

# DEPARTMENT OF TECHNICAL EDUCATION

From	To
The Commissioner of Technical Education Directorate of Technical Education Chennai 600 025.	All the Principals of Government, Government Aided and Self-financing Polytechnic Colleges and Self-financing Engineering Colleges(offering Diploma programme)

File No: 32739/Y3/CDC/2017, Dated 09.11.2017

Sir / Madam,

Sub:		Technical Education – Curriculum Development Center –‘M’ Scheme Diploma in ICE - new subjects Test Engineering & Test Engineering Practical – suggestion to replace this subject with new subjects as given by various Polytechnic College principals – Regarding.
Ref:	1.	The Principal, GPT, Thoothukudi Letter No:393/A3/2017 dt 14.06.2017
	2.	This office Letter No. 22639/Y3/CDC/2014, Dated 18.07.2017
	3.	The Principal, Mohamed Sathak Polytechnic College, Kilakarai letter no nil dated 24.07.2017
	4.	The Principal, I R T Polytechnic College, Chromepet, Chennai letter no 001/IRTPC/ECE/2017 dated 31.08.2017
	5.	The Principal, I R T Polytechnic College, Tirunelveli letter no 001/IRTPC-T/ECE/2017 dated 31.08.2017
	6.	Mail received from various Polytechnic College.
	7.	Letter received from various Self Financing Polytechnic Colleges
	8.	This office Letter No. 22639/Y3/CDC/2014, Dated 05.10.2017
	9.	Minutes of the Meeting held on 10.09.2017 at DOTE.
	10.	This office Letter No. 22639/Y3/CDC/2014, Dated 23.10.2017

With reference to the letter cited above, the following changes have been incorporated in M Scheme VI Semester ICE Branch as per the decision taken on the Meeting held on 10.09.2017 at DOTE.

1. The Core Subject “Test Engineering Theory (34062)” is being shifted as Elective Subject. The New subject code for Test Engineering is 34082.
2. The already available Elective Subject “Bio Medical Instrumentation (34082)” is being shifted to Core Subject in the place of Test Engineering. The New Subject code for Bio Medical Instrumentation is 34062.
3. The already existing Elective Theory Embedded System(34283) has been removed and New Theory Subject “Power Plant Instrumentation” has been introduced as Elective Subject in the place of Embedded System. The New Subject code for Power Plant Instrumentation” is 34283.

4. The "Test Engineering Practical (34065)" is being moved as Elective Practical. The New Subject code for Test Engineering Practical is 34085.
5. The New Practical Subject "P&I Drawings using CAD Practical" has been introduced as Elective Practical. The Subject code for P&I Drawings using CAD Practical is 34284.
6. As per these Changes, Sixth semester Subjects as follows:

SUBJECT CODE	SUBJECT	HOURS PER WEEK			
		Theory	Tutorial/ Drawing	Practical Hours	Total
34062	Bio Medical Instrumentation #	6	-	-	6
34262	Industrial Automation and Drives	6	-	-	6
	<b>Elective II</b>				
34763	1 Robotics \$	5	-	-	5
34082	2. Test Engineering #				
34283	3. Power Plant Instrumentation				
34264	Industrial Automation Practical	-	-	5	5
	<b>Elective Practical</b>				
34284	1.P&I Drawings using CAD Practical	-	-	4	4
34085	2.Test Engineering Practical #				
34266	Programmable Logic controller Practical	-	-	4	4
34267	Project Work		-	4	4
	Seminar	1	-	-	1
	Total	18		17	35

\$ Common with Electronics (Robotics) # Common with ECE Branch

7. The Institutions who are offering Test Engineering Theory as Elective theory may offer the Test Engineering Practical as Elective Practical. The Institutions who are offering other Elective theory may offer P&I Drawings using CAD Practical as Elective Practical.
8. The New Theory Power Plant Instrumentation and New Practical Paper P&I Drawings using CAD syllabus content is enclosed in the Annexure.

Hence, the Principals & Faculty members of the Polytechnic Colleges are requested to offer their views and suggestions for the above, through email id **socdcdote@gmail.com** on or before **15.11.2017**.

Encl: Power Plant Instrumentation and P&I Drawings using CAD Practical Syllabus.

