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3 June 1988
ENGLISH

STRENGTHENING THE ROYAL DRUG RESEARCH LABORATORY

DP/NEP/80/003
NEPAL

Technical Report: Laboratory Instruments Maintenance*

Prepared for the Government of Nepal
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Mr. S.K. Suri
Expert in Instrument Maintenance

Backstopping Officer: R.O.B. Wijesekera,
Chemical Industries Branch

United Nations Industrial Development Organization
Vienna

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V.88-25314

CONTENTS

INTRODUCTION

The Royal Drug Research Laboratory, Kathmandu,Nepal had in operation, a Unido Project since 1983 for strengthening its capability to generate the research and technology for the production of pharamaecuticals from medicinal plants. Under this project, it has acquired sophisticated research, production and testing instruments and equipments of recent origin and manufactured in Western Europe and USA. The research equipment which has been in operation for many years now, has been developing faults partly due to normal use and partly due to the unsatisfactory mains supply. Since there are no agents of manufacturers in this country and not much help was available from local sources, the laboratory had to seek the help of the manufacturers representatives or independent commercial facilities in India or Singapore. This entailed expense and long waits.

It was therefore decided to create a capability within the laboratory to upgrade the knowledge of the staff operating this equipment and to give them training in the fault analysis and remedial action at least in simple problems and to set up a schedule of preventive maintenance for all equipment used for this work and which included equipment acquired earlier by the laboratory's own resource, some of which was ageing and needed expert maintenance attention and/or technical inspection to recommend its discarding, where necessary.

Objectives

The objective of this mission was to train the staff attached to the Instrument Section where all the major analytical instruments are housed, in the repair and maintenance of sophisticated instruments used in Drug Research such as Nuclear Magnetic Resonance, Infra red, Ultraviolet and Visible range Spectrophotometers, Gas-liquid chromatography instruments etc. and to set up preventive maintenance schedule, so that the equipment continues to work to the maximum extent possible.

WORK PLAN

Arrival Friday January 15, 1988

(Weekly Holiday, Saturday, January 16)

Week 1 — January 17 - 22 January

To take stock of Test Equipment and Spare parts already received. To collect manuals for installed Apparatus and study them.

Week 2 — January 24 - 29 January

To start the first commissioning of the Test equipment already arrived i.e. Frequency Counter, Function Generator, Oscillosocope, L.C.R. Meter, Integrated Circuit Pulser, I.C. Probe, Multimeters etc.

Week 3 — January 31 - February 5

Lists of supplies required and the above activity continued.

Week 4 to 11 — February 7 - April 1

Teaching work 3 times a week, on

1. Electronic Fundamentals
2. Methods of measurements
3. Test Instruments and their application
4. Tranducers
5. Principles of Instruments of Analysis
6. Defect Diagnosis in Instruments and practical work on out of order Instruments.

Week 12 to 16 — April 3 - May 6

Practical work on circuitry.

Week 17 — May 8 - May 13

Writing of report and discussions.

Week — May 15 Departure (Sunday)

Activities & Findings

To start a realistic programme of training and to work out a maintenance schedule for the existing instruments, information was collected on all laboratory apparatus both supplied under this Project from time to time and what ever was acquired earlier. This is tabulated in Annexe II, where the country of manufacture and date of installation is also given. The latter information is necessary as measuring instruments become obsolute earlier than others due to advances in technology which leads to better accuracies ease in operation and larger data-acquiring capability. These also become un-repairable when critical sparesare no longer available.

Visits were made within the laboratory to collect information on non-working instruments and equipments and whether service manuals were available, in cases where they were necessary for repair.

Visits was also made to other centres like RONAST. (Royal Nepal Academy for Science & Technology) who had started a small instrumentation unit primarily as an aid to teaching and to the upcoming Institute for Standards, Metrology under Unido Project No. 84/031 whose equipment has yet to arrive but who will need a similar service, sooner or later.

The Physics Dept. of the Tribhuvan University was also visited with a view to see if any recent catalogues or technical books on Instrumentation, Electronics and data books were available. The laboratories of the Bureau of mines and Geology were also visited.

The objectives of this mission as given in the job description, Annexe - I are to train the local staff in the repair, maintenance of electronic

equipment and to set up maintenance schedule for all equipments and recommend measures to be taken to keep this laboratory equipment in working order. Since all instruments are not electronic in nature although many of them use electronics for control purposes and keeping in view that the staff of 4 persons attached to the instrument section were primarily (see Annexe III) chemists and only one of them had a general mechanics background, it was considered advisable to mix theory and practice. Accordingly a programme of lectures were devised to include basic electronics and instrumentation principles on thrice-a-week basis and to use the out-of-order instruments to give demonstrations of repair and to illustrate the various sub-components such as meters, sensors, relays photocells, contact thermometers, voltage dependent and light dependent devices which the staff had not seen or used before independently. This was to give them confidence in their handling and use.

