FACILITIES AND EQUIPMENT INSTALLATION PLAN
RIYADH ELECTRONICS TECHNICAL INSTITUTE
THE KINGDOM OF SAUDI ARABIA

OCTOBER 1975

FACILITIES AND EQUIPMENT INSTALLATION PLAN
RIYADH ELECTRONICS TECHNICAL INSTITUTE
THE KINGDOM OF SAUDI ARABIA

OCTOBER 1975

CRITERIA AND PROCEDURES FOR PREPARATION

This installation plan was prepared according to the following criteria and procedures.

1. All the facilities and equipment were so planned as will fill the quantitative requirements arising from the number of students, number of classes and formation of courses proposed in the Report of Japanese Implementation Survey Mission for Riyadh Electronics Technical Institute Project, Saudi Arabia (hereafter called the "Report:). However, the curriculms proposed in the Report were so rearranged that a total of 46 and not 34 credits will be taken in each year (See Table 1-1).

2. A draft plan containing the subjects, items and contents of practical training of the lectures and experiments to be conducted in the technical training rooms (hereafter called the "classrooms") was prepared for each course of the curriculum (See Table 2). As for the contents of practical training, the standard training themes to be completed in each year and course were selected.

3. A detailed table of equipment and instrument required for respective experimental and training subjects in each classroom was prepared (See Table 3). Standard market price in Japan was given for each equipment and instrument listed, with estimated price shown for any equipment and instrument not available on the market.

4. The number of students who can be trained at a time in a single experimental and training subject varies by the kind and contents of the subject. Accordingly, the quantity of equipment and instrument was determined on the assumption that the students will be organized into a suitable number of groups for each subject.

5. It is understood that excepting those furnished with the equipment and instrument, all consumables and expendable supplies such as smaller tools, samples, replacement parts, connecting wires and recording papers will be separately supplied together with the teaching materials.

6. It is also understood that the installation of the power unit for lighting and motor circuits as well as the power distribution unit for operation of classroom equipment and instrument, which are both appurtenant to the school facilities, will be separately arranged for.

7. The lay-out of classrooms including their demensions mentioned here is not necessarily followed in proposals made in the Report.

8. An audio-visual teaching materials centre is required for preparation, compilation and storage of transparencies of overhead projectors and for preparation of microfilms, slides and VTR tapes. Details of the equipment to be installed in the centre were therefore listed up. It is hoped that each classroom will be so designed as can be concurrently used as an audio-visual room, and that a special audio-visual education room will be attached to the teaching materials centre.

9. The schoolroom occupancy was checked by distributing the school hours according to the recitation schedule (Tables 1-2 and 1-3) prepared from the curriculum table (Table 1-1). As a result, it was found that account must be taken of the following points.

   a) The drawing room will be a little too small if designed to have the dimensions proposed in the Report. However, if two rooms each capable of accommodating 15 students are provided, it will be possible to accomodate one class.

   b) There should be provided two radio engineering classrooms.

c) It is expected that classrooms for Workmanship I & II and electronics I & II will be used very frequency for practical training than otherwise. These classrooms should be vacant for at least two hours each day in order to make preparations for materials, put the equipment, and instrument in order, and effect the necessary repairs and cleanings. Hence, there should be three classrooms for each of these four subjects.

d) Considering the number of students and the contents of experiments, it is desirable that two each of anechoic rooms and shielding rooms be separately provided.

e) Since it is probable that the computer room will be used by all courses, there should be two classrooms for Instrumentation Engineering.

f) The computer room should have a punching room and a debugging room attached to it.

10. Students of the four-year course can conduct experiments and researches necessary for preparation of their graduation thesis by making use of the equipment and instrument in respective classrooms.

Table 1-1

CURRICULUM PLAN (46 credits/year)

Course / Year / Subject	3-Year Course				4-Year Course				
	1	2	3	Total	1	2	3	4	Total
General Subjects	24	18	6	48	24	18	18	20	80
HR.Other than General Subjects	2	2	2	6	2	2	2	2	8
Sub-total	26	20	8	54	26	20	20	22	88
Technical Subjects									
Drawing	6	2	2	10	6	2			8
Workmanship I	6	6		12	6	6			12
Workmanship II		6	6	12		6	4		10
Electronics I	8	6		14	8	6			14
Electronics II		6	8	14		6	6		12
Electronics III			8	8			2	2	4
Solid State Physics			8	8			2	2	4
Applied Mathematics							8	4	12
Radio Engineering TV Engineering Communications Engineering Instrumentation Engineering Graduation Research	(Minor)		14	14			6 each	10 each	16 each
Sub-total	20	26	38	84	20	26	26	24	96
Total	46	46	46	138	46	46	46	46	184

CLASSROOM OCCUPANCY CONDITION

(TABLE 1-2)

CLASSROOM \ DAY / SCHOOL HOUR	MONDAY								TUESDAY								WEDNESDAY								THURSDAY								FRIDAY								SATURDAY						OCCUPIED HOURS
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	
DRAWING ~1		1F	1F	1F					2C	2C				1B	1B	1B	1A	1A	1A						1D	1D	1D		1B	1B	1B		1A	1A	1A	3B	3B			1C	1C	1C	1D	1D	1D	28
" ~2		2B	2B						3A	3A		2D	2D				1C	1C	1C						1F	1F	1F		2F	2F	2F		2E	2E								2A	2A	1F	1F	1F	22
WORKMANSHIP I~1		1C	1C	1C		1F	1F	1F	1A	1A	1A			1D	1D	1D	1E	1E	1E			1A	1A	1A	1B	1B	1B		1C	1C	1C		1F	1F	1F			1B	1B	1B	2C	2C	2C		2B	2B	35
" ~2		2A	2A	2A		2F	2F	2F	2E	2E	2E	2B	2B	2F	2F	2F	2C	2C	2C	2B	2B	1D	1D	1D	2A	2A	2A		1D	1D	1D		2D	2D	2D	1E	1E	1E		2D	2D	2D	2B	2E	2E	40
WORKMANSHIP II~1		2E	2E	2E		3A	3A	3A	2D	2D	2D			2C	2C	2C	2A	2A	2A			2B	2B	2B	2D	2D	2D	3E/	3E/	3E/	3E/		3T	3T	3T	3T		2B	2B	2B				3A	3A	3A	35
" 2		3TC	3TC	3TC	3TC	3B	3B	3B	3R	3R	3R	3R		3B	3B	3B						2F	2F	2F	2E	2E	2E						2F	2F	2F			2C	2C	2C				2A	2A	2A	29
ELECTRONICS I~1		1B	1B	1B		1E	1E	1E	1F	1F	2C	2C	2C	1A	1A	1A	1B	1B	1B	1A	1A	2D	2D	2D	1C	1C			2B	2B	2B		2B	2B	2B	1C	1C	2F	2F	2F	1B	1B		1A	1A	1A	40
" ~2		1D	1D	1D		2C	2C	2C	2F	2F	2F	1C	1C	2D	2D	2D	1D	1D	1D	1C	1C	1F	1F	1F	1E	1E	1E		2E	2E	2E		1D	1D	2E	2E	2E	2A	2A	2A				1F	1F	1F	38
ELECTRONICS II~1		2D	2D	2D		2A	2A	2A	3B	3B	3B			2E	2E	2E	3B	3B	2D	2D	2D	2E	2E	2E	2F	2F	2F		2C	2C	2C		2A	2A	2A			3TC	3TC	3TC	2B	2B	2B	2C	2C	2C	38
" ~2		2E	2E	2E		2B	2B	2B	3T	3T	3T			3E/	3E/	3E/	3A	3A	3TC	3TC	3TC	3T	3T	3T	3A	3A	3A		3R	3R	3R		3B	3B	3B			3E/	3E/	3E/	3A	3A	3A	3R	3R	3R	38
ELECTRONICS III~1		3B	3B	3A	3A		4R	4R	3TC	3TC							3R	3R				4TC	4TC	3B	3B	3B		3A	3A	3A		3A	3A	3A			3B	3B	3B						3T	3T	26
" ~2		(3A	3A)	(3B	3B)					(3A	3A	3A	3A	3A	3A)			(3A 3B	3A 3B	3A 3B	3A 3B	3A 3B	3A 3B)					4E/	4E/				3E/	3E/				4T	4T	(3B	3B	3B	3B	3B	3B)	28
SOLID STATE PHYSICS						4E/	4E/														4T	4T	4TC	4TC							4R	4R												8
RADIO ENGINEERING																									3R	3R	3R	4R	4R	4R	4R						3R	3R	3R	4R	4R	4R	4R	4R	4R	29
TV ENGINEERING		3A	3A	3B	3B	3T	3T	3T				4T	4T	4T	4T			3A	3A	3A	3A	3A	3A	3T	3T	3T						4T	4T	4T	4T	4T	4T			3B	3B	3B	3B	3B	3B	34
COMMUNICATIONS ENGINEERING						3TC	3TC	3TC			3A	3A	3A	3A	3A			3B	3B	3B	3B	3B	3B				4TC	4TC	4TC	4TC	3TC	3TC	3TC					4TC	4TC	4TC	4TC	4TC	4TC	32
INSTRUMENTATION ENGINEERING						3ET	3E/	3E/																	3E/	3E/	3E/						4E/	4E/	4E/	4E/			4E/	4E/	4E/	4E/	4E/	4E/	32

NOTES : ( ) & } ····· OPTIONAL SUBJECTS

EXAMPLE OF RECITATION SCHEDULE (46 HOURS A WEEK) No.1 (TABLE 1-3)

MON-DAY	1A	1B	1C	1D	1E	1F	2A	2B	2C	2D	2E	2F	3A	3B	3R	3T	3TC	3EI	4R	4T	4TC	4EI
1				HOME ROOM (ALL GRADES)																		
2		ELCTRONICS I	WORKMANSHIP II	ELECTRONICS I		DRAWING	WORKMANSHIP I	DRAWING		ELECTRONICS II	WORKMANSHIP II	ELECTRONICS II	MINOR	ELECTRONICS II			WORKMANSHIP II					
3																						
4									DRAWING				ELECTRONICS II	MINOR								
5																						
6					ELECTRONICS I	WORKMANSHIP I	ELECTRONICS II	ELECTRONICS I	ELECTRONICS I			WORKMANSHIP I	WORKMANSHIP II	WORKMANSHIP II		TV ENGINEERING	COMMUNICATIONS ENGINEERING	INSTRUMENTATION ENGINEERING	ELECTRONICS III			
7																						
8																						SOLID STATE PHYSICS

TUES-DAY	1A	1B	1C	1D	1E	1F	2A	2B	2C	2D	2E	2F	3A	3B	3R	3T	3TC	3EI	4R	4T	4TC	4EI
1						ELECTRONICS I			DRAWING	WORKMANSHIP II	WORKMANSHIP I	ELECTRONICS I	DRAWING	ELECTRONICS II	WORKMANSHIP II	ELECTRONICS I	ELECTRONICS III					
2																						
3									ELECTRONICS I	WORKMANSHIP II												
4			ELECTRONICS I						WORKMANSHIP I	ELECTRONICS I												
5			ELECTRONICS I						WORKMANSHIP I	ELECTRONICS I								ELECTRONICS III				
6	ELECTRONICS I								WORKMANSHIP II	ELECTRONICS I	ELECTRONICS II	ELECTRONICS I	MINOR	WORKMANSHIP II						TV ENGINEERING		
7	DRAWING			WORKMANSHIP I																		
8																						

WEDNESDAY	1A	1B	1C	1D	1E	1F	2A	2B	2C	2D	2E	2F	3A	3B	3R	3T	3TC	3EI	4R	4T	4TC	4EI
1	DRAWING	ELECTRONICS I	DRAWING	ELECTRONICS I	WORKMANSHIP I		WORKMANSHIP II		WORKMANSHIP I				ELECTRONICS II	ELECTRONICS II	ELECTRONICS III							
2																						
3	ELECTRONICS I																ELECTRONICS II					
4	ELECTRONICS I		ELECTRONICS I		WORKMANSHIP I				ELECTRONICS II													
5	WORKMANSHIP I												MINOR	MINOR								
6				DRAWING																		
7	ELECTRONICS I															ELECTRONICS II						
8	WORKMANSHIP I																CONTROL ENGINEERING			SOLIDSTATE PHYSICS		

SAT-URDAY	8	7	6	5	4	3	2	1
1A			ELECTRONICS I					
1B							ELECTRO-NICS I	
1C						DRAWING		
1D			DRAWING					
1E			DRAWING			ELECTRO-NICS I		
1F			ELECTRONICS I					
2A			WORKMANSHIP II			DRAWING		
2B			WORKMANSHIP I			ELECTRONICS II		
2C			ELECTRONICS II			WORKMANSHIP I		
2D						WORKMANSHIP II		
2E			WORKMANSHIP I					
2F								
3A			WORKMANSHIP II			ELECTRONICS II		
3B				MINOR				
3R			ELECTRONICS II					
3T			ELECTRO-NICS III					
3TC								
3EI								
4R				RADIO ENGINEERING				
4T								
4TC				COMMUNICATIONS ENGINEERING				
4EI				INSTRUMENTATION ENGINEERING				

FRI-DAY	8	7	6	5	4	3	2	1
1A							DRAWING	
1B		WORKMANSHIP I						
1C				ELECTRO-NICS I				
1D							ELECTRO-NICS I	
1E				WORKMANSHIP I				
1F						WORKMANSHIP I		
2A		ELECTRONICS I				ELECTRONICS II		
2B		WORKMANSHIP II				ELECTRONICS I		
2C		WORKMANSHIP II						
2D						WORKMANSHIP I		
2E				ELECTRON NICS I			DRAWING	
2F		ELECTRONICS I				WORKMANSHIP II		
3A						ELECTRONICS III		
3B		ELECTRONICS III		DRAWING		ELECTRONICS III		
3R		RADIO ENGINEERING						
3T							WORKMANSHIP II	
3TC		ELECTRONICS II					COMMUNICA-TION ENGI-NNIEERING	
3EI		ELECTRONICS II					ELECTRO-NICS III	
4R				SOLID STATE PHYSICS				
4T		ELECTRO-NICS III				T V ELECTRONICS		
4TC								
4EI				INSTRUMENTATION ENGINEERING				

SOCIAL CLUB ACTIVITIES (ALL GRADES)	8	7	6	5	4	3	2	1
1A								
1B			DRAWING			WORKMANSHIP I		
1C			WORKMANSHIP I				ELECTRO-NICS I	
1D			WORKMANSHIP I			DRAWING		
1E						ELECTRONICS I		
1F						DRAWING		
2A						WORKMANSHIP I		
2B			ELECTRONICS I					
2C			ELECTRONICS II					
2D						WORKMANSHIP II		
2E			ELECTRONICS I			WORKMANSHIP II		
2F			DRAWING			ELECTRONICS II		
3A			ELECTRONICS III			ELECTRONICS II		
3B						ELECTRONICS III		
3R			ELECTRONICS II			RADIO ENGINEERING		
3T						T V ENGINEERING		
3TC								
3EI						INSTRUMENTA-TION	ENGINEERING	
4R			RADIO ENGINEERING					
4T								
4TC			COMMUNICATIONS ENGINEERING				SOLID STATE PHYSICS	
4EI				ELECTRO-NICS II				

THURSDAY ~ SATURDAY

TABLE 2

THEMES AND ITEMS OF STUDY AND CONTENTS OF PRACTICAL TRAINING BY SUBJECT

1. DRAWING

Theme of Study	Item	Contents of Practical Training	Remarks
1. Outline of drawing	1. Drawings and drafting.	1. Handling of drafting machines and method of drafting.	
	2. Lines	2. Practice in ruling lines.	
	3. Letters.	3. Practice in drawing letters.	
	4. Method of drafting.	4. Drawings of patterns and figures.	
	5. Fitting and roughness.	5. Symbolic representation of fitting.	
	6. Sketch.	6. Sketch of part (e.g., joints).	
2. Machine parts.	1. Screw.	7. Screw .... drawing.	
	2. Bolt and nut	8. Bolt and nut ..... drawing.	
	3. Key.	9. Cone clutch ..... "	
	4. Gear.	10. Spur gear ..... "	
3. Parts of electronic equipment	1. Fixed resistance	11. Resistance ..... "	
	2. Variable resistance	12. Variable resistance ..."	
	3. Coil.	13. Coil .... drawing and design.	
	4. Capacitor.	14. Capacitor ..... drawing.	
	5. Switch.	15. Changeover switch ... "	
	6. Transformer.	16. Small transformer ... drawing and design.	
	7. Semiconductor	17. Semiconductor ..... drawing.	
	8. Printed circuit board	18. Printed circuit board ... "	
	9. Integrated circuit.	19. IC amplifier .... drawing.	
4. Electronic equipment.	1. Measuring instrument.	20 Filter .... drawing and design.	
	2. TV receiver.	21. TV receiver ..... drawing.	
	3. Micro-computer.	22. Composition of micro-computer ... drawing.	
	4. Telephone exchange.	23. Telephone exchange circuit ..... "	
	5. Radio receiver.	24. Radio receiver circuit ..... "	
	6. Transmitter.	25. Transmitter circuit ..... "	

Theme of Study	Item	Contents of Practical Training	Remarks
5. Electronic industrial facilities.	7. FM receiver.	26. FM receiver circuit ..... drawing.	
	8. Stereophonic equipment.	27. Speaker and box ..... "	
	9. Stereophonic amplifier.	28. Stereophonic amplifier circuit ... "	
	1. TV studio.	29. Studio wiring diagram ..... "	
	2. Automatic control unit.	30. Model plant ..... "	
	3. Electronic computer.	31. Computer system wiring diagram ... "	
	4. Power unit.	32. Constant-voltage power unit ..... "	
	5. Radio terminal station	33. Radio terminal station system chart ....."	

2. WORKMANSHIP - I

Theme of Study	Item	Contents of Practical Training	Remarks
1. Machining.	1. Machining by lathe (turning and threading)	1. Cutting of a round bar.	
	2. Machining by boring maching (drilling).	2. Manufacture of a knob.	
	3. Hand finishing (surface finishing and fitting).		
	4. Machining by milling machine.	3. Manufacture of a weight.	
	5. Machining by sawing machine.	4. Cutting of angle bar and piping materials.	
2. Thin plate working.	1. Cutting and bending.	5. Manufacture of a flat chassis.	
	2. Marking-off.	6. Manufacture of a tool kit.	
	3. Drilling.	7. Manufacture of a box-type chassis.	
	4. Assembling.	8. Manufacture of the chassis of a small measuring instrument.	
	5. Welding and reveting.	9. Manufacture of a movable frame.	
	6. Painting.	10. Manufacture of a pipe truck.	
3. Angle bar working.	1. Cutting.	11. Practice in piping work.	
	2. Welding and assembling.	12. Practice in electrical work.	
	3. Drilling.	13. Practice in internal wiring work.	
	4. Painting.	14. Painting work.	
4. Pipe working.	1. Cutting, bending and machining.	15. Manufacture of a coil.	
	2. Threading.	16. Manufacture of a transformer.	
	3. Jointing.	17. Manufacture of a fluorescent lamp.	
5. Electrical work.	1. Pipe working.	18. Manufacture of a transformer.	
	2. Wiring work.	19. Manufacture of a power unit.	
	3. Testing.	20. Manufacture of a tester.	

Theme of Study	Item	Contents of Practical Training	Remarks
6. Coil winding.	1. Winding of high-frequency coil. 2. Winding of a power transformer coil	21. Practice in transformer assembling work. 22. Manufacture of an interphone. 23. Manufacture of a printed circuit board.	

3. WORKMANSHIP - II

Theme of Study	Item	Contents of Practical Training	Remarks
1. Manufacturing practice	1. Assembling of rotary equipment	1. Manufacture of a small DC motor.	
		2. Assembling of an induction motor winding.	
	2. Assembing of antenna.	3. Manufacture of a Yagi antenna.	
2. Fundametals of electronic circuit.	1. Amplifier.	4. Assembling of an amplifier.	
	2. Oscillator.	5. Assembling of an oscillator.	
		6. Assembling of a crystal oscillator.	
	3. Modulator and detector.	7. Manufacture and adjustment of a modulator and a detector.	
	4. Negative feedback amplifier.	8. Assembling of a negative feedback amplifier.	
	5. Power unit.	9. Manufacture of a constant-voltage power unit.	
	6. IC amplifier.	10. Manufacture and adjustment of a resonance circuit.	
	7. Logical circuit.	11. Manufacture of a logical circuit.	
3. Assembling of electronic equipment.	1. Radio receiver.	12. Assembling of a simple radio receiver.	
		13. Manufacture of a 6 TRANSISTOR 2-band radio receiver.	
	2. Acoustic equipment and stereophonic appliance.	14. Manufacture of a tape recorder.	
		15. Manufacture of a stereophonic amplifier.	
		16. Manufacture of a player.	
		17. Manufacture of a speaker.	
	3. Basic pulse circuit	18. Manufacture of a flip-flop circuit.	
		19. Manufacture of a frequency divider.	
	4. TV receiver.	20. Manufacture of a black-and-white TV receiver.	
		21. Manufacture of a colour TV receiver.	

Theme of Study	Item	Contents of Practical Training	Remarks
	5. Transmitter.	22. Manufacture of a simple transmitter.	
4. Practice in wire telebraphy and telephone	1. Telegraph.	23. Manufacture of a telegraph.	
	2. Telephone.	24. Manufacture of a telephone set.	
	3. Carrier telephony.		

4. ELECTRONICS - I

Theme of Study	Item	Contents of Practical Training	Remarks
1. Electric circuit & its materials.	1. Current (electron), voltage, and resistance (resistivity, temperature fluctuation and materials).	1. Handling of voltmeters and ammeters.	
	2. Ohm's law.	2. Experiment on Ohm's law.	
	3. Series and parallel connection of resistance.	3. Experiment in parallel and series connection of resistance (incl. combined resistance).	
	4. Series and parallel connection of batteries.	4. Experiment in parallel and series connection of batteries.	
	5. Electromotive force.	5. Measurement of electromotive force by a potentiometer.	
	6. Multiplier and shunt.	6. Experiment on a multiplier and a shunt.	
	7. Kirchhoff's law.	7. Experiment with a network.	
2. Measurement of resistance .	1. Measurement by a voltammeter.	8. Measurement of resistance by the method of fall-of-potential.	
	2. Internal resistance	9. Measurement of internal resistance of an ammeter and a cell.	
	3. Measurement by a bridge.	10. Measurement of resistance by the bridge method.	
	4. Measurement of low resistance and high resistance.	11. Measurement of resistance by a double bridge.	
3. Action of current.	1. Thermogenic action of current.	12. Experiment in Joule heat.	
	2. Electric power and electric energy.	13. Measurement of electric power and electric energy.	
	3. Seebeck effect and Peltier effect	14. Measurement of thermoelectromotive force.	
	4. Electrolysis of electrolyte.	15. Practice in electrolysis.	
	5. Cell.	16. Manufacture of a cell.	

