Labs of Industries.
2. Understand methods of prevention of accident.
3. Provide first aid and rescue in case of any accident.

Course Contents:

Detail of Contents:

1. Introduction and Importance of Safety 1Hr
   - 1.1 Introduction to safety and House keeping
   - 1.2 Importance in Institute workshops /labs
   - 1.3 Importance in industry
   - 1.4 Accident cost
2. Accidents in Chemical Industry 2 Hrs
   - 2.1 Accidents in petroleum, paint and fertilizer industry
   - 2.2 Explosive vapors and gases
3. Accidents in Mechanical Industry 3 Hrs
   - 3.1 Due to material handling and transportation
   - 3.2 Accidents due to hand tools
   - 3.3 Accidents in machines shop
   - 3.4 Accidents in Metal workshop
   - 3.5 Accidents in wood working shop

12.2 Procedure and training
12.3 Extended medical services

13. **Analyzing Causes of Accidents** 3 Hrs
13.1 Accident prevention fundamentals
13.2 Plant inspections and accidents investigation
13.3 Safety inventory, auditing, records and annual reports

14. **Promoting Safety Culture** 2 Hrs
14.1 Employees training culture
14.2 Displays
14.3 Guidance
14.4 Introduction to Sustainability

15. **Safety Regulations & adherence to International Safety Standards 2Hrs**
15.1 Safety Regulations & adherence to International Safety Standards
15.2 Pakistan Factory Act (laws concerning to safety)
15.3 Workman compensation act
15.4 Industrial insurance and social security
15.5 Legal aspects of safety

Mech-312

HYDRAULICS

AND HYDRAULIC MACHINES

Draft
2017

Revised by GCT Project JICA
Red color; Contents added or delete

Mech-312 **HYDRAULICS AND HYDRAULIC MACHINES**

Total Contact Hrs.		**T**	**P**	**C**
Theory	32	**1**	**3**	**2**
Practical	96			

AIMS: At the end of the course the students will able to understand properties of incompressible fluids, pressure and flow of fluids, able to apply problems of total head of water for losses of heads etc. The student will be able to know the Introduction to water wheels, hydraulic turbines, pumps and, hydraulics machines. Knowledge of essential parts of hydraulic circuits, types of Actuators, their applications & maintenance, Knowledge of different types of directional control valves used in hydraulic control / circuits. The student will also be able to study hydraulic circuits of different machines & can rectify their basic faults

Course Contents:

1.	**Introduction to hydraulics**	**3 Hrs**
2.	**Hydro kinetics**	**3Hrs**
3.	**Flow Through Pipes**	**4 Hrs**
4.	**Impact of Jet**	**1 Hr**
5.	**Water Turbines**	**2 Hrs**
6.	**Pumps**	**4Hrs**
7.	**Hydraulic Valves and Seals**	**3Hrs**
8.	**Hydraulic machines**	**4Hrs**
9.	**Hydraulic Actuators**	**4Hrs**
10.	**Hydraulic Circuits and Accessories**	**4Hrs**

Detail of Contents:

1. Introduction to Hydraulics **4 Hrs**
1.1 Introduction to hydraulics
1.2 Introduction to different properties of liquids(Water &oils)
1.2.1 Care of Hydraulic liquids
1.3 Density of liquids
1.3.1 Specific weight of liquids
1.3.2 Specific gravity of liquids
1.4 Viscosity of liquids, S.I. Units of Viscosity, Relation of change of viscosity with the change of temperature
1.4.1 Difference between Hydraulic & Lubricating oils
1.4.2 Effects of viscosity on flow of liquids

1.5 Pressure head of liquids, Conversion of intensity of pressure in head of liquid
1.6 Pascal's law
1.7 Pressure and its Types, Atmospheric pressure, Gauge pressure, Absolute pressure,
1.8 Measurement of pressure with,
1.8.1 Piezo-meter tube
1.8.2 **Pressure** gauges(Bourdon tube pressure gauge, Diaphragm pressure gauge)
1.8.3 Dead weight pressure gauge calibrator
1.8.4 Calibration of pressure Gauges with Dead Weight pressure& master Gauge calibrator
1.9 Solution of simple problems on above topics

2. Hydro Kinetics **3 Hrs**
2.1 Introduction
2.2 Rate of discharge
2.2.1 Equation of discharge(volume, weight, mass)
2.3 Equation of continuity of flow
2.4 Total energy/head of liquid particles in motion
2.5 Bernoulli's Equation
2.5.1 Limitations of Bernoulli's Equation
2.5.2 Application of Bernoulli's Equation
2.6 Types of flow
2.7 Use of Pitot-tube gauge for measurement of velocity and discharge of flowing fluids
2.8 Solution of simple problems of discharge, Velocity head, pressure head, Datum head intensity of pressure in flowing liquid when all parameter are given
2.9 Flowmeter (Ventura meter and orifice meter)

3. Flow through pipes **3 Hrs**
3.1 Introduction to losses of head in pipes
3.1.1 Reynold's Number for internal flow
3.2 Loss of head of liquid flowing in pipe (major & minor losses)
3.2.1 Losses of head due to friction
3.2.2 Loss of head due to sudden enlargement
3.2.3 Loss of head due to sudden contraction
3.2.4 Loss of head at entrance in a pipe
3.2.5 Loss of head in bends, elbows, valves & other pipe fittings
3.3 Solution of simple problems by direct application of formulae

4. Impact of Jet **1 Hrs**
1.1 Introduction
1.2 Force of Jet normally on fixed plate
1.3 Force of Jet normally on inclined plate
1.4 Force of Jet normally on moving plate
1.5 Force of Jet in series of vanes
1.6 Calculate force of jet in all above cases by application of simple formulae

5. Water Turbines **2 Hrs**
5.1 Introduction to Development of water Wheels & water turbines

5.2 Advantages of water turbines over water Wheels
5.3 Classification of water turbines
5.4 Impulse Turbines (Pelton wheel) & its main parts
5.4.1 Working of Pelton wheel water Turbine
5.4.2 Sketch a Pelton wheel turbine and state main parts
5.5 Reaction turbine and main parts
5.6 Differentiate between Impulse & reaction turbine
5.7 State different types of low head, high discharge water (Reaction) Turbines
Advantages of hydraulics turbines

6. Pumps **4 Hrs**

6.1 Introduction to pump
6.2 Types of pumps
6.3 Construction and working of Centrifugal Pumps
6.4 Construction and working of reciprocating pump
6.4.1 Discharge of a single acting reciprocating pump
6.4.2 Slip of a reciprocating pump
6.4.3 Positive Displacement (e.g. Reciprocating, Vane, Gear etc) pumps
6.5 Comparison of centrifugal and reciprocating pump
6.6 Cavitation's in pumps, their causes and remedy
6.7 Solution of simple problems by using above formulae

7. Hydraulic valves and Seals **3 Hrs**

7.1 Types of Directional control valves, their study, symbols and function
7.2 Pressure relief valves and their types
7.3 Flow control/ Speed control valves & their types
7.4 Study of Pilot operated directional control valves construction, uses and symbols
7.5 Study of Check valves
7.6 Study of Seals used in hydraulics circuits
7.7 Study of Safety Devices necessary in a hydraulic circuits

8. Hydraulic Simple Machines **4Hrs**

8.1 Types of simple hydraulic machines
8.2 Hydraulic press
8.3 Mechanical advantage of hydraulic press
8.4 Accumulators Their Types and uses in Hydraulic Circuits
8.5 Hydraulic Intensifiers
8.6 Solve simple problems on mechanical advantage of hydraulic press, Accumulators, and Intensifier

9. Hydraulics Actuators **4Hrs**

9.1 Classification of Rotary Actuators & their method of actuation
9.1.1 Uses of Hydraulic motors
9.1.2 Difference between hydraulic motors & pumps
9.2 Classifications of reciprocating Actuators their construction and working

10. Hydraulic Circuits and Accessories **4 Hrs**

10.1 The parts/ components of hydraulic circuits
10.2 Uses of proximity switches
10.3 Uses of different hydraulic filters, chillers, different types of rubber hoses, pipe fittings, and couplings

Recommended Textbooks:

1. Fluid Mechanics by John F. Douglas (Fifth Edition)
2. Fluid Mechanics with Engineering Applications by Robert L. Daugherty, Joseph B. Fanzine
3. Hydraulics and Hydraulics Machines by E.H.LEWITT (Sir ISAAC Pitman & Sons Ltd London)
4. Fluid and power with applications by Anthony Esposito
5. Basic applied fluid power by Oster Jon

Mech-312 **HYDRAULICS AND HYDRAULIC MACHINES**

Instructional Objectives:

1. Introduction to Hydraulics

1.1 Understand basic terms of Hydraulics
1.1.1 Define hydraulics
1.1.2 State difference between liquid and fluid
1.1.3 Enlist properties of liquid (hydraulic oil, lubricating oil etc.)
1.1.4 Define following terms, unit weight of liquids,, viscosity, pressure density, specific gravity
1.1.5 Describe SI units of viscosity, effects of change of viscosity on change of temperature
1.1.5.1 Difference between hydraulic & lubricating oils
1.1.5.2 Effect of viscosity on flow , compression of hydraulic oil and its leakage from hydraulic components (valves & cylinders)
1.1.6 Explain pressure head conversion of hydraulic pressure/ Intensity of Pressure in terms of pressure head
1.1.7 Explain Pascal's law
1.1.8 Describe types of pressure
1.2 Understand Pressure Management Techniques
1.2.1 Explain measurement of pressure by simple piezometer tube and conversion of pressure head in terms of intensity of pressure
1.2.2 Explain diaphragm pressure gauge and bourdon tube pressure gauge
1.2.3 Explain dead weight pressure gauge and calibration procedure of gauges
1.3 Solve simple problems of pressure head & intensity of pressure

2. Hydro Kinetics

2.1 Understand basic terms of Hydro Kinematics
2.2 Describe rate of discharge
2.3 Explain equation of continuity of flow
2.4 Explain energy/head / total head of a liquid in motion
2.5 Explain Bernoulli's Theorem and its applications
2.6 Understand types of flow
2.6.1 Describe the types of flow
2.7 Describe use of pitot tube in determination of velocity of flowing liquid
2.8 Solution of simple problems of discharge, velocity head, pressure head datum head, intensity of pressure in flowing fluid when all parameters are given

3. Flow through pipes

3.1 Introduction to loss of head in pipes
3.2 Understand Remolds' Number for internal flows
3.3 Identify various losses of head of a liquid flowing in pipes (major & minor) and their formula
3.4 Explain methods of calculation of Losses of head due to friction
a) Chaz's formula (b) Darcy's formula
3.5 Explain methods of calculation of loss of head due to sudden enlargement
3.6 Explain methods of calculation of loss of head due to sudden contraction

3.7 Explain methods of calculation of loss of head at entrance to a pipe
3.8 Explain methods of calculation of loss of head in bends elbow valves & other pipe fittings
3.9 Solve simple problems for calculation of various losses of head by direct application of formula, when all parameters are given

4. Impact of Jet

4.1 Describe Jet of water through noses
4.2 Describe force of jet impinging normally on fixed plate
4.3 Describe force of jet impinging on inclined fixed plate
4.4 Describe force of jet impinging on moving plate
4.5 Solve simple problems based on all above cases

5. Water Turbines

5.1 Understand development of water Wheels & water turbines
5.2 State advantages and disadvantages of water turbines over water Wheels
5.3 State classification of water turbines
5.4 Impulse Turbines (Pelton wheel)
5.4.1 Explain working of Pelton wheel water turbine
5.4.2 Sketch Pelton wheel turbine and state its various parts
5.4.3 Explain Nozzle
5.4.4 Describe Runner and buckets
5.4.5 Describe Casing
5.4.6 Describe Breaking jet mechanism
5.5 Understand reaction turbine and its parts
5.5.1 Describe spiral casing
5.5.2 Describe guide vane mechanism
5.5.3 Describe turbine runner
5.5.4 Describe Draft tube
5.5.5 Differentiate between reaction turbine and impulse turbine
5.6 State different types of low head, high discharge water Reaction Turbines (Francis Turbine, Propeller Turbine, Kaplan Turbine) and their main parts
5.6.1 Spiral casing
5.6.2 Guide Vane mechanism
5.6.3 Turbine runner
5.6.4 Draft tube
5.7 Sketch and study of reaction turbine and label its parts

6. Pumps

6.1 State functions of pumps
6.2 Describe classifications of pumps
6.3 Centrifugal pump
6.3.1 Explain construction of Centrifugal pump
6.4 Explain construction and working of reciprocating pump
6.4.1 State simple formula for calculation of discharge of a single acting reciprocating pump (Q=LAN / 60)
6.4.2 Explain Slip of a pump

6.4.3 Explain construction of Following Positive Displacement pumps, Reciprocating, Vane, Gear etc.

6.5 Compare the centrifugal and reciprocating pump

6.6 Cavitation's in pumps and their remedy

6.7 Solve simple problems by using above formulas

7. Hydraulic valves and Seals

7.1 Describe types of hydraulic valves and their symbols

7.2 Describe different directional control valves, their construction, types of spools and their symbols

7.3 Describe types of pressure relief valves and their symbols

7.4 Describe speed control valves/ flow control valve, their construction, uses and symbols

7.5 Describe pilot operated directional valves construction, uses and symbols

7.6 Describe check valves their types, construction and their symbols

7.7 Describe seals used in hydraulic circuits

7.8 Describe safety devices used in hydraulic circuits

8. Hydraulic Simple Machines

8.1 Describe types of simple hydraulic machines

8.2 Explain construction of Hydraulic press

8.3 Explain Mechanical advantage of hydraulic press

8.4 Explain Hydraulic Intensifiers

8.5 Accumulators Their Types and uses in Hydraulic Circuits

8.6 Solve simple problems on mechanical advantages of hydraulic press, Hydraulic Intensifier, Hydraulic accumulator

9. Hydraulics Actuators

9.1 Describe classification of Rotary Actuators

9.1.1 Explain Use and Construction of different Hydraulic motors

9.1.2 Differentiate between hydraulic motors & pumps

9.1.3 Explain different types of seals used in Hydraulic motors

9.2 Describe classifications of reciprocating Actuators

9.2.1 Describe Use of single acting spring return hydraulic cylinder

9.2.2 Describe Use & construction of double acting reciprocating hydraulic cylinder

9.2.3 Describe Use and construction of different hydraulic cylinder & their seals

10. Hydraulic Circuits and Accessories

10.1 Parts/ components of hydraulic circuits (Actuator, Control valve, Reservoir, Filter, Pump, pressure control valve, Directional control valve, Hydraulic pipes and couplings, Flow control Valve)

10.2 Describe Use of proximity switches

10.3 Describe Use of hydraulic filters, chillers, different types of rubber hoses, pipe fittings, and couplings

10.4 Describe different hydraulic circuits of hydraulic control machines

Mech-312 **HYDRAULICS AND HYDRAULIC MACHINES**

List of Practical:

1. Observe hydraulic bench and its function
2. Practice of Calibration of Bourdon tube and diaphragm pressure gauge with dead weight and master gauge calibrator
3. Operate hydraulic press and observe power required to derive it
4. Practice on hydraulic bench for verification of conversion of velocity head, pressure head and datum head
5. Performance test on friction pipe apparatus
6. Performance test for loss of head due to sudden enlargement, contraction and entrance in a pipe using friction in a pipe apparatus
7. Performance test on Impulse turbine /Pelton turbine
8. Performance test on Reaction Turbine /Francis turbine
9. Performance of centrifugal pump at different speed
10. Performance test on reciprocating pump and observe the operation of reciprocating pump
11. Practice of Measurement of pressure at various connections in hydraulic circuits.
12. Actuation of double acting hydraulic cylinder at push of a switch , develop speed regulation through throttle and flow control valves also draw its circuit diagram
13. Actuation of double acting hydraulic cylinder at a Rapid Traverse By using one way Throttle Valve
14. Setup a pressure device on a double acting cylinder by using pressure reducing valve.
15. Practice to hold a specific load by using Double Acting Cylinder & pilot operated Check Valve
16. Construct a circuit for double acting hydraulic(differential cylinder) for mechanical interlocking with switch also draw its Hydraulic & Electric circuit diagram
17. Construct a circuit to control a double acting Hydraulic cylinder, by using 02, push button, and canceling with limit switch/Proximity switch also draw its Hydraulic & Electric circuit diagram
18. Practice to set a Hydraulic motor R.P.M. & direction by using Flow Control & directional Valve
19. To construct a Hydraulic circuit in which Accumulator stored energy can be utilized by double acting cylinder, when required

20. Visit to related industry plant

Mech-312 **HYDRAULICS AND HYDRAULIC MACHINES**

Practical Objectives

Student will be able to performed explain;

1. Observe hydraulic bench and its function

1.1 Observe pressure head

1.2 Specific gravity of liquid

1.3 Observe the conversion of intensity pressure in to head of liquid and head of liquid in to intensity

1.4 Practice to use simple manometer

2. Practice of Calibration of Bourdon tube and diaphragm pressure gauge with dead weight and master gauge calibrator

2.1 Basic principle use in dead weight pressure calibrator

2.2 Observe the construction of Bourdons tube pressure gauge

2.3 Observe the construction of diaphragm pressure gauge

2.4 Calibration of Bourdon tube pressure gauge and diaphragm pressure gauge with dead weight pressure calibrator

3. Operate hydraulic press and observe power required to derive it

3.1 Work done against a pressure

3.2 Power required for driving a hydraulics press

4. Practical application of Hydraulic bench for Conservation of energy of flowing fluid in pressure head an datum head as $H=v^2/2g$

4.1 Verify the Law of conservation of energy

4.2 Verify total head of liquid

4.3 Bernoulli's theorem and practical application

4.4 Calculate conversion of velocity head, pressure head and datum head

5. Performance test on friction pipe apparatus to know total head status of flowing fluid/ Bernoulli's theorem

5.1 Observe the function of viscosity of liquid, & K.E. of flowing fluid.

5.2 Observe the friction due to roughness of ideal surface as in gauge blocks etc.

5.3 Observe friction due to roughness of pipe

5.4 Measure loss of head in pipes due to friction in pipe apparatus

5.5 Practice of calculation of loss of head due to friction by using friction in pipe apparatus

6. Observe behavior of flowing fluid due to sudden enlargement of cross sectional area of pipe, & formation eddies current at enlarged cross section of pipe

6.1 Observe behavior of liquid at sudden contracted cross sectional area in pipe

6.2 Observe formation of vena contract beyond contraction (due to sudden enlargement)

6.3 Measure loss of head due to sudden enlargement, contraction and entrance in a pipe using friction in a pipe apparatus

7. Perform the function of impulse turbine

7.1 Observe behavior of water jet at the reduction in cross sectional area at the movement of spear in the nozzle of impulse turbine (Pelton wheel)

7.2 Observe function of casing of Pelton wheel

7.3 Observe pressure / atmospheric pressure around the water jet and water wheel/ impulse Turbine/ Pelton wheel

7.4 Observe water hammer at the start and stop of Pelton wheel turbine on pipe and hear noise of water hammer on pipe

7.5 Observe output HP at the shaft at Pelton wheel turbine using purely brake mechanism

7.6 Observe the parts of a Pelton wheel turbine

8. Performance test on reaction turbine

8.1 Operate the reaction turbine

8.2 Measure difference of pressure at different position of reaction turbine by piezometer tube or with Gauges/ dial gauges

8.3 Measure in put power at the inlet of Francis turbine

8.4 Observe the reaction turbine (Francis turbine)

9. Performance Test on centrifugal force

9.1 Observe the different parts of centrifugal pump

9.2 Observe the different parts of reciprocating pump

9.3 Compare centrifugal pump with reciprocating pump

10. Performance test on positive displacement pump

10.1 Measure discharge of reciprocating pump

10.2 Verify discharge of reciprocating pump

10.3 Measure slip of reciprocating pump

10.4 Observe the parts of reciprocating pump

11. Practice of measurement of pressure at various connections in hydraulic circuit

11.1 Perform the function of temperature gauge at oil reservoir/oil tank in a circuit

11.2 Perform the function of oil filter in hydraulic Circuit

11.3 Observe all safety devices which necessary in a hydraulic circuit

11.4 Observe the necessity of pressure relief valve in hydraulic circuit

11.5 Measure pressure at various positions in hydraulic circuit

11.6 Draw block/ circuit diagram of a Hydraulic circuit

11.7 Uses and positions of directional control valve in a Hydraulic circuit

11.8 Use, position & necessity of non-return valve in a Hydraulic circuit

11.9 Set the equipment into the test panel

11.10 Check all the connections houses are firmly coupled

11.11 Practice of determination of pressure at various connections to the driven elements and direction of flow depending different settings of directional control valve

12. Actuation of double acting hydraulic cylinder at push of a switch, develop speed regulation through throttle valve and flow control valves

12.1 Measure pressure at various positions in hydraulic circuit

12.2 Draw block/ circuit diagram of a Hydraulic circuit

12.3 Uses and positions of directional control valve in a Hydraulic circuit

12.4 Use, position & necessity of non-return valve in a Hydraulic circuit

12.5 Set the equipment into the test panel

12.6 Check all the connections houses are firmly coupled
12.7 Practice of determination of pressure at various connections to the driven elements and direction of flow depending different settings of directional control valve

13. Actuation of double acting hydraulic cylinder at a rapid Traverse by using one way Throttle Valve
13.1 Make sure the pump is switched off and oil is not in pressure at the coupling/ fitting stage
13.2 Set the equipment into the test penal
13.3 Connect the units according to the circuit diagram with connection Hoses
13.4 Check all the connection Hoses firmly coupled
13.5 Carry out the experiment as rapidly as possible to keep the overheating of oil during practical (not more than 45°C)
13.6 Observe the function of Throttle Valve and draw Circuit Diagram
13.7 Observe the function by extending a double acting hydraulic cylinder at push of a switch develop speed regulation through throttle and flow valves