Copy to:

Mr.M. Jeganmohan,  
Principal (I/C) / Convener (ECE Branch M Scheme),  
Government Polytechnic College, Uthappanayakanur, Usilampatti – 625 537

for Commissioner of Technical Education

S. E. S.  
9/11/17



## M-SCHEME

(Implemented from the Academic year 2015 - 2016 onwards)

**Course Name : Electronics and Communication Engineering**

**Subject code : 34062**

**Semester : VI Semester**

**Subject title : BIO MEDICAL INSTRUMENTATION**

### TEACHING AND SCHEME OF EXAMINATION:

Number of Weeks/ Semester : 15 weeks

Subject	Instruction		Examination			
	Hrs./ Week	Hrs./ Semester	Marks			Duration
			Internal Assessment	Board Examination	Total	
Bio Medical Instrumentation	6	90	25	75	100	3 Hrs

### TOPICS AND ALLOCATION

Unit	Topic	Time (Hrs)
I	Bio - electric signals, electrodes and clinical measurement	16
II	Bio - medical recorders	16
III	Therapeutic instruments	16
IV	Biotelemetry and patient safety	15
V	Modern imaging techniques	15
Vi	Revision, Test	12
	TOTAL	90

## RATIONALE

Bio medical engineering education is in the growing stage. But every year, there is a tremendous increase in the use of modern medical equipment in the hospital and health care industry therefore it is necessary for every student to understand the functioning of various medical equipments. This subject to enable the students to learn the basic principles of different biomedical instruments viz Clinical measurement, Bio - medical recorders, Therapeutic instruments, Biotelemetry and Modern imaging techniques instruments.

## OBJECTIVES

After learning this subject the student will be able to understand the about

- The generation of Bio-potential and its measurement using various electrodes.
- The measurement of blood pressure.
- The measurement of lung volume.
- The measurement of respiration rate.
- The measurement of body temperature and skin temperature.
- The principles of operations of ECG recorder.
- The principles of operations of EEG recorder.
- The principles of operations of ENG recorder.
- The working principles of audio meter.
- The principles of operations of pacemaker.
- The basic principle of dialysis.
- The basic principle of short wave diathermy.
- The basic principle of ventilators.
- The working principles of telemetry.
- The basic principle of telemedicine.
- To learn about patient safety.
- The various methods of accident prevention.
- The basic principle of various types of lasers.
- The basic principle of CT and MRI scanner.
- The principle of operation of various imaging techniques

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**34062 - BIO MEDICAL INSTRUMENTATION**

**DETAILED SYLLABUS**

Units	Name of the topic	Hours
I	<p><b><u>BIO-ELECTRIC SIGNALS AND ELECTRODES</u></b></p> <p>Elementary ideas of cell structure, Bio – potential and their generation – resting and action potential – propagation of action potential. Electrodes – Micro – Skin surface – needle electrodes.</p> <p><b>CLINICAL MEASUREMENT:</b></p> <p>Measurement of Blood pressure (direct, indirect) – blood flow meter (Electro magnetic &amp; ultrasonic blood flow meter) – blood pH measurement - Measurement of Respiration rate – measurement of lung volume – heart rate measurement – Measurement of body and skin temperature - Chromatography, Photometry, Flurometry.</p>	16
II	<p><b><u>BIO - MEDICAL RECORDERS:</u></b></p> <p>Electro cardiograph (ECG) – Lead system – ECG electrodes – ECG amplifiers – ECG recording units – analysis of ECG curves. Nervous system – EEG recorder – 10-20 lead system – recording techniques – EEG wave types – Clinical use of EEG – brain tumour Electro – myograph (EMG) – EMG waves – measurement of conduction velocity – EMG recording techniques – Electro – retinograph (ERG) Audiometer – principle – types – Basics audiometer working.</p>	16
III	<p><b><u>THERAPEUTIC INSTRUMENTS:</u></b></p> <p>Cardiac pacemaker – classification – External pace makers – implantable pacemaker – pacing techniques – programmable pacemaker – Cardiac defibrillators – types – AC and DC defibrillators - Heart lung machine with Block diagram. Dialysis – Hemo dialysis – peritoneal dialysis. Endoscopes Endoscopic laser coagulator and applications – physiotherapy equipment – short wave diathermy – micro wave diathermy – ultrasonic therapy unit (block / circuit) – Ventilators – types – modern ventilator block diagram.</p>	16
IV	<p><b><u>BIOTELEMETRY AND PATIENT SAFETY:</u></b></p>	