Theme of Study	Item	Contents of Practical Training	Remarks
4. Current and magnetism	1. Magnet and magnetism.	17. Experiment on the distribution of magnetic field.	
	2. Magnetic flux and its density.	18. Measurement of magnetic flux density.	
	3. Magenetic field produced by current.	19. Measurement of magnetic field produced by current.	
	4. Magnetic substance and magnetic circuit.	20. Measurement of magnetization curve.	
	5. Electromagnetic force.	21. Measurement of electromagnetic force.	
5. Ammeter and voltmeter.	1. Moving-coil type.		
	2. Rectifier type.		
	3. Others.		
6. Electromagnetic induction.	1. Electromagnetic induction.	22. Experiment in electromagnetic induction.	
	2. Eddy current.	23. Experiment in eddy current.	
	3. Self-induction.	24. Experiment in self-induction.	
	4. Mutual induction.	25. Experiment in mutual induction.	
7. Action of static electricity.	1. Electrification and electric charge.	26. Electrification and measurement of electric potential.	
	2. Electric field.		
	3. Electrostatic induction.		
	4. Electrostatic screening.		
	5. Electrostatic capacity.	27. Dielectric and measurement of electrostatic capacity.	
	6. Series and parallel connection of capacitors.	28. Measurement of series and parallel connection of capacitors.	
	7. Piezo-electricity.	29. Observation of piezo-electric phenomenon.	
	8. Dielectric breakdown.		
	9. Electric discharge.	30. Observation of electric discharge.	

Theme of Study	Item	Contents of Practical Training	Remarks
8. Wave form observation and sinusoidal AC.	1. Wave form observation.	31. Wave form observation by an oscillograph and voltage measurement.	
	2. Pen-type oscillograph.		
	3. Cathode-ray oscillograph.		
	4. AC wave form and sine wave	32. Measurement of sine wave and effective value.	
	5. Effective value.		
	6. Phase and phase difference.	33. Measurement of phase difference.	
	7. Vector and the method of its expression.		
9. Fundamentals of AC circuit.	1. Ohmic circuit.		
	2. Inductive circuit.		
	3. Capacitive circuit.		
	4. R-L-C series circuit.		
	5. R-L-C parallel circuit.	34. Experiment with R-L-C circuit.	
	6. Parallel resonance.	35. Measurement of resonance characteristics.	
	7. Measurement of electric energy.		
10. Calculation of AC circuit.	1. Complex number.		
	2. Calculation of series circuit.		
	3. Calculation of parallel circuit.		
	4. Matching circuit.	37. Experiment in matching.	
	5. Differentiation circuit.	38. Experiment with differentiation circuit and integration circuit.	
	6. Integration circuit.		
11. AC bridge.	1. Principles of AC bridge.	39. Measurement of R,L,C by an AC bridge.	
	2. Measurement.		

Theme of Study	Item	Contents of Practical Training	Remarks
12. Method of expressing 3-phase AC.	1. Method of expressing 3-phase AC.	40. Practice in the connection of 3-phase AC.	
	2. Method of connection.		
	3. 3-phase electric power	41. Measurement of 3-phase electric power.	
	4. Revolving magnetic field.	42. Experiment with revolving magnetic field.	
13. Non-sinusoidal AC.	1. Non-sinusoidal AC and higher harmonics.	43. Experiment in the analysis and synthesis of wave form.	
	2. Effective value.	44. Experiment in the resonance of higher harmonics.	
	3. Resonance of higher harmonics.		
	4. Form factor and crest factor.		
	5. Fundamentals of pulse shape.	45. Experiment with pulse-forming network (fundamentals of R, L and C circuits only)	
	6. Charge and discharge characteristics of R-C circuit.	46. Measurement of charge and discharge characteristics of R-C circuit.	
14. Instrumentation in general.	1. Electric metering and counting.		
	2. Handling of measuring error and measured value.	47. Error test of measuring instrument.	
	3. Electric meters and their structure.	48. Handling of different measuring instrument.	
	4. Indicating instrument.		
	5. Recording meter.		
	6. Integrating meter.		
	7. Industrial instrumentation.	49. Handling of industrial instrument.	
	8. Telemetering.		

5. ELECTRONICS - II

Theme of Study	Item	Contents of Practical Training	Remarks
2. Electronic tube and semiconductor.	1. Vacuum tube (diode, triode and multielectrode tube) and its materials.	1. Measurement of static characteristics of vacuum tube.	
	2. Semiconductor diode (junction, point contact, etc.)	2. Measurement of static characteristics of diode.	
	3. Transistor.	3. Measurement of static characteristics of transistor.	
	4. Main technical terms relating to integrated circuit.		
3. Electronic circuit.	1. Fundamentals of amplification.	4. Measurement of changes in the characteristics of amplifier due to bias.	
	2. Amplifying circuit.	5. Measurement of characteristics of amplifier.	
	3. Oscillating circuit.	6. Measurement of oscillating characteristics of oscillator.	
	4. Modulation and detector circuits.	7. Measurement of modulation characteristics.	
	5. Pulse circuit.	8. Measurement of characteristics of pulse circuit incorporating transistor.	
	6. Integrated circuit.	9. Measurement of characteristics of IC amplifier.	
4. Acoustic equipment	1. Sound (sound pressure level and loudness level).	10. Measurement of sound pressure and tone colour.	
	2. Microphone.	11. Measurement of frequency characteristics of microphone.	
	3. Speaker.	12. Measurement of frequency characteristics of speaker.	
	4. Recorder-player.	13. Handling of tape recorder-player and measurement of its characteristics.	

Theme of Study	Item	Contents of Practical Training	Remarks
5. Wire communication equipment.	1. Wire communication network	14. Performance test of telephone.	
	2. Telephone and telephone exchange.	15. Handling of telephone exchange.	
	3. Telegraph.	16. Handling of telegraph.	
	4. Lines and carrier telephony.	17. Handling of carrier telephone.	
	5. Telemetering equipment.	18. Handling of telemetering equipment.	
6. Electromagnetic wave.	1. Electromagentic wave	21. Practice in the generation of electromagnetic wave.	
	2. Antenna.	22. Measurement of antenna directivity and gain.	
	3. Microwave transmitter.	23. Measurement of microwave characteristics.	
	4. Feeder line.	24. Measurement of feeder standing wave.	
	5. Radio wave propagation.		
	6. Coaxial line.		
	7. Waveguide.	25. Measurement of waveguide standing wave.	
	8. Cavity resonator.	26. Measurement of frequency using cavity resonator.	
	9. Microwave transmission circuit.	27. Practice in microwave transmission.	
7. Radio communication equipment.	1. Composition of radio communication channel.	28. Practice in the operation of radio transmitter.	
	2. Systems of radio communication.	29. Practice in the operation of radio receiver.	
	3. Radio transmitter.		
	4. Radio receiver.		
	5. Examples of transmitter and receiver.		
	6. Satellite communication.		
	7. Laser communication.	30. Experiment in laser communication.	

Theme of Study	Item	Contents of Practical Training	Remarks
8. Power supply equipment	1. Electric power system.	31. Study of electric power system and substation.	
	2. Power transducer circuit.		
	3. Cell.	32. Manufacure and measurement of cell.	
	4. Rectifier and its circuit	33. Practice in the operation of rectifier and its circuit.	
	5. Constant-voltage power circuit.	34. Manufacture and test of constant voltage power circuit.	
	6. Thyrister and current control circuit.	35. Thyrister-applied control circuit.	
	9. Source equipment.		
9. Rotary machine	1. AC generator	36. Characteristics test of AC generator.	
	2. AC motor.	37. Characteristics test of DC generator.	
	3. DC generator.	38. Characteristics test of AC induction motor.	
	4. DC motor.	39. Characteristics test of DC motor.	
10. TV receiver.	1. Image and vision.	40. Handling and test of TV transmitter and receiver.	
	2. Fundamentals.		
	3. Video transmitter.		
	4. TV receiver.		
	5. Colour TV receiver.	41. Handling and test of colour TV receiver.	
	6. Closed-circuit TV.		

ELECTRONICS - III

Theme of Study	Item	Contents of Practical Training	Remarks
Electric measurement.	1. Measurement of high-frequency current, voltage and electric power.	Measurement of high-frequency current by thermocouple type high-frequency ammeter.	
		Structure and characteristics of electronic voltmeter.	
		Measurement of electric power by 3 ammeters.	
		Measurement of electric power by bolometer.	
	2. Measurement of R, L, C and Z in high-frequency.	Measurement of impedance by high-frequency bridge.	
		Measurement of impedance, Q, by Q-meter.	
	3. Measurement of high-frequency.	Measurement of frequency.	
Electronic phenomena.	1. Structure of atom and electron emission.	Electron and its emission	Common to all subjects
	2. Electron and action of magnetic field and electric field.	Structure and deflection effect of picture tube.	
	3. Semiconductor.	Semiconductor and thermoelectric effect.	
Electronic measuring instrument.	1. Oscilloscope.	Performance and structure of oscilloscope.	
		Handling of oscilloscope.	
	2. Recorder.	Characteristics of automatic potential balancing mechanism.	
		Characteristics and structure of X - Y recorder.	
Automatic control.	1. Sequential control.	Experiment on sequential control model incorporating relay.	
		Sequential control by logical relay.	
	2. Feedback control.	Experiment on feedback control by servo mechanism.	
		Characteristics test and optimum adjustment using process model.	

Theme of Study	Item	Contents of Practical Training	Remarks
		Automatic control of generator.	
Automatic control device.	1. Sequential control device.	Characteristics of relay.	
		Characteristics of logical circuit.	
	2. Detection of industrial quantities.	Measurement and conversion of temperature.	
		Measurement and conversion of pressure and flow rate.	
		Characteristics of controller.	
Application of automatic control.	Model of automatic control.		
	Sequential control.	Sequential control of model elevator.	
	Process control.	Model of temperature control model. (air-conditioning system)	
Electronic computer	1. Systems and functions of electronic computer.	Principles of operation and performance of I/O unit	Computer Room
	2. Programming.	Analysis of subject and programming.	
	3. Programme and data punching.	Handling of card punch and tape punch, and practice in punching operation.	Punching Room
	4. Operation.	Handling of computer.	
Application of electronic computer.	1. Sequential control.	Computer sequential control	Micro-computer
	2. Digital control.	Direct digital control	
	3. OR and management.	Simulation and computer application for management.	

R-4 DESIGN OF RADIO CIRCUIT - 4

R

Theme of Study	Item	Contents of Practical Training	Remarks
1. Type and structure of radio receiver.		1. Measurement and manufacture of tuning circuit	Relationship between selectivity and Q.
2. Straight receiver.	1. Tuning circuit.	2. Characteristics test and manufacture of detector.	
	2. Detector circuit.	3. Characteristics test and manufacture of low-frequency amplifier.	
	3. Low-frequency amplifying circuit.	4. Manufacture and adjustment of straight receiver.	Incl. repairs
	4. Design of straight receiver.	5. Measurement and manufacture of high-frequency amplifier.	
3. Superheterodyne receiver.	1. High-frequency amplyfier circuit.	6. Gain measurement and manufacture of frequency converter.	
	2. Frequency converter circuit.	7. Measurement and manufacture of intermediate frequency amplifier.	
	3. Intermediate frequency amplifier circuit.	8. Manufacture of eliminator DC power unit.	
	4. Eliminator DC power circuit.	9. Manufacture of superheterodyne receiver.	
	5. Design of superheterodyne receiver.	10. Measurement of overall characteristics and repair of receiver.	
3. AM transmitter	1. Circuit and performance of AM transmitter.	11. Design and manufacture of all-band receiver.	
	2. Design of AM transmitter.	12. Manufacture and adjustment of transmitter.	
	3. SSB transmitter.	13. Measurement and adjustment of SSB transmitter and receiver.	

R-4 DESIGN OF RADIO CIRCUIT-4

R

Theme of Study	Item	Contents of Practical Training	Remarks
4. FM transmitter and receiver.	1. Circuitry and performance of FM transmitter and receiver.	14. Manufacture and adjustment of AM-FM modulator.	
	2. Design of FM transmitter.	15. Measurement and manufacture of FM receiver	Incl. measurement of characteristics of limiter and discriminator
5. Adjustment.	1. Repair of AM receiver.	16. Measurement and manufacture of multiplex FM-stereo unit.	
	2. Repair of FM receiver.	17. Design and manufacture of FM-stereo receiver.	Incl. measurement of stereophonic separativity.
	3. Adjustment and operation of transmitter.	18. Measurement of S/N ratio.	
6. Stereophonic system.	1. Stereo-convertible system.	19. Measurement of antenna characteristics	Incl. gain and directivity.
	2. Multiplex stereophonic transmitter.	20. Manufacture of IC-incorporated receiver.	
	3. Stereophonic receiver.	21. Repair of receiver.	

R-5 RADIO-AUDIO ENGINEERING

R

Theme of Study	Item	Contents of Practical Training	Remarks
1. Amplifier circuit.	1. Theory of amplifier circuit.	1. Manufacture and measurement of fundamental circuit of various amplifiers.	1-transistor amplifier, PP amplifier, IC amplifier, etc.)
	2. Design of amplifier.	2. Design, manufacture and characteristics test of pre-amplifier.	
	3. Design of power circuit.	3. Measurement of frequency, phase and characteristics.	
	4. Design of 30W stereo-amplifier.	4. Measurement of distortion factor.	
	5. Theory and design of IC amplifier.	5. Measurement of input and output characteristics and dynamic range.	
2. Sound and audio-signal.	1. Fundamental of acoustics.	6. Design, manufacture and measurement of high-output stereo-amplifier	30W + 30W or 70W + 70W
	2. Sound and autio-equipment.	7. Design, manufacture and measurement of IC stereo-amplifier.	
3. Measurement of audio equipment.	1. Measuring instrument and their handling.	8. Measurement of sound and acoustic sense.	
	2. Measuring of characteristics.	9. Measurement of speaker characteristics.	
4. Audio equipment.	1. Speaker.	10. Measurement of speaker box.	
	2. Microphone.	11. Assembling and characteristics of 3-way speaker.	
	3. Player.	12. Characteristics measurement of microphone.	
	4. Tape recorder.	13. Measurement of running fluctuation of player.	
	5. Auxiliary audio amplifier (incl. tuner).	14. Measurement of frequency characteristics of cartridge.	

R-5 RADIO-AUDIO ENGINEERING R

Theme of Study	Item	Contents of Practical Training	Remarks
5. Stereophonic equipment	1. Theory of stereophonic equipment.	15. Measurement of wow and flutter.	
	2. Stereophonic reproducing equipment.	16. Characteristics measurement of stereo amplifier.	
	3. Stereophonic broadcasting equipment.	17. Measurement of stereophonic effect.	
6. Recorder and recording.	1. Disk recording.	18. Practice in disk recording.	
	2. Tape recording.	19. Manufacture and characteristics measurement of tape recorder.	
7. Architectural acoustics.	1. Acoustic effect of buildings and structures.	20. Handling of tape recorder and recording practice.	
	2. Design of listening room.	21. Measurement of acoustic effect of listening room.	
	3. Measurement of sound output and volume.	22. Design of listening room.	
		23. Training in audition.	

T-4 DESIGN OF TV ELECTRONIC CIRCUIT

T-1

Theme of Study	Item	Contents of Practical Training	Remarks
1. TV receiver.	1. Type and structure of TV receiver.	1. Study of structure and waveform observation using panoramic receiver.	
	2. TV antenna and feeder.	2. Characteristics test and manufacture of TV antenna.	
	3. Input circuit and tuner.	3. Characteristics test of tuner	VHF & UHF
	4. High-frequency amplifier circuit.	4. Characteristics test and manufacture of high-frequency amplifier circuit.	
	5. Mixer circuit.	5. Measurement of conversion gain of mixer.	
	6. Local oscillator circuit.	6. Characteristics measurement and manufacture of intermediate image frequency amplifier.	
	7. Intermediate image frequency amplifier circuit.	7. Characteristics measurement and manufacture of video amplifier.	
	8. Video frequency detection and video amplifier circuit.	8. Manufacture and characteristics measurement of synchronous separation circuit.	
	9. Synchronous separation circuit.	9. Manufacture and performance test of deflection circuit.	
	10. Deflection circuit.	10. Characteristics test of picture tube.	
	11. Picture tube circuit.	11. Manufacture and characteristics test of audio circuit.	Incl. FM receiver.
	12. Audio circuit	12. Manufacture and performance test of automatic control.	
	13. Automatic control.	13. Manufacture and test of power circuit.	
	14. Power circuit.	14. Manufacture and test of high-tension generating circuit.	
	15. TV measuring instrument.	15. Overall characteristics test of TV receiver.	
	16. Adjustment and test of TV receiver.	16. Repair of TV receiver.	

T-4 DESIGN OF TV ELECTRONIC CIRCUIT

T-1

Theme of Study	Item	Contents of Practical Training	Remarks
	17. Repair of TV receiver.	17. Practice in the removal of interference and community receiving system.	
	18. Interference and community receiving system.	18. Film video recording.	
2. Image transcription.	1. Film video recording.	19. Manufacture and adjustment of video tape recorder.	
	2. Video tape recorder (VTR).	20. Studio work (adjustment and handling of ITV).	
3. Studio work.	1. Pattern adjustment.	21. Adjustment and handling of pattern oscillator.	
	2. Adjustment and handling of ITV	22. Manufacture of black-and-white TV receiver.	
	3. Wire broadcasting.		

T-5 TV ENGINEERING

Theme of Study	Item	Contents of Practical Training	Remarks
1. Colour TV receiver	1. Colour and image.	1. Experiment in colour matching and chromaticity.	
	2. Systems of colour TV (NTSC, SECAM, and PAL).	2. Experiment in multiplex signal transmission by NTSC system.	or PAL system
	3. Luminance signal and chrominance signal.	3. Chracteristics test and manufacture of video amplifier	Incl. measurement of delay time
	4. Multiplex transmission of chrominance signals.	4. Characteristics test and manufacture of chrominance signal regenerative circuit.	
	5. Structure of colour TV receiver.	5. Characteristics test and manufacture of band amplifier.	
	6. Colour picture tube	6. Characteristics test and manufacture of colour burst circuit and ACC circuit.	
	7. Video signal amplifier circuit and luminance circuit.	7. Characteristics test and manufacture of demodulation circuit.	
	8. Regenerative circuit of chrominance signals.	8. Test and manufacture of chrominance signal amplifier matrix circuit.	
	9. Convergence circuit.	9. Test and manufacture of horizontal deflection circuit.	
	10. Colour TV measuring instrument	10. Test and manufacture of high-tension circuit	Incl. test of constant-voltage circuit.
	11. Adjustment and test of colour TV receiver.	11. Test and manufacture of receiver circuit	incl. high-frequency circuit and detection
	12. Repair	12. Characteristics test and manufacture of synchronizing circuit	Incl. colour burst circuit

T-5 TV ENGINEERING

Theme of Study	Item	Contents of Practical Training	Remarks
	13. UHF receiving circuit	13. Test and manufacture of automatic control circuit.	
2. Video recording	1. Film colour video recording	14. Adjustment of colour picture tube circuit	Incl. fitting practice
	2. Colour video tape recorder	15. Manufacture of colour TV receiver	Incl. adjustment
3. Colour TV studio work	1. Adjustment of colour pattern	16. Film colour video recording	
	2. Adjustment and handling of colour TV camera	17. Handling and adjustment of video colour tape recorder.	
	3. Wire broadcasting	18. Studio work	Handling of colour TV ITV camera.
		19. Adjustment and handling of colour pattern oscillator.	
		20. Repair of colour TV receiver.	
		21. Removal of interference.	

TC-3 ELECTRONIC COMMUNICATIONS - I (Wire Communication & Data Communication) (TC)

Theme of Study	Item	Contents of Practical Training	Remarks
1. Data and telecommunication.	1. Data transmission.	1.1 Operation of display panel of the world's telecommunication network.	
	2. Situation and system of international telecommunications.	1.2 Operation of model equipment and facilities of telecommunication network.	
	3. Facilities and equipment for telecommunications.		
2. Wire communication line.	1. Transmission line.	2.1 Characteristics measurement of transmission line.	
	2. Various communication lines.	2.2 Measurement of voltage and current distribution of distributed constant line.	Lecher wire and VHF oscillator.
		2.3 Characteristics measurement of various cables.	
	3. Attenuator and filter	2.4 Characteristics measurement of attenuator.	
		2.5 Characteristics measurement of filter.	
3. Wire telegraphy	1. System of wire telegraphy.	3.1 Practice in wire telegraphy (Morse code keying).	
	2. Various telegraphs.	3.2 Performance test of various telegraphs.	
	3. Teletyping	3.3 Adjustment and test of teletypewriter (telex).	
		3.4 Practice in teletyping.	
4. Wire telephony	1. Telephone and exchange system.	4.1 Performance test of various types of telephones	Magneto type, common-battery type, and key sender type.

Theme of Study	Item	Contents of Practical Training	Remarks
		4.2 Adjustment and test of auxiliary parts of telephone	Signal oscillator and power circuit.
	2. Exchange	4.3 Performance test of manual exchange.	
	3. Traffic	4.4 Performance test of step-by-step switch type exchange.	
		4.5 Performance test of cross-bar type exchange.	
		4.6 Performance test of electronic switching type exchange.	
5. Carrier telegraphy	1. Principles and structure of carrier telegraphy.	5.1 Characteristics measurement and test of carrier-frequency terminal equipment.	
	2. Equipment and facilities of carrier telegraphy.	5.2 Experiment in frequency sharing system.	
		5.3 Experiment in time sharing system.	
		5.4 Characteristics measurement of PCM communication equipment.	
6. Data transmission	1. Computer control system.	6.1 Practice in computer hardware.	
	2. On-line real time system.	6.2 Practice in computer software.	
		6.3 Practice in computer control.	
		6.4 Characteristics measurement and test of data transmission equipment.	
7. Image transmission	1. Image transmission.	7.1 Adjustment and test of phototelegraphic apparatus.	
	2. Facsimile.	7.2 Adjustment and test of facscimile equipment.	
	3. Image transmission by telephone line.	7.3 Adjustment and test of electrowriter.	

TC-3 ELECTRONIC COMMUNICATIONS - I (Wire Communication & Data Communication) (TC)

Theme of Study	Item	Contents of Practical Training	Remarks
	4. Pattern electronics.	7.4 Characteristics measurement of various display equipment. 7.5 Characteristics measurement of laser holography. 7.6 Characteristics measurement of electro-fax.	