An outline of the course content is given in Annexe X.

By the time, this programme of work was over, the staff had developed sufficient confidence to open up the defective apparatus, study the circuit diagram and operating principle & proceed to analyse the fault by co-relating the two.

The Expert had noticed at this laboratory that when they needed services assistance and wrote to the agents for the instruments in India or elsewhere the Agents wrote back suggesting certain measurements to be made in the circuit and readings of voltages and currents at certain test points to be sent back to them. Even for this the laboratory had to locate some one out side its own staff to do this preliminary work.

As a result of the present training they can do this work and even more themselves and save a service call altogether or at least save a considerable amount of time if a call by the service engineer becomes necessary due to the critical nature of the fault or non-availability of specific components.

It was noticed that an average service call costs about Rs.6,000/- and it took almost six months. Also noticed were advertisements from other laboratories requesting for any technician to come and repair tneir apparatus, in the daily newspaper. This points to the need for a central facility which could help many laboratories in Kathmandu

Recommendations

1. A list of additional test equipment and spares has been drawn up, considering the limited but varied need of this laboratory. The indent for these has been prepared & forwarded to Unido. These should be procured as soon as possible.

2. The available furniture which was meant for chemical work associated with microbiology is unsuited for Instrumentation work. These table are too narrow and also too high. The blue print of a proper 3-level work table is provided in the Annexe II. These tables can be made in the local market and steps should be taken to get them made as soon as practicable.

3. Instruments over 10 years old become too expensive to repair and a stage arrives when it is better that they are phased out-whether a replacement is available immediately or not due to budget constraints etc. since they waste valuable space and are a drain on the resources of the laboratory. Such instruments have been pointed out to the authorities.

4. At least 2 persons of the Instrument Staff will benefit from periodic upgrading of their training in Instrumentation in more developed countries like India and they should be encouraged to participate in seminars on instrumentation.

5. A nucleus of technical books has been suggested in the report . This will be helpful in learning the principles of newer technology instruments that the laboratory will be acquiring in future and also in fault analysis. These books should be obtained as well as data sheets which give the designers recommendations for use in circuitey. These are different from data books which are meant for general components. An arrangement should be made with the supplier companies to keep receiving them in future also.

6. Considering the fact that there are on-going projects in Kathmandu of other UN agencies and the projects already ended which have a large complement of sophisticated instruments, as in the Bureau of Mines & Geology or the on-going project of Unido on standards, or the complex of Agriculturals Laboratories - Kathmandu there is need for a separate & a bigger common centre which can attend to the day-to-day problems of a variety of instruments, including medical, for their laboratory instrument's maintenance work. Whatever facilities exist as present, if at all, such as those at the Royal Drug Research Laboratory after the implementation of these recommendations, are barely adequate for these instruments & they have hardly any spare capacity. The Expert can advise further on this matter, if so desired, since he has done so before in many other developing countries and most recently as the CTA of a 1.3 million Dollar Instrument Maintenance Project in Hanoi.

Acknowledgements

The Expert wishes to acknowledge the congenial work atmosphere provided by the Director General Dr. S. B. Malla,for his work and access to all facilities available in the laboratory.

He also wishes to thank Dr. S. R. Adhikari, Dr. Binod Acharya, Mr. D. M. Shakya, Mr. D. R. Shakya and Mrs. Har Devi Shrestha for the close cooperation given to him in course of his lecture & training work & for arranging visits to other institutions whenever requested.

The support given by Mr. G. M. Malla, administrative assistant of the project by maintaining liason with UNDP is also acknowledged. At the UNDP office, Miss I. Lasson was always available to sort out any problems.

Annexe I
R. Wijesekera/la

UNITED NATIONS

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

3 February 1986

PROJECT IN THE KINGDOM OF NEPAL

JOB DESCRIPTION

DP/NEP/80/003/11-55

Post title	Instrument Maintenance Engineer.
Duration	4 months,
Date required	January 1988
Duty station	Kathmandu
Purpose of project	To enable His Majesty's Government of Nepal through the Royal Drugs Research Laboratory to acquire the necessary capability to generate the research and technology for production of pharmaceuticals from medicinal plants.
Duties	The expert will work under the supervision of the National Project Director and will be responsible for training local staff in the repair and maintenance of electronic equipment. The Royal Drugs Research Laboratory (RDRL) is a well equipped drug development laboratory containing relatively sophisticated instruments such as NMR, IR, UV, GLC, HPLC, Polygraph etc. The consultant will be required to set up maintenance schedules for all equipment and recommend measures that should be taken to keep the RDRL's equipment in sound working order. He will be required to furnish a report embodying his observations and recommendations within two weeks of completion of the mission.

..../..