14. Setup a pressure device on a double acting cylinder by using pressure reducing valve
14.1 Observe the function of Pilot operated Check Valve
14.2 Observe the sequence of Elements used in circuit
14.3 Observe the Function of Pressure Relief valve, know function of Non Return Valve in this Circuit Diagram
14.4 Mount the various units in the test panel according to the layout/circuit diagram
14.5 Connect the circuit with Pressure Houses
14.6 Connect the cylinder and measure Inlet and Outlet Pressure on Pump
14.7 Set the throttle check valve
14.8 Draw Hydraulic circuit diagram for this Practical
14.9 Check rapid Traverse of cylinder at return of stroke and complete this practical

15. Practice to hold a specific load by using double acting cylinder and pilot operated check valve
15.1 Mount various components in the test panel
15.2 Check/set sequence of components 3/2 and 4/2 directional control valve, pressure relief valve and pilot operated chuck valve
15.3 Draw circuit diagram for the circuit I conduct the experiment according to the circuit diagram

16. Construct a circuit for double acting cylinder for mechanical interlocking with switch contacts also draw its circuit diagram
16.1 Arrange the components/valve in the test panel as per circuit diagram
16.2 Observe what is Mechanical interlocking with switch contacts
16.3 Draw circuit diagram for the circuit & conduct the experiment according to the circuit diagram Complete the experiment

17. Construct a circuit to control a double acting hydraulic cylinder , by using 02 , push button, and canceling with proximity limit switch
17.1 Observe the types of limit switches/proximity switches (conductive, capacitive & optical) used in a hydroelectric circuit
17.2 Observe what is the function of two hand safety circuit?
17.3 Draw a Hydraulic circuit diagram to connecting a double acting Hydraulic cylinder using push button, direction hold in circuit and connecting with limit switch using two hand electrical pushbutton safety circuit

17.4 Draw circuit diagram for the circuit & conduct the experiment according to the circuit diagram Complete the experiment

18. Practice to set a hydraulic motor R.P.M & direction by using Flow Control & Directional valve
18.1 Practice the use of a direction control valve changes the direction of rotation of a hydraulic motor
18.2 Observe that how we can change the velocity of hydraulic motor by using throttle valve
18.3 Draw circuit diagram for the circuit & conduct the experiment according to the circuit diagram Complete the experiment

19. To construct a hydraulic circuit in which Accumulator stored energy can be utilized by double acting cylinder , when required
19.1 Observe the types of accumulators
19.2 How much we can store energy in an accumulator
19.3 Draw circuit diagram for the circuit & conduct the experiment according to the circuit diagram Complete the experiment

20. Visit to related industry plant

Mech-312 **HYDRAULICS AND HYDRAULIC MACHINES**

List of Machinery:

1.	Fluid friction in pipes with hydraulic bench	2-set
2.	Bernoulli's Theorem Demonstration Apparatus	2
3.	Orifice Discharge Apparatus	2
4.	Apparatus of Energy Losses in Pipes	2
5.	Centrifugal Pump Apparatus	1
6.	Axial Pump Apparatus	1
7.	Reciprocating Pump Apparatus	1
8.	Pelton Turbine	1
9.	Reaction Turbine	1
10.	Hydraulic Control Equipment Set	1
11.	Gear Pump (Transparent Model)	1
12.	Vane Pump (Transparent Model)	1
13.	Axial Piston Pump (Transparent Model)	1
14.	Pressure Gauge (Transparent Model)	1
15.	Pressure Relief Valve (Transparent Model)	1
16.	Pressure Switch (Transparent Model)	1
17.	Piston Accumulator (Transparent Model)	1
18.	Dead Weight Master Gauge Calibrator	1

Mech-323

APPLIED THERMODYNAMICS

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Mech-323 **APPLIED THERMODYNAMICS**

Total Contact Hours		**T**	**P**	**C**
Theory	**64**		**2**	**3** **3**
Practical96				

AIMS: To transfer the knowledge of fundamentals of thermodynamics, laws and properties of gases, thermodynamic processes and cycles, formation and properties of steam, steam boilers and their performance , steam and Gas turbines , I.C. Engines, Air compressors and their performance, refrigeration and air conditioning etc.

Course Contents:

1.	**Fundamentals of Thermodynamics**	**08 Hrs**
2.	**Laws and properties of perfect gases**	**06 Hrs**
3.	**Thermodynamic processes and cycles**	**10 Hrs**
4.	**Formation and properties of Steam**	**4 Hrs**
5.	**Steam Boilers and their performance**	**8 Hrs**
6.	**Steam and Gas turbines**	**8 Hrs**
7.	**Internal Combustion Engines**	**8 Hrs**
8.	**Air Compressors and their performance**	**6 Hrs**
9.	**Refrigeration and Air Conditioning**	**6 Hrs**
	Total	**64 Hrs**

Details of Contents:

1. Fundamentals of Thermodynamics **8 Hrs**

1.1 Introduction to thermodynamics

1.2 Units, Systems of units, Thermodynamic systems, its classification and properties

1.3 Heat, Mass and weight, Force, Work and power

1.4 Temperature, Absolute Temperature and Temperature Scales, Normal / Standard Temperature and Pressure

1.5 Pressure, Absolute pressure, Gauge pressure and Vacuum pressure

1.6 Energy, Potential energy, Kinetic energy and Internal energy of gas

1.7 Laws of thermodynamics, Laws of conservation of energy and matter, limitations of 1'st law of thermodynamics

1.8 Solution of problems by direct application of formulae for above topics

1.9 Mode of heat transfer

2. Laws and properties of perfect gases **6 Hrs**

2.1 Introduction

2.2 Boyle's law, Charles law, Gay-Lussac's law, Joule's law, Avogadro's law, Regnault's law and Dalton's law

2.3 General gas equation, Characteristic Gas equation, Universal Gas equation

2.4 Specific heats of a gas, Molar specific heats of a gas and its mathematical relations

2.5 Enthalpy, and Entropy of a gas, importance of Entropy and relation between Heat & Entropy

2.6 Solution of problems by direct application of formulae for above topics

3. Thermodynamic processes and cycles **10 Hrs**

3.1 Introduction of thermodynamic process

3.2 Classification/types of thermodynamic processes

3.3 Application of 1st law of thermodynamics for work done during a non-flow-reversible process

3.4 Heating and Expansion of gases in Non flow-Reversible & Irreversible processes

3.5 Solution of problems by direct-application of formulae

3.6 Introduction and classification/types of thermodynamic cycles

3.7 Assumptions in thermodynamic cycles

3.8 Reversible and Irreversible cycles

3.9 Working of an ideal engine

3.10 CARNOT's Cycle, OTTO Cycle, DIESEL Cycle and Dual Combustion Cycle

3.11 Solution of problems for air standard efficiency of thermodynamics cycles

4. Formation and properties of Steam **4 Hrs**

4.1 Introduction of steam, its formation, properties and classification

4.2 Important terms used for steam

4.3 Temperature-Enthalpy and Temperature- Entropy diagrams for steam formation

4.4 Use of steam tables

4.5 Calculation of total heat of Wet ,dry and super-heated steam (Solution of Problems)

5. Steam Boilers and Their performance **8 Hrs**

5.1 Introduction of boiler

5.2 Classification of boilers

5.3 Selection of a steam boiler

5.4 Important terms used for steam boilers

5.5 Constructions and Working of:

- 5.5.1 Simple vertical boiler (Single tube boiler)
- 5.5.2 COCHRAN boiler (Multi tubular boiler)
- 5.5.3 Locomotive Boiler
- 5.5.4 Marine boiler (scotch type)
- 5.5.5 Babcock and Wilcox Boiler

5.6 Boiler mountings and accessories

5.7 Comparison between Water Tube and Fire Tube boilers

5.8 Performance of steam boilers, Equivalent evaporation and boiler efficiency

~~5.9 Solution of problems regarding equivalent evaporation, power/H.P and efficiency of boiler~~

6. Steam and Gas Turbines **8 Hrs**

6.1 Introduction and classification of turbines

6.2 Steam Turbine (Impulse type)

- 6.2.1 Introduction
- 6.2.2 De-**Laval** impulse turbine
- 6.2.3 Advantages **of steam turbine**

6.3 Steam turbine (Reaction type)

- 6.3.1 Introduction.
- 6.3.2 PARSON's Reaction turbine.
- 6.3.3 Comparison between Impulse & Reaction Turbines

6.4 Gas Turbines

- 6.4.1 Introduction
- 6.4.2 Classification
- 6.4.3 Cycles of Gas turbines
- 6.4.4 Uses of Gas turbines
- 6.4.5 Comparison of closed cycle and open cycle turbines
- 6.4.6 Comparison of Gas turbine & Steam turbine

7. Internal Combustion Engines **8Hrs**

7.1 Introduction of Internal & External Combustion Engines

7.2 Classification of I.C. Engines

7.3 Cycle of operations & important terms used

7.4 Comparison of Two Strokes Cycle and Four Strokes Cycle Engines

7.5 Petrol Engine

- 7.5.1 Construction and working with the help of P-V , T-S diagrams & neat sketch
- 7.5.2 Valve Timing Diagrams for two strokes and four strokes cycle petrol engine

7.6 Diesel Engine

- 7.6.1 Construction and working with its P-V, T-S diagrams and neat sketch
- 7.6.2 Valve Timing Diagrams for two strokes cycle and four strokes cycle Diesel engine

7.7 Indicated power, Brake power, Friction power and efficiencies of I.C. Engines

7.8 Comparison of I.C. engine and E.C. engine

7.9 Comparison of Petrol and Diesel engines

7.10 Solution of Problems regarding I.P, B.P, Friction Power and efficiencies of I.C. engines

8. Air Compressors and their performance (Reciprocating & Rotary) **6 Hrs**

8.1 Introduction

8.2 Classification of air compressors(Reciprocating & Rotary)

8.3 Technical terms used

8.4 Construction and working of single stage reciprocating Air Compressor with help of PV-diagram and neat sketch

- 8.4.1 Work done per cycle by a single stage reciprocating air compressor without and with clearance volume.

8.5 Multistage compression and its advantages

8.6 Two stage reciprocating air compressor with intercooler, work done

Per cycle with polytrophic law of compression

8.7 Power required to drive a single stage and two stage reciprocating air compressors

8.8 Comparison of reciprocating and rotary air compressors

8.9 Work done per cycle and power required to drive a rotary compressor

8.10 ~~Solution of Problems regarding work done power required for single stage & multistage rotary air compressors~~

9. Refrigeration and Air Conditioning **6Hrs**

9.1 Introduction

9.2 Classification of refrigeration systems / cycles

9.3 Units, terms used

9.4 Refrigerants and its properties

9.5 Introduction to vapor compression, vapor absorption in refrigeration system

9.6 Fundamentals of air conditioning system
9.7 Classification of air conditioning systems

Recommended Textbooks:

1. **Principle of Refrigeration by Royj. Dossat**
2. **Air conditioning principles and system an energy approach by Edward. G. Pita**
3. **Applied Thermodynamics T.D Eastop, A. Mcconkey**
4. **Thermodynamics by Rayner Joel**
5. **Thermodynamics Applied to Heat Engines by E.H.LEWITT (Published by; Sir ISAAC Pitman & Sons Ltd London)**
6. **Heat Engines by D.A Low (McGraw Hill Book Company , New York)**

Mech-323 APPLIED THERMODYNAMICS

Instructional Objectives:

At the completion of this course, the students will be able to:

1. Know the Fundamentals of Thermodynamics

1.1 State the following:
- 1.1.1 Fundamentals of thermodynamics
- 1.1.2 Units and Systems of units

1.2 Describe the Thermodynamic systems, its classification and properties

1.3 State the following:
- 1.3.1 Heat
- 1.3.2 Mass and weight
- 1.3.3 Force
- 1.3.4 Work and power

1.4 Describe the following:
- 1.4.1 Temperature, Absolute Temperature and Temperature Scales
- 1.4.2 Normal Temperature and Pressure
- 1.4.3 Standard Temperature and Pressure

1.5 Describe the following:
- 1.5.1 Pressure and Absolute pressure.
- 1.5.2 Gauge pressure and Vacuum pressure

1.6 State the following:
- 1.6.1 Energy, Potential energy and Kinetic energy
- 1.6.2 Internal energy of a gas

1.7 Describe the following:
- 1.7.1 Laws of thermodynamics
- 1.7.2 Laws of conservation of energy and matter
- 1.7.3 Limitations of 1st law of thermodynamics

1.8 Describe mode of heat transfer
- 1.8.1 Describe Conduction
- 1.8.2 Describe Convection
- 1.8.3 Describe Radiation

1.9 Solve the problems by direct application of formulae for the above topics

2. Understand the laws and properties of perfect gases

2.1 State the perfect gas and its properties

2.2 Describe the following; also derive its mathematical relations:
- 2.2.1 Boyle's law
- 2.2.2 Charles's law
- 2.2.3 Gay-Lussac's law
- 2.2.4 Joule's law
- 2.2.5 Avogadro's law
- 2.2.6 Regnault's law
- 2.2.7 Dalton's law

2.3 Describe the following; also derive its mathematical relations:
- 2.3.1 General gas equation
- 2.3.2 Characteristic Gas equation
- 2.3.3 Universal Gas equation

2.4 Describe the following:
- 2.4.1 The two specific heats of a gas and derive its mathematical relations
- 2.4.2 The molar specific heats of a gas and derive its mathematical relations

2.5 State the following:
- 2.5.1 Enthalpy of a Gas
- 2.5.2 Entropy of a gas
- 2.5.3 Importance of Entropy
- 2.5.4 Relation between Heat & Entropy

2.6 Solve the problems by direct application of formulae for the above topics

3. Understand the Thermodynamics Processes and Cycles

3.1 State the thermodynamic process

3.2 State Classification /Types of thermodynamic processes

3.3 State the application of 1st law of thermodynamics for work done during a non-flow-reversible process

3.4 Describe the following
- 3.4.1 The Non flow-Reversible & Irreversible processes with the help of P-V & T-S diagrams
- 3.4.2 The constant pressure process with the help of P-V & T-S diagrams: also derive its mathematical relations for work done during expansion
- 3.4.3 The constant volume process with the help of P-V & T-S diagrams: also derive its mathematical relations for work done during expansion
- 3.4.4 The constant temperature process with the help of P-V & T-S diagrams: also derive its mathematical relations for work done during expansion
- 3.4.5 The adiabatic process with the help of P-V & T-S diagrams: also derive its mathematical relations for work done during expansion
- 3.4.6 The polytrophic process with the help of P-V & T-S diagrams: also derive its mathematical relations for work done during expansion

3.5 Solve the problems by direct application of formulae for the above topics

3.6 Describe the following:
- 3.6.1 Thermodynamic cycle with the help of P-V diagram
- 3.6.2 Classification / Types of thermodynamic cycles

3.7 Describe the assumptions in thermodynamic cycles

3.8 Describe the Reversible & Irreversible cycles with help of PV diagram

3.9 Explain the construction and working of an ideal engine with the help of neat sketch

3.10 Explain the following
- 3.10.1 CARNOT'S CYCLE with the help of P-V & T-S diagrams; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation
- 3.10.2 OTTO CYCLE with the help of P-V & T-S diagrams; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation
- 3.10.3 DIESEL CYCLE with the help of P-V & T-S diagrams; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation

3.10.4 DUAL COMBUSTION CYCLE with the help of P-V & T-S diagrams; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation

3.11 Solve the problems by direct application of formulae for the above topics

4. Understand the Formation and properties of Steam

4.1 Describe the steam formation, its properties and classification

4.2 State the important terms used for steam

4.3 Describe the Temperature-Enthalpy and Temperature- Entropy diagrams for steam formation

4.4 Describe the use of steam tables with help of examples

4.5 Describe the following:

4.5.1 Derive the formulae for the calculation of total heat of wet, Dry, and super-heated steam

4.5.2 Solve the problems by direct application of formulae for the above topics

5. Understand the Steam Boilers & its performance

5.1 Describe the working and general construction of a boiler

5.2 Describe the classification of boilers

5.3 State the selection factors of a good steam boiler

5.4 Describe the important terms used for steam boilers

5.5 Explain the Following:

5.5.1 The construction and working of Simple Vertical Boiler with the help of neat sketch

5.5.2 The construction and working of COCHRAN Boiler (Multi tubular boiler) with the help of neat sketch

5.5.3 The construction and working of MARINE Boiler (Scotch type) with the help of neat sketch

5.5.4 The construction and working of Locomotive Boiler with the help of neat sketch

5.5.5 The construction and working of Babcock and Wilcox Boiler with the help of neat sketch

5.6 State the List of boiler mountings & accessories:

5.7 Make a Comparison between Water tube and Fire tube boilers

5.8 Describe the following with the help of mathematical expressions

5.8.1 Performance of boiler

5.8.2 Equivalent evaporation of boiler

5.8.3 Efficiency of boiler

5.9 Describe the Following :

5.9.1 The formulae for the calculation of power /H.P and efficiency of boiler

5.9.2 Solve the problems by direct application of formulae for above topics

6. Understand the Steam and Gas Turbines

6.1 State the introduction and classification of turbines

6.2 Explain the following:

6.2.1 The construction and working of De-Level Impulse turbine with the help of neat sketch

6.2.2 State the advantages of steam turbine over reciprocating steam engine

6.3 Explain the following:

6.3.1 The Construction and working of PARSON'S Reaction turbine with the helping neat sketch

6.3.2 Make a comparison between Impulse and Reaction turbine

6.4 Describe the following

6.4.1 The introduction of Gas Turbines

6.4.2 The classification/types of Gas turbines

6.4.3 The cycles of Gas turbine with help of diagram

6.4.4 State the uses of gas turbines

6.4.5 Make a Comparison of closed cycle and open cycle turbines

6.4.6 Make a Comparison of Gas turbine and steam turbine

7. Understand the Internal Combustion Engines

7.1 State the introduction of I.C and E.C Engines(Internal and External combustion engines)

7.2 Describe the classification of I.C Engines

7.3 Describe the cycle of operations with the help of P-V diagram and important terms used for I.C Engines

7.4 Make a comparison of two strokes cycle and four strokes cycle engines

7.5 Explain the following:

7.5.1 The Construction and working of PETROL Engine with the help of PV- diagram & neat sketch

7.5.2 The valve timing diagrams for two strokes and four strokes cycle PETROL Engine

7.6 Explain the following:

7.6.1 The Construction and working of DIESEL Engine with the help of PV- diagram & neat sketch

7.6.2 The valve timing diagrams for two strokes and four strokes cycle DIESEL Engine

7.7 Describe the following also derive its mathematical formulae:

7.7.1 Indicated power

7.7.2 Brake power

7.7.3 Friction power

7.7.4 Efficiencies of I.C. engines

7.8 Make a Comparison of I.C. and E.C. engines

7.9 Make a Comparison of PETROL and DIESEL engines

7.10 Solve problems for calculation of I.P, B.P, Friction Power and efficiencies of I.C. engines

8. Understand the Air Compressors and their performance (Reciprocating & Rotary)

8.1 State the introduction of Air Compressors

8.2 Describe the classification / types of Air Compressors(Reciprocating & Rotary)

8.3 State the terms used for Air Compressors

8.4 Explain the following:

8.4.1 The Construction and working single cylinder- single stage double acting reciprocating air compressor with the help of P-V diagram and neat sketch

8.4.2 The work done single stage. Single cylinder reciprocating air compressor without and with clearance volume; also drive its Mathematical Expression.