TC-4 ELECTRONIC COMMUNICATIONS (Radio Communications, Radar, etc.) (TC)

Theme of Study	Item	Contents of Practical Training	Remarks
1. Radio wave and antenna.	1. Classification and properties of radio wave.	1.1 Measurement of properties and wavelength of radio wave using ultra-short wave equipment.	
	2. Classification and characteristics of antennas.	1.2 Characteristics measurement of various antennas.	
		1.3 Design, manufacture and test of directional antenna.	
	3. Feeder line.	1.4 Characteristics measurement of feeder line.	
2. System of radio communication.	1. Systems of radio communication.	2.1 Operation, test and maintenance of radio station.	
	2. Classification and operation of radio stations.	2.2 Operation, adjustment and maintenance of amateur radio station.	
3. Radio communication equipment.	1. Classification, structure and performance of transmitters.	3.1 Design, manufacture, adjustment and test of small type transmitter.	
	2. Design, adjustment and repair of transmitter.	3.2 Adjustment and test of FM transmitter.	
	3. Classification, structure and performance of receivers.	3.3 Manufacture, adjustment and test SSB transmitter-receiver.	
	4. Design, manufacture, adjustment and repair of receiver.	3.4 Design, manufacture, adjustment and test of radio receiver.	
		3.5 Design, manufacture, adjustment and test of FM receiver.	
		3.6 Measurement of overall characteristics of receiver.	
		3.7 Adjustment and test of panoramic receiver.	

TC-4 ELECTRONIC COMMUNICATION (Radio Communication, Radar, etc.) (TC)

Theme of Study	Item	Contents of Practical Training	Remarks
		3.8 Measurement of field strength.	
	5. Radio telemetering.	3.9 Radio telemetering.	
	6. Radio remote control.	3.10 Radio remote control.	
	7. Power unit	3.11 Design, manufacture and adjustment of power supply equipment.	
4. Television	1. Theory of television.	4.1 Characteristics measurement and adjustment of TV camera.	
	2. TV video transmission equipment.	4.2 Adjustment of TV video transmission equipment.	
	3. TV relaying	4.3 Adjustment of TV relaying equipment.	
	4. TV receiver	4.4 Characteristics measurement, adjustment and repair of TV receiver.	
	5. TV video recording equipment.	4.5 Characteristics measurement of TV video recording equipment.	
	6. TV adjusting equipment.	4.6 Handling of TV measuring instrument.	
5. Radar and radio navigation.	1. Principles, structure and performance of radar.	5.1 Characteristics measurement, adjustment and test of radar equipment.	
		5.2 Characteristics measurement of radar antenna.	
		5.3 Characteristics measurement, adjustment and test of Doppler radar.	
	2. Radio direction finding	5.4 Characteristics measurement, adjustment and test of radio direction finder.	
	3. Radio navigation.	5.5 Characteristics measurement and adjustment of loran receiver.	
	4. Aeronautical radio facilities and equipment.	5.6 Characteristics measurement and adjustment of decca receiver.	

TC-4 ELECTRONIC COMMUNICATION (Radio Communication, Radar, etc.) (TC)

Theme of Study	Item	Contents of Practical Training	Remarks
6. Mobile radio equipment.	1. Classification and characteristics of mobile radio equipment.	6.1 Handling of various mobile radio equipment.	Pocket bell and citizen band set, etc
	2. Mobile radio equipment.	6.2 Practice in mobile radio communication	Transceiver, mobile station equipment, etc.)
	3. Power unit.	6.3 Characteristics measurement of various equipment.	
7. Microwave communication.	1. Characteristics of microwave communication.	7.1 Characteristics measurement of microwave communication equipment.	
	2. Systems of microwave communication.	7.2 Characteristics measurement of microwave transmission line.	
	3. Microwave communication equipment.	7.3 Characteristics measurement of microwave antenna.	
		7.4 Characteristics measurement of microwave terminal equipment.	
		7.5 Characteristics measurement of microwave relaying equipment.	
8. Special radio communication.	1. Ultrasonic wave communication	8.1 Characteristics measurement of ultrasonic wave communication equipment.	
	2. Light wave communication.	8.2 Characteristics measurement of light wave communication equipment.	
	3. Laser communication.	8.3 Characteristics measurement of laser communication equipment.	
	4. Cosmic communication and noise.	8.4 Measurement of cosmic noise.	
	5. Scret communication.	8.5 Characteristics measurement of secret communication equipment.	

TC-4 ELECTRONIC COMMUNICATION (Radio Communication, Radar, etc.) (TC)

Theme of Study	Item	Contents of Practical Training	Remarks
9. Laws and rules governing telecommunication.	1. Fundamental knowledge of laws and regulations. 2. International agreements and laws. 3. Outline of laws and regulations governing telecommunication. 4. Laws and regulations governing radiowave. 5. Laws and regulations governing wire telegraphy. 6. Laws and regulations governing public telecommunication. 7. International telecommunications services. 8. Other relevant laws and regulations.		

INDUSTRIAL INSTRUMENTATION (EI)

Theme of Study	Item	Contents of Practical Training	Remarks
Industrial quantities and their electronic measurement.	1. Fundamental measurement.	1. Measurement of length. Measurement with normal accuracy. Measurement of microscopic length. Precision measuring method. 2. Measurement of mass and weight. Measurement by balance. Measurement by spring balancer. 3. Measurement of temperature and humidity. Measurement by termal expansion type thermometer. Measurement by open type pychrometer. Measurement by optical pyrometer. 4. Measurement of flow rate and pressure. Flow rate measurement by weir. Flow rate measurement by orifice. Pressure measurement by manometer. Measurement of differential pressure by U-tube.	
	2. Measurement and conversion of displacement.	Circuit measurement by differential transformer. Measurement by electric micrometer. Measurement by Hall element. Measurement by strain meter.	
	3. Measurement and conversion of pressure.	Measurement by air micrometer. Characteristics of nozzle and flapper. Characteristics of bellow gauge and diaphragm gauge.	

INDUSTRIAL INSTRUMENTATION (EI)

Theme of Study	Item	Contents of Practical Training	Remarks
	4. Measurement and conversion of liquid level, flow rate and density.	Application of ultrasonic wave: 1) Liquid level gauge. 2) Densimeter.	
		Electromagnetic flow meter.	
		Integrating flow meter.	
	5. Measurement and conversion of temperature and humidity.	Temperature characteristics of resistance thermometer bulb.	
		Temperature measurement by various types of thermocouple.	
		Temperature measurement by radiation pyrometer.	
		Characteristics of resistance pyrometer.	
	6. Characteristics of secondary converter.	Characteristics of voltage-current converter.	
		Measurement of operation constant.	
		Characteristics voltage-pulse converter.	
Feedback control	1. Theory and characteristics of feedback system.	Test of feedback control by servomotor.	
	2. Configuration and characteristics of control system.	Assembling and test of control system by process model system	Electric and pneumatic systems
	3. Test of optimal control.	Test and adjustment of frequency response of feedback system.	
	4. Sequential control and computer.	Characteristics of control system and computer programme.	
	5. DDC control.	Characteristics of control by computer.	
Control unit.	1. Measurement and conversion of industrial quantities.	Structure and performance test of pressure converter.	

Theme of Study	Item	Contents of Practical Training	Remarks
		Resistance characteristics and converter circuit characteristics of resistance thermometer bulb.	
		Test of air-electric converter.	
	2. Recorder and controller.	Characteristics of automatic balancing recorder.	
		PID characteristics of process controller.	
	3. Transmission converter.	Characteristics of converter for DDC.	
	4. Control device.	Characteristics of pneumatic valve.	
	5. Computer connector.	Characteristics of computer connecting peripheral equipment.	Interface
Sequenctial control.	1. Sequential control circuit using relay.	Structure and test of relay-aided sequential circuit.	
	2. Logical circuit.	Fundamental characteristics of logical circuit.	
		Test of sequential circuit by logical circuit.	
	3. Computer and sequential control	Sequential control by computer.	
		Sequential control programme.	
Sequential control device	1. Circuit element.	Characteristics of relay.	
		Assembly and characteristics of logical circuit.	
		Structure and characteristics of switch, indicator and alarm.	
	2. Sequential control panel.	Design and manufacture of control panel.	

INDUSTRIAL INSTRUMENTATION (EI)

Theme of Study	Item	Contents of Practical Training	Remarks
Numerical control.	1. Data logging.	Test of model computing logger	Mini-computer
	2. DDC (direct digital control).	Structure and programme of control system	Model plant
	3. Optimum control.	Sequencial control and DDC control	Computer control
	4. Digital control.	Programming and performance test of numerically controlled machine tool	NC boring machine
Hybrid computer and simulation.	1. Analogue computer.	Characteristics test of arithmetic unit amplifier.	
		Programming of analogue computer.	
		Simulation of feedback control system.	
	2. Hybrid computer system.	Structure and programming of hybrid computer system	Analogue computer + interface + mini-computer
Instrumentation work.	Piping work	Threading and jointing of pipes	Workmanship-I classroom.
		Piping arrangement and fixing	"
		Inspection of piping work	"
	Electrical work	Connection of wires	"
		Conduit work	"
		Cable laying	"
	Machining of instrument board	Thin plate working	"
		1) Manufacture of panel.	
		2) Drilling of square and round holes.	
		3) Instrumentation and painting.	

Theme of Study	Item	Contents of Practical Training	Remarks
	Non-destruction inspection.	4) Test and inspection. Ultrasonic detection Inspection by industrial X-ray device.	Workmanship-I room "

INSTRUMENTATION CIRCUIT (EI)

Theme of Study	Item	Contents of Practical Training	Remarks
Pulse circuit.	Pulse generation and forming.	Structure and performance of pulse-oscillating circuit. Forming of pulse shape. Pulse-amplitude and pulse-time modulation.	
Logical circuit.	Performance of logical circuit.	Structure and performance of AND, OR and NOT circuits. Structure and performance of flip-flop circuit.	
Pulse-counter circuit.	Pulse-counter circuit.	Binary counter circuit. Decimal counter circuit. Ring counter circuit. Binary - decimal conversion circuit.	
Operation circuit	Performance of adder.	Half adder and full adder. 16-bit and 8-bit adders. Shift register.	
AD conversion circuit.	Coding panel AD conversion. Counter type AD conversion. Comparison type AD conversion.	AD conversion by coding panel circuit. AD conversion by counter circuit. AD conversion by comparison circuit.	
DA conversion circuit.	Direct DA conversion. Current generating DA conversion.	Characteristics of direct type DA circuit. Characteristics of voltage and current conversion circuit.	
Counter circuit.	Counter conversion circuit.	Characteristics of power transducer.	

INSTRUMENTATION CIRCUIT (EI)

Theme of Study	Item	Contents of Practical Training	Remarks
		Characteristics of strain gauge amplifier.	
		Characteristics of small input amplifier.	
	Counter secondary conversion circuit.	Voltage - pulse converter.	
	Telemetering control circuit.	Characteristics of telemetering equipment.	
	Radioactive ray detection circuit.	Structure and characteristics of Geiger counter.	
	Circuit for intensity measurement of radioactive rays.	Structure and characteristics of photo-multiplier counter.	
		Characteristics measurement of radioactive rays by gamma-ray spectrometer.	

SOLID STATE PHYSICS

Common to R.T.V. and E.I.

Theme of Study	Item	Contents of Practical Training	Remarks
1. Substance and electron	1. Properties of electron.		
	2. Structure of matter	Structure of matter and model of electronic configuration.	
2. Electron emission	1. Free electron.		
	2. Thermoelectronic emission	Experiment on the behaviour of thermo-electrons.	
	3. Field emission.		
	4. Secondary emission.	Experiment in the secondary emission.	
	5. Photoelectric emission.	Characteristics measurement of photo-electric tube.	
	6. β rays.	Observation of β rays.	
3. Movement of electrons in a vacuum.	1. Electron movement in electric field.	Experiment on the deflection of electrons due to electric field.	
	2. Electron movement in magnetic field.	Experiment on the deflection of electrons due to magnetic field.	
	3. Space charge.		
	4. Control of electron current.		
	5. Electron lens.	Experiment on the convergence of electrons.	
4. Electrons in solid matter.	1. Electrons in atom.		
	2. Structure of solid matter.		
	3. Electrons in conductor.		
	4. Semiconductor.	Properties of semiconductor.	
4. Semiconductor	1. Junction of semiconductor.		
	2. Effects of semiconductor.	Experiment in Hall effect.	

SOLID STATE PHYSICS

Common to R.T.V. and E.I.

Theme of Study	Item	Contents of Practical Training	Remarks
	3. Thermoelectricity.	Experiment in electronic cooling.	
	4. Electrons in dielelctric.		
	5. Electrons in magnetic substance.		
5. Electromagnetic wave	1. Properties of electromagnetic wave.		
	2. Radiation of electromagnetic wave.	Experiment in the radiation of electromagnetic wave.	
6. Quantum electronics	1. Laser.	Experiment in laser.	
7. Plasma application.	1. Development of plasma.	Observation of plasma.	
8. Application of solid state physics.			

TEACHING MATERIALS CENTER

Theme of Study	Item	Contents of Practical Training	Remarks
		The Teaching Materials Centre should be so planned that all the technical data and teaching materials can be prepared and supplied to meet the need of each subject. It should also have video tape recorders and other equipment necessary for picture transmission to each classroom.	
Audio visual Centre	Training studio	ITV camera (2 sets + colour TV cameras)	Films, slides and videotapes to be provided to transmit pictures to each classroom for educational and training purposes.
	Control room	Comprised of control room and broadcasting room.	
	Film library	8- and 16-mm cine-cameras and projectors.	
	Record and tape library		
	OHP data room	OHP data and materials	
	Preview room and cutting room	Preview, cutting and transmission to classrooms.	
	Dark room	Development of photos and films.	
Printing room	Copying room	Copying machine	
	Printing room	Offset press for printing test papers and technical data, and bookbinding machine.	
	Printing materials room		
	Data room		

TEACHING MATERIALS CENTER

Theme of Study	Item	Contents of Practical Training	Remarks
Audio-visual Equipment to be Installed in Each Classroom		19-inch TV set (2 - 5 sets)	1 set in each ordinary classroom.
		Overhead projector and epidiascope	TP manufacturing device and slides inclusive.
		Tape recorder	Cassette type
		Projector	16mm and 8mm
		Copying machine	
		VTR	To be used with TV
		Answer checker	
			Total:
		Barometer and dry bulb thermometer.	Approx1 1 million yen per classroom

TABLE 3

EQUIPMENT LIST

COST OF EQUIPMENT BY FACILITY

Facility No.	Facility Name	Price Thousand Yen	Price US $	Subject, Equipment and Materials
1-	Drawing	*(8,846) 17,556	*(29,099) 57,750.-	Drawing and sketch room and preparation room.
2-	Workmanship-I	*(36,270) 60,630	*(119,309) 199,441.-	Machining, thin plate working, angle bar working, piping, electrical work, and coil winding.
3-	Workmanship-II	*(1,990) 77,898	*(6,546) 256,243.-	Electronic machining, assembling of electronic equipment, and telephone installation work.
4-	Electronics-I	*(65,736) 137,504	*(216,237) 452,316.-	Electric circuit, magnetism, AC circuit, 3-phase, and pulse.
5-	Electronics-II	*(7,000) 143,040	*(23,026) 470,526.-	Electronic circuit, acoustics, wire and radio communication, TV, and power equipment.
6-	Electronics-III	96,600	317,763.-	High frequency measurement, electronic computer, and automatic control.
7-	Radio Engineering	205,465	675,872.-	Radio transmitter and receiver, FM equipment, acoustic equipment, and stereophonic equipment.
8-	TV Engineering	212,515	699,063.-	TV studio, monochrome and colour TV.
9-	Telecommunications Engineering	465,485	1,531,201.-	Telephone, telegraph, exchange, Teletype, facsimile, radio and TV.
10-	Electronic Instrumentation Engineering	250,600	824,342.-	Fundamental industrial instrumentation, computer control, and counter circuit.

Facility No.	Facility Name	Price Thousand yen	Price US $	Subject, Equipment and Materials
11-	Computer centre	94,010	309,243.-	Small (medium) type electronic computer.
12-	Teaching Materials centre	*(109,400) 109,400	*(359,868) 359,868.-	Printing of all materials, and centralized control of audio-visual education.
13-	Solid State Physics Experiment	17,170	56,480.-	Common subjects (4th grade) to be studied in Electronics classrooms.
Grand Total:		*(229,242) 1,887,873	*(754,085)6,210,108.-	

Note : 1) * indicates the equipments and materials required in the initial year.

2) Parentheses indicate the quantities and values of the equipments and materials required in the initial year.

3) Conversion rate of 304 yen to 1 US dollar was adopted, with fraction of 0.5 and over counting as a whole number and disregarding the rest.

1. Drawing

	No.	Name	Q'ty	Unit price	Amount	Remarks
*	1-1	Universal drafting machine	60 (30)	70	4,200 (2,100)	For A1 size, w/drafting board, chair and lighting fixture
*	1-2	Universal drafting machine	4 (2)	100	400 (200)	For A-0 size, w/drafting board, chair and lighting fixture; for preparatory room.
*	1-3	Drawing printer	4 (2)	400	1,600 (800)	For A1 positive
*	1-4	Copier	4 (2)	300	1,200 (600)	Dry type
*	1-5	Cutter	4 (3)	20	80 (60)	
*	1-6	Desk-top calculator	30	10	300	w/arithmetic and root functions
*	1-7	Sketching tablet	20 (10)	60	1,200 (600)	Decorative plate, covered with renewable plywood sheet
*	1-8	Speaker system	2 (1)	150	300 (150)	Incl. taperocorder, player and microphone
*	1-9	Locker	12 (6)	100	1,200 (600)	For drawings
*	1-10	Locker	18 (9)	60	1,080 (540)	For samples, etc.
*	1-11	Overhead projector	4 (20)	150	600 (300)	
*	1-12	Movie projector	2 (1)	500	1,000 (500)	16 mm
*	1-13	Device model	lot	—	200	
	1-14	TV receiver	6	150	900	
*	1-15	VTR	2 (1)	550	1,100 (550)	

	No.	Name	Q'ty	Unit price	Amount	Remarks
*	1- 7-1	Chair, w/drawing board	32	3	96	A-4 sketching tablet
*	1-16	Kent paper	100 Packages	3	300	
*	1-17	Pencils and other consumables	360 sets (190) sets	5	1,800 (950)	
		TOTAL			17,556 Thousand Yen (8,846 Thousand Yen)	US $ 57,750 (US $ 29,099)

2. Workmanship I

	No.	Name	Q'ty	Unit price	Amount	Remarks
	o	Machine tools				
*	2- 1	Bench lathe	10	500	5,000	Center-to-center distance, 180 mm
*	2- 2	Bench drill press	10	100	1,000	Small-sized
*	2- 3	Milling machine	5 (2)	500	2,500 (1,000)	Bench type vertical, small-sized
*	2- 4	Tool grinder	4 (2)	45	180 (90)	Double-headed
*	2- 5	Surface plate	10	60	600	
*	2- 6	Vise	30	7	210	Box type, small- sized
*	2- 7	Hacksawing machine	3	400	1,200	For cutting pipes and angles
*	2- 8	Tool set	180sets (160 sets)	30	5,400 (4,800)	Training tools in box
	o	Plateworking machines				
*	2- 9	Cutter	3	100	300	1 m wide, 1.5 mm thick
*	2-10	Hand shear	5	30	150	1 mm thick
*	2-11	Crank press	5	50	250	For perforating chassis
*	2-12	Small-sized press	5	100	500	1.5 mm thick, L bending
*	2-13	Bender	5	300	1,500	1.5 mm thick, rectangular bending
*	2-14	Electric drill	30	20	600	Hand drill
*	2-15	Electric tool	12	50	600	Incl. carpenter's tools, w/attachments (encased)
*	2-16	Spot welder	5	150	750	Sheet thickness, 1.5 mm; applicable to aluminum sheet
*	2-17	Electric welder	2	200	400	For welding angles and pipes
*	2-18	Drying oven	2	200	400	

	No.	Name	Q'ty	Unit price	Amount	Remarks
*	2-19	Painting tools	3sets (1 set)	500	1,500 (500)	Incl. two units of compressor for painting use
*	2-20	Coiler	10	50	500	For honeycomb coil, solenoid coil, small-sized transformer winding
*	2-21	Engraving machine	2 (1)	150	300 (150)	For engraving panels
*	2-22	Vacuum impregnator	1	150	150	For small-sized transformer
	2-23	Nondestructive flaw detector	2	800	1,600	For testing pipe connections
	2-24	Pipe cutter	2sets	150	300	
*	2-25	Tools for machinist and electrician	180sets (100 sets)	50	9,000 (5,000)	For platework, wiring, electric work (encased)
	2-26	Tools for plumber	180sets	30	5,400	Tools for air-conditioner, automatic controls, and piping work
	o	Measuring instruments				
*	2-28	Gauges for machinist	15sets	50	750	Scale, square, slide caliper, calipers, micrometer, etc.
	2-29	Gauge	8sets	100	800	Taper gauge, block gauge, etc.
	2-30	Stereomicroscope	2	500	1,000	
*	2-31	Disk-top projector	2 (1)	500	1,000 (500)	
*	2-32	Worktable	70 (35)	100	7,000 (3,500)	w/stool
*	2-33	Shelf	15 (8)	60	900 (480)	
*	2-34	Movable blackboard	4 (2)	50	200 (100)	

	No.	Name	Q'ty	Unit price	Amount	Remarks
	o	Audio-visual teaching materials				
	2-35-1	Copier	1	350	350	Dry type, w/a year's worth of sensitive paper
*	2-35-2	Overhead projector	2 (1)	250	500 (250)	w/screen and accessories
*	2-35-3	Automatic slide projector	2 (1)	150	300 (150)	w/demonstration slides
	2-35-4	Movie projector	1	500	500	16mm, w/stand and film
*	2-35-5	Amplifier for lecture	2 (1)	150	300 (150)	w/speaker, wireless mike, and cassette tape
*	2-35-6	VTR unit	2 (1)	1,500	3,000 (1,500)	w/5 units of colour monitor
	o	Materials for object lesson				
*	2-36	Materials for practice	180	6	1,080	Metals, wires, etc.
*	2-37	Materials for practice	180	6	1,080	Non-metals, etc.
*	2-38	Mateirals for transformer	180	6	1,080	
	2-39	Preparatory tools for practice	50	10	500	Common tools, preparatory tools and materials
		TOTAL			60,630 Thousand Yen (36,270 Thousand Yen)	US $ 199,441 (US $ 119,309)

3. Workmanship II

	No.	Name	Q'ty	Unit price	Amount	Remarks
	o	Machines and appliances for plate works				
	3- 1	Cutter	4	100	400	1.2 mm thick, 1 m wide
	3- 2	Small-sized shear	5	30	150	1.0 mm
	3- 3	Bench drill press	5	100	500	
	3- 4	Electric drill	16	20	320	Hand drill
	3- 5	Bender	6	300	1,800	1.2 mm thick
	3- 6	Small-sized press	5	100	500	ditto
	3- 7	Crank press	6	50	300	ditto; used for angle bending
	3- 8	Electric grinder	2	45	90	used also as a hand drill
	3- 9	Electric tool	6	50	300	Double-headed tool grinding
	3-10	Spot welder	6	150	900	1.2 mm thick
	3-11	Painting machine	2	500	1,000	incl. compressor which can be used for other purpose
	3-12	Engraving machine	2	150	300	Small-scale plate engraving
	3-13	Coiler	10	50	500	For solenoid and honeycomb coil
	3-14	Vise	20	10	200	Box type
	3-15	Tools for plateworking	100 sets	15	1,500	Tools for chassis-making (encased)
	3-16	Wiring tools	100 sets	20	2,000	Tools for radio and TV set (w/chest)
*	3-17	Indusction motor for assembly practice	12 (1)	150	1,800 (150)	For training in winding-making and setting-up
*	3-18	DC motor for assembly practice	12 (1)	150	1,800 (150)	ditto.
*	3-19	Printing machine for printed circuit board	1	400	400 (400)	

	No.	Name	Q'ty	Unit price	Amount	Remarks
*	3-20	Tools for making printed circuit boards	100 sets (10) sets	5	500 (50)	
	o	Electric measuring instruments				
	3-21	Circuit tester	17	20	340	Medium-sized
	3-22	Electronic volt & ohm meter	17	30	510	
	3-23	Voltmeter	100	15	1,500	
	3-24	Ammeter	100	15	1,500	
	3-25	LCR meter	6	150	900	
	3-26	Megger	4	70	280	500 V and above
	3-27	Digital counter	8	300	2,400	Capable of measuring frequency
	3-28	Galvanometer	8	6	48	For experimental use
	3-29	Rheostat	40	30	1,200	Slide rheostat
	3-30	Resistor	40	80	3,200	Variable resistor
*	3-31	AC bridge	3 (1)	80	240 (80)	
	3-32	Transistor tester	2	400	800	
*	3-33	IC tester	40 (1)	60	2,400 (60)	
*	3-34	Transistor checker	4 (1)	300	1,200 (300)	In-circuit checker
	3-35	Clamp-on ammeter	8	350	2,800	DC mA meter
	3-36	Q meter	4	200	800	
*	3-37	Oscillator	8 (2)	250	2,000 (500)	For low-frequency use
	3-38	Oscillator	8	400	3,200	For high-frequency use
	3-39	Oscillator	20	50	1,000	Utility type, 10 Hz - 300KHz or higher

	No.	Name	Q'ty	Unit price	Amount	Remarks
	3-40	Sweep generator	4	500	2,000	For low-frequency use
	3-41	Sweep generator	4	300	1,200	For high-frequency use
*	3-42	Pattern generator	4 (1)	300	1,200 (300)	For TV set adjustment
	3-43	Oscilloscope	36	250	9,000	5", 10 MHz or higher
	3-44	Thin-film vacuum coater	1	1,500	1,500	
	3-45	Electrolytic plating machine	1	500	500	For small parts; incl. power unit
	3-46	Power unit	32	50	1,600	Stabilized power supply
	3-47	Eliminator power unit	5	300	1,500	
	3-48	Workbench	75	100	7,500	w/stool
	3-49	Locker	10	60	600	
	3-50	Rack	20	40	800	For measuring instruments
	3-51	Movable blackboard	5	100	500	
	3-52	Copier	2	350	700	Dry type, w/a year's worth of sensitive paper
	3-53	Overhead projector	2	250	500	w/screen and accessories
	3-54	Automatic slide projector	2	150	300	w/slides
	3-55	Movie projector	2	500	1,000	16 mm, w/stand and film
	3-56	Amplifier for lecture	2	150	300	w/speaker, wireless mike, cassette tape
	3-57	Taperecorder	2	70	140	w/cassette and radio set
	3-58	VTR unit	2	1,500	3,000	w/5 units of colour monitor
	o	Materials for object lesson				
	3-59	Wires	180	6	1,080	Wiring materials, etc.
	3-60	Parts	180	5	900	L,C,R, terminals, etc.