Applications and communications regarding this Job Description should be sent to:
Project Personnel Recruitment Section, Industrial Operations Division,
UNIDO, VIENNA INTERNATIONAL CENTRE, P.O. Box 300, Vienna, Austria

V.81-33106

Annexe II

The following Research & Testing Equipment exists in the Laboratory. The Equipment supplied by UNDP is marked with an asterisk. The installation year is also given.

A

*1 Fourier Transform Infra red Spectrometer of Nicolet (USA) make, with computer (1984).

*2 High pressure liquid chromatograph (1983 of Water (UK) make.

3 Gas Chromatograph of Perkin Elmer (USA) make (1967)

4. Infra red spectrometer of Pye-Unicom (UK) make (1972)

5. Ultra-violet/visible spectrophotometer of Varian (USA) make (1973)

6. Gas chromatograph, Hewlett- Packard (USA) make (1976)

7. Nuclear Magnetic Resource Spectrometer of Varian (Swiss) make (1974.

8. Atomic Absorption Spectrophotometer of Hilger (UK) make (1974)

In addition to the major instruments listed above there are smaller instruments distributed over the other departments of the Laboratory such as:-

B

1. Differential Volume meter (France)

2. Ph meter (EIL-UK)

3. Single pan side loading balance (Swiss)

4. Single pan top loading balance (Swiss)

5. Experimental fermentation unit (UK)

Annexe II Contnd

6. High speed centerfuge (FRG)

7. Refrigerated centerfuge (UK)

8. Densitometer

9. Polarimeter

10. Melting point apparatus (Austrian)

11. Flame Photometer

12. Polarograph

13. Polygraph

14. Kymograph (Palmer-UK)

15. Isolated Tissue bath

16. Binocular Microscope (Japan) (Olympus - Japan)

17. Respiration pump

18. Microtome

19 Rota rod

20 Isometric Transducer

21 Temperature recorder

22 Broncospasm transducer

23 Hebb-William Maze

24. Analgasiometer

Annexe II Contnd

25. Oscilloscope

26 Swimming Test Apparatus

27 Plathysometer

28 Blood Analyser (Ames - USA)

29 Fraction Collector (LKB - Sweden)

30 Ozone Generator (Fischer - USA)

31 Disintegrator (Japan)

32 Refractometer (Abbe type, B & S, UK)

33 Temperature Controlled water bath (memmert-FRG)

34 Colony Counter (Gallen Kamp, UK)

35 Autoclave

36 Incubator (Heraus - FRG)

37 Thermostirrer

38 Double-distillation Unit

39 Projecting Microscope

C Some of the safety equipment used for research instruments is:

1. Automatic Voltage Stablisers (India made) 5 KW
2. Automatic Voltage Stabliser (Japan make) 500 watt
3. Uninterruptable Power Supply (Japan made) 500 watt.