	<p>Introduction to biotelemetry – physiological – adaptable to biotelemetry – components of a biotelemetry system – application of telemetry – elements of biotelemetry; AM, FM transmitter and receiver – requirements for biotelemetry system – radio telemetry with sub carrier – single channel and multi channel telemetry – Telemedicine; introduction, working, applications.</p> <p>Patient safety: Physiological effects of electric current – Micro and macro shock – leakage current – shock hazards from electrical equipment. Methods of Accident Prevention – Grounding – Double Insulation – Protection by low voltage – Ground fault circuit interrupter – Isolation of patient connected parts – Isolated power distribution system. Safety aspects in electro surgical units – burns, high frequency current hazards, Explosion hazards.</p>	15
V	<p><b><u>MODERN IMAGING TECHNIQUES:</u></b></p> <p>LASER beam properties – block diagram – operation of CO<sub>2</sub> and NDYag LASER – applications of LASER in medicine. X ray apparatus – block diagram – operation – special techniques in X-ray imaging – Tomogram – computerized Axial tomography – Ultrasonic imaging techniques – Echo cardiography – Angiography – CT scanner - Magnetic resonance imaging techniques.</p>	15
	Revision and Test	12

### **Text Book:**

Dr.M. Arumugam – Biomedical Instrumentation ,Anuradha publications, chennai (Page no. 1-15, 21-33, 117-136,142-159,164-179, 182-195, 202-209, 212-215, 255 – 256, 274-277, 285-286, 266-268, 293-297, 299- 310, 319-320, 329 – 340, 347-358, 360-367, 374-390, 390-400)

### **Reference Books.**

- Leslie Cromwell –Fred j. Wibell, Erich A.P Feither – Bio medical Instrumentation and measurements, II Edition.
- (Page no. 49-64, 63-76, 93-97, 106-149,195-205, 260-276, 296-303, 316 – 339, 363- 383,430-439)
- Jacobson and Webster – Medicine and clinical Engineering.
- R.S .Khandpur – Hand book of Bio –Medical Instrumentation.
- Medical Electronics - Kumara doss
- Introduction to Medical Electronics. B.R. Klin
- Introduction to Biomedical Instrumentation Mandeep Singh Printice Hall India 2010.

## M-SCHEME

(Implemented from the Academic year 2015-2016 onwards)

Course Name: Electronics and Communication Engineering

Subject code : 34082

Semester : VI Semester

Subject title : TEST ENGINEERING

### TEACHING AND SCHEME OF EXAMINATION:

Number of Weeks/ Semester : 15 weeks

Subject	Instruction		Examination			
Test Engineering	Hrs/ week	Hrs/ semester	Marks			Duration
			INTERNAL ASSESMENT	BOARD EXAM	TOTAL	
	5	75	25	75	100	3Hrs

### TOPICS AND ALLOCATION:

Unit	TOPIC	Hrs
I	INTRODUCTION TO TEST ENGINEERING	13
II	AUTOMATED TESTING METHODS AND TECHNOLOGY	13
III	V-I(SIGNATURE) TESTING METHODS AND TECHNOLOGY	13
IV	BOUNDARY SCAN TESTING METHODS AND TECHNOLOGY	13
V	ATE TEST PROGRAM GENERATION AND SEMICONDUCTOR TESTING	13
	Revision & Test	10
	TOTAL	75