No.	Name	Q'ty	Unit price	Amount	Remarks
3-61	Preparatory tools	50 sets	10	500	Common tools, special tools for preparatory work
	TOTAL			77,898 Thousand Yen (1,990) Thousand Yen	US $ 256,243 (US $ 6,546)

4. Electronics I

	No.	Name	Q'ty	Unit price	Amount	Remarks
	o	Basic study experiment				
*	4- 1	DC circuit experimental unit	32	30	960	Ohm's law, series & parallel connections, etc.
*	4- 2	DC potentiometer	17	100	1,700	w/standard cell, shunt, power unit.
*	4- 3	Experimental network unit	17	30	510	Kirchhoff's law
*	4- 4	Experimental bridge unit	32	50	1,600	Basic circuits (excl. variable resistance box)
*	4- 5	Bridge circuit unit	12	20	240	
*	4- 6	Experimental Joule's heat unit	17	30	510	Measurement of Joule's heat
*	4- 7	Thermocouple equipment	17	20	340	Measurement of thermoelectromotive force
*	4- 8	Magnetic field demonstration unit	32	20	640	
*	4- 9	Magnetization testing equipment	12	80	960	
*	4-10	Magnetization curve display unit	1	300	300	
*	4-11	Electromagnetic force testing equipment	17	50	850	
*	4-12	Electromagnetic induction testing equipment	17	50	850	Electromagnetic induction, self- and mutual - induction
*	4-13	Static electricity testing equipment	17	150	2,550	
*	4-14	Discharge phenomena observation equipment	12	100	1,200	Discharge valve; utility type
*	4-15	Oscilloscope	32 (16)	350	11,200 (5,600)	2-element type
	4-16	AC basic circuit experimental unit	17	200	3,400	R,L,C vector, resonance test
	4-17	AC bridge circuit unit	17	130	2,210	

	No.	Name	Q'ty	Unit price	Amount	Remarks
	4-18	Three-phase ac experimental unit	12	600	7,200	star-delta connection, rotating field, and other low voltage tests
	4-19	Pulse circuit experimental unit	17	300	5,100	Practice on basic RLC circuits
	4-20	Transformer experimental arrangement	12	60	720	Practice on three-phase wiring
	o	Electric measuring instruments				
*	4-22	DC ammeter	150 (150)	7	1,050 (1,050)	
			150	15	2,250	
*	4-23	DC voltmeter	150 (150)	7	1,050 (1,050)	
			150	15	2,250	
*	4-24	AC ammeter	150	7	1,050	
			(50)		(350)	
			150	15	2,250	
*	4-25	AC voltmeter	150	7	1,050	
			(50)		(350)	
			150	15	2,250	
*	4-26	Electronic volt & ohm meter	32	30	960	
*	4-27	Electronic voltmeter	32 (15)	50	1,600 (750)	mV - 300V
*	4-28	Digital circuit tester	17 (15)	150	2,550 (2,250)	
*	4-29	Circuit tester	34 (15)	15	510 (225)	
	4-30	Phase meter	17	150	2,550	
*	4-31	Galvanometer	32 (18)	7	224 (126)	Class 2.5
	4-32	Galvanometer	17	15	255	Class 0.5

	No.	Name	Q'ty	Unit price	Amount	Remarks
	4-33	Flux meter	17	60	1,020	
*	4-34	Thermistor type thermometer	17	70	1,190	
*	4-35	Demonstration galvanometer	2	70	140	
*	4-36	Mirror galvanometer	4	60	240	
*	4-37	Mirror galvanometer	2	60	120	
	4-38	LCR meter	12	150	1,800	
	4-39	Wattmeter	32	40	1,280	For commercial frequency use
	4-40	Integrating watthourmeter	18	30	540	ditto.
	4-41	Three-phase wattmeter	12	120	1,440	ditto.
	4-42	Three-phase integrating watthourmeter	12	60	720	ditto.
	4-43	Power factor meter	12	40	480	ditto.
	4-44	Frequency meter	12	20	240	ditto.
*	4-45	Gauss meter	32 (17)	250	8,000 (4,250)	
*	4-46	Clamp-on ammeter	12	350	4,200	DC 1 mA - 1A
*	4-47	Electrostatic voltmeter	12	250	3,000	For measuring potential of electrostatic charge
	o	Reference instruments				
*	4-48	DC voltmeter	1	180	180	
*	4-49	DC ammeter	1	180	180	
	4-50	AC voltmeter	1	180	180	
	4-51	AC ammeter	1	180	180	
*	4-52	Resistor	40	30	1,200	0.001, 0.01, 1, 100 ohms, 10 units each.
*	4-53	Inductance	20 (10)	80	1,600 (800)	Variable type

	No.	Name	Q'ty	Unit price	Amount	Remarks
*	4-54	Capacitor	12	70	840	Variable type
	o	Measuring instruments				
*	4-55	Resistor	60 (30)	30	1,800 (900)	Wound type
*	4-56	Resistor	60 (30)	80	4,800 (2,400)	Variable
*	4-57	Autotransformer	17	15	255	Variable voltage
*	4-58	Counter	12	350	4,200	Applicable to frequency measurement
*	4-59	Stopwatch	17	50	850	
	4-60	Oscillator	17	200	3,400	10 Hz - 500 kHz or higher
	4-61	Special waveform generator	6	400	2,400	
	4-62	Oscillograph	2	400	800	Pen-type, light beam type
	4-63	X-Y recorder	6	400	2,400	
*	4-66	Megger	4	100	400	
*	4-67	Grounding resistance meter	4	100	400	
*	4-68	Stabilized power unit	32	50	1,600	
*	4-69	Eliminator power unit	4 (2)	600	2,400 (1,200)	
*	4-70	Workbench	65 (35)	100	6,500 (3,500)	w/stool
*	4-71	Locker	30 (15)	60	1,800 (900)	
*	4-72	Movable blackboard	4	50	200	
	o	Audio visual teaching aids				
*	4-73-1	Copier	2 (1)	350	700 (350)	Dry type, w/a year's worth of sensitive paper

	No.	Name	Q'ty	Unit price	Amount	Remarks
*	4-73-2	Overhead projector	2 (1)	250	500 (250)	w/screen and accessories
*	4-73-3	Automatic slide projector	2 (1)	150	300 (150)	w/slides
*	4-73-4	Movie projector	2 (1)	500	1,000 (500)	16 mm, w/stand and film
*	4-73-5	Amplifier for lecture	2 (1)	150	300 (150)	w/speaker, wireless mike, cassette tape
*	4-73-6	Taperecorder	2 (1)	70	140 (70)	w/cassette and radio set
*	4-73-7	VTR unit	2 (1)	1,500	3,000 (1,500)	w/5 colour monitors
	o	Consumables and tools for practice				
*	4-74	Wires	180	5	900	Wires, etc.
*	4-75	Parts	180	10	1,800	L, C, R, terminals, etc.
*	4-76	Tool set	100sets	5	500	Student's tool in case
*	4-77	Tools for preparatory work	50sets	10	500	Common tools, special tools for preparatory work
		TOTAL			137,504 Thousand Yen (65,736Thousand Yen)	US $ 452,316 (US $ 216,237)

5. Electronic II

	No.	Name	Q'ty	Unit price	Amount	Remarks
	o	Equipment for object lesson				
*	5- 1	Semiconductor element testing arrangement	17 (1)	100	1,700 (100)	Basic circuits using diodes, thyristors, etc.
*	5- 2	Transistor testing arrangement	17 (1)	200	3,400 (200)	Characteristics and constants
*	5- 3	Electronic circuit testing arrangement	17 (1)	150	2,550 (150)	Amplification, oscillation, modulation, etc.
*	5- 4	Pulse circuit testing arrangement	17 (1)	350	5,950 (350)	Circuits using diodes and transistors
*	5- 5	IC circuit testing arrangement	12 (1)	600	7,200 (600)	IC check, and measurement of operating characteristics
*	5- 6	Acoustic equipment testing arrangement	6 (1)	350	2,100 (350)	Fundamental measurement of speaker and microphone
*	5- 7	Sound-recorder testing arrangement	6 (1)	350	2,100 (350)	Fundamental measurement of taperecorder, player, etc.
*	5- 8	Stereophonic amplifier testing arrangement	6 (1)	300	1,800 (300)	Measurement of separate type amplifier
*	5- 9	Automatic exchange testing arrangement	1	800	800 (800)	Step type and crossbar type, w/18 telephone sets
	5-10	Teleprinter arrangement	2	500	1,000	For teleprinting practice
	5-11	Carrier telephone arrangement	2	1,000	2,000	For telephoning practice; 2 ch or more
	5-12	Remote measurement arrangement	1	500	500	Carrier measurement of voltage and current
	5-13	Experimental antenna arrangement	1	150	150	Generation of electromagnetic wave and examination of its characteristics
*	5-14	Experimental microwave arrangement	1	1,000	1,000	Transmission and reception of microwaves

	No.	Name	Q'ty	Unit price	Amount	Remarks
	5-15	Feeder standing wave measuring arrangement	1	200	200	Measurement of standing waves
	5-16	Radio transmitter/receiver	2	200	400	Small output (10 W or less)
	5-17	FM transmitter/receiver	2	200	400	Transmission and reception of FM signals
*	5-18	Experimental logic circuit arrangement	2 (1)	400	800 (400)	
	5-19	Experimental laser arrangement	1	500	500	Practice of laser communication
	5-20	Stabilized power unit	32	50	1,600	DC 0 - 30 V, 2A DC 0 - 15 V, 1 A
	5-21	Current regulator	8	50	400	Thyristor-applied dimmer, power unit, etc.
	5-22	Experimental rotating machinery arrangement	1	1,500	1,500	Basic drills about DC and AC generators and motors; incl. power supply
	5-23	Exploded demonstration TV set	2	100	200	Exploded type
	5-24	Exploded demonstration colour TV set	2	700	1,400	Exploded type
	o	Electrical instruments				
	5-25	DC ammeter	120	15	1,800	Various types
	5-26	DC voltmeter	120	15	1,800	ditto
	5-27	AC ammeter	32	15	480	ditto
	5-28	AC voltmeter	32	15	480	ditto
	5-29	High-frequency ammeter	32	20	640	ditto
	5-30	Electronic volt & ohm meter	34	30	1,020	medium-sized
	5-31	Electronic voltmeter	34	50	1,700	High-sensitivity ac voltmeter

	No.	Name	Q'ty	Unit price	Amount	Remarks
	5-32	Circuit tester	34	15	510	medium-sized
	5-33	Digital voltmeter	8	250	2,000	Volt & ohm meter
	5-34	Phase meter	12	150	1,800	
	o	Electronic measuring instruments				
	5-35	Resistor	64	80	5,120	Variable
	5-36	Resistor	64	30	1,920	Slide type
	5-37	Resistance attenuator	8	55	4,400	
	5-38	Standard inductance	12	40	480	Variable
	5-39	Standard capacitor	12	60	720	Variable
	5-40	Filter	18	200	3,600	Variable
	5-41	Megger	4	100	400	
	5-42	Oscilloscope	17	150	2,550	5"
	5-43	Oscilloscope	32	350	11,200	5", 2-element, more than 5MHz
	5-44	Oscilloscope	4	350	1,400	
	5-45	X-Y recorder	17	500	8,500	
*	5-46	Level meter	12 (1)	250	3,000 (250)	
	5-47	Output meter	5	50	250	For measuring amplifier and transmitter output
	5-48	Absorption type frequency meter	17	50	850	Dep meter
*	5-49	Digital frequency meter	12 (1)	350	4,200 (350)	Also serves as a counter
	5-50	High-frequency bridge	4	300	1,200	
*	5-51	Q-meter	6 (1)	200	1,200 (200)	
	5-52	Distortion factor meter	12	250	3,000	
	5-53	Wave analyzer	2	2,500	5,000	w/recorder

	No.	Name	Q'ty	Unit price	Amount	Remarks
*	5-54	Oscillator	12 (1)	200	2,400 (200)	
	5-55	Standard signal generator	12	180	2,160	50 kHz - 100 MHz
*	5-56	Standard signal generator	6 (1)	300	1,800 (300)	20kHz - 600 MHz
	5-57	Low-frequency oscillator	12	150	1,800	0.01 Hz - 600 kHz
*	5-58	Special waveform generator	5 (1)	300	1,500 (300)	Ultra-low frequency wave, square wave, etc.
*	5-59	Sweep generator	6 (1)	300	1,800 (300)	For radio and TV sets
*	5-60	LCR meter	12 (1)	150	1,800 (150)	
	5-61	Amplifier	6	100	600	
	5-62	Desk-top calculator	32	10	320	w/arithmetic and roof functions
	5-63	Field intensity meter	2	300	600	w/test antenna
*	5-64	Transistor characteristic display unit	1	350	350	
	5-65	Copier	2	350	700	Dry type, w/a year's worth of sensitive paper
	5-66	Overhead projector	2	250	500	w/screen and accessories
	5-67	Automatic slide projector	2	150	300	w/slides
	5-68	Movie projector	2	500	1,000	16 mm, w/stand and film
	5-69	Amplifier for lecture	2	150	300	w/speaker, wireless mike, cassette tape
	5-70	Taperecorder	2	70	140	Cassette type; w/radio set

No.	Name	Q'ty	Unit price	Amount	Remarks
5-71	VTR unit	2	1,500	3,000	w/5 colour monitors
o	Consumables and tools for practice				
5-73	Wires	180	5	900	Wires, etc.
5-74	Parts	180	10	1,800	L, C, R, terminals, etc.
5-75	Tool set	100sets	5	500	Student's tools in case
5-76	Tools for preparatory work	50sets	10	500	Common tools, special tools for preparatory work
5-77	Workbench	62	100	6,200	w/stool
5-78	Locker	20	60	1,200	
	TOTAL			143,040 Thousand Yen (7,000 Thousand Yen)	US $ 470,526.- (US $ 23,026.-)

6. EI-2 Electronics III

No.	Name	Q'ty	Unit price	Amount	Remarks
	o Electrical instruments				
6-1	High-frequency ammeter	36	30	1,080	Thermocouple type
6-2	Electronic voltmeter	8	100	800	DC - 10 MC
6-3	Digital	8	400	3,200	4 digits or more; for measurement of voltage and resistance
6-4	Electronic circuit tester	8	50	400	For measurement of voltage, current and resistance; w/accessories
6-5	DC voltmeter	60	15	900	Class 0.5
6-6	DC ammeter	60	15	900	Class 0.5
6-7	AC voltmeter	60	15	900	Class 0.5
6-8	AC ammeter	60	15	900	Class 0.5
	o Electronic measuring instruments				
6-9	High-frequency bridge	8	150	1,200	For 10 kHz
6-10	Standard resistor	36	30	1,080	Various fixed and variable types
6-11	Standard inductance	36	80	2,880	Various fixed and variable types
6-12	Standard capacitor	36	60	2,160	Various fixed and variable types
6-13	Q-meter	3	400	1,200	Up to about 10 M Hz
6-14	Counter	3	300	900	4 digits or more
6-15	Absorption type frequency meter	3	100	300	10 kHz - 10M Hz
6-16	Oscillograph	1	600	600	6-element type, w/accessories

No.	Name	Q'ty	Unit price	Amount	Remarks
6-17	X-Y recorder	8	500	4,000	2-pen type
6-18	Basic pulse circuit testing arrangement	2	1,000	2,000	w/power unit, various pulse circuits & accessories
6-19	Oscilloscope	8	200	1,600	5 MC
6-20	Oscilloscope	8	600	4,800	30 MC, 2-element type
6-21	Electronic galvanometer	8	30	240	Approx. ± μV, battery used
	o Automatic control				
6-22	Sequence control experimental arrangement	1	1,000	1,000	Relay
6-23	Logic sequence experimental arrangement	1	1,000	1,000	Logic circuits (semiconductors)
6-24	Servo mechanism experimental arrangement	1	1,000	1,000	
6-25	Process control experiemental arrangement	1	1,000	1,000	Flow and temperature control
6-26	Motor-generator automatic regulator	1	2,000	2,000	Automatic control
6-27	Electronic controller	8	500	4,000	PID control and recording; electronic SCC, DDC
6-28	Transducer	3	150	450	Temperature - electrical quantity
6-29	Transducer	3	150	450	Pressure - electrical quantity
6-30	Elevator control model	1	3,000	3,000	2-cage, 6-floor model
6-31	Temperature control model	1	4,000	4,000	Temperature and flow control (temperature control by chilled and heated water)

No.	Name	Q'ty	Unit price	Amount	Remarks
	o Electronic computer				
6-33	Electronic computer	1	15,000	15,000	16 kB or more; w/line printer and other system components, and a year's worth of consumables
6-34	Perforating typewriter	8	1,000	8,000	8-channel, ISO code, w/a year's worth of paper tape
6-35	Paper tape cabinet	1	100	100	
	o Power unit				
6-36	Power unit	8	100	800	Stabilized dc power unit
6-37	Power unit	8	100	800	Experimental variable multitap voltage source
6-38	AC voltage stabilizer	2	500	1,000	100V, 10 kVA
6-39	Oscillator	8	400	3,200	Function, 10 - 2 MC or higher
6-40	Oscillator	8	400	3,200	High-frequency
6-41	Oscillator	3	400	1,200	Ultra-low frequency
6-42	Study desk and chair	70	30	2,100	
6-43	Workbench	24	100	2,400	
6-44	Movable blackboard	18	50	900	
6-45	Locker	16	60	960	
6-46	Copier	2	500	1,000	Dry type, w/a year's worth of sensitive paper
6-47	Overhead projector	4	250	1,000	w/screen, accessories and wagon
6-48	Movie projector	2	500	1,000	16mm, w/stand and film

No.	Name	Q'ty	Unit price	Amount	Remarks
6-49	Slide projector	2	150	300	W/slides
6-50	VTR unit	2	1,500	3,000	W/5 colour monitors
6-51	Amplifier for lecture	2	150	300	W/wireless mike, cassette tape and speaker
6-52	Taperecorder	8	50	400	Cassette type, w/radio set
	Total			96,600 Thousand Yen	US$317,763.-

7. Radio Engineering

No.	Name	Q'ty	Unit price	Amount	Remarks
	o Materials for radio engineering practice				
7-1	Radio receiver for measurement	32	10	320	
7-2	FM radio receiver for measurement	32	50	1,600	Incl. stereophonic circuit
7-3	Exploded demonstration radio receiver	8	50	400	AM/FM demonstration panel
7-4	AM/FM transmitter	4	200	800	10W, for practice
7-6	FM stereophonic transmitter	1	500	500	Exploded demonstration type, for FM stereophonic transmission, small output
	o Measuring instruments for use with radio set				
7-7	Radio characteristics measuring console	30	1,500	45,000	W/workbench for repair, display unit, characteristic measurement; covers FM set
7-8	Transmitter adjusting and measuring rack	4	500	2,000	Movable type
7-9	Circuit tester	10	15	150	
7-10	Electronic volt & ohm meter	10	30	300	
7-11	High-sensitivity voltmeter	60	50	3,000	1 mV - 300 V
7-12	Voltmeter	60	15	900	
7-13	Ammeter	60	15	900	
7-14	High-frequency ammeter	10	20	200	
7-15	Digital voltmeter	17	250	4,250	
7-16	Resistor	36	30	1,080	Variable
7-17	Resistor	36	80	2,880	Slide type
7-18	Resistance attenuator	17	55	935	