8.5 Describe the Multistage compression with the help of P-V diagram and its advantages

8.6 Describe the two stage reciprocating air compressor with intercooler; also derive its mathematical Expression for the work done per cycle considering polytropic law of compression

8.7 Describe the power required to drive a single stage and two stages reciprocating Air compressors; also derive its formulae

8.8 Make a comparison of reciprocating and rotary air compressors

8.9 Describe the work done and power required to drive a rotary air compressor; also derive its formulae

8.10 Solution of the problems regarding work done and power required to drive the rotary and reciprocating air compressors

9. Understand the Refrigeration and Air Conditioning

9.1 State the concept of Refrigeration and Air conditioning
9.2 Describe the Classification/types of Refrigeration systems
9.3 State the Units and terms used for Refrigeration and Air Conditioning
9.4 State the names and Properties of refrigerants
9.5 Describe the simple mechanism of a vapor compression vapour **absorption** in refrigeration system with the help of neat schematic diagram
9.6 State the fundamentals of Air Conditioning Systems
9.7 Describe the Classification/types Air Conditioning Systems

Mech-323 APPLIED THERMODYNAMICS

List of Practical:

1. Pressure measurement by Barometer
2. Introduction of Thermometers and Thermocouples
3. Sketch and study of Steam Boilers
   - 3.1 Simple vertical boiler
   - 3.2 Cochran (Multi tubular) boiler
   - 3.3 Marine boiler(Scotch type)
   - 3.4 Locomotive boiler
4. Sketch and study of Boiler Mountings and Accessories
   - 4.1 Pressure gauge (Bourdon type)
   - 4.2 Water level indicator
   - 4.3 Safety valve (Spring loaded)
   - 4.4 Feed water pump
5. Study of fault diagnosis of steam boiler apparatus ~~Problem solving on steam generation~~
6. Study on petrol engine ~~Practice on Petrol Engine~~
7. Study on diesel engine ~~Practice on Diesel Engine~~
8. Practice on Ignition point Testing Machine ~~Practice on Ignition systems for I.C. Engines~~
9. Study and problem solution on Steam Turbine
10. Study of Gas Turbine
11. Performance Test of Reciprocating Air Compressor
12. Performance Test of Heating and Cooling system (Compression type A/C system)
13. ~~Performance Test of Refrigeration system (Compression type)~~

Mech-323 APPLIED THERMODYNAMICS

Practical Objectives: 96 Hrs

AIMS: To transfer practical knowledge of pressure, temperature measuring instruments, boilers, I.C. engines, Turbines and air compressors etc. The students will be able to:

1. Pressure measurement by Barometer
   - 1.1 Construction and working of BAROMETER
   - 1.2 Calculation of pressure measurement
2. Know Thermometers and Thermocouples
   - 2.1 Operate to learn the construction and working of Thermometers &Thermocouples
   - 2.2 Application the method of calibration
3. Sketch and study of the following boilers
   - 3.1 Study the construction, working and safety precautions of:
     - 3.1.1 Simple Vertical Boiler
     - 3.1.2 Cochran (Multi tubular) Boiler
     - 3.1.3 Marine Boiler (Scotch types)
     - 3.1.4 Locomotive Boiler
     - 3.1.5 Babcock and Wilcox Boiler
4. Sketch and study of the following Boiler Mountings and Accessories
   - 4.1 Study the construction, working and safety precautions of:
     - 4.1.1 Pressure Gauge (Bourdon type)
     - 4.1.2 Water level Indicator
     - 4.1.3 Safety Valve (Spring loaded)
     - 4.1.4 Feed Water Pump
5. Problem solving on Steam Boiler
   - 5.1 Study the procedural steps for operations of a boiler
   - 5.2 Study the performance of a boiler & safety precautions
6. Practice on Petrol Engine
   - 6.1 Operate to learn the construction, working and safety precautions

   - 6.2 Operate to learn the valves timing diagrams for 2- Stroke & 4 – Stroke cycle petrol engines
7. Practice on Diesel Engine
   - 7.1 Operate to learn the construction, working and safety precautions
   - 7.2 Operation of the valves timing diagrams for 2- Stroke & 4 – Stroke cycle diesel engines
8. Practice on Ignition system for I.C. Engines
   - 8.1 Operate to learn the ignition system for petrol engine
   - 8.2 Operate to learn the ignition system for diesel engine
9. Study and problem solution Turbine
   - 9.1 Study the construction, working and safety precautions of steam turbines
   - 9.2 Study the performance of steam turbines
10. Performance test of Gas Turbine
    - 10.1 Operate to learn the construction, working and safety precautions of Gas turbines
    - 10.2 Practical performance of Gas turbines
11. Practical test of Reciprocating Air Compressor
    - 11.1 Operate to learn the construction, working and safety precautions of Reciprocating Air Compressor
    - 11.2 Practical performance of Reciprocating Air Compressor
12. Performance Test of Heating and Cooling system (Compression type A/C system)
    - 12.1 Operate to learn the general components of system
    - 12.2 Operate to learn the operational procedure of system and safety measures
13. Performance Test of Refrigeration system (Compression type)
    - 13.1 Operate to learn the general components of system
    - 13.2 Operate to learn the operational procedure of system and safety measures

Mech-323 APPLIED THERMODYNAMICS

List of Machinery:

1.	Barometer	5-Set
2.	~~Dead Weight Gauge Tester with Pressure gauge~~	1
3.	Thermometers of Celsius, Fahrenheit, Kelvin and Rankine	5
4.	Thermocouples(Different Ranges)	2
5.	Sectioned model of Simple Vertical Boiler	2
6.	Sectioned model of COCHRAN (Multi tubular boiler)	2
7.	Sectioned model of Marine Boiler (Scotch types).	2
8.	Sectioned model of Locomotive Boiler	2
9.	Working model of safety valve (spring loaded)	5
10.	"C" class working boiler water tube/fire tube package type with all mounting and accessories	1
11.	~~Working~~ Mmodel of steam Turbine (Impulse and Reaction type)	1+1
12.	~~Working~~ Mmodel of gas turbine(Impulse and Reaction type)	1+1
13.	Reciprocating air compressor	1
14.	~~Rotary air compressor~~	1
15.	Ignition point Testing Machine	1
16.	Air Compressor Testing Machine	1
17.	Gas Turbine Testing Machine	1
18.	AC System Trainer (Heating and Cooling)	1
19.	Refrigeration Trainer	1
20.	~~Working~~ Mmodels of Petrol Engine	1
21.	~~Working~~ Mmodels of Diesel Engine	1

Mech-331

INDUSTRIAL PLANNING

AND PRODUCTION METHODS

Draft

2017

Revised by GCT Project JICA

Red color; Contents added or delete

Mech-331 **INDUSTRIAL PLANNING AND PRODUCTION METODS**

Total contact Hrs:	**T**	**P**	**C**
Theory 32	**1**	**0**	**1**

AIMS: At the end of this course, the student will be able to:

i) Understand the fundamental functions of industrial concerns.
ii) Understand the methods(which methods, specify) generally employed in various manufacturing organizations

Course Contents:

1.	**Industrial planning**	**3 Hrs**
2.	**Site selection for industry**	**2 Hrs**
3.	**Plant lay out**	**4 Hrs**
4.	**Production methods**	**3 Hrs**
5.	**Job analysis**	**5 Hrs**
6.	**Production planning and control**	**4 Hrs**
7.	**Quality assurance**	**3 Hrs**
8.	**Maintenance activities**	**4 Hrs**
9.	**Cost determination and control**	**2 Hrs**
10.	**Store operation in industry**	**2 Hrs**

Detail of Contents:

1. Industrial Planning **3 Hrs**

1.1 Need of industrial planning

1.2 Phases of industrial planning

2. Site selection ~~for industry~~ **2 Hrs**

2.1 Economical and technical factors considered while selecting factory site

3. ~~Plant layout~~ Layout **4 Hrs**

3.1 ~~Definition~~ Introduction to layout

3.2 ~~Objectives~~ Types of layout

3.3 ~~Types~~ Good layout

3.4 ~~Criteria for a good lay out~~ Preparation a layout

~~3.5 Advantages of a good lay out~~

~~3.6 Preparing a lay out~~

4. Production Methods **3Hrs**

4.1 Introduction to production

4.2 ~~Important~~ Types of production

4.3 New trend of types of production

5. Job Analysis **6Hrs**

5.1 Motion study

5.2 Time study

6. Production planning and control **4Hrs**

6.1 Production planning

6.2 Production control

6.3 Improvement of productivity

7. Quality assurance **2Hrs**

7.1 Inspection

7.2Quality control (Quality management)

7.3Quality control circle

8. Maintenance activities **4Hrs**

8.1 Responsibilities of maintenance department

8.2 Types of maintenance

8.3~~Comparison of different types of maintenance~~ Total productive maintenance

8.4 Replacement studies

9. Cost determination and control **2Hrs**

9.1 Cost calculation of industrial product.

9.2 Cost control

10. Store operation ~~in industry~~ **2Hrs**

10.1 Receipt of store items

10.2 ~~Records of store~~ Issue of store items

~~10.3 Issue of store items~~

Recommended Textbooks:

1. Motion and time study by RALPH M. BARNES (Publisher: Wiley, 1980)
2. Industrial Engineering and Management System by Dr. Mansor Ali (Publisher: Urban Resauce Center,2001)
3. Factory and Production Management by Lockyer(Publisher: Pitman, 1974)
4. Industrial Management by Prof. M.H. Zubairi

Mech-331 INDUSTRIAL PLANNING AND PRODUCTION METHODS

Instructional Objectives:

1. **Industrial planning**
   - 1.1 Explain the need of industrial planning
     - 1.1.1 Define industrial planning
     - 1.1.2 Explain need and importance of industrial planning
   - 1.2 Explain different phases of industrial planning
     - 1.2.1 Explain financial planning
     - 1.2.2 Explain product planning and selection of material
     - 1.2.3 Explain selection of process and equipment
2. **Know the Economical and technical factors considered during site selection Procedure**
   - 2.1 Explain economical and technical factors in site selection
     - 2.1.1 Define site (location of industry)
     - 2.1.2 Describe factors for site selection
     - 2.1.3 Economical factors (cost of site, rebate in taxes, special grants)
     - 2.1.4 Technical factor (availability of labor, raw material, market of Product, services, transportation etc.)
3. **Understand plant layout**
   - 3.1 Define plant lay out and its importance – Introduction to layout
   - 3.2 Describe the types objectives of lay out
   - 3.3 Explain criteria for a good layout Describe the types of lay out (product/process) with its advantages and limitations
   - 3.4 Explain preparation criteria for a good layout
   - 3.5 Describe advantages of a good lay out
   - 3.6 Explain different factors / procedures followed in preparing layout
     - 3.6.1 Explain factors considered while preparing a lay out (man, Material, machine, Movement etc.)

   - 3.6.2 Describe procedure and various steps followed in developing a lay out
4. **Production Methods**
   - 4.1 Define introduction to Production.
   - 4.2 Explain different types of production
     - 4.2.1 Explain Mass Production, Job order Production, Batch Production
     - 4.2.2 Explain flow Production
     - 4.2.3 Describe requirements of flow production
   - 4.3 New trend of types of production
5. **Job Analysis**
   - 5.1 Explain motion study
     - 5.1.1 Define motion study
     - 5.1.2 Explain techniques developed by the gilbreth, like therbligs, process charts etc.
     - 5.1.3 Describe micro motion study
   - 5.2 Explain time study
     - 5.2.1 Define time study
     - 5.2.2 Describe uses of time study
     - 5.2.3 Describe instruments used in motion and time study
     - 5.2.4 Describe time study procedure
     - 5.2.5 Explain observation sheet (Time study tool)
6. **Production Planning and Control**
   - 6.1 Define PPC
   - 6.2 Describe the objectives of PPC
   - 6.3 Explain functions of production control
   - 6.4 Explain routing, scheduling and loading
   - 6.5 Explain Packaging and Dispatching
7. **Quality Assurance**
   - 7.1 Explain inspection and its types

   - 7.2 Explain quality control and assurance
     - 7.2.1 Explain quality control and assurance at various levels
     - 7.2.2 Describe quality standards
8. **Maintenance Activities**
   - 8.1 Explain duties of maintenance department.
   - 8.2 Explain types of maintenance
     - 8.2.1 Explain Preventive maintenance and Break-down maintenance
     - 8.2.2 Describe maintenance schedules
   - 8.3 Explain replacement studies
     - 8.3.1 Explain replacement of parts in machines and equipment
     - 8.3.2 Explain replacement policy
9. **Cost Determination and Control**
   - 9.1 Explain cost calculation of industrial products
     - 9.1.1 Explain procedure of cost calculation
     - 9.1.2 Describe elements of cost
     - 9.1.3 Explain factory overhead
   - 9.2 Describe cost control
10. **Store Operation**
    - 10.1 Explain procedure adopted by the store on receipt of store items
    - 10.2 Describe forms used in store operation
    - 10.3 Explain the procedure of issuance of store items

Mech-343
MACHINE DESIGN

Draft

2017

Revised by GCT Project JICA

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Mech-343 **MACHINE DESIGN**

	T	P	C
Total Contact Hours:			
Theory: 64 Hrs	**2**	**3**	**3**

Practical: Machine design **96 Hrs**

AIMS: At the end of the course the students will be able to:

i) Calculate and analyze stresses induced in different machine parts
ii) Design Simple machine parts, welded joints, Screwed joints, pressure vessels, shafts and Couplings, Keys, Belt Drives, helical springs, Bearings and CAMS & Followers.

Course Contents:

1. Design Methodology
2. **Simple Stresses in Machine Parts** **8Hrs**
3. **Pressure Vessels** **6Hrs**
4. **Welded Joints** **6Hrs**
5. **Screwed Joints** **6Hrs**
6. **Design of Keys** **5Hrs**
7. **Shafts and Couplings** **8Hrs**
8. **Belt Drives** **6 Hrs**
9. **Springs** **6Hrs**
10. **Bearings** **6 Hrs**
11. **Cam and Followers** **7 Hrs**

Details of Contents:

1. Design Methodology

1.1 Fundamental designing
1.2 Type of designing
1.3 Design product concept
1.4 Design methods
1.5 Basic product requirement for designing

2. Simple Stresses in Machine Parts **8Hrs**

2.1 Load and its types
2.2 Stress and strain

1.1 Tensile stress and strain
1.2 Compressive stress and strain
1.3 Shear stress and strain
1.4 Young's Modulus of elasticity
1.5 Modulus of rigidity or Shear Modulus
1.6 Stress strain diagram
1.7 Working stress
1.8 Factor of safety
1.9 Selection of Factor of Safety
1.10 Poisson's Ratio
1.11 Temperature stress
1.12 Volumetric strain and bulk modulus
1.13 Resilience and Toughness
1.14 Solution of problems of the above topics by direct application of formulae

3. Pressure Vessels **6Hrs**

2.1 Introduction
2.2 Classification of pressure vessels
2.2.1 According to dimensions.
2.2.2 According to end – construction
2.3 Stresses in a thin cylindrical shell due to internal pressure
2.3.1 Hoop stress
2.3.2 Longitudinal stress
2.4 Calculation of thickness of cylinder by direct application of formula, while all parameters are provided (e.g.), Pressure. Internal Dia, hoop or longitudinal stress and efficiency of joint are given)
2.5 Calculation of hoop or longitudinal stress by direct application of formula, while P. d, t and efficiency of joint are given
2.6 Thin spherical shell subjected to internal pressure

2.7 Calculation of thickness of spherical shell when all other parameters are provided by direct application of formula
2.8 Thick cylindrical shell subjected to internal pressure
2.9 Calculation of thickness of thick vessel made of brittle material by LAME,S equation, while all other parameters are given

4. Welded Joints **6Hrs**

3.1 Types of various welding joints
3.2 Strength of transverse and parallel fillet welded joint under static and fatigue loading
3.3 Calculation of length of weld under static loading, when load, plate thickness & width, tensile & shears stress are given

5. Screwed Joints **6Hrs**

4.1 Introduction
4.2 Advantages and disadvantages
4.3 Thread terminology
4.4 Stress in screwed fastening due to external forces under static loading
4.5 Initial stress due to screwing up forces
4.6 Solution of simple problem by direct formula application

6. Design of Keys **5 Hrs**

5.1 Introduction
5.2 Types of keys
5.3 Forces acting on a sunk key
5.4 Strength of a sunk key
5.5 Calculate length of sunk key by direct application of formula, while all parameters are directly provided

7. Shafts and Couplings **8Hrs**

6.1 Introduction to shaft
6.2 Materials used for shaft and its properties
6.3 Types of shafts
6.4 Standard sizes
6.5 Stresses in shafts
6.6 Shafts subjected to twisting moment
6.6.1 Solid shaft

6.6.2 Hallow shaft
6.7 Calculate diameter of solid and hollow shafts by direct application of formula
6.8 Shafts subjected to bending moment
6.8.1 Solid shaft
6.8.2 Hollow shaft
6.9 Calculate diameter of solid and hollow shaft (bending only) by direct application of formula
6.10 Calculation of dia. of shaft subjected to bending and twisting moments
6.11 Introduction of shaft coupling
6.12 Types of couplings
6.13 Design of flange coupling
6.14 Solve problems on calculation of sizes of different components in flange coupling by direct application of formula

8. Belt Drives **6 Hrs**

7.1 Introduction to Belt and pulley drives
7.2 Selection of Belt drive
7.3 Types of Belt drive
7.4 Type of Belts and pullies
7.5 Type of Flat Belts drive
7.6 Velocity ratio of Belt drive
7.7 Slip / **creep** of Belt
7.8 Length of open Belt drive
7.9 Solve problem to find out the speed of shaft considering the diameters of flat pulleys and slip between belt and flat pulleys

9. Springs **6Hrs**

8.1 Introduction
8.2 Types and uses of springs
8.3 Materials used for helical springs
8.4 Terms used in helical springs
8.5 Stresses in helical springs of circular wire

8.6 Deflection of helical springs of circular wire

8.7 Solution of simple problem on helical springs of circular wire regarding finding out stresses, deflection and diameter of wire by direct application of formulae

10. Bearings **6 Hrs**

9.1 Functions of bearings
9.2 Classification of bearing
9.2.1 Depending upon the direction of load to be supported
9.2.2 Depending upon the nature of contact
9.3 Uses of bearings
9.4 Terms used in journal bearings
9.5 Lubrication of bearings
9.6 Solution of simple problems on journal bearings when all parameter of journal bearing are directly provided

11. Cam and Follower Design **7Hrs**

10.1 Cam and its Types

10.2 Followers and its Types

10.3 Terminology of Cam and Follower

10.4 Cam profile design

Mech-343 MACHINE DESIGN

Instructional Objectives:

2. Simple Stresses in Machine Parts

1.1 Describe Load and its types
- 1.1.1 Dead load
- 1.1.2 Live load
- 1.1.3 Suddenly applied load
- 1.1.4 Impact load

1.2 Describe Stress and strain

1.3 Describe Tensile stress and strain

1.4 Describe Compressive stress and strain

1.5 Describe Shear stress and strain

1.6 Describe Modulus of elasticity

1.7 Describe Modulus of rigidity

1.8 Explain Stress strain diagram
- 1.8.1 Proportional limit
- 1.8.2 Elastic limit
- 1.8.3 Yield points
- 1.8.4 Ultimate stress
- 1.8.5 Breaking stress
- 1.8.6 Percentage reduction in area
- 1.8.7 Percentage elongation

1.9 Describe Working stress

1.10 Describe Factor of safety

1.11 Describe selection of factor of safety

1.12 Describe Poisson's ratio

1.13 Describe temperature stress

1.14 Describe volumetric strain and bulk modulus

1.15 Describe Resilience and Toughness

1.16 Solve of simple problems of the above topics by direct application of formula

3. Pressure Vessels

2.1 Describe pressure vessels

2.2 Explain Classification of pressure vessels

2.2.1 According to dimensions
2.2.2 According to end – construction

2.3 Explain Stresses in a thin cylindrical shell due to internal pressure

2.3.1 Hoop stress
2.3.2 Longitudinal stress

2.4 Calculate thickness of cylinder by direct application of formula, while all parameters are provided (e.g., Pressure. Internal Dia, hoop or longitudinal stress and efficiency of joint are given)

2.5 Calculate hoop or longitudinal stress by direct application of formula, while P. d, t and efficiency of joint are given

2.6 Explain thin spherical shell subjected to internal pressure

2.7 Calculate thickness of spherical shell when all other parameters are provided by direct application of formula

2.8 Explain Thick cylindrical shell subjected to internal pressure

2.9 Solve simple problem to Calculate of thickness of thick vessel made of brittle material by LAME, S equation, while all other parameters (e.g., Pressure. Internal Dia, tensile stress) are given

4. Welded Joints

3.1 Describe list of types of various welding joints

3.2 Explain strength of transverse and parallel fillet welded joint under static and fatigue loading

3.3 Calculation of length of weld under static loading and fatigue loading, when load, plate thickness, plate width, tensile and shears stress are given

5. Screwed Joints

4.1 Describe Screwed Joints

4.2 Describe Advantages and disadvantages of Screwed Joints

4.3 Explain Thread terminology
- 4.3.1 Major diameter
- 4.3.2 Minor diameter
- 4.3.3 Pitch diameter
- 4.3.4 Pitch
- 4.3.5 Lead
- 4.3.6 Helix and Helix angle
- 4.3.7 Thread angle
- 4.3.8 Root
- 4.3.9 Crest and Apex

4.4 Explain Stresses in screwed fastening due to external forces under static loading

4.5 Describe Initial stress due to screwing up forces

4.6 Solve simple problem on screwed fastening by direct application of formula

6. Design of Keys

5.1 Describe Keys and its use

5.2 Describe Types of keys
- 5.2.1 Sunk keys
  - 5.2.1.1 Rectangular (Parallel & Taper) Sunk key
  - 5.2.1.2 Square (Parallel & Taper) Sunk key
  - 5.2.1.3 Gib-Head key
  - 5.2.1.4 Feather key
  - 5.2.1.5 Wood ruff key
- 5.2.2 Saddle keys
  - 5.2.2.1 Flat Saddle Key
  - 5.2.2.2 Hollow Saddle Key
- 5.2.3 Tangent keys
- 5.2.4 Round keys

5.2.5 Splines

5.3 Describe Forces acting on a sunk key

5.4 Explain strength of a sunk key

5.5 Solve simple problem to Calculate length of sunk key (Square & Rectangular) by direct application of formula, while all parameters are directly provided

7. Shafts and Couplings

6.1 Describe Shafts

6.2 Describe Materials used for shaft and its properties

6.3 Describe Types of shafts

6.4 Describe Standard sizes of shafts

6.5 Describe Stresses in shafts

6.6 Explain shafts subjected to twisting moment

6.6.1 Solid shaft

6.6.2 Hallow shaft

6.7 Solve simple problem to Calculate diameter of solid and hollow shafts by direct application of formula

6.8 Explain shafts subjected to bending moment

6.8.1 Solid shaft

6.8.2 Hollow shaft

6.9 Solve simple problem to Calculate diameter of solid and hollow shaft (under bending only) by direct application of formula

6.10 Solve simple problem to calculate dia. of shaft subjected to combined bending and twisting moments

6.11 Describe Shafts coupling

6.12 Describe Types of couplings

6.13 Explain design of flange coupling

6.14 Solve problems on calculation of sizes of different components in flange coupling by direct application of formula

8. Belt Drives

7.1 Introduction to Belt and pulley drives

7.2 Describe Selection of Belt drive

7.3 Describe Types of Belt drive

7.3.1 Light drives

7.3.2 Medium drives

7.3.3 Heavy drives

7.4 Describe Types of Belts and pullies

7.4.1 Flat belt and pullies

7.4.2 V-belt and pullies

7.4.3 Circular belt and pullies

7.5 Describe Types of Flat Belts drive

7.5.1 Open belt drive

7.5.2 Crossed or Twist belt drive

7.5.3 Quarter Turn belt drive

7.5.4 Belt drive with idler pulley

7.5.5 Compound belt drive

7.6 Explain Velocity ratio of Belt drive

7.7 Explain Slip of Belt

7.8 Describe Length of open Belt drive

7.9 Solve problem to find out the speed of shaft considering the diameters of flat pulleys and slip between belt and flat pulleys

9. Springs

8.1 Describe function of springs

8.2 Explain Types and uses of springs

8.2.1 Helical spring

8.2.2 Conical and volute spring

8.2.3 Torsion spring

8.2.4 Leaf spring

8.2.5 Disc spring

8.3 Describe Materials used for springs

8.4 Explain Terms used in helical springs of circular wire along with formulae for each term

8.5 Derive formula for torsional and direct shear stress induced in helical springs of circular wire. Maximum shear stress should also be found out by considering the effect of wire curvature

8.6 Derive formula for deflection of spring

8.7 Solve problems on stresses, deflection and diameters for helical springs of circular wire by direct application of formulae

10. Bearings

9.1 Describe function of bearings

9.2 Explain classification of bearing

9.2.1 Depending upon the direction of load to be supported

9.2.1.1 Radial bearing

9.2.1.2 Thrust bearing

9.2.2 Depending upon nature of contact

9.2.2.1 Friction bearing or sliding contact bearing

9.2.2.2 Anti friction or rolling contact bearing

9.3 Describe uses of bearings

9.4 Describe terms used in hydrodynamic journal bearing

9.5 Explain lubrications of bearings

9.6 Solve simple problems on journal bearing when load on shaft, speed of shaft, viscosity of lubricant, bearing pressure, coefficient of friction and bearing modulus are provided.