Instrument Section Staff

1. Dr. Binod P. Acharya
   MSc, Ph. D. (Physical Chemistry)
   Training in UK & Japan

2. Mr. Dev. M. Sakya
   MSc. (Physical Chemistry)
   Trainin Bristol Poly Technic, UK

3. Mr. Dharam Ratna Shakya
   B.A.
   Training in Bristol Poly Techhic, UK

4. Mrs. Har Devi Shrestha
   MSc. (Organic Chemistry)
   Training in Singapore National University.

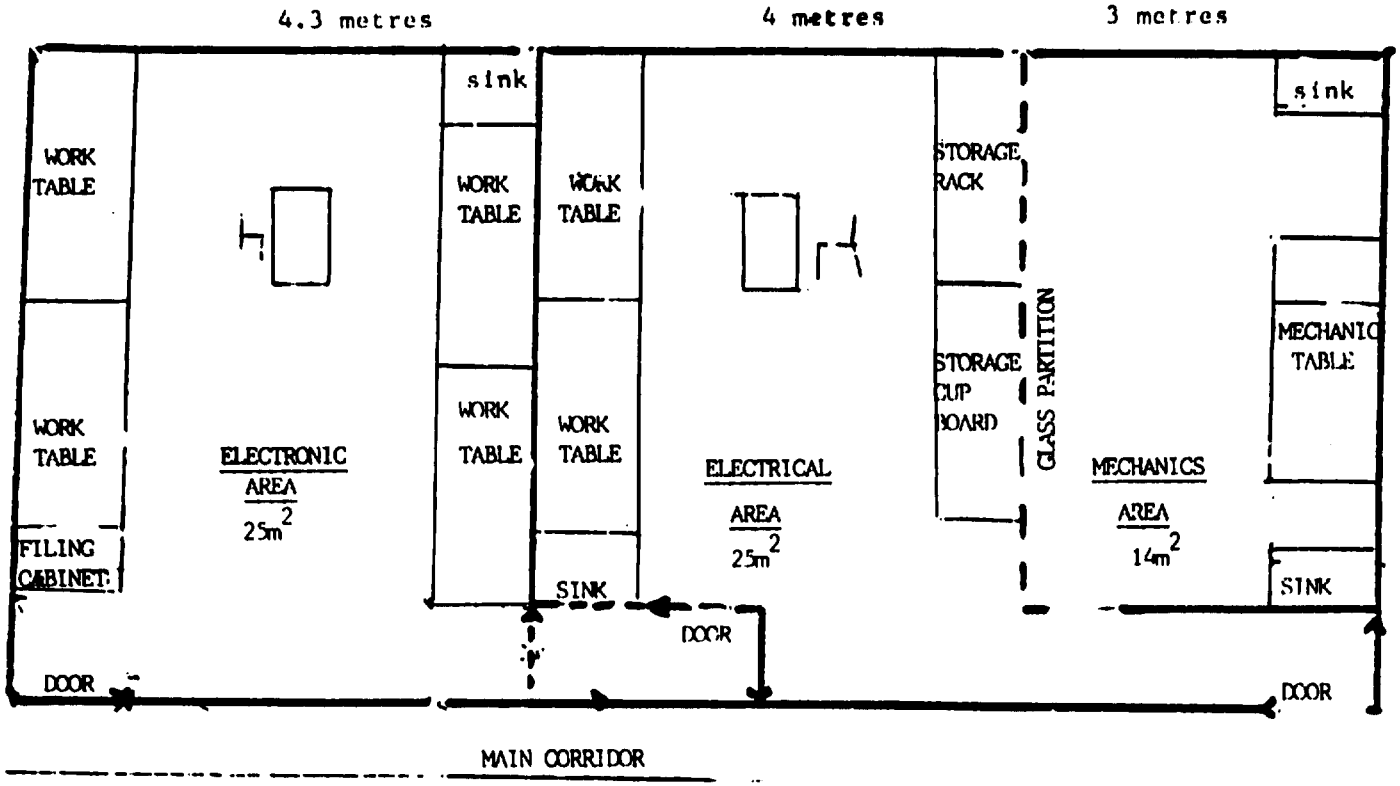
Annexe IV

LABORATORY FURNITURE (For local purchase)

S. No.	Item and Quantity	Specification
1.	Three Level Laboratory Table (x7)	as per Sketch 170 x 85 x 85 (3 cm thick) cm Top
2.	Lockable Steel Cabinets (x2)	180 x 90 x 45 cm or Nearest Standard Size
3.	Open-type steel storage racks (x2)	180 x 90 x 45 cm or Nearest Standard Size
4.	Filing Cabinet (x one piece)	4 Shelves Standard Office filing Cabinet.
5.	Instrument Trolleys x 2	2 levels with wheels Preferred size 77 x 45 x (80 cm) high
6.	Aluminium Sheet x 1	180 x 90 cm x 1mm thick x 2mm " x 3mm :