No.	Name	Q'ty	Unit price	Amount	Remarks
7-19	Filter	17	200	3,400	Variable type
7-20	Standard inductance	17	40	680	
7-21	Standard variable capacitor	17	60	1,020	
7-22	Megger	2	100	200	500V or higher
7-23	Oscilloscope	10	200	2,000	
7-24	Oscilloscope	17	350	5,950	2-element type
7-25	X-Y recorder	12	350	4,200	
7-26	Oscillograph	3	350	1,050	
7-27	Sampling transducer	3	500	1,500	
7-28	Wave meter	17	50	850	Absorption type, dep meter
7-29	Frequency meter	17	300	5,100	Digital counter
7-30	High-frequency bridge	3	240	720	
7-31	Radio frequency bridge	3	240	720	
7-32	Q-meter	17	200	3,400	
7-33	Standard signal generator	2	400	800	For AM/FM
7-34	Test oscillator	10	50	500	
7-35	Oscillator	5	300	1,500	10 Hz - 600 kHz or above
7-36	Sweep generator	4	300	1,200	Used for IF and commercial frequency
7-37	Amplifier	3	100	300	Linear amplifier, detective amplifier
7-38	Amplifier	2	200	400	Wide band
7-39	Calibrating receiver	1	200	200	
7-40	Transistor characteristics display unit	2	350	700	
7-41	Transistor checker	12	100	1,200	

No.	Name	Q'ty	Unit price	Amount	Remarks
7-42	IC tester	8	150	1,200	
7-43	LCR meter	12	150	1,800	
7-44	Field strength meter	12	300	3,600	
7-45	Impedance bridge unit	2	250	500	
	o Audio equipment for object lesson				
7-46	Large-output stereophonic amplifier	32	80	2,560	W/pre-amplifier and headphone (30W + 30W)
7-47	Mixer amplifier	32	60	1,920	
7-48	Record player	12	60	720	
7-49	Speaker	6 sets	80	480	For stereophonic system, w/cabinet (typical speakers of various brands)
7-50	Speaker for hall	1 set	200	200	4 channels
7-51	Tuner	3	50	150	For AM/FM stereophonic device
7-52	Exploded demonstration amplifier	4	100	400	
7-53	Microphone	17	10	170	
7-54	Taperecorder	32	100	3,200	3-head open real measurement
7-55	Taperecorder	6	70	420	Cassette type, stereophonic
	o Measuring instruments for audio equipment				
7-56	Audio amplifier measuring system	30	1,500	45,000	W/workbench, incl. taperecorder measurement
7-57	Acoustic measuring instruments	12	1,000	12,000	Movable rack

No.	Name	Q'ty	Unit price	Amount	Remarks
7-58	Measuring instruments for anechoic room	1	1,000	1,000	
7-59	Amplifier characteristics display recorder	1	1,000	1,000	
7-60	Player characteristics measuring instrument	12	500	6,000	Movable rack
7-61	Level meter	2	300	600	
7-62	Frequency analyzer	2	1,000	2,000	
7-63	Distortion factor meter	4	500	2,000	
7-64	Low-frequency generator	4	250	1,000	
7-65	Special waveform generator	2	300	600	
7-66	Constant-voltage unit	10	50	500	
7-67	Eliminator power unit	5	200	1,000	
7-68	Workbench	18	100	1,800	
7-69	Locker	20	60	1,200	
	o Audio-visual teaching materials				
7-70-1	Copier	2	350	700	Dry type, w/a year's worth of sensitive paper
7-70-2	Overhead projector	2	250	500	W/screen and accessories
7-70-3	Automatic slide projector	2	150	300	W/slides
7-70-4	Movie projector	2	500	1,000	16mm, w/stand and film
7-70-5	Amplifier for lecture	2	150	300	W/Speaker, wireless mike, cassette tape
7-70-6	Taperecorder	2	70	140	Cassette type, w/radio set
7-70-7	VTR unit	2	1,500	3,000	W/5 colour monitors

No.	Name	Q'ty	Unit price	Amount	Remarks
	o Consumables and tools for practice				
7-71	Wires	180	5	900	Wires, etc.
7-72	Parts	180	10	1,800	L, C, R, terminals, etc.
7-73	Tool set	100 sets	5	500	Student's tools in case
7-74	Tools for preparatory work	50 sets	10	500	Common tools, special tools for preparatory work
	Total			205,465 Thousand Yen	US$675,872.-

8. TV Engineering

No.	Name	Q'ty	Unit price	Amount	Remarks
	o Equipment for TV engineering practice				
8-1	Exploded demonstration monochrome TV receiver set	8	200	1,600	Exploded demonstration type, permitting waveform observation
8-2	Exploded demonstration colour TV receiver set	8	600	4,800	ditto
8-3	Monochrome TV receiver	32	40	1,280	
8-4	Colour TV receiver	32	130	4,160	
8-5	Exploded demonstration video recorder	8	600	4,800	Exploded demonstration type for colour, permitting observation of waveform and function
8-6	Video recorder	12	250	3,000	For monochrome
8-7	Colour video recorder	12	350	4,200	For colour
8-8	Variable element Yagi antenna	11	20	220	For VHF & UHF practice
	o TV studio equipment				
8-9	Monochrome ITV camera	2	300	600	W/remote controller
8-10	Colour IRV camera	2	1,200	2,400	W/remote controller
8-11	Video recorder	1	1,500	1,500	For open reel
8-12	Pattern generator	1	1,000	1,000	Centrally controlled type, wired to each workbench
8-13	Lighting equipment	1	200	200	Utility type studio lighting
8-14	TV control console	1	1,800	1,800	Switching and control of video and audio signals
8-15	Film video signal converter	1	1,000	1,000	Film-to-video signal conversion
8-16	Video transmitter control rack	1	1,500	1,500	Morable rack for adjusting and measuring studio equipment

No.	Name	Q'ty	Unit price	Amount	Remarks
	o Measuring instruments				
8-18	Circuit tester	12	20	240	Medium-sized
8-19	Electronic volt & ohm meter	12	30	360	
8-20	Electronic voltmeter	12	50	600	High-sensitivity voltmeter
8-21	Monochrome TV set characteristics measuring system	30	1,000	30,000	For measurement of sweep and marker, etc. Builton workbench
8-22	Colour TV set characteristics measuring system	30	2,000	60,000	For colour control and measurement
8-23	Antenna characteristics measuring rack	11	300	3,300	W/oscillator (for measuring gain characteristics and directivity characteristics)
8-24	Voltmeter	70	15	1,050	
8-25	Ammeter	70	15	1,050	
8-26	Digital circuit tester	12	250	3,000	
8-27	Resistor	32	30	960	Variable resistance box
8-28	Resistor	32	80	2,560	Wound type slide resistor
8-29	Resistance attenuator	17	55	935	Variable
8-30	Standard inductance	6	40	240	ditto
8-31	Standard capacitor	6	60	360	ditto
8-32	Oscilloscope	5	200	1,000	For TV control
8-33	Videoscope	17	600	10,200	For TV waveform observation
8-34	Wave meter	17	40	680	Absorption type, frequency meter
8-35	Digital frequency counter	17	300	5,100	
8-36	Q-meter	3	300	900	
8-37	Radio frequency bridge	3	300	900	

No.	Name	Q'ty	Unit price	Amount	Remarks
8-38	Waveform analyzer	2	2,500	5,000	Incl. recorder
8-39	Standard signal generator	6	400	2,400	For LF, MF, HF, VHF
8-40	Standard signal generator	6	300	1,800	For HF, VHF, UHF
8-41	Test oscillator	22	40	880	50 kHz - 250 MHz
8-42	Sweep generator	5	300	1,500	For TV set
8-43	Oscillator	5	300	1,500	
8-44	Transistor characteristics display unit	3	350	1,050	
8-45	Transistor checker	5	150	750	Incl. in-circuit type
8-46	IC tester	5	300	1,500	IC checker
8-47	LCR meter	6	150	900	
8-48	Phase meter	12	500	6,000	Vector scope
8-49	X-Y recorder	4	500	2,000	
8-50	Field strength	12	300	3,600	For TV
8-51	UHF test rack	12	600	7,200	Tuner tester, combination with 8-21 & -22 permitted
8-52	Video tape testing arrangement	10	600	6,000	Mainly covering mechanism; combination with 8-21 & -22 permitted
8-53	Eliminator power unit	10	150	1,500	
8-54	Constant-voltage unit	10	50	500	
8-55	Workbench	5	100	500	
8-56	Locker	10	60	600	
8-57	Movable blackboard	4	50	200	
8-58	Copier	2	350	700	Dry type, with a year's worth of sensitive paper
8-59	Overhead projector	2	250	500	W/screen and accessories

No.	Name	Q'ty	Unit price	Amount	Remarks
8-60	Automatic slide projector	2	150	300	W/slides
8-61	Movie projector	2	500	1,000	16mm, w/stand and film
8-62	Amplifier for lecture	2	150	300	W/speaker, wireless mike and cassette tape
8-63	Tape recorder	2	70	140	Cassette type, w/radio unit
8-64	VTR unit	2	1,500	3,000	W/5 colour monitors
	o Consumables and tools for practice				
8-66	Wires	180	5	900	Wires, etc.
8-67	Parts	180	10	1,800	L, C, R, terminals, etc.
8-68	Tool set	100 sets	5	500	Student's tools in case
8-69	Tools for preparatory work	50 sets	10	500	Common tools, special tools for preparatory work
	Total			212,515 Thousand Yen	US$699,063.-

9.a TC-3 Electronic telecommunication I (Wire telecommunication, data transmission)

No.	Name	Q'ty	Unit price	Amount	Remarks
	o Information and electric telecommunication				
9-1	Electric telecommunication network display panel	1	3,500	3,500	
9-2	Electric telecommunication network model	1	300	300	
	o Wire telecommunication line				
9-3	Experimental cable circuit	2	1,000	2,000	Approx. 2 km including equipment
9-4	Dummy line	10	100	1,000	
9-5	Attenuator	18	80	1,440	
9-6	Filter	18	100	1,800	
9-7	Cables	18	100	1,800	
9-8	Lecher wire testing arrangement	10	100	1,000	Incl. VHF transmitter & receiver
	o Wire telegraphy				
9-9	Experimental telegraph arrangement	35	80	2,800	Incl. keys, relays, receiver, etc.
9-10	Telegraphy training arrangement	1	200	200	Incl. training apparatus (central control system)
9-11	Teletype arrangement	12	2,500	30,000	
9-12	Adjusting instruments	3	500	1,500	Built on a rack
9-13	Typewriter	12	100	1,200	Electric type

No.	Name	Q'ty	Unit price	Amount	Remarks
	o Wire telephony				
9-14	Telephone set	20	10	200	Magnet type
9-15	Telephone set	20	7	140	Common battery type
9-16	Telephone set	50	8	400	Automatic dial type
9-17	Telephone set	50	12	600	Pushphone type
9-18	Exchange	6	150	900	Various types, incl. power unit
9-19	Exchange	2	7,000	14,000	Automatic type, incl. power unit
9-20	Adjusting instruments	3	300	900	Built on a rack
	o Carrier telecommunication				
9-21	Experimental carrier telecommunication arrangement	2	6,000	12,000	
9-22	Experimental frequency division multiplex system	2	1,000	2,000	
9-23	Experimental time sharing telecommunication arrangement	2	1,000	2,000	
9-24	Experimental PCM telecommunication arrangement	2	1,200	2,400	
9-25	Adjusting instruments	3	400	1,200	
	o Data transmission				
9-26	Computer system	1	14,000	14,000	A complete set of basic components
9-27	Peripherals	2	3,500	7,000	Memory, I/O device
9-28	Experimental data transmission system	17	2,200	37,400	Incl. terminals and ancillaries

No.	Name	Q'ty	Unit price	Amount	Remarks
9-29	Adjusting instruments	3	1,000	3,000	
	o Video transmission				
9-30	Phototelegraphic arrangement	2	1500 × 2	6,000	
9-31	Facsimile telegraphy arrangement	2	800 × 2	3,200	
9-32	Electrowriter	6	450	2,700	
9-33	EL display unit	3	300	900	
9-34	Liquid crystal display unit	3	300	900	
9-35	Plasma display unit	3	400	1,200	
9-36	Leser holographic device	2	800	1,600	
9-37	Electrofax	2	1,000	2,000	
	o Measuring instruments				
9-38	Voltmeter	120	15	1,800	DC precision type
9-39	Voltmeter	100	10	1,000	DC utility type
9-40	Voltmeter	60	15	900	AC precision type
9-41	Voltmeter	50	10	500	AC utility type
9-42	Ammeter	120	15	1,800	DC precision type
9-43	Ammeter	100	10	1,000	DC utility type
9-44	Ammeter	60	15	900	AC precision type
9-45	Ammeter	50	10	500	AC utility type
9-46	Wattmeter	6	40	240	
9-47	Circuit tester	40	20	800	
9-48	LCR meter	6	150	900	

No.	Name	Q'ty	Unit price	Amount	Remarks
9-49	Resistor	50	30	1,500	Standard and variable types
9-50	Resistor	50	60	3,000	ditto
9-51	Resistor	50	80	4,000	ditto
9-52	Inductance	30	80	2,400	ditto
9-53	Capacitor	30	70	2,100	ditto
9-54	Oscilloscope	10	800	8,800	W/accessories and wagon
9-55	Oscilloscope	10	400	4,000	ditto
9-56	Oscilloscope	35	200	7,000	
9-57	Laser projection oscilloscope	1	600	600	
9-58	Oscillograph	2	450	900	For recording
9-59	X-Y recorder	6	500	3,000	W/accessories
9-60	Counter	6	300	1,800	
9-61	Bridge circuit unit	6	240	1,440	
9-62	Q-meter	3	300	900	For high-frequency use
9-63	Distortion factor meter	3	300	900	
9-64	Level meter	3	300	900	
9-65	Amplifier	10	200	2,000	
9-66	Modulator	10	150	1,500	
9-67	Demodulator	10	100	1,000	
9-68	Oscillator	10	100	1,000	
9-69	Standard signal generator	6	400	2,400	
9-70	Special waveform generator	6	400	2,400	
9-71	Pulse generator	6	450	2,700	
9-72	Characteristics display unit	6	750	4,500	

No.	Name	Q'ty	Unit price	Amount	Remarks
9-73	Frequency analyzer	1	2,500	2,500	
9-74	Electronic voltmeter	6	50	300	
9-75	Electronic element tester	3	800	2,400	Incl. semiconductor checker, IC checker
	o Audio visual teaching aids				
9-76	Copier	1	350	350	Dry type, incl. a year's worth of sensitive paper
9-77	Overhead projector	1	250	250	W/screen
9-78	Automatic slide projector	1	150	150	
9-79	Movie projector	1	500	1,000	16mm, w/film
9-80	Movie projector	1	200	200	8 mm, w/film
9-81	Amplifier for lecture	1	150	150	
9-82	Taperecorder	2	250	500	
9-83	VTR unit	1	1,500	1,500	W/5 monitors
9-84	Mass reaction psycometer	1	7,000	7,000	Controlled with micro-computer
	o Desks and lockers				
9-85	Testing bench	6	100	600	For teletype unit
9-86	Testing bench	35	100	3,500	For telegraphy and other
9-87	Desks and chairs	35	30	1,050	
9-88	Movable blackboard	6	50	300	
9-89	Locker	20	60	1,200	
	Sub Total			258,410 Thousand Yen	US$850,033.-

9.b TC-4 Electronic telecommonucation (wireless telecommunication, radar, etc.)

No.	Name	Q'ty	Unit price	Amount	Remarks
	o Radio wave and aerial				
9-90	Hertz wave experimental arrangement	6	100	600	
9-91	Fundamental electric wave testing arrangement	6	250	1,500	
9-92	Antenna	2	800	1,600	For MF
9-93	Antenna	3	400	1,200	For HF
9-94	Antenna	3	250	750	For VHF
9-95	Antenna	3	100	300	For UHF
9-96	Antenna erection equipment	5	200	1,000	
9-97	Feeder system	6	150	900	
9-98	Antenna control equipment	6	100	600	
	o Wireless telecommunication system				
9-99	Radio station equipment	1	6,000	6,000	MF/HF transmitter/receiver system
9-100	Amateur station equipment	1	2,000	2,000	HF/VHF transmitter/receiver system
	o Wireless telecommunication equipment				
9-101	Transmitter	2	1,000	2,000	For MF & HF
9-102	Transmitter	2	400	800	For HF & VHF
9-103	Transmitter	10	260	2,600	For VHF & UHF
9-104	Transmitter/receiver	10	400	4,000	VHF transceiver
9-105	Transmitter/receiver	10	300	3,000	UHF transceiver
9-106	Field strengthmeter	10	600	6,000	
9-107	Wireless remote measuring equipment	2	2,500	5,000	

No.	Name	Q'ty	Unit price	Amount	Remarks
9-108	Wireless remote control equipment	3	250	750	
9-109	Adjusting device for radio equipment	6	600	3,600	Wattmeter, counter, oscilloscope, etc.
9-110	Power unit	18	150	2,700	Various types, incl. high voltage and low voltage
9-111	Receiver	35	250	8,750	For locating broadcast stations
	o TV equipment				
9-112	TV video signal transmitter	1	5,000	5,000	Camera, controls, power unit, monitor, etc.
9-113	TV program circuit	1	5,000	5,000	Incl. power unit and accessories
9-114	TV video recorder	2	1,200	2,400	VTR, controls, power unit, monitor, etc.
9-115	TV receiver	18	150	2,700	Colour
9-116	TV receiver	18	50	900	Monochrome
9-117	TV receiver	18	250	4,500	Exploded demonstration panel
9-118	TV measuring instruments	10	150	1,500	
	o Radar and radio navigation				
9-119	Radar arrangement	2	1,000	2,000	Pulse microwave
9-120	Radar arrangement	2	3,500	7,000	Pulse millimeter wave
9-121	Radar arrangement	2	1,000	2,000	Doppler system
9-122	Radio direction finder	2	400	800	
9-123	Loran receiver	2	450	900	

No.	Name	Q'ty	Unit price	Amount	Remarks
9-124	Decca receiver	2	750	1,500	
9-125	Adjusting trimming instruments	2	600	1,200	
	o Mobile radio station equipment				
9-126	Experimental mobile radio station equipment	1	5,000	5,000	Mobile radio station
9-127	Mobile radio equipment	15	200	3,000	
	o Microwave telecommunication				
9-128	Experimental microwave testing arrangement	2	1,000	2,000	For element measuring test
9-129	Microwave telecommunication equipment	2	1,000	2,000	For telecommunication characteristic measurement
9-130	Experimental microwave terminal station arrangement	2	2,500	5,000	
9-131	Experimental microwave relaying station arrangement	2	1,800	3,600	
9-132	Experimental microwave antenna arrangement	2	800	1,600	
9-133	Experimental microwave transmis-sion arrangement	2	1,200	2,400	
9-134	Adjusting instruments	6	900	5,400	
	o Special wireless telecommunication				
9-135	Ultrasonic telecommunication equipment	1	1,000	1,000	
9-136	Light telecommunication equipment	1	300	300	

No.	Name	Q'ty	Unit price	Amount	Remarks
9-137	Experimental laser telecommunication equipment	1	1,800	1,800	
9-138	Cosmic noise measuring equipment	1	6,000	6,000	
9-139	Experimental secrecy communication equipment	1	1,000	1,000	
	o Measuring equipment				
9-140	Voltmeter	100	15	1,500	DC precisiontype
9-141	Voltmeter	50	10	500	DC utility type
9-142	Voltmeter	30	15	450	AC precision type
9-143	Voltmeter	30	10	300	AC utility type
9-144	Ammeter	100	15	1,500	DC precision type
9-145	Ammeter	50	10	500	DC utility type
9-146	Ammeter	30	15	450	AC precision type
9-147	Ammeter	30	10	300	AC utility type
9-148	Wattmeter	6	40	240	
9-149	Circuit tester	36	20	720	
9-150	LCR meter	6	150	900	
9-151	Resistor	50	30	1,500	Standard and variable types
9-152	Resistor	50	60	3,000	ditto
9-153	Resistor	50	80	4,000	ditto
9-154	Inductance	30	80	2,400	ditto
9-155	Capacitor	30	70	2,100	ditto
9-156	Oscilloscope	3	1,200	3,600	High measure range
9-157	Oscilloscope	5	400	2,000	W/accessories and wagon
9-158	Oscilloscope	35	200	7,000	Portable type

No.	Name	Q'ty	Unit price	Amount	Remarks
9-159	Laser projection oscilloscope	1	600	600	
9-160	Oscillograph	2	450	900	
9-161	X-Y recorder	3	500	1,500	
9-162	Counter	3	750	2,250	
9-163	Bridge circuit unit	3	240	720	
9-164	Q-meter	3	300	900	
9-165	Distortion factor meter	3	300	900	
9-166	Level meter	3	300	900	
9-167	Amplifier	10	200	2,000	
9-168	Modulator	10	250	2,500	
9-169	Demodulator	10	150	1,500	
9-170	Oscillator	10	280	2,800	
9-171	Standard signal generator	10	400	4,000	
9-172	Special waveform generator	3	400	1,200	
9-173	Pulse generator	3	450	1,350	
9-174	Characteristics display unit	3	750	2,250	
9-175	Frequency analyzer	3	1,000	3,000	
9-176	Electronic voltmeter	6	50	300	1mV - 300V range
9-177	Electronic voltmeter	6	200	1,200	1μV - 500V range
	o Audio visual teaching aids				
9-178	Copier	1	350	350	
9-179	Overhead projector	1	250	250	W/screen etc.
9-180	Automatic slide projector	1	150	150	
9-181	Movie projector	1	500	500	16mm w/film

No.	Name	Q'ty	Unit price	Amount	Remarks
9-182	Movie projector	1	200	200	8mm, w/film
9-183	Amplifier for lecture	1	150	150	
9-184	Taperecorder	2	250	500	
9-185	VTR unit	1	1,500	1,500	W/5 monitors
9-186	Mass reaction psycometer	1	1,500	1,500	
	o Desks and lockers				
9-187	Workbench	6	100	600	
9-188	Testing bench	16	100	1,600	
9-189	Desks and chairs	35	30	1,050	
9-190	Movable blackboard	6	50	300	
9-191	Lockers	10	60	600	
	o Consumables and tools				
	Cables and wires			360	@8,000 x (30 + 15) persons
	Tools and materials			135	@3,000 x (30 + 15) "
	Electronic parts			225	@5,000 x (30 + 15) "
	Materials for data processing			225	@5,000 x (30 + 15) "
	Sub Total			207,075 Thousand Yen	US$681,168
	TC-3 electronic telecommunication I			258,410 Thousand Yen	US$850,033.-
	TC-3 electronic telecommunication II			207,075 Thousand Yen	US$681,168.-
	Total			465,485 Thousand Yen	US$1,531,201.-