11. Cam and Follower Design

10.1 Explain Cam and its Types

10.1.1 Cylindrical Cam

10.1.2 Radial Cam

10.1.3 Wedge type Cam

10.1.4 Face Cam

10.2 Describe Followers and its Types

10.2.1 Roller Follower

10.2.2 Knife Edge Follower

10.2.3 Flat face Follower

10.2.4 Spherical face Follower

10.3 Define Terminology of Cam and Follower

10.3.1 Base circle

10.3.2 Trace Point

10.3.3 Pressure angle

10.3.4 Pitch point

10.3.5 Pitch circle

10.3.6 Prime circle

10.3.7 Lift or Stroke

10.3.8 Dwell

10.4 Explain Cam profile design

10.4.1 Draw/ Sketch displacement diagram, velocity and acceleration diagram when knife edge follower moves with uniform velocity

10.4.2 Draw/ Sketch displacement diagram, velocity and acceleration diagram when knife edge follower moves with Simple Harmonic Motion(S.H.M)

Recommended Textbooks:

1. **Machine Design by: Paul H. Black (Published by McGraw Hill Book Company , New York)**
2. **Machine Design by Stanton. E. Wiston (Published by McGraw Hill Book Company , New York)**
3. **Machine Design by: Lafayette. Ind. (Purdue University of California)**

Mech-343 MACHINEDESIGN

List of Practical:

1. **Calculate (tensile, compressive and shear), stress and strain, modulus of elasticity, %age elongation, %age reduction in area, factor of safety for simple machine parts**
2. **Calculate force required to punch a hole**
3. **Calculate thickness and diameter of thin cylinders for hoop and longitudinal stresses**
4. **Calculate thickness of thick cylinders by LAME 'S Equation**
5. **Calculate thickness and diameter of spherical shell.**
6. **Design welded joints for transverse and parallel fillet weld under static loading only**
7. **Calculate stresses setup due to initial tightening and external load on screws.**
8. **Check dimensions of square and rectangular keys due to failure in shearing and crushing.**
9. **Design solid shaft subjected to twisting moment only.**
10. **Design hollow shaft subjected to twisting moment only.**
11. **Design Solid & Hollow shafts subjected to combined bending & twisting moment.**
12. **Design un-protected flange coupling for specific torque.**
13. **Check the speed of shaft when diameters of flat pulleys (Driver or Driven) and slip between belt and flat pulley is given.**
14. **Design the dimensions of closely coiled helical spring of circular wire subjected to tensile load.**
15. **Suggest suitable journal bearing, considering the load on shaft, speed, viscosity of lubricant, bearing pressure, coefficient of friction and bearing modulus.**
16. **Design and draw the CAM profile with knife edge follower for uniform velocity:**

(a) Out Stroke during 60°of Cam rotation (b) Dwell for next 30°of Cam rotation (c) return Stroke during next 60°of Cam rotation (d) Dwell of remaining 210°of Cam rotation (e) Stroke of follower is 22 mm (f) Minimum Radius of Cam is 50 mm (g) Axis of Follower is passing through axis of Cam shaft (h) Follower moves with uniform velocity during both out Stroke and return Stroke.

Mech-343 MACHINEDESIGN

Practical objectives:

1. **Calculate (tensile, compressive and shear), strain, modulus of elasticity, %age elongation, %age reduction in area, factor of safety for simple machine parts**
   - 1.1 Stresses induced in machine parts
   - 1.2 Cross-sectional area of machine element under load
   - 1.3 modulus of elasticity of materials
   - 1.4 Calculate dimensions of component under specific load
   - 1.5 %age elongation and %age reduction in area of a component in a tensile test
2. **Calculate force required to punch a hole**
   - 2.1 Stresses induced in punch and plate
   - 2.2 Area of shear by the punch
   - 2.3 Calculate different cases of die and punch
3. **Calculate thickness and diameter of thin cylinders for hoop and longitudinal stresses**
   - 3.1 Difference between thin and thick shells
   - 3.2 Hoop and longitudinal stress in cylindrical shells
   - 3.3 Transverse and longitudinal failure of pressure vessel
4. **Calculate thickness of thick cylinders**
   - 4.1 Lame's equations for brittle materials
   - 4.2 Calculate Different cases of thickness of thick shells of brittle material
5. **Calculate thickness and diameter of spherical shell for circumferential stresses**
   - 5.1 Stresses on thin spherical shells
   - 5.2 Stress on spherical shells considering pressure, internal diameter, thickness and joint efficiency
6. **Design welded joints for transverse and parallel fillet under static loading only**
   - 6.1 Transverse and parallel fillet weld
   - 6.2 Observe tensile and shear stresses in transverse and parallel fillet weld
   - 6.3 Calculate different cases of transverse and parallel fillet weld under static and fatigue loading

7. **Analyze stresses setup due to initial tightening and external load on screws**
   - 7.1 Stress area of a screw
   - 7.2 Relation between core dia. and nominal dia. of a screw thread
   - 7.3 Initial tightening and its specific values
   - 7.4 Calculate different cases of external load raised by different bolts
8. **Check dimension of square and rectangular keys due to failure in shearing and crushing**
   - 8.1 Understand sunk keys of all types
   - 8.2 Understand sizes of keys proportional to the shaft diameter
   - 8.3 Check length of a sunk key for same material with shaft and equal strength with shaft
   - 8.4 Check torque transmitted by rectangular and square keys against shearing as well as crushing
   - 8.5 Calculate length of a sunk key when torque transmitted dia. of shaft, stress (shear & compressive) and width of key is given
9. **Design solid shaft subjected to twisting moment only**
   - 9.1 Understand twisting and bending moment on solid shaft
   - 9.2 Understand torsion and bending equation for strength of shaft
   - 9.3 Calculate diameters of shaft under torsion when torque to be transmitted and torsional shear stress is given
   - 9.4 Analyze diameter of shafts subjected to combine bending and twisting moments
10. **Design hollow shaft subjected to twisting moment only**
    - 10.1 Understand twisting moment and bending moment on hollow shaft
    - 10.2 Know torsion and bending equation
    - 10.3 Calculate dia. of hollow shaft (inside & outside dia.) when bending moment, twisting moment and stresses are given
11. **Design Solid & Hollow shafts subjected to combined bending &twisting moment**
    - 11.1 Understand twisting moment and bending moment on solid & hollow shaft
    - 11.2 Know torsion and bending equation
    - 11.3 Calculate inside & outside dia. of hollow shaft when bending moment, twisting moment

Are given.

12. **Design un-protected flange coupling for specific torque**
    - 12.1 Un protected flange coupling

12.2 Know empirical size of flange coupling
12.3 Design assembly (hub, keys, flange, and bolts) of unprotected type flange coupling.

13. Check the speed shafts(Driver or Driven) when diameters of flat pulleys and slip between belt and flat pulley is given

13.1 Understand belt and belt drives
13.2 Calculate dimensions of flat pulleys for specific speed of shaft
13.3 Calculate the effect of slip between belt and pulley

14. Design the dimensions of closely coiled helical spring of circular wire subjected to Tensile load.

19.1 Understand helical springs of circular wire

19.2 Understand terms used in helical springs
19.3 Calculate deflection in helical spring

19.4 Solve problems on calculation of dimensions of helical springs

15. Suggest suitable journal bearing considering load on shaft, speed of shaft, viscosity of lubricant, bearing pressure, coefficient of friction and bearing modulus.

15.1 Verify length of journal bearing
15.2 Know the viscosity of lubricants
15.3 Calculate the bearing modulus
15.4 Apply the coefficient of friction in the design of journal bearings

16. Design and draw the CAM profile with knife edge follower for uniform velocity

16.1 Movement of knife edge follower
16.2 Practice to sketch Displacement, velocity and acceleration diagram when knife edge Follower.
16.3 moves with Simple Harmonic Motion (S.H.M)
16.4 Practice to sketch Displacement, velocity and acceleration diagram when knife edge follower moves with uniform velocity

16.5 Practice to draw CAM profile as given data

MT-362
MATERIALS TESTING
AND HEAT TREATMENT

Draft
2017

Revised by GCT Project JICA
Red color: Contents added or delete

Mech-362 **MATERIALS TESTING AND HEAT TREATMENT**

Total Contact Hours		T	P	C
Theory	32	1	3	2
Practical	96			

AIMS: After going through this course, student will be able to:

I) understand destructive and non-destructive test
II) Understand working of testing equipment
III) Know the basic theories of heat treatment processes
IV) Understand common heat treatment processes
V) Understand common heat treatment processes of nonferrous metals

Course Contents:

(A) MATERIALS TESTING

1. Mechanical properties of Metallic Materials 2 Hrs
2. Destructive Test 7Hrs
3. Non-Destructive Tests 7Hrs

(B) HEAT TREATMENT

4. Heat Treatment of steels 3 Hrs
5. Heat Treatment Processes 4 Hrs
6. Heat Treatment Equipment 3 Hrs
7. Case hardening Processes 3 Hrs
8. Heat Treatment of Non-Ferrous Metals and Cast iron 3 Hrs

Detail of Contents:

(A) MATERIALS TESTING

1. Mechanical properties of Metallic Materials 2 Hrs
   - 1.1 Mechanical Properties of Materials
     - 1.1.1 Hardness
     - 1.1.2 Toughness
     - 1.1.3 Ductility
     - 1.1.4 Malleability
     - 1.1.5 Elasticity
     - 1.1.6 Brittleness
     - 1.1.7 Plasticity
     - 1.1.8 Stiffness
   - 1.2 Testing of materials
     - 1.2.1 Destructive tests.
     - 1.2.2 Nondestructive tests

2. Destructive Test 7 Hrs
   - 2.1 Hardness tests
     - 2.1.1 Brinall hardness test
     - 2.1.2 Rockwell hardness test
     - 2.1.3 Vickers hardness test
     - 2.1.4 Shore Hardness Test
   - 2.2 Izod impact test
   - 2.3 Tensile test
   - 2.4 Compression Test
   - 2.5 Bending test
   - 2.6 Shear Test
   - 2.7 Torsion test
   - 2.8 Fatigue test
3. Non-Destructive Test 7 Hrs
   - 3.1 Field of Utilization of NDTs
   - 3.2 Pressure Test
   - 3.3 Hammer Test (Sonic Inspection)
   - 3.4 Visual Inspection (Boroscopy and videoscopy)
   - 3.5 Dye Penetrant Test
   - 3.6 Eddy Current inspection
   - 3.7 Ultrasonic Inspection
   - 3.8 Magnetic Particle Inspection
   - 3.9 Radiographic Inspection
   - 3.10 Infrared Thermography

B) HEAT TREATMENT

4. Heat Treatment of steels 3 Hrs
   - 4.1 Iron-Iron carbide diagram
   - 4.2 Phase diagrams
   - 4.3 Effect of heating on steel
   - 4.4 Effect of cooling on steel
5. Heat Treatment Processes 4 Hrs
   - 5.1 Annealing
   - 5.2 Hardening
   - 5.3 Tempering
   - 5.4 Normalizing
6. Heat Treatment Equipment 3 Hrs
   - 6.1 Heat Treatment Furnaces
   - 6.2 Pyrometers
   - 6.3 Metallurgical microscope
7. Case Hardening Processes 3 Hrs
   - 7.1 Carburizing (pack, gas, liquid)
   - 7.2 Induction hardening
   - 7.3 Flame hardening
   - 7.4 Cyaniding
   - 7.5 Nitriding
8. Heat Treatment of Non-Ferrous Metals and Cast Iron 3 Hrs

8.1 Heat treatment of cast iron
8.2 Heat treatment of Non-ferrous metals and alloys
8.3 Annealing of non-ferrous metals and precipitation hardening

Recommended Textbooks:

1. The Testing and Inspection of Engineering Materials By Harmer E-Davis, George Earl Troxel (McGraw Hill Book Company, New York)
2. Materials and Processes by James. F. Young (Jhon wiley & sons Inc. New York)
3. Physical Metallurgy by AVNER

Mech-362 MATERIALS TESTING AND HEAT TREATMENT

Instructional Objectives:

1. **Mechanical properties of materials**
   - 1.1 Know Mechanical Properties of Materials
     - 1.1.1 Enlist mechanical properties of materials (hardness, toughness, ductility malleability, brittleness, elasticity, plasticity and stiffness)
     - 1.1.2 Define each property
   - 1.2 Know Destructive Tests
     - 1.2.1 Enlist destructive tests
     - 1.2.2 Define each test
   - 1.3 Know Non-Destructive Tests
     - 1.3.1 Enlist non-destructive tests
     - 1.3.2 Define each test
2. **Destructive Tests**
   - 2.1 Understand Hardness Tests and selection of test for a material
     - 2.1.1 Explain Brinnel Hardness Test
       - 2.1.1.1 Knows types of hardness tests
       - 2.1.1.2 Enlist parts of brinell hardness testing machine
       - 2.1.1.3 Explain working of Brinell hardness testing machines
       - 2.1.1.4 Explain preparation of specimen for Brinell hardness testing machine
       - 2.1.1.5 Explain the measurement of impression by microscope for brinell test
       - 2.1.1.6 Describe relevant calculations
     - 2.1.2. Explain Rockwell hardness testing machine
       - 2.1.2.1 Explain construction and working of Rockwell hardness testing machine (minor load, major load, scales B, C)
       - 2.1.2.2 Explain preparation of specimen for Rockwell hardness testing machine
       - 2.1.2.3 Appreciate correct dial reading procedure
       - 2.1.2.4 Enlist difference between brinell and Rockwell hardness testing
     - 2.1.3 Explain Vicker hardness test
       - 2.1.3.1 Describe Vicker hardness testing machine
       - 2.1.3.2 Explain Vicker hardness testing method
     - 2.1.4 Shore Hardness Test
       - 2.1.3.1 Describe shore hardness testing machine
       - 2.1.3.2 Explain shore hardness testing method
   - 2.2 Explain the working Principles of Impact testing Machine
     - 2.2.1 Enlist capacity and parts of Izod impact machine
     - 2.2.2 Explain function of each part
     - 2.2.3 Explain working principle
     - 2.2.4 Explain preparation of specimen (ASTM, JIS, and ISO)
     - 2.2.5 Appreciate correct dial reading technique
   - 2.3 Explain the working Principle of Universal Testing Machine
     - 2.3.1 Describe tensile testing machine
     - 2.3.2 Enlist capacity and different parts of tensile testing machine and extensometer
     - 2.3.3 Describe different function of tensile testing machine

     - 2.3.4 Explain the preparation of standard tensile test specimen (ASTM, ISO)
     - 2.3.5 Explain the procedure of tensile test of mild steel
     - 2.3.6 Describe the stress strain curve obtained in a tensile test of mild steel
     - 2.3.7 Describe the %age elongation and %age reduction in area of specimen in tensile test
     - 2.3.8 State need of correct holding of specimen on machine
   - 2.4 Explain Compression test
     - 2.4.1 Describe compression test
     - 2.4.2 Describe procedure for the conduct of compression test
     - 2.4.3 Describe standard specimen for compression test
   - 2.5 Understand Bending Test
     - 2.5.1 Describe bending
     - 2.5.2 Explain bending test and shape factor
     - 2.5.3 Describe deflection in specimen and bending equation.
   - 2.6 Understand Shear Test
     - 2.6.1 Explain shear test procedure on universal testing machine
     - 2.6.2 Explain shear stress calculation of round bar and punched plate specimen
   - 2.7 Understand Torsion Testing Machines and Torsion Test
     - 2.7.1 Describe torsion
     - 2.7.2 Explain shafts subjected to twisting moment
     - 2.7.3 Explain working of torsion testing machine
     - 2.7.4 Explain procedure of torsion test
   - 2.8 Understand Fatigue Testing Machine and Fatigue Test
     - 2.8.1 Define fatigue
     - 2.8.2 Describe the Phenomenon of Stress Hysteresis
     - 2.8.3 Describe cyclic loading
     - 2.8.4 Explain effect of fatigue on metals and fatigue failure
     - 2.8.5 Explain working of fatigue testing machine
     - 2.8.6 Explain procedure for fatigue test
3. **Non Destructive Test**
   - 3.1 Describe Pressure Test (pneumatic, hydraulic)
   - 3.2 Describe Hammer Test
   - 3.3 Describe Visual Inspection
   - 3.4 Explain Dye Penetrant Test
     - 3.4.1 Describe need and uses of Dye penetrant test
     - 3.4.2 Describe procedure of Dye penetrant test
   - 3.5 Explain Eddy Current Inspection
     - 3.5.1. Describe need and uses of Eddy Current test
     - 3.5.2 Describe procedure of Eddy Current test
     - 3.5.3 Describe equipment of Eddy Current test
   - 3.6 Understand Ultrasonic Test of metals
     - 3.6.1 Describe need and uses of Ultrasonic test In the Inspection of Metals and Metallic Component
     - 3.6.2 Explain Ultrasonic testing Equipment
     - 3.6.3 Describe procedure of Ultrasonic test
   - 3.7 Understand Magnetic particles inspection Methods
     - 3.7.1 Enlist advantages disadvantages
     - 3.7.2 Explain the equipment used
     - 3.7.3 Explain the basic principle
     - 3.7.4 Explain crack detection procedure
   - 3.8 Understand Radiographic inspection
     - 3.8.1 X-Ray Method
       - 3.8.1.1 Enlist advantages and disadvantages of x-ray test.
       - 3.8.1.2 Explain the basic principle of x-ray test
       - 3.8.1.3 Explain the equipment used

       - 3.8.1.4 Enlist the safety measures adapted in x-ray method
       - 3.8.1.5 Explain the use of x-ray method in the inspection of castings and welded joints
     - 3.8.2 Gamma Ray Method
       - 3.8.2.1 Describe basic principle of Gamma Rays methods
       - 3.8.2.1 Enlist advantages and disadvantages of Gamma Rays methods with respect to X-ray method
4. **Heat Treatment**
   - 4.1 Understand Heat Treatment of Steel
     - 4.1.1 Describe heat treatment of steel
     - 4.1.2 Explain constituents of steel
     - 4.1.3 Describe allotropic phases of steel
     - 4.1.4 Explain change of structure on heating
     - 4.1.5 Explain role of heating rate/cooling rate
     - 4.1.6 Distinguish between micro and macro structure
     - 4.1.7 Sketch iron carbide diagram
     - 4.1.8 Describe significance of various areas in iron carbide diagram
     - 4.1.9 Explain role of iron carbide diagram in heat treatment of carbon steel
     - 4.1.10 Describe time temperature transformation diagram
   - 4.2 Understand Phase Diagram (Alloy steel)
     - 4.2.1 Define phase diagram
     - 4.2.2 Explain importance of phase diagram
     - 4.2.3 Name different phases
     - 4.2.4 Explain different phases
   - 4.3 Understand effect of heating on steels
     - 4.3.1 Describe heating curve of steels
     - 4.3.2 Describe its importance in heat treatment of steel
   - 4.4 Understand Effect of rate of Cooling on Steel
     - 4.4.1 Explain the change of micro structure on cooling
     - 4.4.2 Explain the importance of rate of cooling
     - 4.4.3 Enlist different methods of cooling and its effect
     - 4.4.4 Explain cooling curve of steels
5. **Heat Treatment Processes**
   - 5.1 Understand Hardening
     - 5.1.1 Describe hardening and its objectives
     - 5.1.2 Enlist steps taken in hardening
     - 5.1.3 Describe effects of cooling rate on hardening
     - 5.1.4 Define different media used for quenching
     - 5.1.5 Describe harden ability of steels
   - 5.2 Understand Tempering
     - 5.2.1 Describe tempering and its objectives
     - 5.2.2 Describe au tempering and martempering
   - 5.3 Understand Annealing
     - 5.3.1 Define annealing and its objectives
     - 5.3.2 Describe types of annealing
       - 5.3.2.1 Process Annealing
       - 5.3.2.2 Full annealing
       - 5.3.2.3 Isothermal annealing
       - 5.3.2.4 Spherodizing annealing
   - 5.4 Understand Normalizing
     - 5.4.1 Define Normalizing and its objectives
     - 5.4.2 Describe comparison between annealing and normalizing