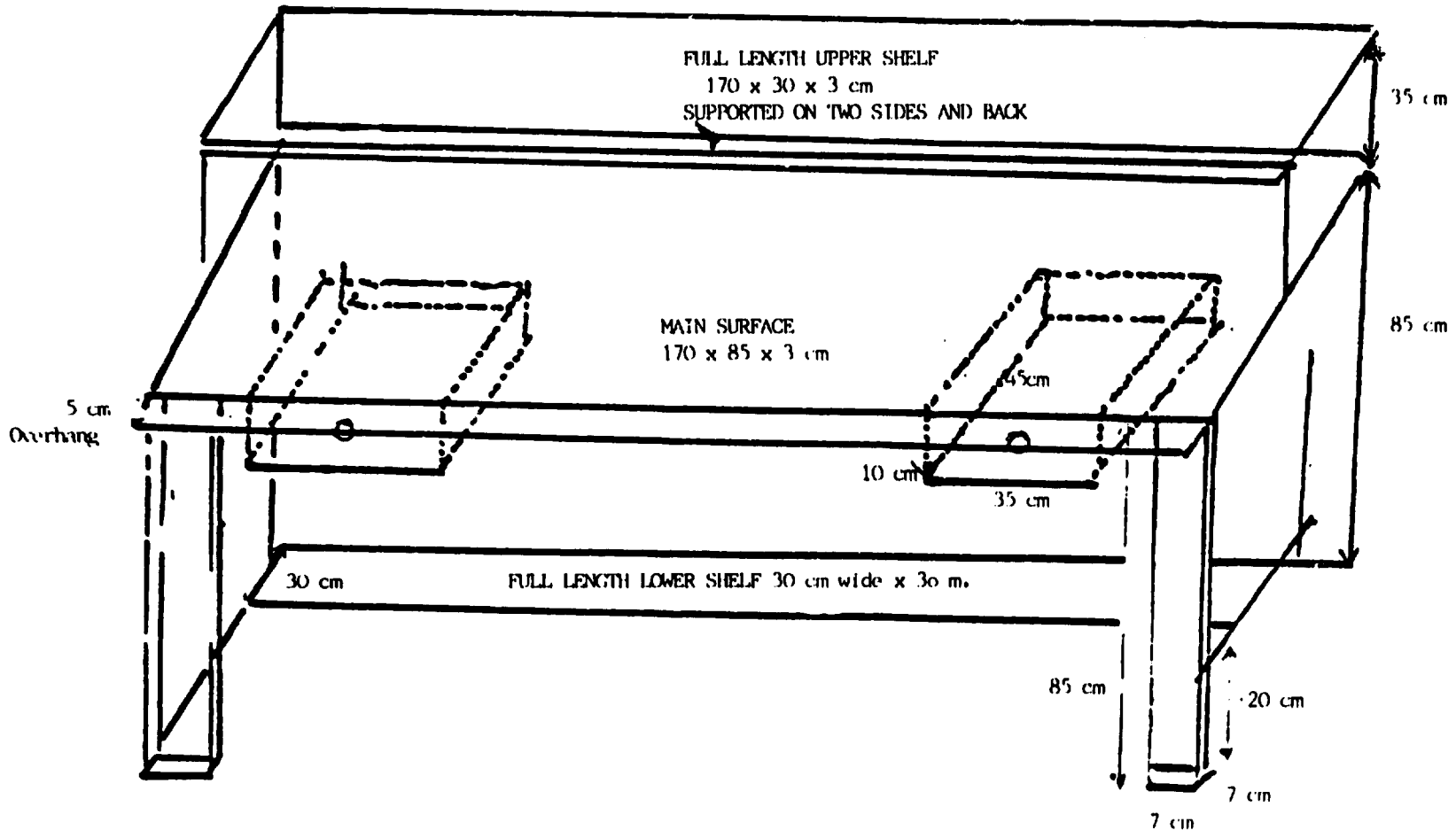
ANNEXE IV

LAY OUT OF INSTRUMENTS WORKSHOPS 64 SQ METRES



THREE LEVEL WORK TABLE

ANNEXE IV



Annexe V

The test equipment already received under this Project

1. Combined module (3 at a time are used out of 4 but they are on or off together, even when only one of them is used) (Tektronix, USA made)

   a. Oscilloscope (80 Mh 2) SC - 504
   b. Function Generator FG-504
   c. Universal Counter-Timer DC-503A
   d. Time Mark Generator TG-501

2. Oscilloscope (100 Mh 2) No. 2236 (Tektronix - USA made)

3. L. C. R. Meter 4261-A (Hewlett - Packan - USA

4. Data Analyser 308 (Sony - Tektronix - Japan)

5. Logic Probe 545A, logic pulser 546A, current trance 547A (H. P. USA made)

6. Auto Transformer- 8A

7. Multimeter (Metrawatt - FRG)

Annexe VI

Additional Test Equipment Required

S. No	Name & Quantity	Specifications
1.	R. F. Signal Generator one piece	10 Kcps to 40 MHz or better 400 cps A. M. modulation with depth control; output impedance 50 ohms; 220 Volt AC input. Philips make or Hewlett Packard.
2.	Audio Frequency Oscillator one piece	Sine wave out put Frequency variable from 100 cycles per sec to 20 Kcps. max output 10 volts- output control attenuator like: Philips made or Hewlett Packard or Marconi 220 Volt A.C. input
3.	Meter Calibrator one piece	DC current max 5 Amps AC current max 5 Amps Accuracy 0.1 % with calibrated output control: Like Hewlett-Packard HP 200 CD or Philips PM 5107 or General Radio or Marconi TF 2103 220 Volt AC Input
4.	Megger: (Trade Mark(or Portable, Insulation Tester one piece	Test voltage 500 V DC 1000 V DC Hand Generated or portable Electronic Supply To measure upto 2000 Meg ohm like Evershed Vignoles (UK)

Annexe VI Contnd

5.	Clip - on Type AC current/Power meter one piece	Current range 3 Amp AC to 300 Amps AC Voltage range AC 150 Volts to 600 Volts like Yokogawa 2433-11 or KEW model 8
6.	DC Power Supply for I.C.s one piece	Dual Power Supply - variable positive and negative DC five volts or fifteen volts Voltage Stability ɔ.ol % like Tektronix 503-A or Hewlett Packard 6206