10. EI-II Electronic instrumentation engineering

No.	Name	Q'ty	Unit price	Amount	Remarks
	o Mechanical instruments				
10-1	Block gauge	2	400	800	Class A, 40 sets, w/ w/accessories
10-2	Measuring machine	1	2,000	2,000	40 cm
10-3	Automatic collimator	1	300	300	Min. div. 1 sec.
10-4	Universal projector	1	800	800	W/Screen
10-5	Precision surface plate	2	100	200	
10-6	Resistance thermometer	2	200	400	Thermistor, w/range
10-7	Thermocouple thermometer	2	200	400	Thermocouple
10-8	Pyrometer	2	150	300	1,800°C
10-9	Manometer	2	200	400	Master
10-10	Electric furnace	2	100	200	
	o Transducers				
10-11	Experimental differential transformer arrangement	8	200	1,600	W/micrometer
10-12	Electric micrometer	3	300	900	
10-13	Experimental nozzle flapper arrangement	8	200	1,600	
10-14	Pneumatic micrometer	3	300	900	
10-15	Flow integrating meter	3	250	750	
10-16	Resistance wire strain gauge	3	500	1,500	
10-17	Magnetic flowmeter	1	1,200	1,200	

No.	Name	Q'ty	Unit price	Amount	Remarks
	o Equipment for control system				
10-18	Experimental frequency response testing arrangement	3	1,000	3,000	W/a year's worth of consumables
10-19	Electronic controller	3	500	1,500	ditto
10-20	Pneumatic controller	3	500	1,500	ditto
10-21	2-pen recorder	3	500	1,500	W/a year's worth of recording chart and consumables
10-22	Pneumatic recorder	3	300	900	ditto
10-23	Pneumoelectric transducer	3	150	450	
10-24	Electropneumatic transducer	3	200	600	
10-25	Positioner	3	150	450	
10-26	Diaphragm valve	3	150	450	
10-27	Control simulator	3	700	2,100	
10-27	Transfer function measuring system	3	2,000	6,000	
10-28	Experimental servo mechanism arrangement	8	800	6,400	
10-29	Experimental temperature control system	2	1,000	2,000	
10-30	Experimental flow control system	2	1,000	2,000	
10-31	Experimental hydraulic control system	2	1,000	2,000	
10-32	Experimental sequence control system	8	400	3,200	Relays and transistors
10-33	Experimental logic arrangement	8	500	4,000	Electronic circuit elements
10-34	ditto	3	500	1,500	Fluid logic elements

No.	Name	Q'ty	Unit price	Amount	Remarks
10-35	Sequence control arrangement	3	2,000	6,000	
	o Computer control				
10-36	Computer system	1	50,000	50,000	A complete set of DDC system, w/accessories and a year's worth of consumables
10-37	Analog interface	1	10,000	10,000	
10-38	Digital control model arrangement	1	20,000	20,000	SCC, DDC process model
10-39	Analog computer	1	5,000	5,000	W/12 operational amplifier units or more
10-40	Hybrid computer interface	1	5,000	5,000	
	o Machining and inspection				
10-41	NC machine tool	1	4,000	4,000	Drill press, ISO code, w/optional arrangement
	o Utilities				
10-42	Electric power unit	8	250	2,000	
10-43	Air compressor	1	1,500	1,500	
10-44	Hydraulic pump	1	1,000	1,000	
10-45	Water tank	1	500	500	200 lit., w/pump and stabilizer

No.	Name	Q'ty	Unit price	Amount	Remarks
	o Electrical instruments				
10-46	DC voltmeter	45	15	675	Class 0.5
10-47	DC ammeter	45	15	675	Class 0.5
10-48	AC voltmeter	45	15	675	Class 0.5
10-49	AC ammeter	45	15	675	Class 0.5
10-50	Electronic circuit tester	8	50	400	W/accessories
10-51	Digital circuit tester	8	100	800	W/power supply unit
10-52	Digital voltmeter	8	300	2,400	For AC & DC
	o Testing equipment				
10-53	Basic pulse circuit experimental arrangement	8	1,000	8,000	Transistor circuits, IC circuits
10-54	Logic circuit testing arrangement	8	800	6,400	W/various logic element and display units
10-55	Basic operational circuit experimental arrangement	8	1,000	8,000	Adder, shift register, count circuit
10-56	AD, DA experimental arrangement	8	1,000	8,000	Various systems
10-57	Electronic circuit testing arrangement	8	1,000	8,000	Basic transistor circuits
	o Electronic measuring instruments				
10-58	Pulse generator	8	400	3,200	
10-59	Function generator	8	400	3,200	
10-60	Oscilloscope	8	600	4,800	W/wagon
10-61	Resistance attenuator	8	100	800	
10-62	LCR meter	8	300	2,400	

No.	Name	Q'ty	Unit price	Amount	Remarks
10-63	Counter	8	300	2,400	W/wagon
10-64	Amplifier for measuring instruments	8	200	1,600	
10-65	X-Y recorder	8	500	4,000	W/wagon
10-66	Power transducer	8	350	2,800	AC current, voltage, wattage frequency, power factor, DC output
10-67	Oscillograph	3	500	1,500	
	o Radiation engineering				
10-68	Geiger counter	3	400	1,200	
10-69	Scintillation counter	3	1,000	3,000	
10-70	γ-ray spectrometer	2	3,000	6,000	
10-71	Radiation equipment	3	500	1,500	Absorption shield, detector, lead block, radiation source for test use
10-72	Radioactive substance safe	1	500	500	Totally enclosed RI (3 kinds) × 5 = 15, w/markings for radiation hazards
10-73	Desks and charis	35	30	1,050	
10-74	Workbench	12	100	1,200	
10-75	Movable blackboard	6	60	360	
10-76	Locker	10	60	600	
10-77	Copier	2	500	1,000	Floor type, w/a year's worth of sensitive paper
10-78	Overhead projector	2	250	500	W/screen and wagon
10-79	Movie projector	1	500	500	W/stand and film
10-80	Slide projector	2	150	300	W/slides

No.	Name	Q'ty	Unit price	Amount	Remarks
10-81	VTR unit	1	1,500	1,500	Colour, w/5 monitors
10-82	Amplifier for lecture	1	150	150	W/wireless mike, cassette tape, speaker
10-83	Taperecorder	4	50	200	Cassette type, w/radio set
10-84	Wiring materials for practice			350	@5,000 × 70 persons
10-85	Electrical parts for practice			350	@5,000 × 70 "
10-86	Others for practice			140	@2,000 × 70 "
	Total			250,600 Thousand Yen	US$824,342.-

11. Computer Centre

No.	Name	Q'ty	Unit price	Amount	Remarks
	o Electronic computer				
11-1	Electronic computer system	1	60,000	60,000	Memory capacity: 32 kB or more w/typewriter, display, card reader, paper tape reader, punch, magnetic disc, magnetic tape (2 reels/unit), and other ancillary equipment, w/a year's worth of consumables
	o Punch				
11-2	Card pumch	18	1,500	27,000	80 columns, 029 code, w/alphabetical types, digit types, and special types, w/a year's worth of cards
11-3	Paper tape punch	1	1,000	1,000	ISO code, 8-channel, w/accessories, w/a year's worth of paper tape
11-4	Cabinet	10	100	1,000	W/10 drawers for cards
11-5	Cabinet	1	100	100	For paper tape
11-6	Cabinet	2	200	400	For magnetic tape
11-7	Data filing desk	10	50	500	
11-8	Movable blackboard	2	60	120	
11-9	Locker	4	60	240	
11-10	Overhead projector	2	250	500	W/screen & wagon
11-11	Individual study trainer	3	250	750	Interlocked operation of slide and magnetic tape, w/teaching materials
11-12	Slide projector	2	150	300	W/2" 35mm roll, cut slides

No.	Name	Q'ty	Unit price	Amount	Remarks
11-13	Amplifier for lecture	2	150	300	W/wireless mike, cassette tape, speaker
11-14	Taperecorder	2	50	100	Cassette type, w/radio set
11-15	Copier	1	1,000	1,000	Large-sized
11-16	Coding sheets			450	@¥300 x 3 volumes x 500 persons
11-17	Tin plate			250	@¥500 x 500 persons
	Total			94,010 Thousand Yen	US$309,243.-

12. Teaching materials center

	No.	Name	Q'ty	Unit price	Amount	Remarks
*	12-1	ITV studio camera	2	400	800	W/remote stand
*	12-2	ITV colour camera	2	1,200	2,400	W/remote stand
*	12-3	Studio control console	1	2,000	2,000	W/monitor and distributor
*	12-4	Hall broadcast system	1	1,500	1,500	Incl. TV broadcast, audio broadcast, w/4 mikes; 2 systems
*	12-5	Film continuity equipment	1	500	500	16mm film editing, audition
*	12-6	Film video transmitter	1	4,000	4,000	16mm broadcasting equipment
*	12-7	VTR unit, w/monitor	2	2,500	5,000	Cassette type, for continuity work and transmission
*	12-8	Taperecorder	4	200	800	For audio continuity work and transmission
*	12-9	Small-sized portable recording machine	2	100	200	For recording and location
*	12-10	Slide video transmitter	2	1,700	3,400	Slide video transmitter
*	12-11	Slide projector	2	300	600	For slide audition
*	12-12	Darkroom equipment	1	1,000	1,000	3 cameras, enlarger, vat, chemicals, etc.
*	12-13	Record player	4	100	400	For music broadcasting, BGM
*	12-14	Offset printer	2	3,000	6,000	Incl. 10,000 sheets of printing paper, typesetting machine, ink, etc.
*	12-15	Copier	2	500	1,000	Dry copy
*	12-16	Book binder	1	200	200	For brochures of up to A4
*	12-17	Desk & chair	12	100	1,200	
*	12-18	Locker	30	60	1,800	
*	12-19	Shelf	20	50	1,000	

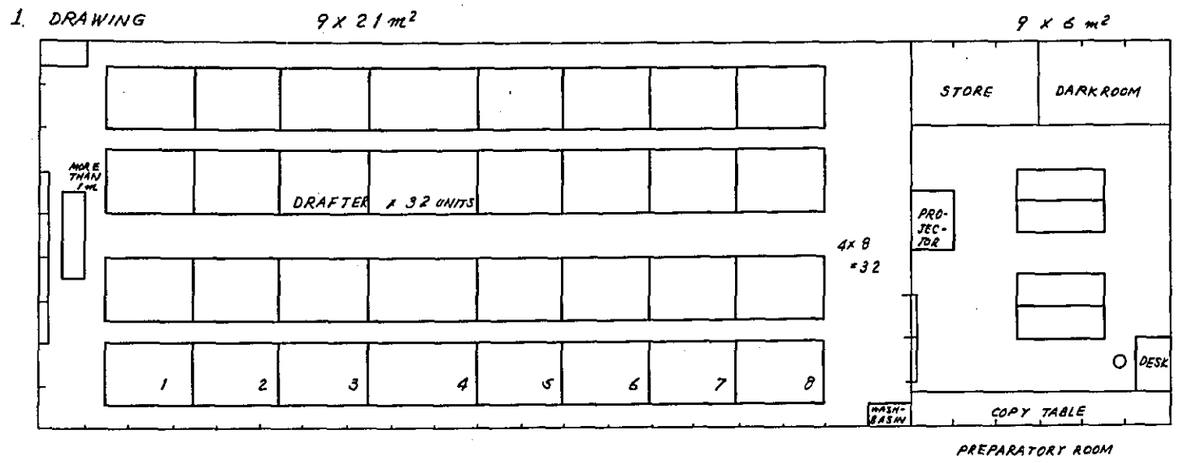
	No.	Name	Q'ty	Unit price	Amount	Remarks
*	12-20	Stationery	—	—	10,000	Paper, writing materials, and other consumables
*	12-21	16mm film	500	100	50,000	Teaching film
*	12-22	Recording tape	100	15	1,500	For TV
*	12-23	ditto	100	1	100	For Audio
*	12-24	Camera film	500	1	500	Colour, monochrome
*	12-25	Record	1000	3	3,000	For teaching
*	12-26	Slide film	100	30	3,000	For teaching
*	12-27	Sensitive paper for copying	1000	1	1,000	B4, B5 (100 sheets)
*	12-28	Recorded tape	100	50	5,000	Teaching material (for VTR)
*	12-29	Recorded tape	300	5	1,500	
		Total			109,400 Thousand Yen (109,400 Thousand yen)	US$359,868.- (US$359,868.-)

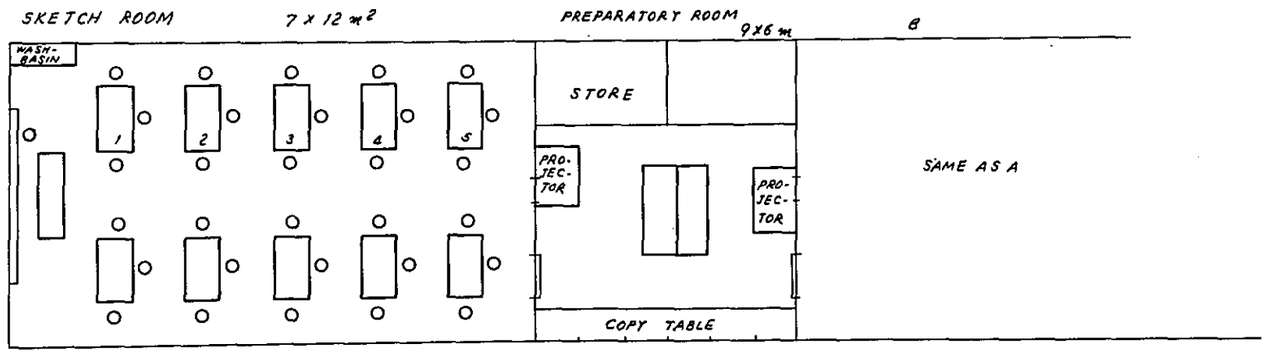
13. Solid state physics experiment (Electronics engineering III)

No.	Name	Q'ty	Unit price	Amount	Remarks
13-1	Experimental laser equipment	1	300	300	For teaching (incl. power unit)
13-2	Millikan's quantum measuring device	8	60	480	ditto
13-3	Planck's constant measuring device	8	50	400	For measurement of constant "h"
13-4	Frank-Hertz's experimental arrangement	8	70	560	Incl. power unit
13-5	Solar battery experimental arrangement	8	50	400	
13-6	Electric heater	8	5	40	300 - 2000 Watts
13-7	ditto	1	100	100	2000 - 5000 Watts
13-8	Spectroscope	8	40	320	For optical experiments
13-9	Discharge tube experimental device	17	150	2,550	Incl. power unit
13-10	Electron specific charge measuring device	8	90	720	ditto
13-11	X-ray equipment	8	300	2,400	ditto
13-12	Photoelectric current experimental arrangement	8	100	800	ditto
13-13	Fog box	8	50	400	For observation of α rays and β rays, incl. power unit
13-14	Radioactivity detector	8	150	1,200	For counting γ rays and β rays, incl. power unit
13-15	Electric resonance experimental arrangement	8	50	400	LC resosnance, eletro-magnetic wave, incl.

No.	Name	Q'ty	Unit price	Amount	Remarks
13-16	Peltier's experimental cooling device	8	100	800	Incl. power unit
13-17	Electromagnetic wave testing arrangement	8	100	800	For simple experiments with electromagnetic waves, incl. power unit
13-18	Plasma testing arrangement	1	900	900	For fundamental experiments with plasma
13-19	Wave and oscillation experimental arrangement	1	200	200	A complete set of physical testing equipment
13-20	Optical testing arrangement	1	200	200	Optical lenses, etc.,; covers synthesis of colours
13-21	Acoustic testing arrangement	1	200	200	Resonance, tuning fork, etc.
	o Exhibits				
13-22	Structural model of molecule	10	200	2,000	
13-23	Electron configuration model of atomic structure	10	100	1,000	
	Total			17,170 Thousand Yen	US$56,480.-

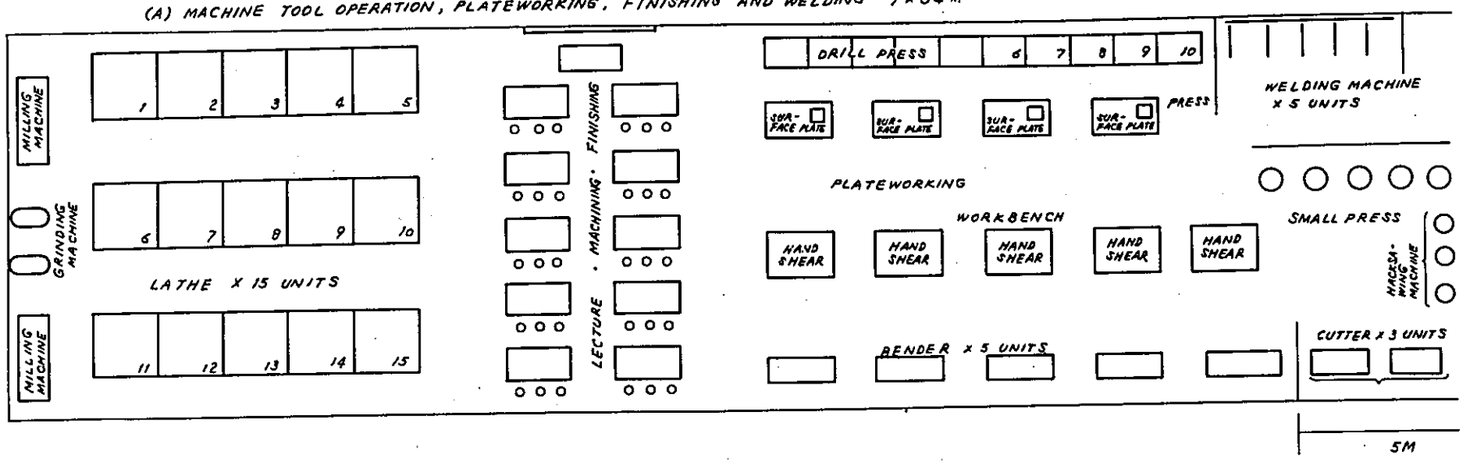
ROOMS AND EQUIPMENT LAYOUT


1. DRAWING
9 x 21 m²
9 x 6 m²
STORE
DARK ROOM
MORE THAN 1 mt
DRAFTER x 32 UNITS
4x8 =32
PRO-JEC-TOR
1
2
3
4
5
6
7
8
WASH-BASIN
DESK
COPY TABLE
PREPARATORY ROOM