6. **Heat Treatment Equipment**
   - 6.1 Understand Heat Treatment Furnaces
     - 6.1.1 Describe heat treatment furnaces
     - 6.1.2 Classification of furnaces
       - 6.1.2.1 Hearth Furnaces (Muffle and Semi-Muffle)
       - 6.1.2.2 Bath furnaces
   - 6.2 Understand Pyrometer
     - 6.2.1 Define Pyrometer
     - 6.2.2 Enlist types of pyrometers
     - 6.2.3 Enlist different parts of thermocouple optical pyrometer, radiation pyrometer
     - 6.2.4 Explain working principle of pyrometer
   - 6.3 Understand Metallurgical Microscope
     - 6.3.1 Describe microscope
     - 6.3.2 Describe working and construction of metallurgical microscope
     - 6.3.3 Explain Metallography
     - 6.3.4 Describe preparation of specimen for metallogrphy
     - 6.3.5 Describe etching and etchants
     - 6.3.6 Describe microstructure study of iron

7. **Case Hardening Processes**
   - 7.1 Understand Carburizing
     - 7.1.1 Describe pack Carburizing
     - 7.1.2 Describe liquid Carburizing
     - 7.1.3 Describe gas Carburizing
   - 7.2 Understand Induction hardening
     - 7.2.1 Induction hardening process
     - 7.2.2 Advantages of Induction hardening
   - 7.3 Describe flame hardening
   - 7.4 Describe cyaniding
   - 7.5 Describe Nitriding

8. **Understand Heat Treatment of Non Ferrous Metals, Alloys and Cast Iron**
   - 8.1 Explain heat treatment of cast iron
   - 8.2 Explain heat treatment of nonferrous metals and alloys
   - 8.3 Describe precipitation hardening and annealing of nonferrous metals

Mech-362 MATERIALS TESTING AND HEAT TREATMENT

List of Practical:

(A) MATERIALS TESTING

1.	Practice for brinnell hardness test	3 Hrs
2.	Practice for Rockwell hardness test for B-scale hardness	6 Hrs
3.	Practice for Rockwell hardness test for C-scale hardness	3 Hrs
4.	Practice for Izod test on cast iron or Aluminum standard test specimens	3Hrs
5.	Practice for tensile test on universal testing machine on standard specimen	6Hrs
6.	Practice for Compression test on cast iron specimen.	6Hrs
7.	Practice for bending test on universal testing machine	3 Hrs
8.	Practice for shear test on universal testing machine	3 Hrs
9.	Practice for torsion test on torsion testing machine	3 Hrs
10.	Practice for fatigue test	3 Hrs
11.	Practice for Dye Penetrant test	3 Hrs
12.	Practice for Ultrasonic test on ultrasonic testing equipment	3 Hrs
13.	Practice for Magnetic particle test	3Hrs

(B) HEAT TREATMENT

14.	Practice for working of metallurgical microscope	3 Hrs
15.	Practice of preparation of specimen for metallography	6 Hrs
16.	Observe grain size of micro-structure of mild steel specimen	6 Hrs
17.	Observe micro-structure of cast iron specimen	6 Hrs
18.	Practice for hardening and observe micro structure of carbon steel	6Hrs
19.	Practice for annealing and observe grain structure of carbon steel	6 Hrs
20.	Practice for normalizing and observe grain structure	6 Hrs
21.	Practice for pack carburizing and observe grain structure	6 Hrs
22.	Practice for stress relieving of Aluminum	3 Hrs

Mech-362 MATERIALS TESTING AND HEAT TREATMENT

Practical Objectives:

(A) MATERIALS TESTING

1. **Practice for Brinell hardness test**
   After performing Brinell hardness test, the students should be able to:
   - I) Perform grinding & polishing of specimen for Brinell test
   - II) Perform Brinell test on Brinell testing machine
   - III) Check hardness of metallic specimen

2. **Practice for Rockwell hardness test for B-scale hardness**
   After performing Rockwell hardness test for B scale, the students should be able to:
   - I) Perform grinding & polishing of specimen for Rockwell test
   - II) Fit steel ball indenter into plunger & placing weights
   - III) Perform Rockwell test for B scale with ball indenter

3. **Practice for Rockwell hardness test for C-scale hardness**
   After performing Rockwell hardness test for C scale, the students should be able to:
   - I) Perform grinding & polishing of specimen for Rockwell test
   - II) Fit Diamond Cone indenter into plunger & placing weights
   - III) Perform Rockwell test for C scale with Diamond Cone indenter

4. **Practice for Izod test on cast iron and aluminum standard test specimens**
   After performing Izod test on Izod testing machine, the students should be able to:
   - I) Make specimen of different materials according to specifications
   - II) Set different energies or pendulum heights, according to the material, on the machine
   - III) Perform Izod test on Izod testing machine
   - IV) Able to determine the toughness of the material

5. **Practice for tensile test on universal testing machine on standard specimen**
   After performing tensile test on Universal testing machine, the students should be able to:
   - I) Make specimen according to standard size
   - II) Mark gauge length points on the specimen
   - III) Clamp specimen properly in the machine gripping jaws
   - IV) Operate inlet and outlet oil valves of machine
   - V) Draw stress strain curve on tracing unit of the machine
   - VI) Remove broken specimen from machine jaws
   - VII) Calculate all observations (% elongation, % reduction in area, yield stresses, ultimate tensile stresses, and breaking stresses) relevant to test

6. **Practice for Compression test on cast iron specimen.**
   After performing Compression test on Universal testing machine, the students should be able to:
   - I) Install compression attachment on machine
   - II) Perform compression test on specimen
   - III) Draw stress strain curve on tracing unit of the machine
   - IV) Calculate compressive stress and all other observations relevant to test

7. **Practice for bending test on universal testing machine**
   After performing bending test on Universal testing machine, the students should be able to:
   - I) Fit bending fixture on Universal testing machine
   - II) Perform bending test on specimen
   - III) Calculate Modulus of elasticity and all other observations relevant to test

8. **Practice for shear test on universal testing machine**
   After performing Shear test on Universal testing machine, the students should be able to:
   - I) Install shear test fixture or die and punch on the machine
   - II) Perform shear test on specimen
   - III) Calculate ultimate shear stress of test specimen

9. **Practice for torsion test on torsion testing machine**
   After performing Torsion test on Torsion testing machine, the students should be able to:
   - I) Fit specimen on torsion testing machine
   - II) Performing torsion test on specimen
   - III) Calculate all observations relevant to test

10. **Practice for fatigue test on fatigue testing machine**
    After performing Fatigue test on Fatigue testing machine, the students should be able to:
    - I) Fit specimen on fatigue testing machine
    - II) Perform fatigue test on specimen
    - III) Calculate all observations relevant to test

11. **Practice for Dye Penetrant test**
    After performing Dye penetrant test, the students should be able to:
    - I) Clean and prepare surface for the test
    - II) Apply fluorescent dye on the specimen
    - III) Apply developer after cleaning the surface
    - IV) Detect surface flaws, cracks, pin holes, surface discontinuities

12. **Practice for Ultrasonic test on ultrasonic testing equipment**
    After performing Ultrasonic test ultrasonic on testing equipment, the students should be able to:
    - I) Clean and prepare surface for the test
    - II) Operate ultrasonic on testing equipment
    - III) Detect flaws, blow holes and other internal defects in metals

13. **Practice for Magnetic particle test on Magnetic particle testing equipment**
    After performing Magnetic particle test on Magnetic particle testing equipment, the students should be able to:
    - I) Clean and prepare surface for the test
    - II) Operate Magnetic particle testing equipment
    - III) Detect flaws, blow holes and other internal defects in metals

(B) HEAT TREATMENT

14. **Practice for working of metallurgical microscope**
    After practice of working of metallurgical microscope, the students should be able to:
    - I) Know different parts of metallurgical microscope
    - II) Operate metallurgical microscope
    - III) Know function of each part
    - IV) Draw a neat sketch of microscope indicating its different parts

15. **Practice of preparation of specimen for metallography**
    After preparation of specimen for metallography the students should be able to:
    - I) Grind and polish the specimen .Etching the specimen with etching solution
    - II) Press specimen with plastic material

16. **Observe grain size of micro-structure of mild steel specimen**
    After study of grain size of specimen the students should be able to
    - I) Examine different microstructures of steel (ferrite, cementite, pearlite, etc.)

17. **Observe grain size of micro-structure of cast iron specimen**
After study of grain size of specimen the students should be able to:
I) Examine different microstructures of cast iron (cementite, pearlite.. etc)

18. **Practice for hardening and observe of micro structure of carbon steel**
After hardening & quenching of specimen the students should be able to:
I) Heat the carbon steel in heat treatment furnace
II) Use proper quenching media
III) Polish, grind, etch specimen for metallography
IV) Examine microstructure of hardened steel

19. **Practice for annealing and observe micro structure of steel**
After annealing of specimen the students should be able to:
I) Heat the steel or specimen on required temperature in electric furnace
II) Give the steel soaking time
III) Remove the specimen from furnace after slow cooling
IV) Polish, grind, etch specimen for observe grain structure

20. **Practice for normalizing of steel and observe grain structure**
After Normalizing of specimen, the students should be able to:
I) Heat the carbon steel specimen on required temperature in electric furnace
II) Give the steel soaking time
III) Remove the specimen from furnace after specified time
IV) Keep the specimen in air for cooling
V) Polish, grind, etch specimen and observe of grain structure

21. **Practice for pack carburizing of steel and observe micro structure**
After Pack-carburizing process of low carbon steel, the students should be able to:
I) Pack and seal specimen with Carbonaceous materials in steel box
II) Heat the specimen up to required time and temperature
III) Check hardness difference between case and core
IV) Polish, grind and etch specimen and observe grain structure

22. **Practice for stress relieving of Aluminum**
I. Select and prepare specimen
II. Heat up specimen in muffle furnace
III. Cool the specimen at specific rate of cooling
IV. Examine the specimen for its variation in strength _____

Mech-362 MATERIALS TESTING AND HEAT TREATMENT

List of Machinery:

1.	Brinell Hardness Testing Machine	1
2.	Rockwell Hardness Testing Machine	1
3.	Izod Impact Testing Machine	1
4.	Universal Testing Machine	1
5.	Heat treatment Furnace (Electric)	1
6.	Specimen Cutoff Machine	1
7.	Specimen Polishing Machine	2
8.	Specimen Mount Press	1
9.	Pedestal Grinder	2
10.	Metallurgical Microscope (1000x)	3
11.	Torsion Testing machine	1
12.	Fatigue testing machine	1
13.	Quenching Bath	1
14.	Ultrasonic testing equipment	1
15.	Magnetic particle testing equipment	1

添付資料 6-6：第 55 回 CCDTE 会議録

Minutes of 55th CCDTE Meeting

Held on

25th September, 2019

At Ramada Hotel Islamabad

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Details of Agenda Items

Sr.	Item No.	Subject	Page#
1	Agenda-1	Confirmation of 54th CCDTE minutes of meeting	04
2	Agenda-2	Setting up Equivalency for G-I, G-II, & G-III with NVQF levels	05
3	Agenda-3	Elucidation of Notification of Sindh Board of Technical Education	06
4	Agenda-4	Reservation on Development of National Vocational Qualification level-5	07
5	Agenda-5	Grant of approval of curriculum for DAE Mechanical Technology (3-Years course) revised, 2019 by Punjab-TEVTA	08
6	Agenda-6	Grant of approval of curriculum for Matric-Vocational (Hotel Operations) (2-Years course) developed, 2019 by Punjab-TEVTA	09
7	Agenda-7	Increase in Amount of Annual Contribution for CCDTE	10
8	Agenda-8	Lifetime registration and unlimited chances for Candidates in all Programs of TVET	11
9	Agenda-9	Equivalence for Aptech's Diploma in Software Engineering with DAE (CIT)	12
10	Agenda-10	Definitions, Objective and Mandate for Affiliation, Registration and Accreditation	13-16
11	Agenda-11	Minimum age limit for admission into each Levels of NVQF	11-17
12	Agenda-12	CBT Qualifications of Level 5 equal to DAE and F. Sc	17-21
13	Agenda-13	Printing Of "By Parts" On DAE Pass Out Diplomas	22-23
14	Agenda-14	Proposal To Alleviate The Miseries and Plights Of DAEExaminations Candidates Who Have Exhausted Their Prescribed Number Of Chances And Fall Under No Chance Category	23-24
15	Agenda-15	Promotion of Technical & Vocational Education in Pakistan through special initiative by the Boards for poor communities / unskilled youth	25-26
16	Agenda-16	Introduction of Post Diploma Courses (Innovative demand driven trades) in the TVET Institute of Sindh Province	27-28
17	Agenda-17	Grant of approval of curriculum for DAE-Furniture Design &Technology (3-Years course) Developed, 2019 by Punjab-TEVTA	29-30

Minutes of Meeting

The 55th meeting of CCDTE (Pakistan) was held on 25 & 26 September, 2019 at Ramada hotel, Islamabad.

The Following Officers attended the meeting.

1) Mr. Muhammad Nazer Khan Niazi, Chairman, CCDTE / PBTE — In Chair
2) Mr. Hussain Ahmad Madni, Secretary, IBCC — Member
3) Dr.Masroor Ahmad Chairman SBTE, Karachi. — Member
4) Mr. Muhammad Yousaf Baloch, Chairman, BISE, Quetta — Member
5) Mr. Hadayatullah Khan, Chairman, KPBTE — Member
6) Mr. Muhammad Sadiq, KP-TEVTA — Member
7) Mr. Waqar Ud Din, P-TEVTA — Member
8) Mr. Faqir Muhammad Kayfi, Secretary, PBTE / CCDTE — Member

Following Officers were present as Observer/special invitees.

1) Mr. Muhammad Muqeem Islam, DG (SS&C), NAVTTC, Islamabad
2) Mr. Muhammad Naeem Akhtar, GIZ, Islamabad

It is regretted that, Director S-TEVTA & Directress Education, Quetta were granted leave of absence.

The meeting started with the recitation of verses from the Holly Quran. The participants of the meeting introduced themselves and exchanged good wishes for one another. The meeting also vowed to play a very positive role in the growth and promotion of Technical Education.

Thereafter, agenda items were taken up.

Agenda Item No. 5

Grant of approval of curriculum for DAE Mechanical Technology (3-Years course) revised, 2019 by Punjab-TEVTA *(Agenda item received from P-TEVTA)*

Background:

Punjab-TEVTA is in continuous process of development and revision of curricula of various duration and streams. Recently, the curriculum of DAE Mechanical (3-Years) has been revised by committee comprising of experts (Annexure-A) from Academia (University & TEVTA) and relevant industry keeping in view, the recent market demand of this field. Diploma of Associate Engineer (DAE) in Mechanical Technology (3-year) Course is being implemented in 27- TEVTA Govt. Colleges/ Institutes as well as in many private Colleges/ Institutes affiliated with PBTE / TEVTA. The same has been notified, accordingly. (Notification at Annexure-B). These DAE Curricula also maintain equivalency with F.Sc. / HSSC (Pre-Engg.).

Point of Issue:

In the light of minutes of 53rd meeting of CCDTE held on 22-03-18 (Item No. 8), every curriculum newly developed or updated/ revised(in this case) by provincial TEVTAs, is to be forwarded to respective provincial BTE (Letter placed at Annexure-C) Academic committee and then the same be communicated to CCDTE forum for approval. As a matter of fact, the forthcoming Academic session for DAE courses, being the annual based programme will be starting w.e.f 1st September, 2019 in which currently revised curriculum for DAE-Mechanical, 2019 will also be implemented for all colleges concerned in Punjab.

Proposed Process/ Working:

Keeping in view the above referred minutes and codal formality of approval by CCDTE, it is proposed that the competent forum may accord the approval of DAE Mechanical technology curriculum revised, 2019.

The matter is placed before the Honourable Members of the CCDTE forum for favourable and affirmative consideration and approval please.

Decision:

The committee examined the matter and resolved to approve the curriculum for DAE Mechanical Technology revised-2019 by Punjab TEVTA.

It was also resolved that the document should be shared with all members.

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添付資料 6-7：改訂シラバス

SYLLABUS
Of
REVISED CURRICULUM

March 2019

The Project for Strengthening DAE in Mechanical Technology at Government Colleges of Technology in Punjab Province in The Islamic Republic Of Pakistan

Government of Punjab
Technical Education & Vocational Training Authority
(TEVTA)

Japan International Cooperation Agency
(JICA)

Subject Code: MT-141
Subject Name: Safety Practices and Procedures (Health Safety and Environment)
Total Contact Hours: 32 hrs.
Related Subjects:
Course Objective: At the end of this course, the students will be able to -

i) Adopt safety standards, codes, rules, etc., to be desired in Mechanical Workshop / labs of Industries.
ii) Understand methods of prevention of accident.
iii) Provide first aid and rescue in case of any accident.

MT-141	Safety Practices and Procedures	Theory

No.	Week	Title	Description
1	1st	Introduction and Importance of Safety	1) Describe importance of housekeeping, Safety and accidents 2) Describe the importance of safety practices in institute shops/labs 3) Describe the hazards for not observing safety 4) State necessity/importance of observing safety in the industry at the Cost of accident
2	2nd _ 3rd	Accident in Chemical Industry	1) State the type and causes of accidents in petroleum, fertilizer, plaint and chemical based industry 2) Describe accidental causes and effects of explosive gases and vapours
3	4th _ 6th	Accidents in Process Industry	1) List of accidents in material handling and transportation in industry 2) Explain proper use of hand tools to prevent accident 3) Describe accidents in machines shop 4) Describe accidents in Metal workshop 5) Describe accidents in wood working shop 6) Describe accidents in foundry, welding and forging shop 7) Describe Safety in CNC machines operation
4	7th -8th	Accidents in Flow Production Industry	1) State the types of accident in flow process industry
5	9th _ 10th	Accidents in other Industries	1) Describe accidents in Mines 2) Describe accidents in Leather industries 3) Describe accidents in Power plant (Steam)
6	11th _ 12th	Electric shocks & Ear thing (Prevention and its remedy)	1) Describe Electricity as danger 2) Describe Electric sock phenomena 3) Describe Reasons of electric shock 4) Describe Prevention of electric shock 5) Describe First aid in electric shock

7	13th -15th	Fire Accidents and their preventions	1) Describe prevention of fire accidents on plant 2) Know the causes of fire hazard 3) Know Steps to control fire/fire fighting 4) Identify the fire safety points and layout 5) Know how to store flammable materials
8	16th _ 17th	Safety in Plants layout	1) Identify the safety aspect in plant layout 2) Describe the house keeping procedure for safety 3) Identify the procedure to layout machines and Equipment by considering safety aspect 4) Explain the instructions use of electricity 5 Implementation of 3S and 5S in Workplace
9	18th - _ 19th	Personal Protective Equipment	1) State useful protective devices 2) List personal protective devices and describe its importance 3) Describe use of protection devices for protecting from chemicals and gases
10	20th _ 22nd	Environmental Safety	1) Knows environmental effects on human beings and surroundings 2) Explain importance and purpose of industrial ventilation 3) Describe exhaust system in industry and their important 4) Identify effect of noise on environment and their role in accidents 5) Explain necessity of plant hygiene for safety and comfort 6) Explain necessity of plant hygiene for safety and comfort 7) Explain causes of thermal radiation and their remedy 8) Explain causes and remedy of spilltoons dust, fumes, improper light and overcrowding accidents 9) Explain needs of artificial humidification 10) Explain effects of polluted water
11	23rd _ 24th	Pollution	1) Describe different stages of Atmosphere 2) Describe the international standards of pure water 3) Describe the solid waste and, its types
12	25th - 26th	First Aid	1) Identify the importance of first aid 2) Explain the methods of providing first aid and their training may be arranged to trained the students in first aid procedure a video 3) Identify the step by step procedure of providing medical services 4) Describe its uses and protection of respiration system and methods of artificial respiration systems in accidents

13	27th -29th	Analysis Causes of Accidents	1) Understand the procedure of analysis the causes of accidents 2) Know the use of data for investigation and resident reports for analysis the causes of accident 3) Identify safety rules procedures in the light of annual accidents report for safe guard
14	30th	Promoting Safety Culture	1) Identify the importance of safety 2) Describe methods of promoting safety concept by display charts, play cards, Banners and wall chalking 3) List methods of promoting safety concepts 4) Introduction to Sustainability
15	31st _ 32nd	Safety Regulations and adherence to International Safety Standards	1) Explain safety Regulations & adherence to International Safety Standards 2) Describe clauses of Pakistan Factory Act related to safety 3) Describe Workman compensation Act 4) Identify the procedure for industrial insurance and social security 5) Describe legal procedure in case of serious accidents

Recommended Books:

1) Industrial Safety Health and Environment Management System by R.KJain, Sunil S. Rao (Khanna Publishers)
2) 5S Guidebook by NPC/ Malaysia
3) Training book for unskilled workers on Safety by Ministry of Health Labour and Welfare, Japan

Subject Code: Mech-312

Subject Name: Hydraulics and Hydraulic Machines

Total Contact Hours: 32 hrs.

Related Subjects:

Couse Objective: At the end of the course the students will able to understand properties of incompressible fluids, pressure and flow of fluids, able to apply problems of total head of water for losses of heads etc. The student will be able to know the Introduction to water wheels, hydraulic turbines, pumps and, hydraulics machines. Knowledge of essential parts of hydraulic circuits, types of Actuators, their applications & maintenance, Knowledge of different types of directional control valves used in hydraulic control / circuits. The student will also be able to study hydraulic circuits of different machines & can rectify their basic faults.