Annexe VII

Electronic Workshop Equipment

S.No.	Item and Quantity	Specification
1.	Soldering gun (x 2) Spade tips (x 5)	220 Volt AC
2.	Soldering paste (x 5 jars) 150 gm each	non corrosive for electrical work
3.	Solder wire spool (x 5) 500 gm spool	60/40 Alloy for electrical work melting point 180° C SWG-18
4.	Solder Removing Pump (x 2)	Standard size
5.	Integrated Circuit de-soldering bit Rectangular (x 2)	14/16 d.i.l. Rectangular
6.	Miniature Soldering Iron (x 2)	220 V AC 15 Watts
7.	Spare heater element for soldering iron (x 5)	220 V/ 15 Watt
8.	Replacement kit for No. 6 above (x 5)	2.3 mm Chisel type
9.	Isolating Transformers (x 2)	220 input AC 50 Hz 220 output AC; 500 VA Capacity
10.	Multipurpose Transformer (x 2)	220 Volt input AC 1 to 40 Volt 50 Hz output AC
11.	Low voltage Transformer (x 2)	220 Volt AC input 50 Hz Two outputs 50 V-1 A/50 C-1A AC AV

Annexe VII Contd

12.	Dual Power Supply (DC) (x 1)	220 Volt AC 50 Hz Input ± 55 V DC output at 1A
13.	Printed Circuit Board Eraser - Cleaner	(one pack of 5 pieces)
14.	Constant Voltage Transformer Static Type	220 Volt AC 50 Hz input ± 15% 220 Volt AC output 500 VA
15.	All purpose Aluminium Solder (lead + tin + Silver) (x1 reel)	One reel 500 gms
16.	Heat Sink Compound (x2)	in Tube 20 cc Size
17.	Printed Circuit Mother Board or STrip board (x5)	291 x 95 x 1.6mm
18,	Strip Board Cutter (x 2)	
19.	Heavy duty Relay (x1)	110 Volt AC/50 Hz coil to control 30 Amps AC double pole Single throw contacts OPEN with coil energised
20	Color code ribbon Cable 10 meter reel	10 way (7/0.2mm)
21	Screened Cable 25 meter one reel	4 core (3.1 mm dia.)
22.	Solder tag Strip (minature) one pack	28 tag
23.	Multipurpose oil tin (x3)	50 gm tube
24.	General purpose adhesive (x 5)	50 gm tube

Annexe VII Contd

25.	2-tube Epoxy (Araldite Type) (cement (x 3 packs)	300 gm pack
26.	PVC insulating Tape (x 5 spool) each color	19 mm wide black 19 mm wide red
27.	Light duty Spring Kit (x 2)	Extension, torsion Compression
28.	Push-on fastner kit (x 2)	Enamelled Steel
29.	Crinkle washer Kit (x 2)	Stainless Steel
30	Hexagon Socket Screw Kit (x 1)	
31	Plastic Sleeves Kit (x 1)	1.2,1.6, 2.4, 3.2, 4.8, mm bore in 10 cm lengths
32	Tinned copper wire (x 2 each type)	18SWG 20SWG 24SWG)
33	Insulated copper wire (x 1 each type)	30SWG (0.315 mm) 34SWG (0.244 mm)
34	Metric nut and washer Kits 2 kits each	M-2 M-4 M-6
35.	Metric Screw kits (50 per kit) 2 kits each size	M-2 M-4 M-6
36	Centre Drill (3 pieces)	3/16 "dia/3/22" point
37.	B.N.C. Connectore miniature (x 10 pairs) size	Male Female

Annexe VII contd

38.	Transistor Sockets x 10 each type	Chassis mounting Style T.O. - 5; T.o. 17; T.O. - 46
39.	Circular IC socket x 10 each type	6 leads' 8 leads; 10 leads
40.	Rectangular IC Socket	8 contact DIL' 14 contact DIL 16 contact DIL
41.	Light Emitting Diode Kit x 5 kits	

Annexe VII contd

Electronic Components

S. No.	Name and Quantity	Specifications
1.	Carbon Track Potentiometer Screw driver adjustable miniature size, vertical Pack of 5 (2 packs each)	1 Kohm 4.7 " 10 " 47 " 100 " 470 " 1 meg ohm
2.	Carbon film, high stability resistor kit 0.25 W (10 each value) one kit	10 ohm to 3.3 Kohm (30 values)
3.	do : 1.0 watt (10 each value) one kit	10 ohm to 3.3 Kohm (27 values) 3.4 Kohm to 1 meg ohm (20 values)
4.	Polyprophlene Capacitors 5 pcs per pack (two packs each)	0.001 to 0.1 microfarad (1000 volts DC) (13 values)
5.	Silver mica capacitors 5 pcs per pack (two packs each)	2.2 picofarad to 10,000 picofarad (350 volts DC)
6.	Axial Electrolytic Capacitors 5 pcs per pack (2 packs each value)	22 F to 4700 F (8 values 10 Volt DC) 10 F to 4700 F (9 values) (25 volt DC) 1 F to 2200 F (11 values) 63 volt DC) 10 F to 220 F (6 values) (100 volt DC)