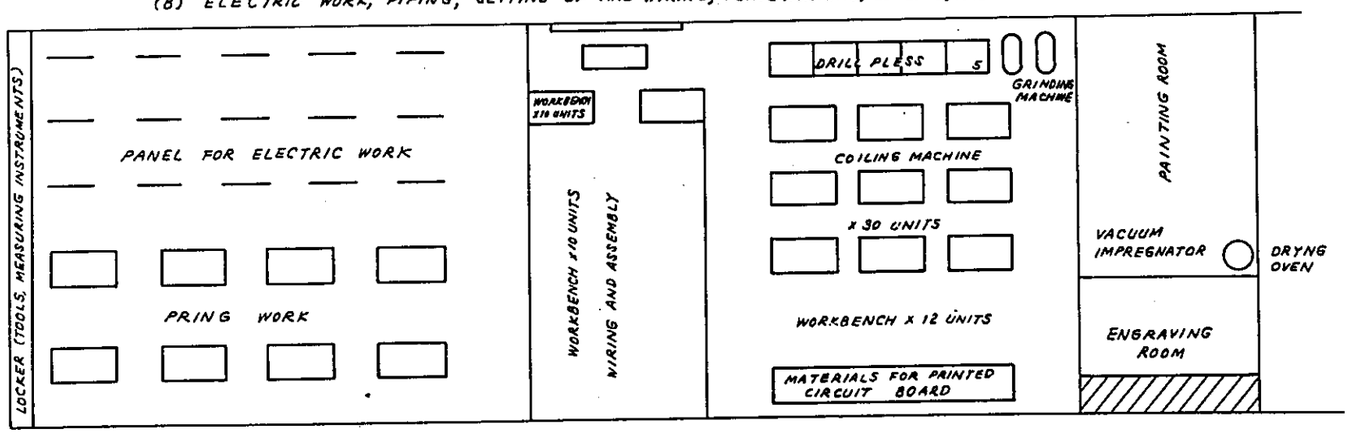

SKETCH ROOM
7 x 12 m²
PREPARATORY ROOM
9x6 m
B
WASH-BASIN
1
2
3
4
5
STORE
PRO-JEC-TOR
PRO-JEC-TOR
SAME AS A
COPY TABLE

2. WORKMANSHIP I

(A) MACHINE TOOL OPERATION, PLATEWORKING, FINISHING AND WELDING 9×34 m²

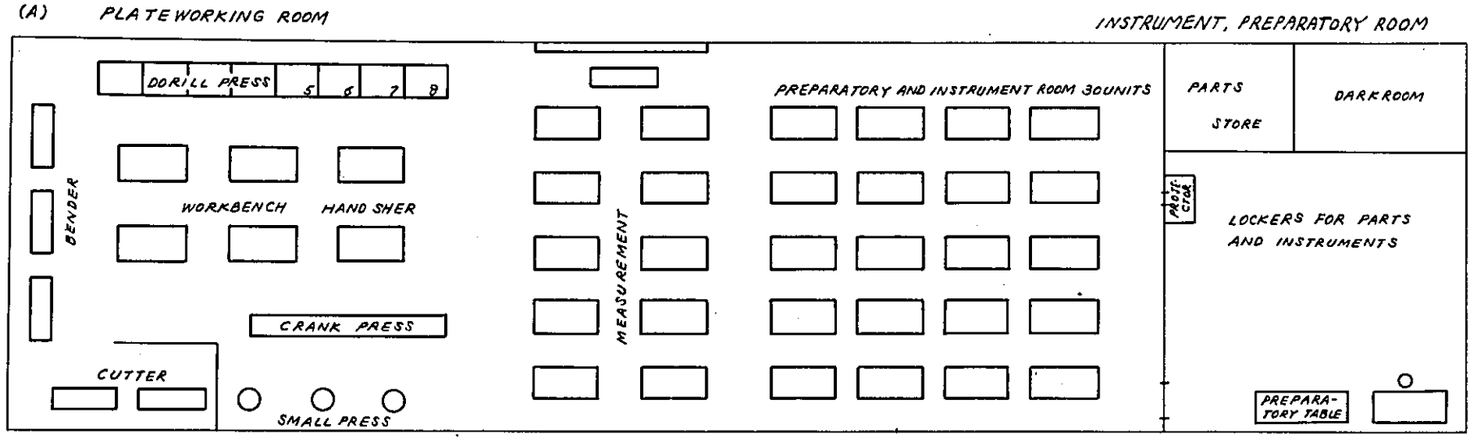


(B) ELECTRIC WORK, PIPING, SETTING UP AND WIRING, PLATEWORKING, COILING, AND PAINTING

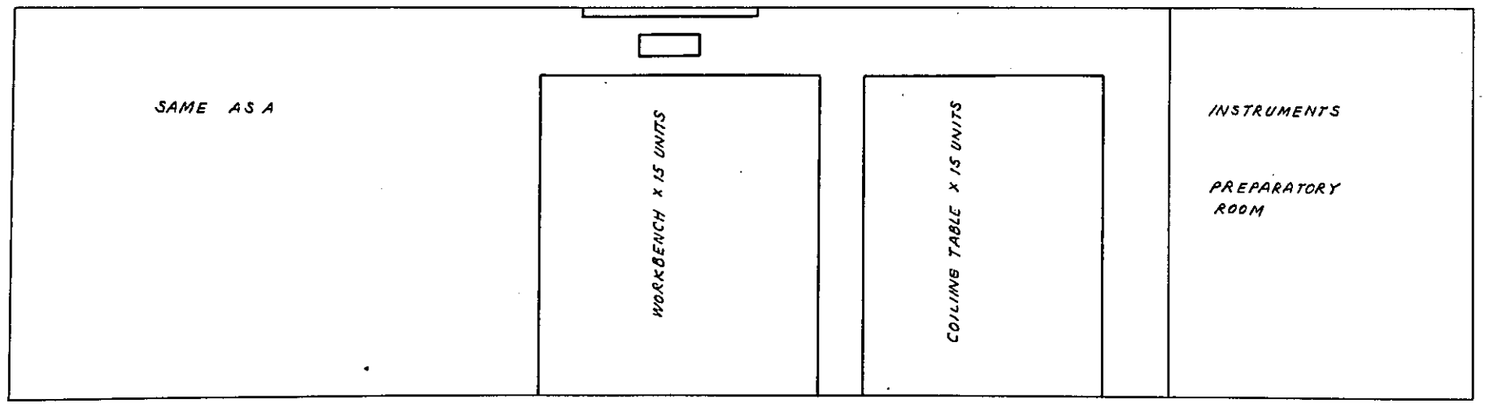


3 WORKMANSHIP II

(A) PLATEWORKING ROOM

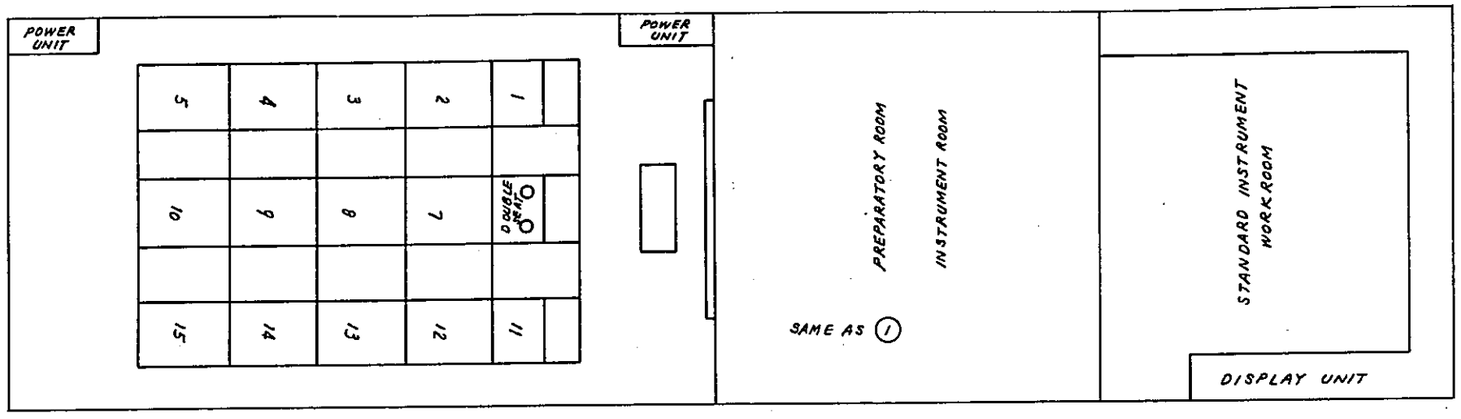


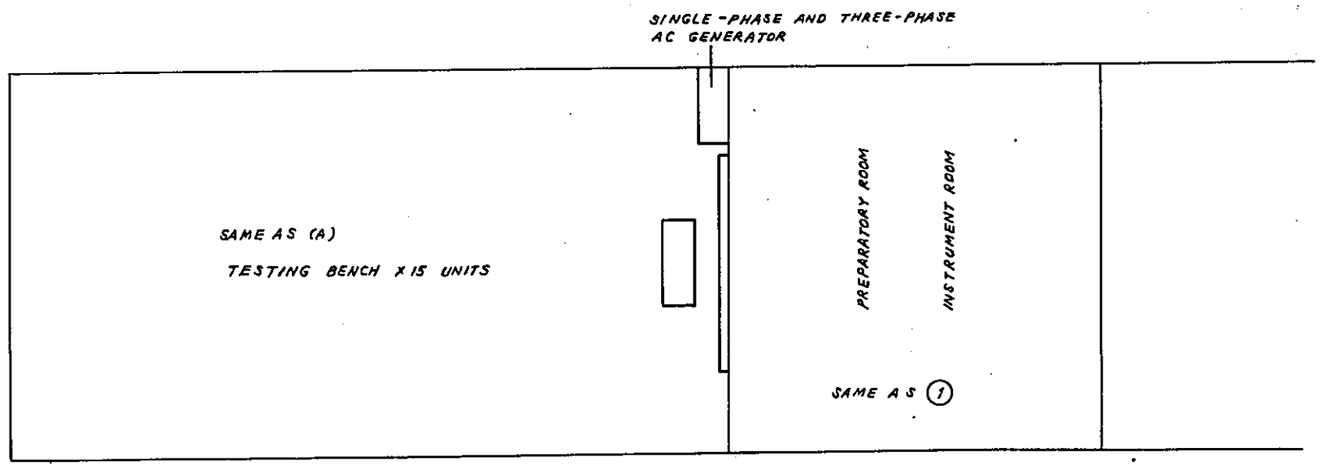
(B) PLATE WORKING ROOM



4. ELECTRONIC 1

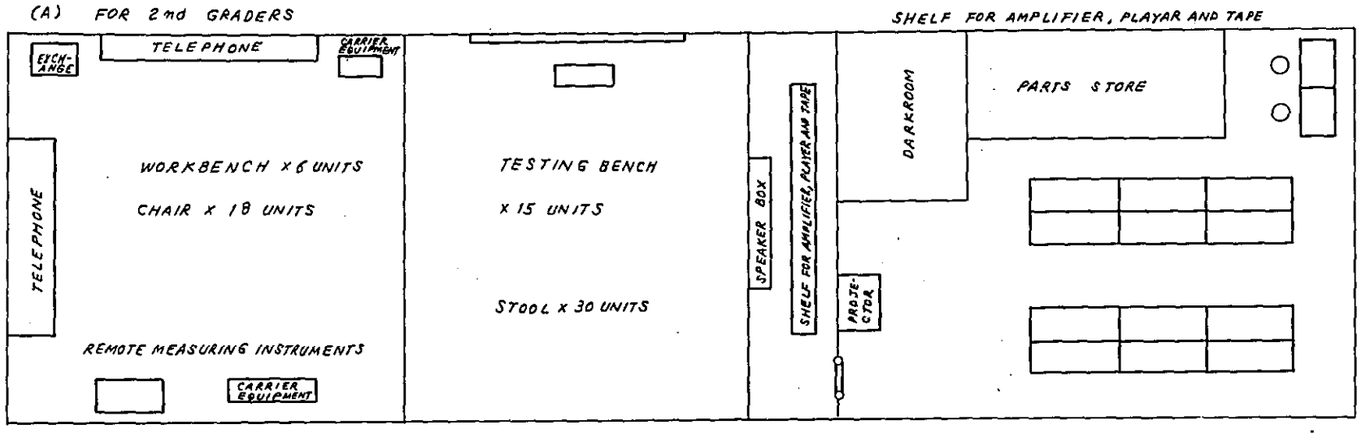
(A) FOR 1ST GRADERS : DC CIRCUITS, MAGNETIC CIRCUITS, STATIC ELECTRICITY



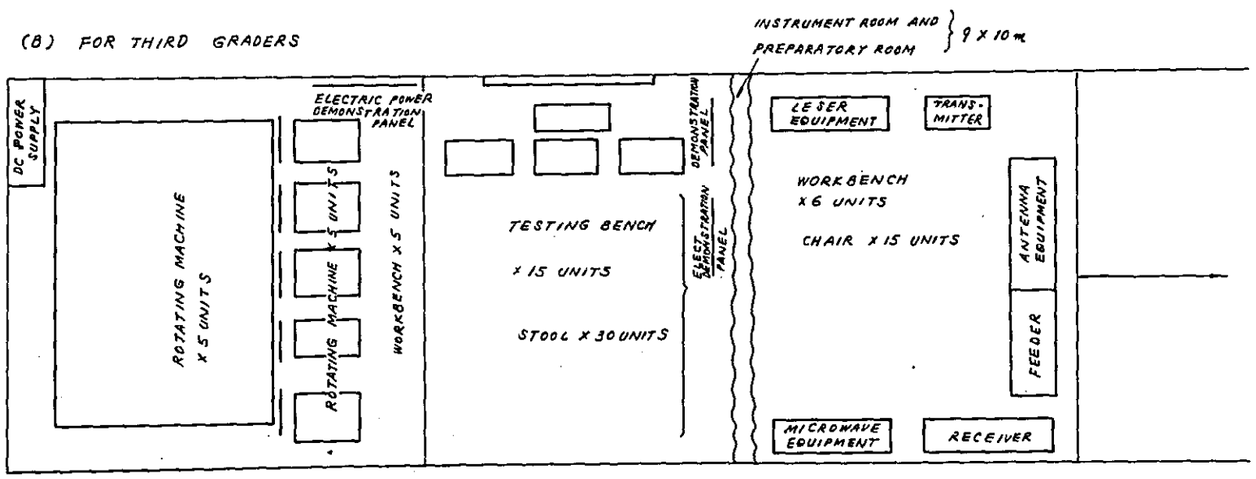


5 ELECTRONIC II

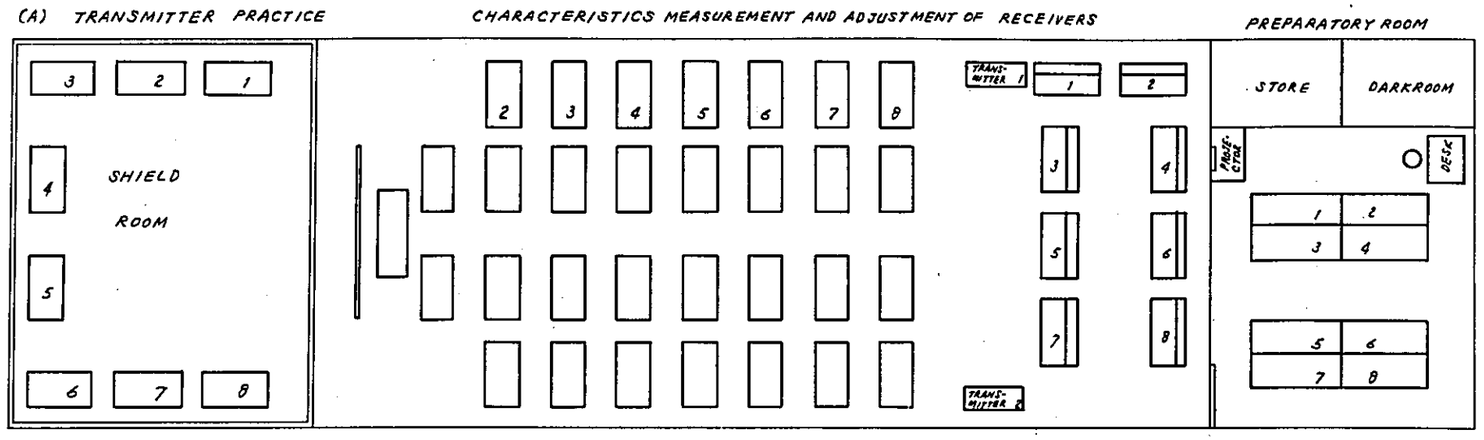
(A) FOR 2nd GRADERS



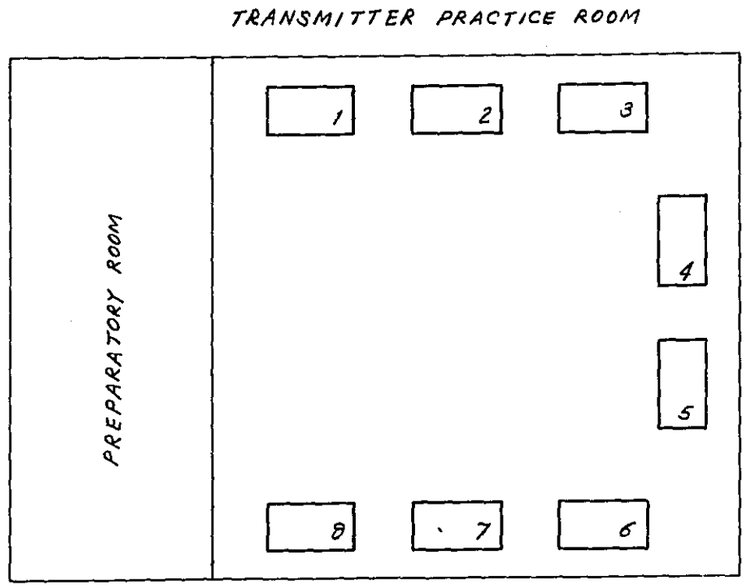
(B) FOR THIRD GRADERS



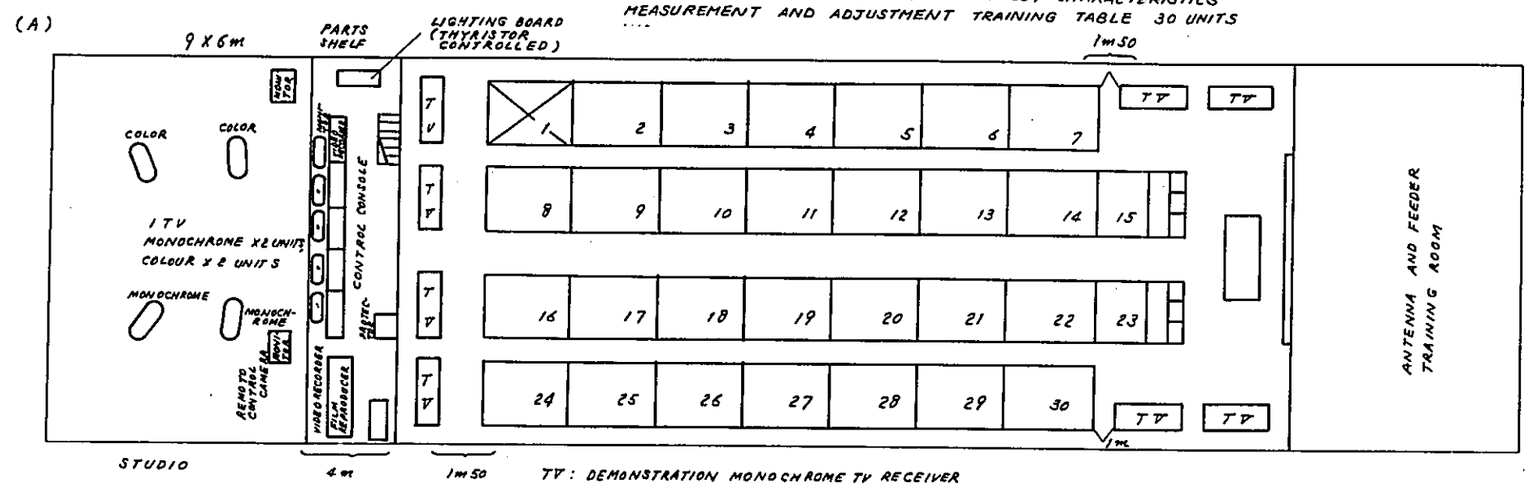
7 RADIO ENGINEERING



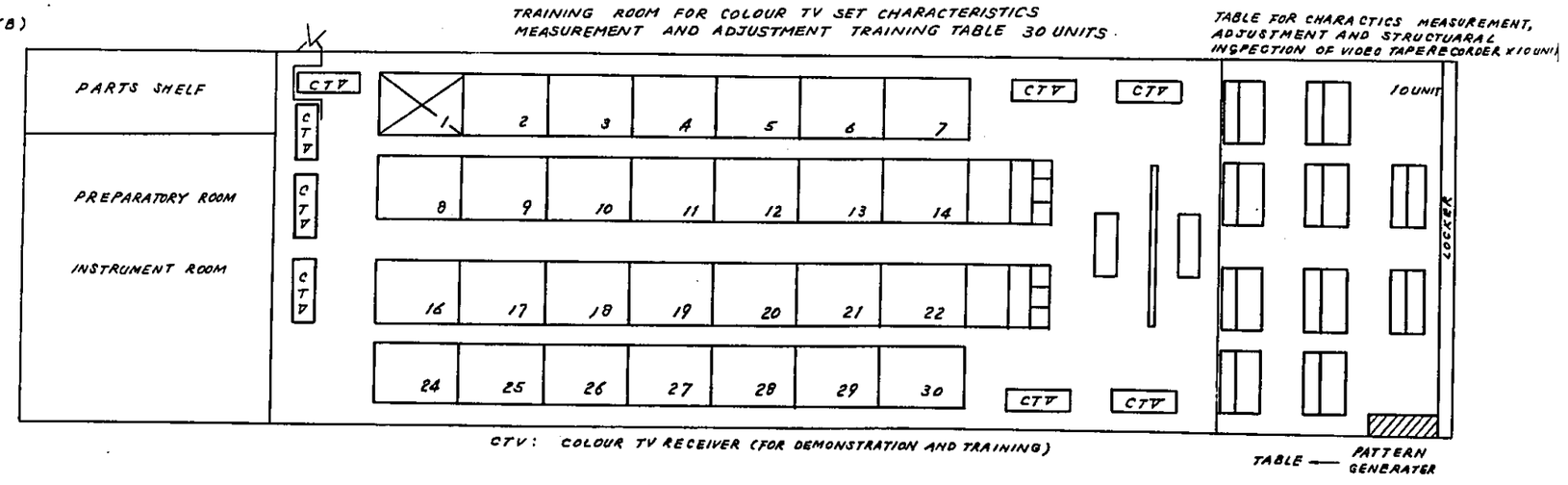
7

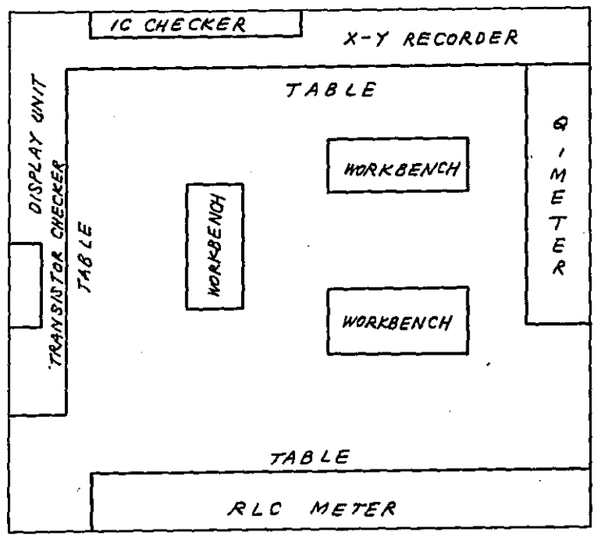


(A)


TRAINING ROOM FOR MONOCHROM TV SET CHARACTERISTICS MEASUREMENT AND ADJUSTMENT TRAINING TABLE 30 UNITS
9 X 6m
PARTS SHELF
LIGHTING BOARD (THYRISTOR CONTROLLED)
1m50
COLOR
COLOR
1 TV
MONOCHROME X2 UNITS
COLOUR X 2 UNITS
MONOCHROME
MONOCHROME
CONTROL CONSOLE
MIXER
VIDEO RECORDER
FILM REPRODUCER
REMOTO CONTROL CAMERA
TV
1 2 3 4 5 6 7
8 9 10 11 12 13 14 15
16 17 18 19 20 21 22 23
24 25 26 27 28 29 30
ANTENNA AND FEEDER TRAINING ROOM
STUDIO
4m
1m50
1m
TV : DEMONSTRATION MONOCHROME TV RECEIVER

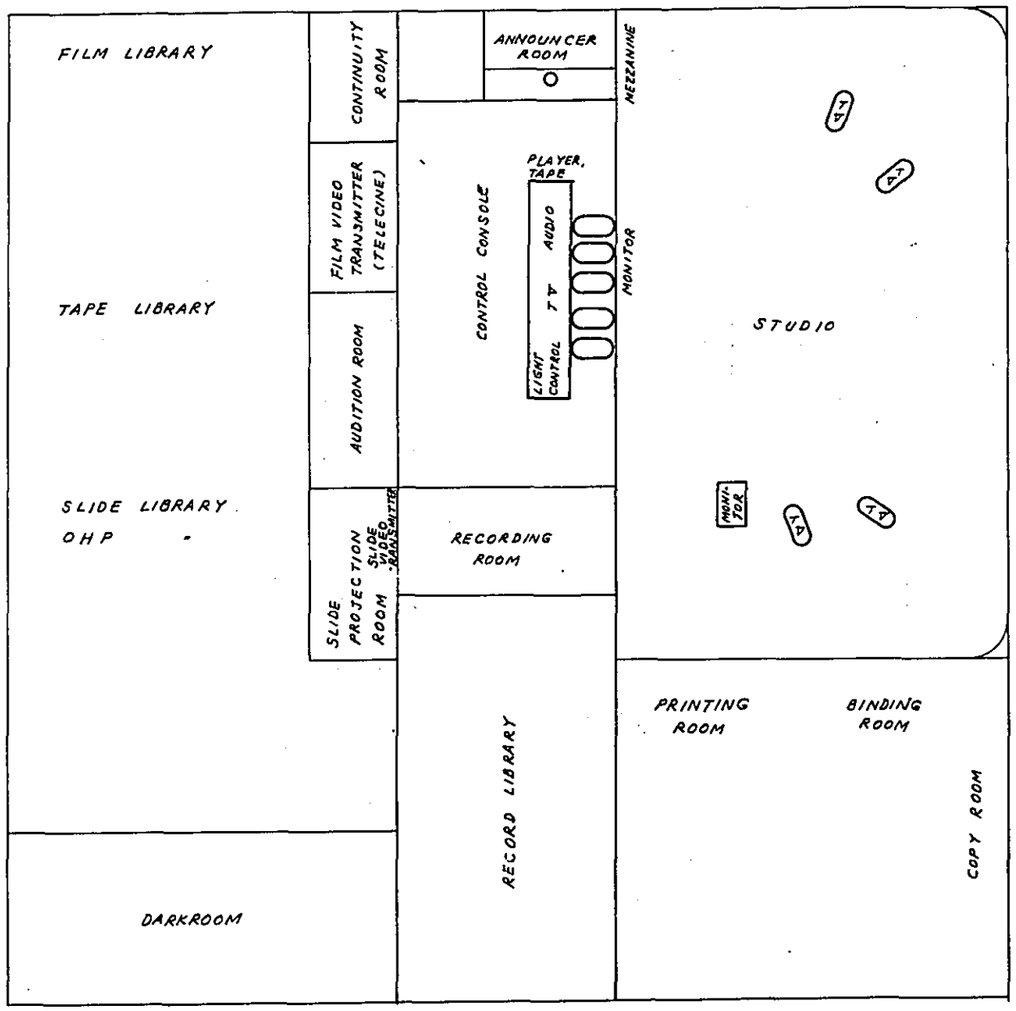
(B)