## **34082 - TEST ENGINEERING**

### **DETAILED SYLLABUS**

UNIT	NAME OF THE TOPIC	HOURS
	<b>INTRODUCTION TO TEST ENGINEERING.</b>	
1	Need and Importance of Test Engineering – Principles of Fundamental Testing Methods – Basic Principles of Memory Testing – PCB Track Short Testing Methods – Concepts of Trouble Shooting PCBs - Manual and Automated PCB Trouble Shooting Techniques.	13
	<b>AUTOMATED TESTING METHODS AND TECHNOLOGY</b>	
2	Introduction to Automated Test Techniques – Fundamental of Digital Logic Families - Concepts of Back-Driving / Node Forcing Technique and its International Defense Standard - Concepts of Digital Guarding - Auto Compensation - Clock Termination – Functional Test Methods - Functional Testing of Digital, Analog and Mixed Integrated Circuit – Different types of Memory Module Functional Test.	13
	<b>V-I(Signature) TESTING METHODS AND TECHNOLOGY</b>	
3	Fundamentals of Electrical Characteristics - Effects of Curve Trace, Characteristics of Passive and Active Components - Understanding Composite VI-Curve and its deviations – Component Identification of Ageing Effects with VI Curve Trace, Input and Output Characteristics of Digital Integrated Circuits - Good Versus Suspect interpretation Comparison.	13
	<b>BOUNDARY SCAN TESTING METHODS AND TECHNOLOGY</b>	
4	Introduction to Boundary Scan – Need of Boundary Scan Test Technique - Principle of Boundary Scan Test - Boundary Scan Architecture - Application of Boundary Scan Test- Boundary Scan Standards - Boundary Scan Description Language (BSDL) – Interconnect test – Serial Vector Format (SVF) Test - Basic of JTAG Port - Digital Integrated Circuit Test using Boundary Scan Techniques.	13
	<b>ATE Test Program generation And Semiconductor testing</b>	
5	ATE in PCB Test – Test Fixtures - Basics of Automatic Test Program Generation - Standard Test Data Format STDF – Basic of Digital Simulator - Introduction to Semiconductor Test, Use of Load Boards.	13
	Revision & Test	10
	Total	75



**REFERENCE BOOKS:**

1. Test Engineering for Electronic Hardware – S R Sabapathi, Qmax Test Equipments P Ltd., 2011.
2. Practical Electronic Fault Finding and Trouble shooting by Robin Pain Newnes, Reed Educational and professional publishing Ltd., 1996
3. The Fundamentals of Digital Semiconductor Testing, Floyd, Pearson Education India, Sep-2005

**M-SCHEME**  
**(Implemented from the Academic year 2015-2016 onwards)**

Course Name: **DIPLOMA IN INSTRUMENTATION AND CONTROL  
ENGINEERING**

Course Code : **1042**

Subject code : **34283**

Semester : **VI Semester**

Subject title : **POWER PLANT INSTRUMENTATION**

**TEACHING AND SCHEME OF EXAMINATION :**

Number of Weeks/ Semester : 15 weeks

Subject Title	Instruction		Examination			
	Hrs. Week	Hrs Semester	Marks			Duration
			Internal Assessment	Board Examination	Total	
POWER PLANT INSTRUMENTATI ON	5	75	25	75	100	3Hrs

**TOPICS AND ALLOCATION**

Unit	Topic	Time(Hrs)
I	Overview Of Power Generation	13
II	Measurements In Power Plant	13
III	Analysers In Power Plant	13
IV	Control Loops In Boiler	14
V	Turbine - Monitoring And Control	12
VI	Revision, Test	10
	<b>TOTAL</b>	<b>75</b>

**RATIONALE**

The per capita consumption is regarded as an index of national standard of living. The fuel and power are the most important items on which national standard of life depend. Therefore the increase and power potential of nation is



considered most important among all. This subject enables the students to learn the basic principles of different methods of power generation and the instrumentation and control involved in the power generation process.

## **OBJECTIVES**

After learning this subject the student will be able to understand about

- The methods of power generation
- The operation of hydro, thermal, solar, wind and nuclear power plants
- The types of boilers and its classification
- The Piping and Instrumentation drawing of boiler
- The Differential pressure measurement of air flow
- The Inferential and Non-Inferential measurements of combustion air flow
- The measurement of Steam flow, Steam pressure and Steam temperature
- The measurement of Dust and Smoke
- The principle of operation of Flue gas Analyser,
- The principle of operation of Electrical conductivity meter
- The principle of operation of Auto analyser
- The principle of operation of Air pollution monitoring system
- The furnace draft control using feed forward and feedback control
- The Boiler feed water pumping and heating system
- The Instrumentation and control in turbines