7.	AC Suppressor Capacitors	250 V AC type
	(5 pcs per pack)	0.01
	(2 packs each)	0.22 class x - 2
		0.47 (across mains)
		0.002
		0.01 class Y
		0.047 (across live and earth)
8.	Metal Oxide Varistor	
	5 pcs per pack (3 packs)	AC 275 V/8.5
	" " (1 pack)	AC 275 V/26
	" " (1 pack)	AC 275 V/61
9.	Silicon Bridge Rectifier	50 V -1A
	molded type	-2A
	(2 packs each value	400V - 2A
	Silicon Rectifier (3 packs)	BY - 127
	(3 packs)	IN - 4001
10.	Silicon Rectifier (3 packs)	IN - 4002
	(3 packs)	IN - 4003
11.	Fuses (Glass)	20 mm x 5 mm following ratings
	(2 packs each value)	50 m A; 63 m A; 80 m A; 100 m A; 250 m A; 500 m A and 1A.
12.	Indicator lamps	
	Neon lamps	Miniature wire ended ½ watt
	5 per pack (5 packs)	250 volt AC
	5 per pack (5 packs)	110 volt AC
13.	Filament Lamps	Screw base
	10 per pack (2 packs each)	6 Volt 0.3 A
		6 Volt 0.15 A
	(")	
	miniature size (")	6 Volt 0.15 A)

Annexe VII contd.

14.	Filament Lamp Holders	
	5 per pack (2 pack)	Screw type
	5 per pack (2 pack)	Bayonet type
15.	Zener Diode Kit	3% Tolerence 1 watt type
	3 Kits	(1.3; 3.9; 5.1; 5.6;
		4.7; 7.5; 10; 13 and 15 V)
16.	Replacement Transistor Kit	
	3 Kits	
17.	I. C's	2N 3565
	(10 pieces each)	2N 3655
		2N 3654
		2N 46049
		LM 3084
		ML 102
		741-C
18.	Heavy duty relay	Coil Voltage 110 volts AC 50 Hz
	X 3 pieces	Contact (normally closed.
		Contacts to open with coil energis
		15 Amp rating: DPST

Annexe VII contd.

Hand Tools & Miscellaneous Supplies

S. No.	Item and Quantity	Specification
1.	Wood and Metal Working Tools Consisting of 36 tools available as a tool kit (one kit)	Stanley Tool Kit
2.	Electrical Work Tools Consisting of 42 tools available as Tool kit. (one kit)	Engineer FF-89 Tool Kit.
3.	Electronic Work Tools (x 2 kits)	Davies Electronic Assembly Tool kit No. 104
4.	Adjustable Lamp x 2 x 2	45 cm long arm With Counterpoise Springs Table mounting type Shelf mounting type 220 V AC - 60 Watt bulb type
5.	Miniature Circuit Breakers 5 each type	for 220 Volts - AC Single phase 50 Hz use 3 Amps rating 5 Amps " 10 Amps " 15 Amps "
6.	Nickel Cd. Battery Charger x 2	NC-10U 220 Volt AC 50 Hz operated For batterysize AA, C,D.

Annex VIII

Technical Books and Data Books

1. Standard Instrumentation Questions and Answer (Part I, II)
   ELONKA AND PARSON
   MCGRAW HILL

2. Electronic Instrumentation Fundamentals
   MALVINO
   MCGRAW HILL

3. Instrumental Methods of Analysis
   Willard, Merritt, Dean and Settle.
   D. Van. Nostrand

4. Basic Electroni Instruments Handbook
   Coombs
   Mcgraw Hill

5. Integrated Electronics. Analogue and Digital circuits.
   Millman and Halkias.

6. Trouble Shooting on Microprocessors based Systems
   G. B. Williams
   Pergammon Press

R. S. Data Sheets on	(Available from R.S. (U.K.))
opto Isolator	No. 4759
SCR and Triacs	3958
Tyristors	4478
Diacs	2494
Power Amplifier module	5178
Regulators 78 & 79 series	6610
CMOS Transistors	2949
Thermistors	1867
Ultrasonic Transducers	3065
Switch Dimmers	5156
Ultrasonic Detection	6648

Technical Magazines

1. Elektor (Elektor house, 10 Longport, Cantorburg, CT 11 PE, Kent, UK)
2. Electronics for You (EFY) (303 Dohill Chambers, 46 Nehru Place New Delhi - 19, India)

Annexe IX

Instruments Serviced

1. Differential Volume Meter

(It was giving erratic reading with the calibrating rod. The defect was identified and corrected)

2. Mains Voltage Stabliser - 500 VA type

(It was giving high readings irrespective of what the mains voltage was. The defect was traced to excessive friction at the variac brush and was rectified)

3. Side-loading Mono Pan Balance (200 gm capacity)

(It was giving a jerky movement in the final balancing position. The defect was traced to the damping mechanism underneath and was corrected)

4. Top-loading, 2000 gm Capacity Single Pan Balance

(It has a 63 milli amp fuse which was located and replaced. The instrument requires an identical fuse as a spare to prevent, damage and as this value is not normally available locally it has heen ordered from abroad)

5. High Speed Centrifuge (18000 rpm)

The apparatus was dismantled and rodent damage to the electronic printed circuit was found. This was corrected and the centrifuge was operational again.