TRAINING ROOM FOR COLOUR TV SET CHARACTERISTICS MEASUREMENT AND ADJUSTMENT TRAINING TABLE 30 UNITS
TABLE FOR CHARACTICS MEASUREMENT, ADJUSTMENT AND STRUCTUARAL INSPECTION OF VIDEO TAPERECORDER X10UNIT
PARTS SHELF
PREPARATORY ROOM
INSTRUMENT ROOM
CTV
1 2 3 4 5 6 7
8 9 10 11 12 13 14
16 17 18 19 20 21 22
24 25 26 27 28 29 30
10UNIT
LOCKER
TABLE
PATTERN GENERATER
CTV : COLOUR TV RECEIVER (FOR DEMONSTRATION AND TRAINING)



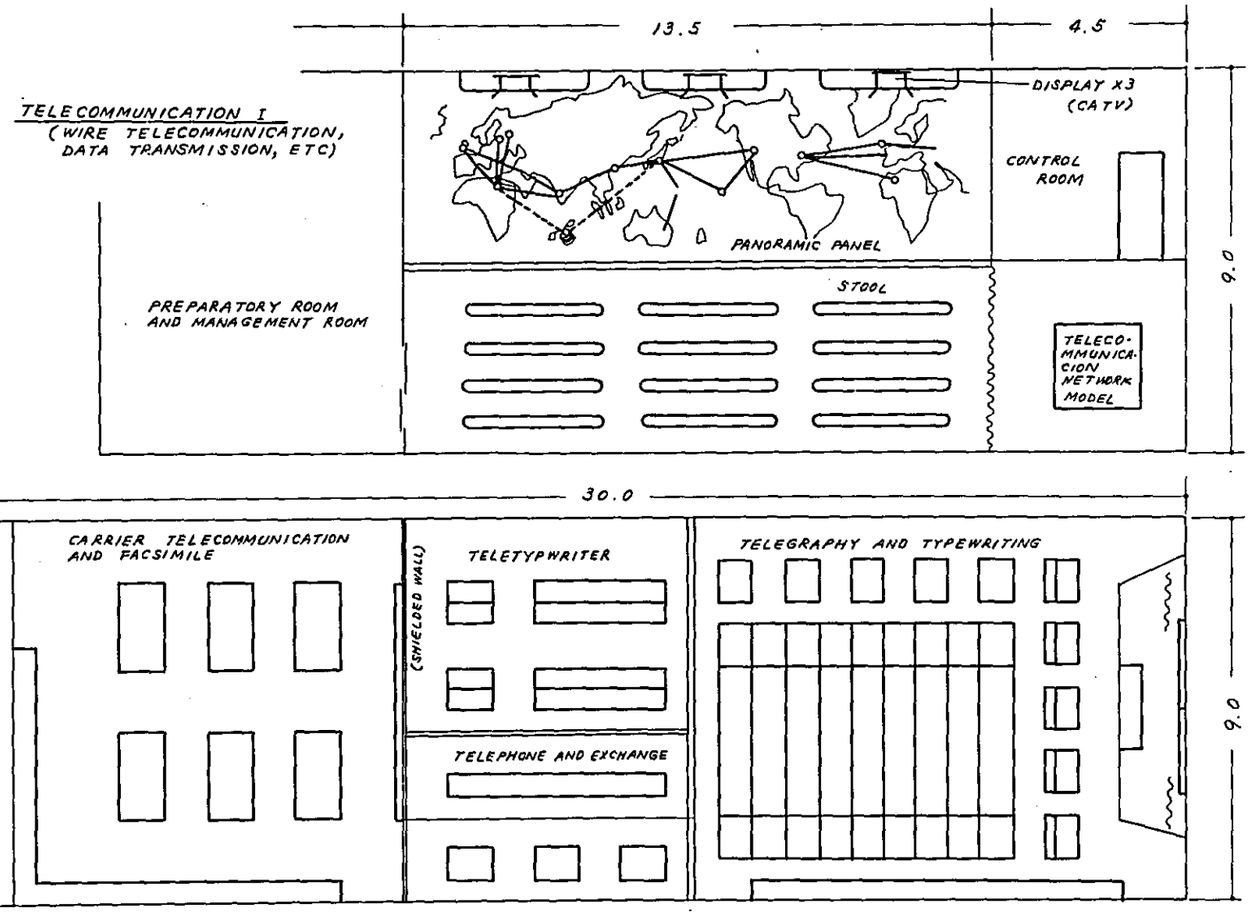
ELEMENT MEASURING ROOM

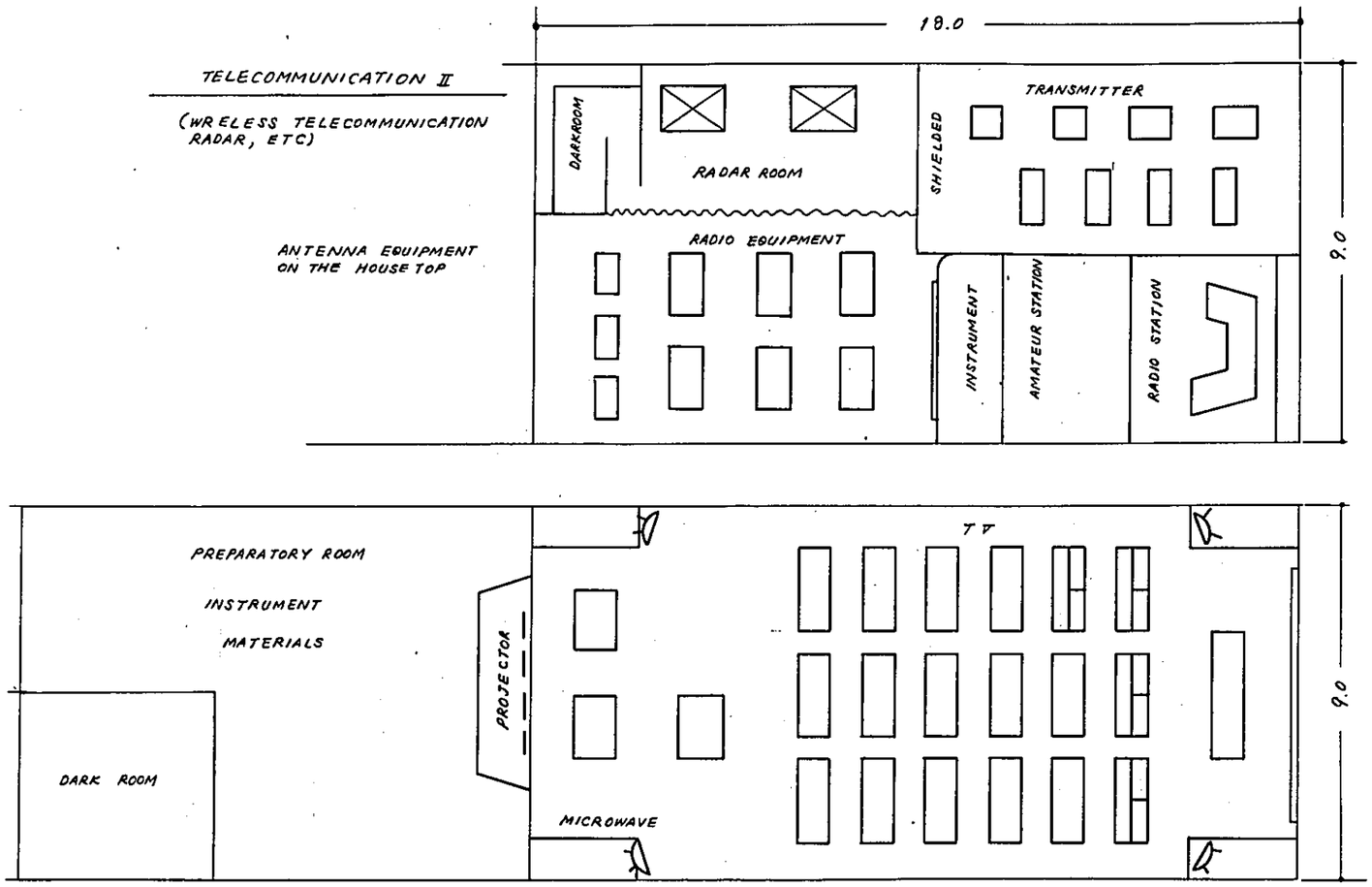
12



TEACHING MATERIALS CENTER

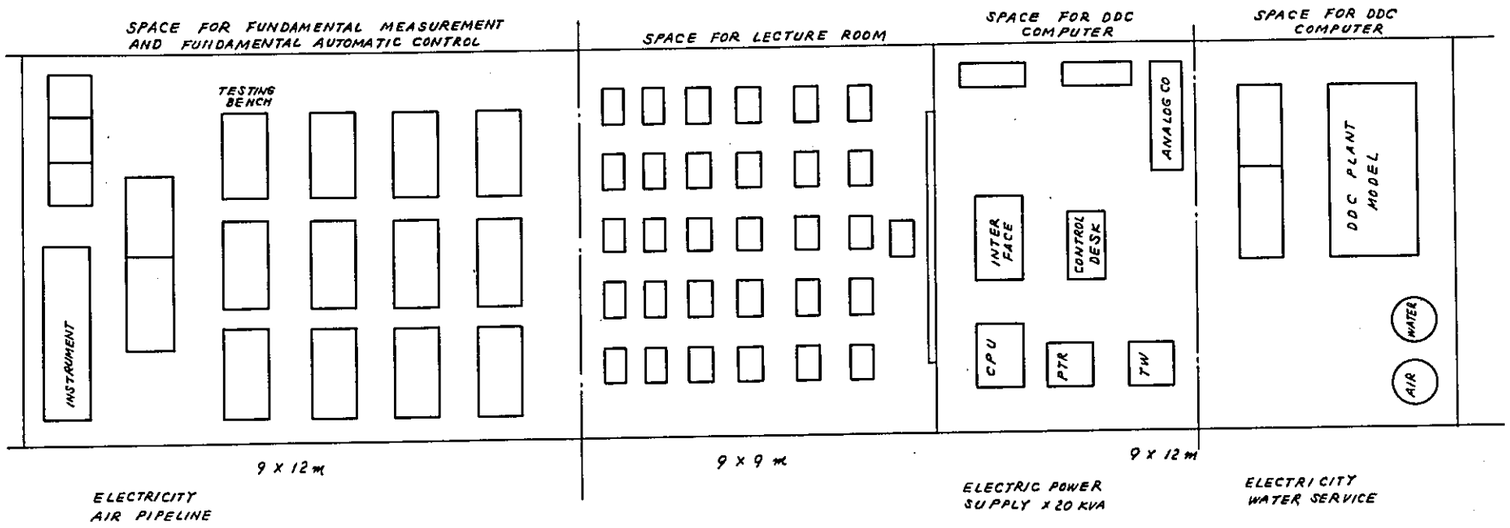
- WIRE TELECOMMUNICATION FACILITIES TO TRANSMIT VIDEO SIGNALS TO EACH CLASSROOM.
- LIBRARY
- PRINTING AND COPYING
- PREPARATION OF MATERIALS IN GENERAL


13.5
4.5
TELECOMMUNICATION I
(WIRE TELECOMMUNICATION, DATA TRANSMISSION, ETC)
DISPLAY X3 (CATV)
CONTROL ROOM
PANORAMIC PANEL
STOOL
PREPARATORY ROOM AND MANAGEMENT ROOM
TELECOMMUNICATION NETWORK MODEL
9.0
30.0
INSTRUMENTS
DATA TRANSMISSION
CARRIER TELECOMMUNICATION AND FACSIMILE
(SHIELDED WALL)
TELETYPWRITER
TELEPHONE AND EXCHANGE
TELEGRAPHY AND TYPEWRITING
9.0


18.0
TELECOMMUNICATION II
(WRELESS TELECOMMUNICATION RADAR, ETC)
DARKROOM
RADAR ROOM
SHIELDED
TRANSMITTER
RADIO EQUIPMENT
ANTENNA EQUIPMENT ON THE HOUSE TOP
INSTRAUMENT
AMATEUR STATION
RADIO STATION
9.0
PREPARATORY ROOM
INSTRUMENT
MATERIALS
PROJECTOR
TV
DARK ROOM
MICROWAVE
9.0

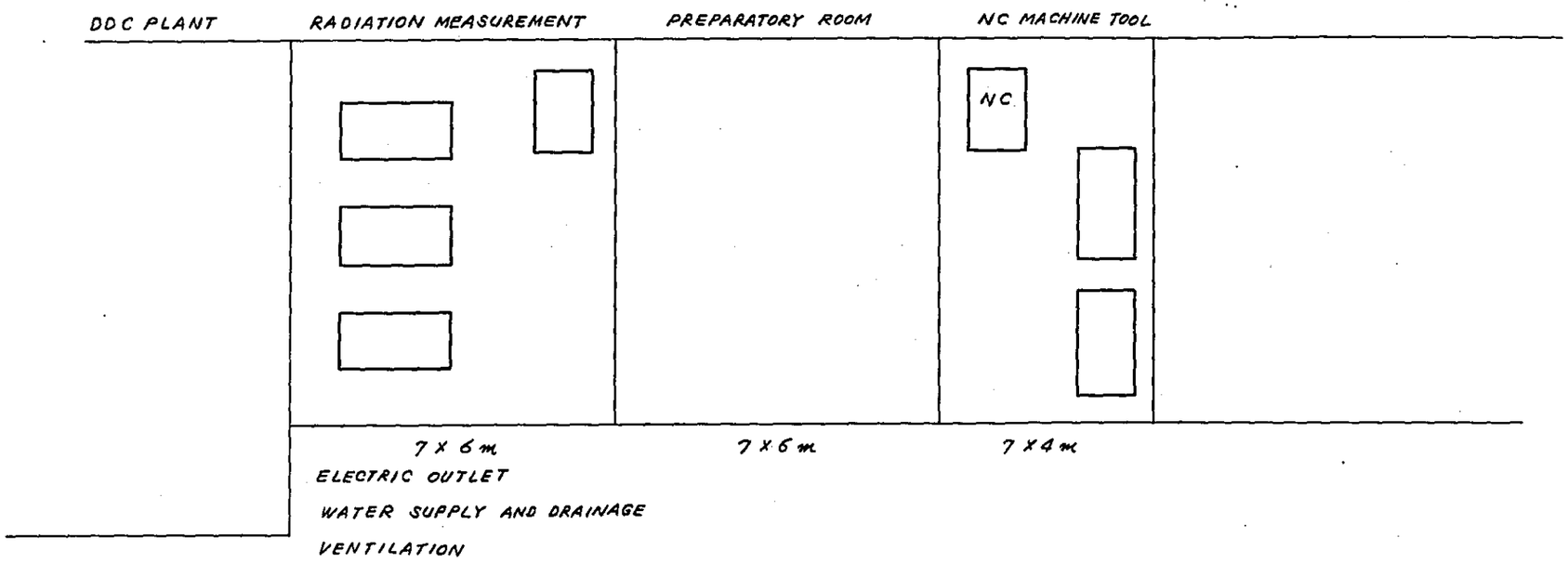
ELECTRONIC INSTRUMENTATION ENGINEERING : TRAINING ROOM (1)

297 m²



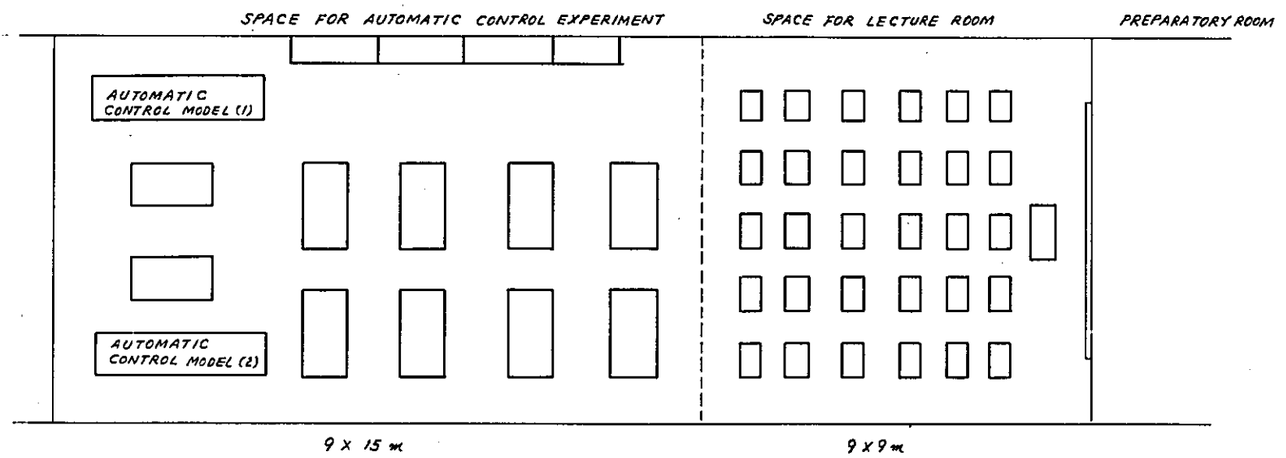
ELECTRONIC INSTRUMENTATION ENGINEERING : TRANING ROOM (2)

70 m² + PREPARATORY ROOM 42 m²



ELECTRONICS III :
TRANING ROOM (1)

216 m²



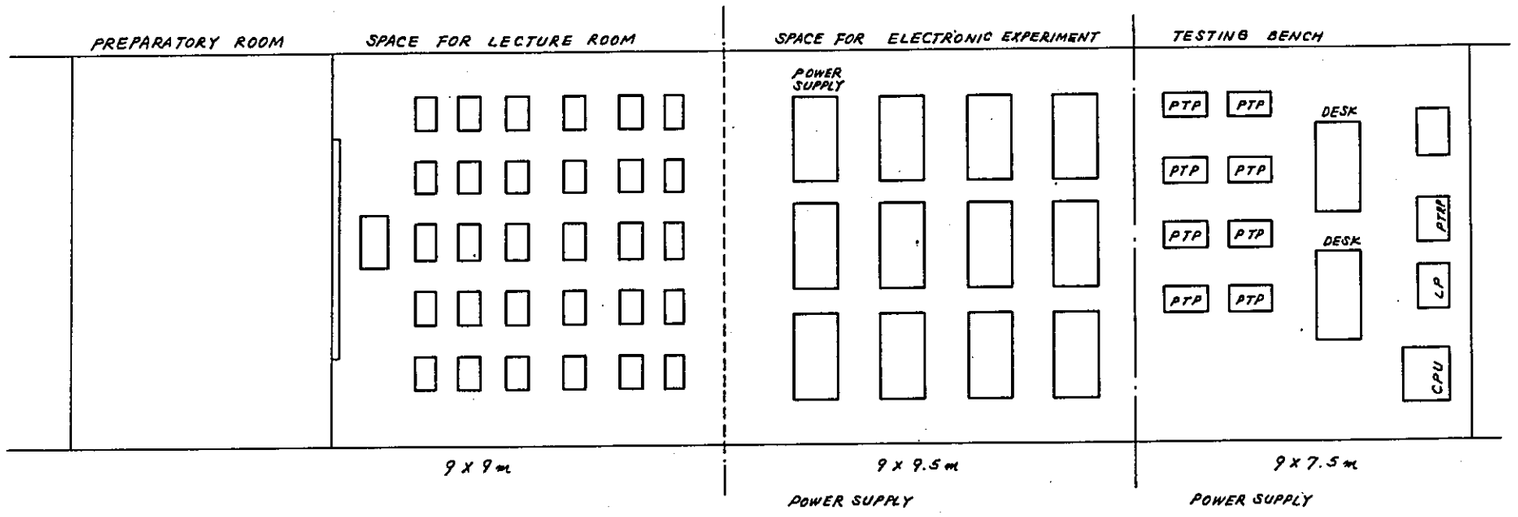
POWER SUPPLY : TO EACH OF TESTING BENCHES AND AUTOMATIC CONTROL MODELS

WATER SUPPLY AND SRAINAGE : TO AUTOMATIC CONTROL MODEL (2)

HYDRAULIC OIL PIPING.

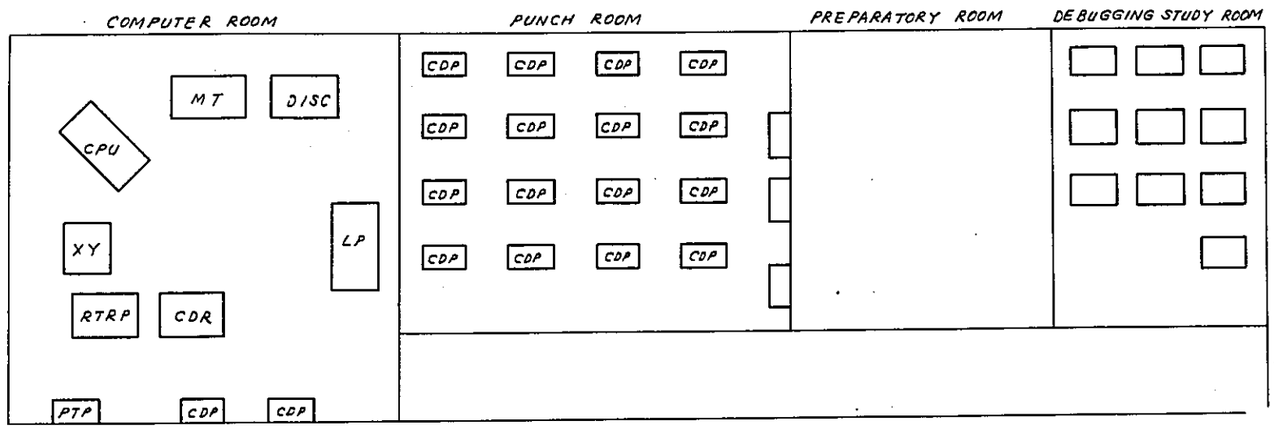
ELECTRONICS III :
TRAINING ROOM (2)

234 m² + PREPARATORY ROOM



COMPUTER ROOM

186m² + PREPARATORY ROOM (42m²)



COMMPUTER ROOM (9×9m)

POWER : SUPPLY : 20KVA

LOAD : INCL. A UNIT WEIGHING 500kg

PUNCH ROOM (7×9m)

POWER SUPPLY : 10KVA (0.6KVA/UNIT)

HEAT DISPPATION : SEVERAL THOUSAND KCAL/h

PREPARATORY ROOM (7×6m)

OUTLET × 3 CIRCUIT

DEBUGGING ROOM (7×6m)

DATA FILLING DESK

OUTLET × 2 CIRCUITS

HEAT DISSIPATION : MORE THAN 10,000 KCAL/hr

CONVENIENCE OUTLET FOR MAINTENANCE

SERVICE : 1 CIRCUIT FOR EXCLUSIVE USE