Units	Name Of The Topic	Hours
<b>I</b>	<b>OVERVIEW OF POWER GENERATION</b>  Hydro electric power plant - Introduction - Hydrology - Hydro graph - Classification of Hydro electric power plant - Basic requirements - Operation - Components used in hydro electric power plant - Thermal power plant - Circuits in thermal power plant - Working of thermal power plant - Coal handling system - Ash and Dust handling system - Draft system - Economizer - Air pre heater - Solar power plant - principle - Flat plate collector - Solar thermal power generation - Photo voltaic power generation - Nuclear power plant - Principle - Pressurized water reactor - Boiling water reactor - Components using nuclear power plant - Wind power plant - Principles - Basic components of wind energy conversion system - Boilers - Steaming process - Basic boilers types and classification - Piping and Instrumentation diagram of boiler - Co-Generation system - topping cycle, bottoming cycle.	<b>13</b>
<b>II</b>	<b>MEASUREMENTS IN POWER PLANT</b>  Differential pressure measurement of air flow measurements - Inferential measurements of combustion air flow - Non-Inferential method of air flow measurements - Oil flow measurements - Steam flow measurements - Steam pressure measurements of high pressure - Steam temperature measurements - Drum level measurements - Dust measurements - Smoke measurements - Radiation Detectors - Pressure Gauges - Strain Gauges.	<b>13</b>
<b>III</b>	<b>ANALYSERS IN POWER PLANT</b>  Flue gas Analyser - Flue gas Oxygen analyser - Measurement of impurity in feed water and steam - Electrical conductivity meter - Steam purity meter - flame Photometer - Dissolved Oxygen analyser - pH meter - Chromotography - Auto analyser - Air pollution monitoring system.	<b>13</b>
<b>IV</b>	<b>CONTROL LOOPS IN BOILER</b>  Boiler control system - Combustion control - Measurement of furnace draft - furnace draft control using feed forward and feedback control - Drum level control Super heat temperature control system - Boiler feed water pumping and heating system - Flue gas dew point control - Soot blowing .	<b>14</b>



<b>V</b>	<b>TURBINE - MONITORING And CONTROL</b>  Introduction – Speed, Vibration, Shell Temperature monitoring and control – Steam pressure control – Lubrication system for steam turbines – Cooling system.	<b>12</b>

### Reference Books:

1. Sam Duekelow, Control of Boilers, Instrument society of America, 1991.
2. Everett wood ruff, Herbert lammers, Thomas lammers, Steam plant operation, 9<sup>th</sup> edition McGraw Hill, 2012
3. Ragput R.K., a Text book of Power plant engineering. 5<sup>th</sup> edition lakshmi Publications, 2013
4. Bela G.Liptak, 'Instrumentation in process industries', Chilton book company 2005.
5. P.K.Nag, power plant engineering Tata McGraw Hill education, 3<sup>rd</sup> edition 2007.
6. Tamilmani Power plant instrumentation, Sams Publishers, 2011.
7. Krishnaswamy.K and Ponni bala.M, Power plant instrumentation, PHI Learning private limited., New Delhi 2011.

**M-SCHEME**  
(Implemented from the Academic year 2015-2016 Onwards)

Course Name : **DIPLOMA IN INSTRUMENTATION AND CONTROL ENGINEERING**

Course Code : **1042**

Subject code : **34284**

Semester : **VI Semester**

Subject title : **P& I DRAWINGS USING CAD PRACTICAL**

**TEACHING AND SCHEME OF EXAMINATION :**

Number of Weeks/ Semester : 15 weeks

Subject Title	Instruction		Examination			
	Hrs. Week	Hrs Semester	Marks			Duration
			Internal Assessment	Board Examination	Total	
<b>P&amp;I DRAWINGS USING CAD PRACTICAL</b>	4	60	25	75	100	3Hrs

**Software requirement: CAD package / CAD P&ID 2012/Edraw Max**

**34284 - P&I DRAWINGS USING CAD PRACTICAL**

**List of Experiments**

1. Study of various symbols and abbreviations used in P&ID diagram.
2. Draw the P&ID of a Drum type Boiler with only measurement points.
3. Draw the P&ID of Feedback control system in a chemical reactor for the control of temperature and pressure.
4. Draw the P&ID of Feedback control system in a tank for the control of level and inlet flow rate.
5. Draw the P&ID of Cascade control system in a steam heat exchanger and Distillation column.
6. Draw the P&ID of Feed forward control system in a stirred tank heater.
7. Draw the P&ID of a ratio control system for the control of two flow rates by ratio.
8. Draw the P&ID of Split range control scheme in a process.
9. Draw the P&ID of On/Off Level, Flow and Pressure Control of Centrifugal Pump.
10. Draw the P&ID of any one Batch Dryer.
11. Draw the P&ID of pneumatic power supply and its distribution.