Theory		(Hydraulics and Hydraulic Machines)	
No.	**Week**		**Description**
1	1st _ 4th	Introduction to Hydraulics	1) Introduction to hydraulics 2) Introduction to different properties of liquids (Water &oils) 3) Viscosity of liquids, 5.1. Units of Viscosity, Relation of change of viscosity with the change of temperature 4) Pressure head of liquids, Conversion of intensity of pressure in head of liquid 5) Pascal's law 6) Pressure and its Types, Atmospheric pressure, Gauge pressure, Absolute pressure, 7) Measurement of pressure with 8) Solution of simple problems on above topics
2	5th _7th	Hydro Kinematics	1) Introduction 2) Rate of discharge 3) Equation of continuity of flow 4) Total energy/head of liquid particles in motion 5) Bernoulli's Equation 6) Types of flow 7) Use of Pitot-tube gauge for measurement of velocity and discharge of flowing fluids
			8) Solution of simple problems of discharge, Velocity head, pressure head, Datum head intensity of pressure in flowing liquid when all parameter are given

3	8th -10th	Flow through pipes	1) Introduction to losses of head in pipes 2) Loss of head of liquid flowing in pipe (major & minor losses) 3) Solution of simple problems by direct application of formulae
4	11th-13th	Water Turbines	1) Introduction to Development of water Wheels & water turbines 2) Advantages of water turbines over water Wheels 3) Classification of water turbines 4) Impulse Turbines (Pelton wheel) & its main parts 5) Reaction turbine and main parts 6) Differentiate between Impulse & reaction turbine 7) Advantages of hydraulics turbines
5	14th _17th	Pumps	1) Introduction to pump 2) Types of pumps 3) Construction and working of Centrifugal Pumps 4) Construction and working of reciprocating pump 5) Comparison of centrifugal and reciprocating pump 6) Cavitation in pumps, their causes and remedy 7) Solution of simple problems by using above formulae
6	18th – 20th	Hydraulic valves and Seals	1) Types of Directional control Valves, their Study, symbols and function 2) Pressure relief valves and their types 3) Flow controll/ Speed control valves & their types 4) Study of Pilot operated directional control valves construction, uses and symbols 5) Study of Check valves 6) Study of Seals used in hydraulics circuits 7) Study of Safety Devices necessary in a hydraulic circuits
7	21st _ 24th	Hydraulic Simple Machines	1) Types of simple hydraulic machines 2) Hydraulic press 3) Mechanical advantage of hydraulic press 4) Accumulators Their Types and uses in Hydraulic Circuits 5) Hydraulic Intensifiers 6) Solve simple problems on mechanical advantage of hydraulic press, Accumulators, and Intensifier
8	25th _ 28th	Hydraulics Actuators	1) Classification of Rotary Actuators & their method of actuation 2) Classifications of reciprocating Actuators their construction and working

9	29th _ 32nd	Hydraulic Circuits and Accessories	1) The parts/ components of hydraulic circuits 2) Uses of proximity switches 3) Uses of different hydraulic filters, chillers, different types of rubber hoses, pipe fittings, and couplings

Recommended Books:

1) Fluid Mechanics by John F. Douglas (Fifth Edition)
2) Fluid Mechanics with Engineering Applications by Robert L. Daugherty, Joseph B. Franzini
3) Hydraulics and Hydraulics Machines by E.H.LEWITT (Sir ISAAC Pitman & Sons Ltd London)

Practical		(Hydraulics and Hydraulic Machines)	
No.	**Week**	**Title**	**Description**
1	1st	Observe hydraulic bench and its function	1) Observe pressure head 2) Specific gravity of liquid 3) Observe the conversion of intensity pressure in to head of liquid and head of liquid in to intensity 4) Practice to use simple manometer
2	2nd _ 3rd	Practice of Calibration of Bourdon tube and diaphragm pressure gauge with dead weight and master gauge calibrator	1) Basic principle use in dead weight pressure calibrator 2) Observe the construction of Bourdons tube pressure gauge 3) Observe the construction of diaphragm pressure gauge 4) Calibration of Bourdon tube pressure gauge and diaphragm pressure gauge with dead weight pressure calibrator
3	4th	Operate hydraulic press and observe power required to derive it	1) Work done against a pressure 2) Power required for driving a hydraulics press
4	5th – 6th	Practical application of Hydraulic bench for Conservation of energy of flowing fluid in pressure head an datum head as H=v2/2g	1) Verify the Law of conservation of energy 2) Verify total head of liquid 3) Bernoulli's theorem and practical application 4) Calculate conversion of velocity head, pressure head and datum head
5	7th – 8th	Performance test on friction pipe apparatus to know total head status of flowing fluid/ Bernoulli's theorem	1) Observe the function of viscosity of liquid, & K.E. of flowing fluid 2) Observe the friction due to roughness of ideal surface as in gauge blocks etc. 3) Observe friction due to roughness of pipe 4) Measure loss of head in pipes due to friction in pipe apparatus 5) Practice of calculation of loss of head due to friction by using friction in pipe apparatus
6	9th _ 10th	Observe behaviour of flowing fluid due to sudden enlargement of cross sectional area of pipe, & formation eddies current at enlarged cross section of pipe	1) Observe behaviour of liquid at sudden contracted cross sectional area in pipe 2) Observe formation of vena contract beyond contraction (due to sudden enlargement) 3) Measure loss of head due to sudden enlargement, contraction and entrance in a pipe using friction in a pipe apparatus
7	11th	Perform the function of impulse turbine	1) Observe behaviour of water jet at the reduction in cross sectional area at the movement of spear in the nozzle of impulse turbine (pelton wheel) 2) Observe function of casing of pelton wheel 3) Observe pressure / atmospheric pressure around the Water jet and water wheel/ impulse Turbine/ pelton wheel 4) Observe water hammer at the start and stop of pelton wheel turbine on pipe and hear noise of water hammer on pipe 5) Observe output HP at the shaft at pelton wheel turbine using purelly brake mechanism 6) Observe the parts of a pelton wheel turbine

8	12th	Performance test on reaction turbine	1) Operate the reaction turbine 2) Measure difference of pressure at different position of reaction turbine by piezometer tube or with Gauges/ dial gauges 3) Measure in put power at the inlet of Francis turbine 4) Observe the reaction turbine (Francis turbine)
9	13th	Performance test on centrifugal force	1) Observe the different parts of centrifugal pump 2) Observe the different parts of reciprocating pump 3) Compare centrifugal pump with reciprocating pump
10	14th	Performance test on positive displacement pump	1) Measure discharge of reciprocating pump 2) Verify discharge of reciprocating pump 3) Measure slip of reciprocating pump 4) Observe the parts of reciprocating pump
11	15th _ 16th	Practice of measurement of pressure at various connections in hydraulic circuit	1) Perform the function of temperature gauge at oil reservoir/oil tank in a circuit 2) Perform the function of oil filter in hydraulic Circuit 3) Observe all safety devices which necessary in a hydraulic circuit 4) Observe the necessity of pressure relief valve in hydraulic circuit 5) Measure pressure at various positions in hydraulic circuit 6) Draw block/ circuit diagram of a Hydraulic circuit 7) Uses and positions of directional control valve in a Hydraulic circuit 8) Use, position & necessity of non-return valve in a Hydraulic circuit 9) Set the equipment into the test panel 10) Check all the connections houses are firmly coupled 11) Practice of determination of pressure at various connections to the driven elements and direction of flow depending different settings of directional control valve
12	17th – 18th	Actuation of double acting hydraulic cylinder at push of a switch ,develop speed regulation through throttle valve and flow control valves	1) Measure pressure at various positions in hydraulic Circuit 2) Draw block/ circuit diagram of a Hydraulic circuit 3) Uses and positions of directional control valve in a Hydraulic circuit 4) Use, position & necessity of non-return valve in a Hydraulic circuit 5) Set the equipment into the test panel 6) Check all the connections houses are firmly coupled 7) Practice of determination of pressure at various connections to the driven elements and direction of flow depending different settings of directional control valve

13	19th	Actuation of double acting hydraulic cylinder at a rapid Traverse by using one way Throttle Valve	1) Make sure the pump is switched off and oil is not in pressure at the coupling/ fitting stage 2) Set the equipment into the test penal 3) Connect the units according to the circuit diagram with connection Hoses 4) Check all the connection Hoses firmly coupled 5) Carry out the experiment as rapidly as possible to keep the overheating of oil during practical (not more than 45oC) 6) Observe the function of Throttle Valve and draw Circuit Diagram 7) Observe the function by extending a double acting hydraulic cylinder at push of a switch develop speed regulation through throttle and flow valves
14	20th	Setup a pressure device on a double acting cylinder by using pressure reducing valve	1) Observe the function of Pilot operated Check Valve 2) Observe the sequence of Elements used in circuit 3) Observe the Function of Pressure Relief valve, know function of Non Return Valve in this Circuit Diagram 4) Mount the various units in the test panel according to the layout/circuit diagram 5) Connect the circuit with Pressure Houses 6) Connect the cylinder and measure Inlet and Outlet Pressure on Pump 7) Set the throttle check valve 8) Draw Hydraulic circuit diagram for this Practical 9) Check rapid Traverse of cylinder at return of stroke and complete this practical
15	21st _ 22nd	Practice to hold a specific load by using double acting cylinder and pilot operated check valve	1) Mount various components in the test panel 2) Check/set sequence of components 3/2 and 4/2 directional control valve, pressure relief valve and pilot operated chuck valve 3) Draw circuit diagram for the circuit I conduct the experiment according to the circuit diagram
16	23rd _ 24th	Construct a circuit for double acting cylinder for mechanical interlocking with switch contacts also draw its circuit diagram	1) Arrange the components/valve in the test panel as per circuit diagram 2) Observe what is Mechanical interlocking with switch contacts 3) Draw circuit diagram for the circuit & conduct the experiment according to the circuit diagram Complete the experiment
17	25th _ 26th	Construct a circuit to control a double acting hydraulic cylinder, by using 02, push button, and cancelling with proximity limit switch	1) Observe the types of limit switches/proximity switches (conductive, capacitive & optical) used in a hydroelectric circuit 2) Observe what is the function of two hand safety Circuit? 3) Draw a Hydraulic circuit diagram to connecting a double acting Hydraulic cylinder using push button, direction hold in circuit and connecting with limit switch using two hand electrical push button safety circuit 4) Draw circuit diagram for the circuit & conduct the experiment according to the circuit diagram Complete the experiment

18	27th _ 28th	Practice to set a hydraulic motor R.P.M & direction by using Flow Control & Directional valve	1) Practice the use of a direction control valve changes the direction of rotation of a hydraulic motor 2) Observe that how we can change the velocity of hydraulic motor by using throttle valve 3) Draw circuit diagram for the circuit & conduct the experiment according to the circuit diagram Complete the experiment
19	29th _ 30th	Construct a hydraulic circuit in which Accumulator stored energy can be utilized by double acting cylinder, when required	1) Observe the types of accumulators 2) How much we can store energy in an accumulator 3) Draw circuit diagram for the circuit & conduct the experiment according to the circuit diagram Complete the experiment
20	31st – 32nd	Visit to related industry plant	1) Understand overview of factory operation including process and volume of production from explanation by company 2) Understand structure and mechanism of focused one hydraulic machine or system from explanation and observation 3) To pick up and understand figures and control criteria of major performance parameters by explanation and observation

List of Equipment:

1)	**Fluid friction in pipes with hydraulic bench**	2-set
2)	**Bernoulli's Theorem Demonstration Apparatus**	2
3)	Orifice Discharge Apparatus	2
4)	Apparatus of Energy Losses in Bends	2
5)	Centrifugal Pump Apparatus	1
6)	Axial Pump Apparatus	1
7)	Reciprocating Pump Apparatus	1
8)	Pelton Turbine	1
9)	Reaction Turbine	1
10)	Hydraulic Control Equipment Set	1
11)	Pneumatic Control Equipment Set	1
12)	Gear Pump (Transparent Model)	1
13)	Vane Pump (Transparent Model)	1
14)	Axial Piston Pump (Transparent Model)	1
15)	Pressure Gauge (Transparent Model)	1
16)	Pressure Relief Valve (Transparent Model)	1
17)	Pressure Switch (Transparent Model)	1
18)	Pressure Switch (Transparent Model)	1
19)	Piston Accumulator (Transparent Model)	1
20)	Dead Weight Master Gauge Calibrator	1

Subject Code: **Mech-322 (Mech-323)**
Subject Name: **Applied Thermodynamics**
Total Contact Hours: **32 hrs.**
Related Subjects:
Course Objective: To transfer the knowledge of fundamentals of thermodynamics, laws and properties of gases, thermodynamic processes and cycles, formation and properties of steam, steam boilers and their performance, steam and Gas turbines, I.C. Engines,, Air compressors and their performance. Refrigeration and air conditioning etc.

	Theory		(Applied Thermodynamics)
No.	**Week**	**Title**	**Description**
1	1st _ 3rd	Fundamentals of Thermodynamics	1) Introduction to thermodynamics 2) Units, Systems of units, Thermodynamic systems, its classification and properties 3) Heat, Mass and weight, Force, Work and power 4) Temperature, Absolute Temperature and Temperature Scales, Normal/Standard Temperature and Pressure 5) Pressure, Absolute pressure, Gauge pressure and Vacuum pressure 6) Energy, Potential energy, Kinetic energy and Internal energy of gas 7) Laws of thermodynamics, Laws of conservation of energy and matter, limitations of 1st law of thermodynamics 8) Solution of problems by direct application of formulae for above topics
2	4th _ 6th	Laws and properties of perfect gases	1) Introduction 2) Boyle's law, Charles law, Gay-Lussac's law, Joule's Law, Avogadro's law, Regnault's law and Dalton's law 3) General gas equation, Characteristic Gas equation, Universal Gas equation 4) Specific heats of a gas, Molar specific heats of a gas and its mathematical relations 5) Enthalpy, and Entropy of a gas, importance of Entropy and relation between Heat & Entropy 6) Solution of problems by direct application of formulae for above topics
3	7th _ 11th	Thermodynamic processes and cycles	1) Introduction of thermodynamic process 2) Classification/types of thermodynamic processes 3) Application of 1st law of thermodynamics for work

			done during a non-flow-reversible process 4) Heating and Expansion of gases in Non flow-Reversible & Irreversible processes 5) Solution of p oblems by direct-application of formulae 6) Introduction and classification/types of thermodynamic cycles 7) Assumptions in thermodynamic cycles 8) Reversible and Irreversible cycles 9) Working of an ideal engine 10) CARNOT's Cycle, ono Cycle, DIESEL Cycle and Dual Combustion Cycle 11) Solution of problems for air standard efficiency of thermodynamics cycles
4	12th _13th	Formation and properties of Steam	1) Introduction of steam, its formation, properties and classification 2) Important terms used for steam 3) Temperature-Enthalpy and Temperature- Entropy diagrams for steam formation 4) Use of steam tables 5) Calculation of total heat of Wet ,dry and super-heated steam (Solution of Problems)
5	14th _17th	Steam Boilers and Their performance	1) Introduction of boiler 2) Classification of boilers 3) Selection of a steam boiler 4) Important terms used for steam boilers 5) Constructions and Working of: i) Simple vertical boiler (Single tube boiler) ii) COCHRANboiler (Multi tubular boiler) iii) Locomotive Boiler iv) Marine boiler (scotch type) v) Babcock and Wilcox Boiler 6) Boiler mountings and accessories 7) Comparison between Water Tube and Fire Tube boilers 8) Performance of steam boilers, Equivalent evaporation and boiler efficiency 9) Solution of problems regarding equivalent evaporation, power/H.P and efficiency of boiler
6	18th _ 21st	Steam and Gas Turbines	1) Introduction and classification of turbines 2) Steam Turbine (Impulse type) 3) Steam turbine (Reaction type) 4) Gas Turbines
7	22nd _ 25th	Internal Combustion Engines	1) Introduction of Internal & External Combustion Engines

			2) Classification of Le. Engines 3) Cycle of operations & important terms used 4) Comparison of Two Strokes Cycle and Four Strokes Cycle Engines 5) Petrol Engine 6) Diesel Engine 7) Indicated power, Brake power, Friction power and efficiencies of Le. Engines 8) Comparison of Le. engine and E.C. engine (Steam Engine) 9) Comparison of Petrol and Diesel engines 10) Solution of Problems regarding LP, B.P, Friction Power and Efficiencies of Le. engines
8	26th _ 30th		1) Introduction 2) Classification of air compressors(Reciprocating & Rotary) 3) Technical terms used 4) Construction and working of single stage reciprocating Air Compressor with help of PV-diagram and neat sketch 5) Multistage compression and its advantages 6) Two stage reciprocating air compressor with intercooler, work done per cycle with polytrophic law of compression 7) Power required to drive a single stage and two stage reciprocating air compressors 8) Comparison of reciprocating and rotary air compressors 9) Work done per cycle and power required to drive a rotary compressor 10) Solution of Problems regarding work done power required for single stage & multi stage rotary air compressors
9	31st_32nd	Refrigeration and Air Conditioning	1) Introduction 2) Classification of refrigeration systems / cycles 3) Units, terms used 4) Refrigerants and its properties commonly used 5) Properties of a good refrigerant 6) Introduction to vapour compression refrigeration system 7) Fundamentals of air conditioning system 8) Classification of air conditioning systems

Recommended Books:

1) Steam Tables (S.I UNITS) by M. Afzal Javaid
2) Principle of Refrigeration by Royj. Dossat
3) Air conditioning principles and system an energy approach by Edward. G. Pita
4) Applied Thermodynamics T.D Eastop, A. Mcconkey
5) Thermodynamics by Rayner Joel
6) Thermodynamics Applied to Heat Engines by E.H.LEWITT (Published by; Sir ISAAC Pitman & Sons Ltd London)
7) Heat Engines by D.A Low (McGraw Hill Book Company, New York)

Practical (Applied Thermodynamics)

No.	Week	Title	Description
1	1st	Pressure measurement by Barometer	1) Operate to learn the construction and working of BAROMETER 2) Calculation of pressure measurement
2	2nd	Know Thermometers and Thermocouples	1) Operate to learn the construction and working of Thermometers & Thermocouples 2) Application the method of calibration
3	3rd – 10th	Practice on the boilers	Study the construction, working and safety precaution of: 1) Simple Vertical Boiler 2) Cochran (Multi tubular) Boiler 3) Marine Boiler (Scotch types) 4) Locomotive Boiler 5) Babcock and Wilcox Boiler
4	11th – 18th	Practice on the Boiler Mountings and Accessories	Operate to learn the construction, working and safety precautions of: 1) Pressure Gauge (Bourdon type) 2) Water level Indicator 3) Safety Valve (Spring loaded) 4) Feed Water Pump
5	19th – 20th	Study of fault diagnosis of steam boiler apparatus Problem solving on Steam Boiler	1) Study the procedural steps for operations of a boiler 2) Study the performance of a boiler & safety precautions
6	21st – 22nd	Study on petrol engine Practice on Petrol Engine	1) Operate to learn the construction, working and safety precautions 2) Operate to learn the valves timing diagrams for 2-Stroke & 4-Stroke cycle petrol engines
7	23rd _ 24th	Study on diesel engine Practice on Diesel Engine	1) Operate to learn the construction, working and safety precautions 2) Operation of the valves timing diagrams for 2-Stroke & 4-Stroke cycle diesel engines
8	25th	Practice on Ignition point Testing Machine Practice on Ignition system for I.C. Engines	1) Operate to learn the ignition system for petrol engine 2) Operate to learn the ignition system for diesel engine
9	26th _ 27th	Study and problem solution on Steam Turbine	1) Operate to learn the construction, working and safety precautions of steam turbines 2) Practical performance of steam turbines
10	28th - 29th	Performance test of Gas Turbine	1) Operate to learn the construction, working and safety precautions of Gas turbines 2) Practical performance of Gas turbines

11	30th	Practical test of Reciprocating Air Compressor	1) Operate to learn the construction, working and safety precautions of Reciprocating Air Compressor 2) Practical performance, of Reciprocating Air Compressor
12	31st – 32nd	Performance Test of Heating and Cooling system (Compression type A/C system)	1) Operate to learn the general components of system 2) Operate to learn the operational procedure of system and safety measures
13	32nd	Performance Test of Refrigeration system (Compression type)	1) Operate to learn the general components of system 2) Operate to learn the operational procedure of system and safety measures

List of Equipment:

1)	Barometer	5-set
2)	Dead Weight Gauge Tester with Pressure gauge	1
3)	Thermometers of Celsius, Fahrenheit, Kelvin and Rankine	5
4)	Thermocouples(Different Ranges)	2
5)	Sectioned model of Simple Vertical Boiler	2
6)	Sectioned model of COCHRAN (Multi tubular boiler)	2
7)	Sectioned model of Marine Boiler (Scotch types).	2
8)	Sectioned model of locomotive Boiler	2
9)	Sectioned model of Babcock and Wilcox Boiler	2
10)	Working model of safety valve (spring loaded)	5
11)	"I" class working boiler water tube/fire tube package type with all mounting and accessories	1
12)	Working model of steam Turbine (Impulse and Reaction type)	1 + 1
13)	Working model of gas turbine (impulse and Reaction type)	1 + 1
14)	Reciprocating air compressor	1
15)	Rotary air compressor	1
16)	Ignition point Testing Machine	1
17)	Air Compressor Testing Machine	1
18)	Gas Turbine Testing Machine	1
19)	AC System Trainer (Heating and Cooling)	
20)	Models of Petrol Engine	
21)	Models of Diesel Engine	

Subject Code: Mech-331
Subject Name: Industrial Planning and Production Methods
Total Contact Hours: 32 hrs.