6. Monitor Oscilloscope used with the NMR Apparatus

(The light spot was not forming but after a while the mains fuse was blowing every time. The defect was located in the voltage doubler power supply. This corrected one fault i.e. the light spot was forming now and x axis shift was under control but the Y shift was not working. This portion has to wait till suspected electron tubes can be replaced. If the tubes are not available any more, which - quite likely, the apparatus would have to be discarded)

7. Refrigerated Centrifuge

(This has been in-operative for a long time. It was cleared up and turned on. The centrifuge and its compressor and blower were working but cooling was not taking place. It was inferred that freon gas had leaked away after the long period. Efforts are being made to get it recharged with refrigerant gas commercially).

8. Control Panel of NMR Apparatus and Other Faults

It was suspected that the tuning of the NMR was not sharp due to loose or intermittent connection in the multi-deck piano-key type switches: mounted directly on the printed circuit. To resolve this matter, all the soldered connections were desoldered & carefully soldered again. The switch was found to behave normally. The defect was finally traced to the magnet temperature controller having stopped working. The main fuse had blown but on testing, section by section, one transistor in the Darlington Pair which acts as a variable and proportional resistor in series with the heater was found defective. This was replaced by taking a similar one from the spare printed circuit board. This work was entered in the history file of the instrument for future reference. This work saved a potential service call.

9. Gas Chromatograph

(The thermocouple wires had broken at the socket lead-out. They were traced and re-connected. However, the shifting-clutch of the temperature programmer has worn out due to long use and cannot be replaced. So the Gas Chromatograph can be used at constant temperature only.

Annexe X

Lecture Course Content

1. Basic Electronics for Instrumentation including transistor-based circuit, power supplies both AC and DC with special applications.

2. Methods of Measurement including wheatstone Bridge, Potentiometric and current comparator.

3. Test Instruments, their principles and uses such as multimeters, Oscilloscope, Digital Voltmeters Signal Generators, Function Generators, RLC Bridges.

4. Transducers for Instruments including resistance, capacity, inductance based and optical, pressure and temperature converting sensors.

5. Instruments of Analysis, Principle & Construction such as colori-meters, Ph meters, spectrophotometer, chromatograph etc.

6. Defect Analysis in Instruments - General guiding principle as well as those applicable to electron tube based, transistor or I.C. based apparatus with examples of specific types.

Annexe X contd.

Demonstrations/Practical Work

1. Characteristics of a moving coil meter: damping: measuring the meter resistance.

2. Characteristics of a static-type magnetic voltage stabliser.

3. Difference between photo tubes, photocells and gas tubes.

4. Constructional principle of a monopan balance using ring weights.

5. Construntional features of an electronic single pan balance using no weights.

6. Basic features of an Oscilloscope.

7. Working principles of a multirange ampere meter and volt, ohmmeter.

8. Making of half wave, full wave - center tapped and Bridge-type power supply.

9. Assembling a Ph meter circuit.

10. Wheat stone Bridge assembly and Analysis.

Annexe XI

Address of Manufacturers/Suppliers

1. R. S. (components and Data Sheets)
   P.O. Box 99, CORBY, NORTH HANTS" NN 17 pRS, UK

2. ALLIED ELECTRONICS 9components, spares)
   401 East 8th Street Forth Worth: DALLAS:
   TEXAS - 76102: U.S.A.

3. PHILIPS (TEST EQUIPMENTS)
   EINDHIVEN, HOLLAND

4. HEWLETT PACKARD (TEST EQUIPMENT)
   H.P. INTERNATIONAL 3200 HILLVIEW AVE:
   PALO ALTO: CALIFORNIA - 94304: U.S.A.

5. YOGOKAWA (TEST INSTRUMENTS)
   5-7. YARSU CHUO-KU: TOKYO 104: JAPAN

6. TEKTRONIX (TEST INSTRUMENTS)
   P.O. BOX - 500 - BEAVERTON - OREGON - 97077: U.S.A.

7. MARCONI INSTRUMENTS (TEST INSTRUMENTS)
   ST. ALBANS HARTS: UK

8. A. ANDREWS (TOOL KITS)
   P.O. BOX 2983: HONG KONG.