12. Draw the P&ID of a Simple Batch process.

13. Draw the P&ID of a bottle filling process using Conveyer system.

### REFERENCE BOOKS

Refer the below books for the P&ID Diagram of the listed experiments

1. Bela G. Liptak, Instrument Engineers Handbook – Process Control, Third edition.
2. Andrews & William, Applied Instrumentation in Process Industries.
3. C.D. Johnson, Process Control Instrumentation Technology, Prentice Hall of India.

### EQUIPEMENT REQUIRED:

Sr.No	Name of the Equipments	Required Nos
	<b>Software required:-</b>	
1	CAD/ CAD P&ID 2012 /Edraw Max Software for multiuser	1 no
	<b>Hardware required:-</b>	
1	PC Pentium Dual Core	30 nos
2	Laser printer	2 nos
3	UPS 5KVA with one hour backup	1 nos

### SCHEME OF VALUATION

DRAWING P&ID	20 MARKS
P&ID DRAWING USING CAD	35 MARKS
RESULT	15 MARKS
VIVA VOICE	5 MARKS
TOTAL	75 MARKS

**M-SCHEME****(Implemented from the Academic year 2015-2016 onwards)****Course Name: Electronics and Communication Engineering****Subject code : 34085****Semester : VI Semester****Subject title : TEST ENGINEERING PRACTICAL****TEACHING AND SCHEME OF EXAMINATION:**

Number of Weeks/ Semester : 15 weeks

<b>Subject</b>	<b>Instruction</b>		<b>Examination</b>			
	<b>Hrs/ week</b>	<b>Hrs/ semester</b>	<b>Marks</b>			<b>Duration</b>
			<b>INTERNAL ASSESSMENT</b>	<b>BOARD EXAM</b>	<b>TOTAL</b>	
<b>TEST ENGINEERING PRACTICAL</b>	4	60	25	75	100	3Hrs

**ALLOCATION OF MARKS**

CIRCUIT DIAGRAM : 20

PROCEDURE: 25

EXECUTION &amp; HANDLING OF EQUIPMENT : 15

OUTPUT / RESULT : 10

VIVA – VOCE : 05

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 TOTAL : 75

**34085 - TEST ENGINEERING PRACTICAL****List of experiments**

1. Locate a Short in a circuit Board using Short Locator.
2. Test and verify the combinational logic circuits NAND, NOR, Half-Adder, Half-Subtractors, Multiplexers, De-multiplexer, Decoder & Encoder using functional test method.
3. Test and verify the Sequential Logic Circuits D-FF, RS-FF, Latch, Counter, Shift Register using functional test method.
4. Test and verify the Memory Devices SDRAM/DRAM Chip . using functional test method.
5. a. Test and verify the digital circuits in a circuit using auto compensation technique.  
b. Test and verify the open emitter circuit using pull down resistor.  
c. .Test and verify the open collector circuit using pull up resistor.
6. Test the functionality of operational amplifier in Inverting , Non-inverting and voltage follower mode.
7. Test the VI characteristics of R,L,C using signature method.
8. Test the VI characteristics of electronic components Diode, Zener Diode, NPN/PNP Transistor using signature method .
9. Test the VI characteristics of RC Filter, Low Pass Filter , Band Pass Filter using signature method.
10. Test the VI characteristics of electronic components MOSFET and Transistor using Trigger pulse and signature method.
11. Test the VI characteristics of electronic components SCR and Opto coupler using Trigger pulse and signature method.
12. Test RLC circuit using in-circuit measurement method.
- 13..Test the Boundary Scan IC using JTAG port and non boundary scan IC using boundary scan IC.
14. Detect and list down the stuck to VCC and stuck to Gnd pins in a boundary scan IC.
15. Develop a device model for NAND and NOR using device library and create a test pattern for testing.

**EQUIPMENTS REQUIRED**

Sl.No	Name of the Equipments
1	PCB SHORTS LOCATOR TRAINER
2	V-I CHARACTERISTICS TRAINER SYSTEM
3	FUNCTIONAL TESTING TRAINER SYSTEM
4	IN-CIRCUIT MEASUREMENT TRAINER SYSTEM
5	BOUNDARY SCAN TEST TRAINER SYSTEM
6	DIGITAL and ANALOG SIMULATOR