Course Objective: At the end of this course, the student will be able to:
I) Understand the fundamental functions of industrial concerns.
II) Understand the methods(which methods, specify) generally employed in various manufacturing organizations

Theory		(Industrial Planning and Production Methods)	
No.	**Week**	**Title**	**Description**
1	1st _ 3rd	Industrial Planning	1) Need of industrial planning 2) Phases of industrial planning
2	4th _ 5th	Know Thermometers and Thermocouples	1) Economical and technical factors considered while selecting factory site
3	6th _ 9th	**Layout**	1) **Introduction to layout** 1) **Introduction to layout** 3) **Good layout** 4) **Preparation a layout**
4	10th _ 12th	Production Methods	1) Introduction to production 2) Important types of production 3) **New trend of types of production**
5	13th _ 18th	Job Analysis	1) Motion study 2) Time study
6	19th _ 22nd	Production planning and control	1) Production planning 2) Production control 3) **Improvement of productivity**
7	23rd _ 24th	Quality assurance	1) Inspection 2) Quality control 3) **Quality control circle**
8	25th _ 24th	Maintenance activities	1) Responsibilities of maintenance department 2) Types of maintenance 3) **Total Productive Maintenance (TPM)** 4) Replacement studies
9	29th _ 30th	Cost determination and control	1) Cost calculation of industrial product. 2) Cost control
10	31th _ 32th	**Store operation**	1) Receipt of store item

Recommended Books:

1) Motion and time study by RALPH M. BARNES (Publisher: Wiley, 1980) 5-set
2) Industrial Engineering and Management System By Dr. Mansor Ali (Publisher: Urban Resauce Center, 2001) 1
3) Factory and Production Management by Lockyer (Publisher: Pitman,1974) 5
4) Industrial Management by Prof. M.H. Zubairy 2

Subject Code: Mech-343
Subject Name: Machine Design
Total Contact Hours: 64 hrs
Related Subjects:

Course Objective: At the end of the course the students will be able to:
I) Calculate and analyse stresses induced in different machine parts
11) Design Simple machine parts, welded joints, Screwed joints, pressure vessels, shafts and Couplings, Keys, Belt Drives, helical springs, Bearings and CAMS & Followers.

Theory (Machine Design)			
No.	**Week**		**Description**
1	1st _ 4th	Simple Stresses in Machine Parts	1) Load and its types 2) Stress and strain 3) Tensile stress and strain 4) Compressive stress and strain 5) Shear stress and strain 6) Young's Modulus of elasticity 7) Modulus of rigidity or Shear Modulus 8) Stress strain diagram 9) Working stress 10) Factor of safety 11) Selection of Factor of Safety 12) Poisson's Ratio 13) Temperature stress 14) Volumetric strain and bulk modulus 15) Resilience and Toughness 16) Solution of problems of the above topics by direct application of formulae
2	5th _ 7th	Pressure Vessels	1) Introduction 2) Classification of pressure vessels 3) Stresses in a thin cylindrical shell due to internal pressure 4) Hoop stress 5) Longitudinal stress 6) Calculation of thickness of cylinder by direct application of formula, while all parameters are Provided (e.g.). Pressure. Internal *Dia*. hoop or longitudinal stress and efficiency of joint are given) 7) Calculation of hoop or longitudinal stress by direct application of formula, while P. d. t and efficiency of joint are given

			8) Thin spherical shell subjected to internal pressure 9) Calculation of thickness of spherical shell when all other parameters are provided by direct application of formula 10) Thick cylindrical shell subjected to internal pressure 11) Calculation of thickness of thick vessel made of brittle material by LAME,S equation, while all other parameters are given
3	8th _ 10th	Welded Joints	1) Types of various welding joints 2) Strength of transverse and parallel fillet welded joint under static and fatigue loading 3) Calculation of length of weld under static loading, when load, plate thickness & width, tensile & shears stress are given
4	11th _ 13th	Screwed Joints	1) Introduction 2) Advantages and disadvantages 3) Thread terminology 4) Stress in screwed fastening due to external forces under static loading 5) Initial stress due to screwing up forces. 6) Solution of simple problem by direct formula application
5	14th _ 15th	Design of Keys	1) Introduction 2) Types of keys 3) Forces acting on a sunk key 4) Strength of a sunk key 5) Calculate length of sunk key by direct application of formula, while all parameters are directly provided
6	16th - 17th	Shafts and Couplings	1) Introduction to shaft 2) Materials used for shaft and its properties 3) Types of shafts 4) Standard sizes 5) Stresses in shafts 6) Shafts subjected to twisting moment 7) Calculate diameter of solid and hollow shafts by direct application of formula 8) Shafts subjected to bending moment 9) Calculate diameter of solid and hollow shaft (bending only) by direct application of formula 10) Calculation of dia. of shaft subjected to bending and twisting moments 11) Introduction of shaft coupling 12) Types of couplings 13) Design of flange coupling 14) Solve problems on calculation of sizes of different
7	21st _ 23rd	Belt Drives	1) Introduction to Belt drive 2) Selection of Belt drive 3) Types of Belt drive 4) Type-of Belts 5) Type of Flat Belts drive 6) Velocity ratio of Belt drive 7) Slip of Belt 8) Length of open Belt drive 9) Solve problem to find out the speed of shaft Considering the diameters of flat pulleys. And slip between belt and flat pulleys

8	24th _ 26th	Springs	1) Introduction 2) Types and uses of springs 3) Materials used for helical springs 4) Terms used in helical springs 5) Stresses in helical springs of circular wire 6) Deflection of helical springs of circular wire 7) Solution of simple problem on helical springs of circular wire regarding finding out stresses, deflection and diameter of wire by direct application of formulae
9	27th – 28th	Bearings	1) Functions of bearings 2) Classification of bearing 3) Uses of bearings 4) Terms used in journal bearings 5) Lubrication of bearings 6) Solution of simple problems on journal bearings when are parameter of journal bearing are directly provided
10	29th _ 32nd	Cam and Follower Design	1) Cam and its Types 2) Followers and its Types 3) Terminology of Cam and Follower 4) Cam profile design

Recommended Textbooks:
Machine Design by: Paul H. Black (Published by Mc Graw Hill Book Company, New York)

1) Machine Design by Stanton, E. Wiston (Published by Mc Graw Hill Book Company, New York)
2) Machine Design by: lafayette. Ind. (Purdue University of California)

Practical		(Machine Design)	
No.	**Week**	**Title**	**Description**
1	1st _ 3rd	Calculate stress (tensile, compressive and shear), strain, modulus of elasticity, age elongation, age reduction in area, factor of safety for simple machine parts	1) Stresses induced in machine parts 2) Cross-sectional area of machine element under load 3) modulus of elasticity of materials 4) Calculate dimensions of component under specific load 5) age elongation and age reduction in area of a component in a tensile test
2	4th	Calculate force required to punch a hole	1) Stresses induced in punch and plate 2) Area of shear by the punch 3) Calculate different cases of die and punch
3	5th _ 6th	Calculate thickness and diameter of thin cylinders for hoop and longitudinal stresses	1) Difference between thin and thick shells 2) Hoop and longitudinal stress in cylindrical shells 3) Transverse and longitudinal failure of pressure vessel
4	7th _ 8th	Calculate thickness of thick cylinders	1) Lame's equations for brittle materials 2) Calculate Different cases of thickness of thick shells of brittle material
5	9th _ 10th	Calculate thickness and diameter of spherical shell for circumferential stresses	1) Stresses on thin spherical shells 2) Stress on spherical shells considering pressure, internal diameter, thickness and joint efficiency
6	11th _12th	Design welded joints for transverse and parallel fillet under static loading only	1) Transverse and parallel fillet weld 2) Observe tensile and shear stresses in transverse and parallel fillet weld 3) Calculate different cases of transverse and parallel fillet weld under static and fatigue loading
7	13th _14th	Analyse stresses setup due to initial tightening and external load on screws	1) Stress area of a screw 2) Relation between core dia. and nominal dia. of a screw thread 3) Initial tightening and its specific values 4) Calculate different cases of external load raised by different bolts
8	15th -16th	Check dimension of square and rectangular keys due to failure in shearing and crushing	1) Understand sunk keys of all types 2) Understand sizes of keys proportional to the shaft diameter 3) Check length of a sunk key for same material with shaft and equal strength with shaft 4) Check torque transmitted by rectangular and square keys against shearing as well as crushing 5) Calculate length of a sunk key when torque transmitted dia. of shaft, stress (shear & compressive) and width of key is given
9	17th _18th	Design solid shaft subjected to twisting moment only	1) Understand twisting and bending moment on solid shaft 2) Understand torsion and bending equation for strength of shaft 3) Calculate diameters of shaft under torsion when torque to be transmitted and torsional shear stress is given 4) Analyse diameter of shafts subjected to combine bending and twisting moments
10	19th	Design hollow shaft subjected to twisting moment only	1) Understand twisting moment and bending moment on hollow shaft 2) Know torsion and bending equation 3) Calculate dia. of hollow shaft (inside & outside dia.) when bending moment, twisting moment and stresses are given
11	20th	Design Solid & Hollow shafts subjected to combined bending &twisting moment	1) Understand twisting moment and bending moment on solid & hollow shaft 2) Know torsion and bending equation 3) Calculate inside & outside dia. of hollow shaft when bending moment, twisting moment are given

12	21st _ 23th	Design un-protected flange coupling for specific torque	1) Un protected flange coupling 2) Know empirical size of flange coupling 3) Design assembly(hub, keys, flange, bolts) of unprotected type flange coupling
13	24th _ 25th	Check the speed shafts (Driver or Driven) when diameters of flat pulleys and slip between belt and flat pulley is given	1) Understand belt and belt drives 2) Calculate dimensions of flat pulleys for specific speed of shaft 3) Calculate the *effect* of slip between belt and pulley
14	26th - 27th	Design the dimensions of closely coiled helical spring of circular wire subjected to tensile load	1) Understand helical springs of circular wire 2) Understand terms used in helical springs 3) Calculate deflection in helical spring 4) Solve problems on calculation of dimensions of helical springs
15	28th _ 29th	Suggest suitable journal bearing, considering load on shaft, speed of shaft, viscosity of lubricant, bearing pressure, coefficient of friction and bearing modulus	1) Verify length of journal bearing 2) Know the viscosity of lubricants 3) Calculate the bearing modulus 4) Apply the coefficient of friction in the design of journal bearings
16	30th _ 32nd	Design and draw the CAM profile with knife edge follower for uniform velocity	1) Movement of knife edge follower 2) Practice to sketch Displacement, velocity and acceleration diagram when knife edge follower 3) Moves with Simple Harmonic Motion (S.H.M) 4) Practice to sketch Displacement, velocity and acceleration diagram when knife edge follower moves with uniform velocity 5) Practice to draw CAM profile as given data

List of Equipment:

1)	**3D CAD Software for Kinetics, Static and Dynamic Analysis**	50-set
2)	**Computer**	50
3)	**Spring Test Equipment**	2
4)	**Machine Design Simulation Software**	1
5)	**Photo Elastic Unit**	**1**
6)	**Machine Elements set**	2

Subject Code: **Mech-362**
Subject Name: **Materials Testing and Heat Treatment**
Total Contact Hours: **32 hrs.**

Related Subjects:

Course Objective: After going through this course, student will be able to:

I) Understand destructive and non-destructive test
II) Understand working of testing equipment
III) Know the basic theories of heat treatment processes
IV) Understand common heat treatment processes
V) Understand common heat treatment processes of Non-Ferrous metals

Theory		(Materials Testing **and Heat Treatment)**	
No.	**Week**		**Description**
		A) Materials Testing	
1	1-2	Mechanical properties of Metallic Materials	1) Mechanical Properties of Materials 2) Testing of materials
2 3-9		Destructive Test	1) Hardness tests 2) Izod impact test 3) Tension ~~Tensile~~ test (change the position, start with Tension ~~tensile~~ test) 4) Compression Test 5) Bending test 6) Shear Test 7) Torsion test 8) Fatigue test
3 10-16		Non-Destructive Tests	1) ~~Pressure Test~~ 2) ~~Hammer Test (Sonic inspection)~~ 3) Visual Test ~~Inspection~~ 4) Liquid ~~Dye~~ Penetrant Testing 5) Eddy Current Testing ~~inspection~~ 6) Ultrasonic Testing ~~inspection~~ 7) Magnetic Particle Testing ~~inspection~~ 8) Radiographic Test ~~Inspection~~
		B) HEAT TREATMENT	
4	17-19	Heat Treatment of steels	1) Iron-carbon phase ~~carbide~~ diagram 2) Iron-graphite phase diagram 3) Time-Temperature-Transformation diagram (Isothermal Transformation diagram) 4) Continuous Cooling Transformation diagram 5) Effect of heating on steel 6) Effect of cooling on steel

5	20-23	Heat Treatment Processes	1) Annealing 2) Quenching ~~Hardening~~ 3) Tempering 4) Normalizing
6	24-26	Heat Treatment Equipment	1) Heat Treatment Furnaces 2) Pyrometers 3) Metallurgical microscope
7	27-29	Case hardening Processes	1) Carburizing (pack, gas, liquid) 2) Induction hardening 3) Flame hardening ~~4) Cyaniding~~ 4~~5~~) Nitriding
8	30 - 32	Heat Treatment of Nonferrous Metals and Cast iron	1) Heat treatment of cast iron 2) Heat treatment of Nonferrous metals and alloys 3) Annealing of non-ferrous metals and precipitation hardening

Recommended Textbooks:

1) **The Testing and Inspection of Engineering Materials by Harmer E-Davis, George Earl Troxel (Mc Graw Hill Book Company, New York)**
2) **Materials and Processes by James, F.Young (Jhon willey & sons Inc. New York)**

(Materials Testing and Heat Treatment)			**Practical**
No.	**Week**	**Title**	**Description**
1	1st	Practice for Brinell hardness test	1) Perform grinding & polishing of specimen for Brinell hardness test 2) Perform Brinell hardness test on Brinell hardness ~~tester testing machine~~ 3) Check hardness of metallic specimen
2	2nd _ 3rd	Practice for Rockwell hardness test for B-scale hardness	1) Perform grinding & polishing of specimen for Rockwell hardness test 2) Fit steel ball indenter into plunger and & placing weights 3) Perform Rockwell hardness test for B scale with ball indenter
3	4th	Practice for Rockwell hardness test for C-scale hardness	1) Perform grinding & polishing of specimen for Rockwell hardness test 2) Fit Diamond Cone indenter into plunger & placing weights 3) Perform Rockwell hardness test for C scale with Diamond Cone indenter

4	5th	Practice for Izod ~~d~~test on cast iron and aluminium standard test specimens	1) Make specimen of different materials according to specifications 2) Set different energies or pendulum heights, according to the material on the tester ~~machine~~ 3) Perform Izod test on Izod tester ~~testing machine~~ 4) Able to determine the toughness of the material
5	6th _ 7th	Practice for tension ~~tensile~~ test on universal testing machine on standard specimen	1) Make specimen according to standard size 2) Mark gauge length points on the specimen 3) Clamp specimen properly in the machine gripping jaws 4) Operate inlet and outlet oil valves of machine 5) Draw stress strain curve on tracing unit of the machine 6) Remove broken specimen from machine jaws 7) Calculate all observations (elongation, reduction of ~~in~~ area, yield stresses, ultimate tensile stresses, and breaking stresses) relevant to test
6	8th _ 9th	Practice for Compression test on cast iron specimen	1) Install compression attachment on the tester ~~machine~~ 2) Perform compression test on specimen 3) Draw stress strain curve on tracing unit of the tester ~~machine~~ 4) Calculate compressive stress and all other observations relevant to test
7	10th	Practice for bending test on universal testing machine	1) Fit bending fixture on Universal testing machine 2) Perform bending test on specimen 3) Calculate Modulus of elasticity and all other observations relevant to test
8,	11th	Practice for shear test on universal testing machine	1) Install shear test fixture or die and punch on the tester ~~machine~~ 2) Perform shear test on specimen 3) Calculate ultimate shear stress of test specimen
9	12th	Practice for torsion test on torsion tester ~~testing machine~~	1) Fit specimen on torsion tester ~~testing machine~~ 2) Performing torsion test on specimen 3) Calculate all observations relevant to test
10	13th	Practice, for fatigue test on fatigue tester ~~testing machine~~	1) Fit specimen on fatigue tester ~~testing machine~~ 2) Perform fatigue test on specimen 3) Calculate all observations relevant to test
11	14th	Practice for Liquid ~~Dye~~ Penetrant testing	1) Clean and prepare surface for the test 2) Apply fluorescent dye on the specimen 3) Apply developer after dyeing ~~dealing~~ the surface 4) Detect surface flaws, cracks, pin holes, surface discontinuities
12	15th	Practice for Ultrasonic testing on ultrasonic testing equipment	1) Clean and prepare surface for the test 2) Operate ultrasonic on testing equipment 3) Detect flaws, blow holes and other internal defects in metals

13	16th	Practice for Magnetic particle testing on Magnetic particle testing equipment	1) Clean and prepare surface for the test 2) Operate Magnetic particle testing equipment 3) Detect flaws, blow holes and other internal defects in metals
14	17th 18th	Practice for working of metallurgical microscope	1) Know different parts of metallurgical microscope 2) Operate metallurgical microscope 3) Know function of each part 4) Draw a neat sketch of microscope indicating its different parts
15	19th 20th	Practice of preparation of specimen for metallography	1) Grind and polish the specimen, Etching the specimen with etching solution 2) Press specimen with plastic material
16	21st _ 22nd	Observe grain size of micro-structure of mild steel specimen	1) Examine different microstructures of steel (ferrite, Cementite, pearlite, etc.)
17	23rd _ 24th	Observe grain size of micro-structure of cast iron specimen	1) Examine different microstructures of cast iron (Cementite, pearlite etc.)
18	25th _ 26th	Practice for quenching ~~hardening~~ and observe of micro structure of carbon steel	1) Heat the carbon steel in heat treatment furnace 2) Use proper quenching media 3) Polish, grind, etch specimen for metallography 4) Examine microstructure of quenched ~~hardened~~ steel
19	27th _ 28th	Practice for annealing and observe micro structure of steel	1) Heat the steel or specimen on required temperature in electric furnace 2) Give the steel soaking time 3) Remove the specimen from furnace after slow cooling 4) Polish, grind, etch specimen for observe grain structure
20	29th _ 30th	Practice for normalizing of steel and observe grain structure	1) Heat the carbon steel specimen on required temperature in electric furnace 2) Give the steel soaking time 3) Remove the specimen from furnace after specified time 4) Keep the specimen in air for cooling 5) Polish, grind, etch specimen and observe of grain structure
~~21~~	~~31st~~	~~Practice for pack carburizing of steel and observe micro structure~~	~~1) Pack and seal specimen with Carbonaceous materials in steel box~~ ~~2) Heat the specimen up to required time and temperature~~ ~~3) Check hardness difference between case and core~~ ~~4) Polish, grind and etch specimen and observe grain structure~~
~~22~~	~~32nd~~	~~Practice for stress relieving of aluminium~~	~~1) Select and prepare specimen~~ ~~2) Heat up specimen in muffle furnace~~ ~~3) Cool the specimen at specific rate of cooling~~ ~~4) Examine the specimen for its variation in strength~~

List of Equipment:

1)	**Brinell Hardness** Tester ~~**Testing Machine**~~ (Work size200mm x 140mm)	2-set
2)	**Rockwell Hardness** Tester ~~**Testing Machine**~~ (Work size: 200mm x 140mm)	2
3)	**Izod Impact Tester Testing Machine**	1
4)	**Universal Testing Machine**	1
5)	**Heat treatment Furnace**	1
6)	**Specimen Cut-off Machine**	2
7)	**Specimen Polishing Machine**	1
8)	**Specimen Mounting Press**	1
9)	**Pedestal Grinder**	1
10)	**Metallurgical Microscope (IO)IQIC.J**	1
11)	**Torsion Tester Testing machine**	2
12)	**Fatigue Tester testing machine**	1
13)	**Quenching Bath**	2
14)	**Ultrasonic testing equipment**	3
15)	**Magnetic particle testing equipment**	1

添付資料 6-8：TMC モニタリングチックレポート

Training Management Cycle
Monitoring Check Report

October 2018

THE PROJECT FOR STRENGTHENING DAE IN MECHANICAL TECHNOLOGY AT GOVERNMENT COLLEGES OF TECHNOLOGY IN PUNJAB PROVINCE
IN THE ISLAMIC REPUBLIC OF PAKISTAN

GOVERNMENT OF PUNJAB
TECHNICAL EDUCATION & VOCATIONAL TRAINING AUTHORITY (TEVTA)

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

It's important to respond accurately to the ability of the human resources from the industrial sector in the implementation of effective TVET.
Therefore, GCT as TVET institution should solve problems and challenges for aim to ensure and improve the reliability and quality of TVET.
And, it's necessary to do proper management and operation at each stage of TVET so that GCT could expect the following effect.

1) Can identify human resources needs from the industrial sector accurately.
2) Can set up the TVET courses corresponding to changes in local economic and employment situation.
3) TVET curriculum is reconsidered flexibly.
4) TVET can be shifted to a systematic work from an individual.
5) The reliability and the quality of TVET improve, and it'll be the effect and efficient.
6) The role of the GCT as TVET institution is clarified.
7) It's possible to give a security and a reliability of GCT to the participants.

Therefore, JICA created "Training Management Cycle Manual (TMC Manual)" aims to establish human resources development process for TEVTA and all GCT in Punjab province in the project starting in 2016.
This report has been investigated according to the TMC monitoring check sheet in GCT-Railway Road and GCT-Faisalabad in September 2018.

Survey date	
GCT- Railway Road	GCT- Faisalabad
18 September 2018	26 September 2018

Monitor	
GCT- Railway Road	GCT- Faisalabad
Engr. TARIQ Mehmood :Principal	Dr. Syed Iftikhar Hussain Shah: Principal
Mr. Muhammad HAFEEZ: Head of Department	Mr. Abdur Rauf: Head of Department
Mr. Muhammad RAZAAQ: Focal person of JICA	Engr. Noor Asif Noor: Focal person JICA

Coordinator: Engr. Osamu SASAKI
JICA Expert

Training Management Cycle
Monitoring Check Sheet

GCT- Railway Road

Remarks

✔ : Meaning of "Task has been completed"

× : Meaning of "Not done"

Check Sheet No.1

Monitoring Check Sheet (Identifying Human Resources Needs)

Item	Detail	check
Survey main points	i) Employ Adoption No. and field	×
	ii) Technical innovation	×
	iii) Required employee ability	×
	iv) Facility & Machinery	×
	v) Accepting GCT internship	×
	vi) Training for employees	×
	vii) Request or expectation to GCT	×
Survey method	i) Document survey	×
	ii) Questionnaire survey	×
	iii) Interview survey	×
Survey plan	i) Survey period	×
	ii) Surveyor	×
	iii) Survey target	×
	iv) Budget	×
Survey Implementation	i) Implementation date	×
	ii) Implementation Person	×
	iii) Decision of question	×
	iv) Preparation of data material	×
	v) Questionnaire sheet making	×
	vi) Collection of questionnaire sheet	×
	vii) Classifying questionnaire sheet	×
Needs Analysis and Report	i) Collection of data	×
	ii) Analyzing of whole data	×
	iii) Analyzing of training needs from company	×
	iv) Organizing educational training challenges	×
	v) Checking of training duty, ability and level	×
	vi) Making a survey report	×

Comments:
* No activity of identifying human resources needs or training needs assessment in 2017 and 2018.
* GCT has not plan it in 2019 yet.

Check Sheet No.2

Monitoring check sheet (Course Subjects and Curriculum Revision)

Item	Detail	check
Subject objective level	i) Knowledge level	✔
	ii) Technic and Skill level	✔
	iii) Attitude level	✔
Training time	i) Starting date	✔
	ii) Training duration	✔
	iii) Total training hours	✔
Instructors in charge	i) List of Instructors in charge	✔
	ii) Outside Lecturer	✔
	iii) Curriculum Vitae	✔
Training place and equipment	i) Classroom	✔
	ii) Workshop	✔
Instruction method	i) Practical instruction utilizing the actual technique	✔
	ii) New kinds of practice technique (Work study and Case study etc.)	✔
	iii) Practicing instruction by a problem solving	✔
	iv) Outside lecturer from an enterprise	✔
	v) Internship training	✔

Comments:
* Starting date: September
* Total training hours: 32weeks/ year, Total 96weeks for 3 years.
* Outside Lecturer: 4 lecturers per year

Check Sheet No.3

Monitoring check sheet (Training Preparation)

Item	Detail	Check
Training Schedule	i) Annual Training Schedule	✔
	ii) Period Training Schedule	-
	iii) Timetable	✔
Training Facility and Machinery Plan	i) Name of Machinery	✔
	ii) Existing Quantity	✔
	iii) Specification	✔
	iv) Maker (Manufacturer)	✔
	v) Type of Machinery	✔
	vi) Supplier	✔
	vii) Supplied year	✔
	viii) Condition	✔
	ix) Remarks	✔
Training Budget Plan	Training Budget Plan	✔

Comments:
* Annual Training Schedule: TEVTA calendar
* Timetable: 45minute a lesson, 6 lessons a day, 36 lessons a week
* Training Budget Plan: TEVTA budget plan

Check Sheet No.4

Monitoring check sheet (Training Implementation)

Item	Detail	Check
Training Material	i) Reference for theory	✔
	ii) Reference for practice	✔
	iii) Job assignment sheet	✔
	iv) Job breakdown sheet	✔
	v) Audio visual	✔
Lesson Plan	i) Training Task	✔
	ii) Main Theme	✔
	iii) Training Date	✔
	iv) Training Place	✔
	v) Trainer	✔
	vi) Training Course	✔
	vii) No. of trainee	✔
	viii) Objective of Study	✔
	ix) Classification (Instruction Stage)	✔
	x) Training time	✔
	xi) Point of instruction	✔
	xii) Instruction materials and method	✔
Subject Evaluation Plan	i) Monthly- Evaluation	✔
	ii) Quarter- Evaluation	✔
	iii) Final- Evaluation	✔
	iv) Follow-up Evaluation	✔

Comments:
* Training Materials: Need to be revised or updated.
* Subject Evaluation Plan: Be in accordance with the Assessment & Promotion Rules of Punjab Board of Technical Education

Check Sheet No.5

Monitoring check sheet (Evaluation and Improvement)

Item	Detail	Check
Evaluation of DAE course (internal evaluation)	i) Number of applicants (rate)	✔
	ii) Promotion & Number of graduates (rate)	✔
	iii) Student grades(Results of the final test)	✔
	v) Self-assessment of trainee	×
	vi) Student impression / opinion	✔
Evaluation and improvement (External evaluation)	i) Evaluation from graduates	✔
	ii) Evaluation for employer	✔
	iii) Evaluation of Industry to GCT (Opinion / Request)	✔
	iv) Social evaluation of GCT	

Comments:
* It needs to invite some information media when GCT hold events like a career day and skill competition.

Training Management Cycle
Monitoring Check Sheet

GCT- Faisalabad

Remarks

✔ : **Meaning of "Task has been completed"**

× : **Meaning of "Not done"**

Monitoring Check Sheet (Identifying Human Resources Needs)

Item	Detail	check
Survey main points	i) Employ Adoption No. and field	×
	ii) Technical innovation	×
	iii) Required employee ability	×
	iv) Facility & Machinery	×
	v) Accepting GCT internship	×
	vi) Training for employees	×
	vii) Request or expectation to GCT	×
Survey method	i) Document survey	×
	ii) Questionnaire survey	×
	iii) Interview survey	×
Survey plan	i) Survey period	×
	ii) Surveyor	×
	iii) Survey target	×
	iv) Budget	×
Survey Implementation	i) Implementation date	×
	ii) Implementation Person	×
	iii) Decision of question	×
	iv) Preparation of data material	×
	v) Questionnaire sheet making	×
	vi) Collection of questionnaire sheet	×
	vii) Classifying questionnaire sheet	×
Needs Analysis and Report	i) Collection of data	×
	ii) Analyzing of whole data	×
	iii) Analyzing of training needs from company	×
	iv) Organizing educational training challenges	×
	v) Checking of training duty, ability and level	×
	vi) Making a survey report	×

Comments:
*The last Surveys were conducted in 2016.
*No activity of identifying human resources needs or training needs assessment in 2017 and 2018.
*GCT will plan to implement a TNA or Industrial Linkage Survey in 2019 that will be repeated every 3 years.

Monitoring check sheet (Course Subjects and Curriculum Revision)

Item	Detail	check
Subject objective level	i) Knowledge level	✔
	ii) Technic and Skill level	✔
	iii) Attitude level	✔
Training time	i) Starting date	✔
	ii) Training duration	✔
	iii) Total training hours	✔
Instructors in charge	i) List of Instructors in charge	✔
	ii) Outside Lecturer	✔
	iii) Curriculum Vitae	✔
Training place and equipment	i) Classroom	✔
	ii) Workshop	✔
Instruction method	i) Practical instruction utilizing the actual technique	✔
	ii) New kinds of practice technique (Work study and Case study etc.)	×
	iii) Practicing instruction by a problem solving	✔
	iv) Outside lecturer from an enterprise	✔
	v) Internship training	✔

Comments:
* Starting date: September
* Total training hours: 32weeks/ year, Total 96weeks for 3 years.
* Outside Lecturer: 4 lecturers per year
* Instruction method: Adopting Master Training contents introduced by Japanese Experts

Monitoring check sheet (Training Preparation)

Item	Detail	Check
Training Schedule	i) Annual Training Schedule	✔
	ii) Period Training Schedule	-
	iii) Timetable	✔
Training Facility and Machinery Plan	i) Name of Machinery	✔
	ii) Existing Quantity	✔
	iii) Specification	✔
	iv) Maker (Manufacturer)	✔
	v) Type of Machinery	✔
	vi) Supplier	✔
	vii) Supplied year	✔
	viii) Condition	✔
	ix) Remarks	✔
Training Budget Plan	Training Budget Plan	✔

Comments:
* Annual Training Schedule: TEVTA calendar
* Timetable: 45minute a lesson, 6 lessons a day, 36 lessons a week
* Training Budget Plan: TEVTA budget plan
* Machine log book will be maintained for their repair and maintenance.

Check Sheet No.4

Monitoring check sheet (Training Implementation)

Item	Detail	Check
Training Material	i) Reference for theory	✔
	ii) Reference for practice	✔
	iii) Job assignment sheet	✔
	iv) Job breakdown sheet	✔
	v) Audio visual	✔
Lesson Plan	i) Training Task	✔
	ii) Main Theme	✔
	iii) Training Date	✔
	iv) Training Place	✔
	v) Trainer	✔
	vi) Training Course	✔
	vii) No. of trainee	✔
	viii) Objective of Study	✔
	ix) Classification (Instruction Stage)	✔
	x) Training time	✔
	xi) Point of instruction	✔
	xii) Instruction materials and method	✔
Subject Evaluation Plan	i) Monthly- Evaluation	✔
	ii) Quarter- Evaluation	✔
	iii) Final- Evaluation	✔
	iv) Follow-up Evaluation	✔

Comments:
* Training Materials: Need to be revised or updated.
* Lesson Plan: Need to be updated
* Subject Evaluation Plan: Be in accordance with the Assessment & Promotion Rules of Punjab
* Board of Technical Education.

Check Sheet No.5

Monitoring check sheet (Evaluation and Improvement)

Item	Detail	Check
Evaluation of DAE course (internal evaluation)	i) Number of applicants (rate)	✔
	ii) Promotion & Number of graduates (rate)	✔
	iii) Student grades(Results of the final test)	✔
	v) Self-assessment of trainee	×
	vi) Student impression / opinion	✔
Evaluation and improvement (External evaluation)	i) Evaluation from graduates	✔
	ii) Evaluation for employer	✔
	iii) Evaluation of Industry to GCT (Opinion / Request)	✔
	iv) Social evaluation of GCT	✔

Comments:
* Student impressions / opinions: Getting them in interview
* Evaluation for employer: Getting it in IMC or internship
* Evaluation of Industry to GCT (Opinion / Request): Getting them in IMC
* Social evaluation of GCT: More inviting medias when holding some institute events

Training Management Cycle Monitoring Check Report

November 2019

THE PROJECT FOR STRENGTHENING DAE IN MECHANICAL TECHNOLOGY AT GOVERNMENT COLLEGES OF TECHNOLOGY IN PUNJAB PROVINCE IN THE ISLAMIC REPUBLIC OF PAKISTAN

GOVERNMENT OF PUNJAB
TECHNICAL EDUCATION & VOCATIONAL TRAINING AUTHORITY (TEVTA)

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

It's important to respond accurately to the ability of the human resources from the industrial sector in the implementation of effective TVET.
Therefore, GCT as TVET institution should solve problems and challenges for aim to ensure and improve the reliability and quality of TVET.
And, it's necessary to do proper management and operation at each stage of TVET so that GCT could expect the following effect.

1) Can identify human resources needs from the industrial sector accurately.
2) Can set up the TVET courses corresponding to changes in local economic and employment situation.
3) TVET curriculum is reconsidered flexibly.
4) TVET can be shifted to a systematic work from an individual.
5) The reliability and the quality of TVET improve, and it'll be the effect and efficient.
6) The role of the GCT as TVET institution is clarified.
7) It's possible to give a security and a reliability of GCT to the participants.

Therefore, JICA created "Training Management Cycle Manual (TMC Manual)" aims to establish human resources development process for TEVTA and all GCT in Punjab province in the project starting in 2016.
This report has been investigated according to the TMC monitoring check sheet in GCT-Railway Road and GCT-Faisalabad in October 2019.

Survey date	
GCT- Railway Road	GCT- Faisalabad
29 October 2019	31 October 2019

Monitor	
GCT- Railway Road	GCT- Faisalabad
Engr. Tariq Mehmood: Principal	Dr. Syed Iftikhar Hussain Shah: Principal
Mr. Muhammad Razaaq: Focal person for JICA	Engr. Noor Asif Noor: Head of Department

Coordinator: Engr. Osamu SASAKI
JICA Expert

Training Management Cycle
Monitoring Check Sheet

GCT- Railway Road

Remarks

✔ : Meaning of "Task has been completed"

× : Meaning of "Not done"

- : Not Applicable

Monitoring Check Sheet (Identifying Human Resources Needs)

Item	Detail	check
Survey main points	i) Employ Adoption No. and field	✔
	ii) Technical innovation	✔
	iii) Required employee ability	✔
	iv) Facility & Machinery	×
	v) Accepting GCT internship	✔
	vi) Training for employees	×
	vii) Request or expectation to GCT	✔
Survey method	i) Document survey	×
	ii) Questionnaire survey	×
	iii) Interview survey	✔
Survey plan	i) Survey period	×
	ii) Surveyor	✔
	iii) Survey target	✔
	iv) Budget	×
Survey Implementation	i) Implementation date	✔
	ii) Implementation Person	✔
	iii) Decision of question	✔
	iv) Preparation of data material	×
	v) Questionnaire sheet making	×
	vi) Collection of questionnaire sheet	×
	vii) Classifying questionnaire sheet	×
Needs Analysis and Report	i) Collection of data	×
	ii) Analyzing of whole data	×
	iii) Analyzing of training needs from company	×
	iv) Organizing educational training challenges	×
	v) Checking of training duty, ability and level	×
	vi) Making a survey report	×

Comments:
* No activity of identifying human resources needs or training needs assessment in 2019.
* Information is collected at the job placement offices and IMC.

Monitoring check sheet (Course Subjects and Curriculum Revision)

Item	Detail	check
Subject objective level	i) Knowledge level	✔
	ii) Technic and Skill level	✔
	iii) Attitude level	✔
Training time	i) Starting date	✔
	ii) Training duration	✔
	iii) Total training hours	✔
Instructors in charge	i) List of Instructors in charge	✔
	ii) Outside Lecturer	✔
	iii) Curriculum Vitae	✔
Training place and equipment	i) Classroom	✔
	ii) Workshop	✔
Instruction method	i) Practical instruction utilizing the actual technique	✔
	ii) New kinds of practice technique (Work study and Case study etc.)	✔
	iii) Practicing instruction by a problem solving	✔
	iv) Outside lecturer from an enterprise	✔
	v) Internship training	✔

Comments:
* Starting date: September
* Total training hours: 32weeks/ year, Total 96weeks for 3 years.
* Outside Lecturer: 4 lecturers per year

Monitoring check sheet (Training Preparation)

Item	Detail	Check
Training Schedule	i) Annual Training Schedule	✔
	ii) Period Training Schedule	-
	iii) Timetable	✔
Training Facility and Machinery Plan	i) Name of Machinery	✔
	ii) Existing Quantity	✔
	iii) Specification	✔
	iv) Maker (Manufacturer)	✔
	v) Type of Machinery	✔
	vi) Supplier	✔
	vii) Supplied year	✔
	viii) Condition	✔
	ix) Remarks	✔
Training Budget Plan	Training Budget Plan	✔

Comments:
* Annual Training Schedule: TEVTA calendar
* Timetable: 45minute a lesson, 6 lessons a day, 36 lessons a week
* Training Budget Plan: TEVTA budget plan

Check Sheet No.4

Monitoring check sheet (Training Implementation)

Item	Detail	Check
Training Material	i) Reference for theory	✔
	ii) Reference for practice	✔
	iii) Job assignment sheet	✔
	iv) Job breakdown sheet	✔
	v) Audio visual	✔
Lesson Plan	i) Training Task	✔
	ii) Main Theme	✔
	iii) Training Date	✔
	iv) Training Place	✔
	v) Trainer	✔
	vi) Training Course	✔
	vii) No. of trainee	✔
	viii) Objective of Study	✔
	ix) Classification (Instruction Stage)	✔
	x) Training time	✔
	xi) Point of instruction	✔
	xii) Instruction materials and method	✔
Subject Evaluation Plan	i) Monthly- Evaluation	✔
	ii) Quarter- Evaluation	✔
	iii) Final- Evaluation	✔
	iv) Follow-up Evaluation	✔

Comments:
* Training Materials: Being revised or updated by the support of Japanese Expert.
* Subject Evaluation Plan: Be in accordance with the Assessment & Promotion Rules of Punjab Board of Technical Education

6

Check Sheet No.5

Monitoring check sheet (Evaluation and Improvement)

Item	Detail	Check
Evaluation of DAE course (internal evaluation)	i) Number of applicants (rate)	✔
	ii) Promotion & Number of graduates (rate)	✔
	iii) Student grades(Results of the final test)	✔
	v) Self-assessment of trainee	-
	vi) Student impression / opinion	✔
Evaluation and improvement (External evaluation)	i) Evaluation from graduates	✔
	ii) Evaluation for employer	✔
	iii) Evaluation of Industry to GCT (Opinion / Request)	✔
	iv) Social evaluation of GCT	✔

Comments:
* GCT invites some media when GCT hold events like a career day and skill competition.
* GCT uses social media like "Facebook" to improve its information, advertisement and social evaluation.

7

Training Management Cycle Monitoring Check Sheet

GCT- Faisalabad

Remarks

✔ : Meaning of "Task has been completed"

× : Meaning of "Not done"

- : Not Adaptation

8

Check Sheet No.1

Monitoring Check Sheet (Identifying Human Resources Needs)

Item	Detail	check
Survey main points	i) Employ Adoption No. and field	✔
	ii) Technical innovation	✔
	iii) Required employee ability	✔
	iv) Facility & Machinery	✔
	v) Accepting GCT internship	✔
	vi) Training for employees	×
	vii) Request or expectation to GCT	✔
Survey method	i) Document survey	×
	ii) Questionnaire survey	×
	iii) Interview survey	✔
Survey plan	i) Survey period	×
	ii) Surveyor	×
	iii) Survey target	×
	iv) Budget	×
Survey Implementation	i) Implementation date	✔
	ii) Implementation Person	✔
	iii) Decision of question	×
	iv) Preparation of data material	×
	v) Questionnaire sheet making	×
	vi) Collection of questionnaire sheet	×
	vii) Classifying questionnaire sheet	×
Needs Analysis and Report	i) Collection of data	×
	ii) Analyzing of whole data	×
	iii) Analyzing of training needs from company	×
	iv) Organizing educational training challenges	×
	v) Checking of training duty, ability and level	×
	vi) Making a survey report	×

Comments:
* No activity of identifying human resources needs or training needs assessment in 2019.
* Information is collected at the job placement offices and IMC.

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Check Sheet No.2

Monitoring check sheet (Course Subjects and Curriculum Revision)

Item	Detail	check
Subject objective level	i) Knowledge level	✔
	ii) Technic and Skill level	✔
	iii) Attitude level	✔
Training time	i) Starting date	✔
	ii) Training duration	✔
	iii) Total training hours	✔
Instructors in charge	i) List of Instructors in charge	✔
	ii) Outside Lecturer	✔
	iii) Curriculum Vitae	✔
Training place and equipment	i) Classroom	✔
	ii) Workshop	✔
Instruction method	i) Practical instruction utilizing the actual technique	✔
	ii) New kinds of practice technique (Work study and Case study etc.)	✔
	iii) Practicing instruction by a problem solving	✔
	iv) Outside lecturer from an enterprise	✔
	v) Internship training	✔

Comments:
* Starting date: September
* Total training hours: 32weeks/ year, Total 96weeks for 3 years.
* Outside Lecturer: 4 lecturers per year
* Instruction method: Adopting Master Training contents introduced by Japanese Experts
* Demonstration Models as teaching material are utilizing in practical lectures by instruction of Japanese experts.

Check Sheet No.3

Monitoring check sheet (Training Preparation)

Item	Detail	Check
Training Schedule	i) Annual Training Schedule	✔
	ii) Period Training Schedule	-
	iii) Timetable	✔
Training Facility and Machinery Plan	i) Name of Machinery	✔
	ii) Existing Quantity	✔
	iii) Specification	✔
	iv) Maker (Manufacturer)	✔
	v) Type of Machinery	✔
	vi) Supplier	✔
	vii) Supplied year	✔
	viii) Condition	✔
	ix) Remarks	✔
Training Budget Plan	Training Budget Plan	✔

Comments:
* Annual Training Schedule: TEVTA calendar
* Timetable: 45minute a lesson, 6 lessons a day, 36 lessons a week
* Training Budget Plan: TEVTA budget plan
* "Equipment Maintenance Manual" will be utilized for machine repair and maintenance.

Check Sheet No.4

Monitoring check sheet (Training Implementation)

Item	Detail	Check
Training Material	i) Reference for theory	✔
	ii) Reference for practice	✔
	iii) Job assignment sheet	✔
	iv) Job breakdown sheet	✔
	v) Audio visual	✔
Lesson Plan	i) Training Task	✔
	ii) Main Theme	✔
	iii) Training Date	✔
	iv) Training Place	✔
	v) Trainer	✔
	vi) Training Course	✔
	vii) No. of trainee	✔
	viii) Objective of Study	✔
	ix) Classification (Instruction Stage)	✔
	x) Training time	✔
	xi) Point of instruction	✔
	xii) Instruction materials and method	✔
Subject Evaluation Plan	i) Monthly- Evaluation	✔
	ii) Quarter- Evaluation	✔
	iii) Final- Evaluation	✔
	iv) Follow-up Evaluation	✔

Comments:
* Training Materials: Being revising or updating.
* Lesson Plan: Being updating
* Subject Evaluation Plan: Be in accordance with the Assessment & Promotion Rules of Punjab Board of Technical Education.

Check Sheet No.5

Monitoring check sheet (Evaluation and Improvement)

Item	Detail	Check
Evaluation of DAE course (internal evaluation)	i) Number of applicants (rate)	✔
	ii) Promotion & Number of graduates (rate)	✔
	iii) Student grades(Results of the final test)	✔
	v) Self-assessment of trainee	-
	vi) Student impression / opinion	✔
Evaluation and improvement (External evaluation)	i) Evaluation from graduates	✔
	ii) Evaluation for employer	✔
	iii) Evaluation of Industry to GCT (Opinion / Request)	✔
	iv) Social evaluation of GCT	✔

Comments:
* Student impressions / opinions: Getting them in IMC
* Evaluation for employer: Getting it in IMC or internship
* Evaluation of Industry to GCT (Opinion / Request): Getting them in IMC
* GCT invites some media when GCT hold events like a career day and skill competition.
* GCT uses social media like "Facebook" to improve its information, advertisement and social evaluation.