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BANGLADESH AGRICULTURAL RESEARCH PROJECT PHASE-II

# Instrumentation, Equipment Repair and Maintenance
# October - December 1985

Ler. Mattick

BANGLADESH AGRICULTURAL RESEARCH COUNCIL
WINROCK INTERNATIONAL INSTITUTE FOR AGRICULTURAL DEVELOPMENT
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# Consultancy Report

to

Bangladesh Agricultural Research Council

(BARC)

on

## Instrumentation, Equipment Repair and Maintenance

October 25 - December 20, 1985

by

Dr. Leonard R. Mattick

Winrock International Short Term Consultant

in

Instrumentation, Equipment Repair, and Maintenance

TABLE OF CONTENTS

## Acknowledgments

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Abbreviations used in this report and the corresponding organization:

AFCD - Atomic Energy Center, Dhaka

(BARC) - Bangladesh Agricultural Research Council

BARI - Bangladesh Agricultural Research Institute

BAU - Bangladesh Agricultural University

BAU-GTI - Bangladesh Agricultural University - Graduate Training Institute

BUET - Bangladesh University of Engineering and Technology

BINA - Bangladesh Institute of Nuclear Agriculture

BJRI - Bangladesh Jute Research Institute

BRRI - Bangladesh Rice Research Institute

BTRI - Bangladesh Tea Research Institute

DU - Dhaka University

FRI - Forest Research Institute

ISI - Institute of Scientific Instrumentation

RARS - Regional Agricultural Research Station

SRDI - Soil Resources Development Institute

SRTI - Sugar Research and Training Institute

USAID - U. S. Agency for International Development

WI - Winrock International

THE AUTHOR

Dr. Leonard R. Mattick received his training in electronics, while in the U. S. Navy, where he served as an Electronics Technician's Mate. Following his discharge in 1946, he matricultated at The Pennsylvania State College (now The Pennsylvania State University), where the Bachelor and Master of Science degrees were awarded in 1950 and 1951, respectively. He then attended The University of Connecticut where he received the Ph.D. degree in 1954. All degrees were in the field of Food Chemistry.

At this time analytical instrumentation was beginning to become an integral part of chemistry, and the commercial production of instruments had not yet begun. With the electronic training and experience in Analytical Chemistry, the instruments were designed and constructed in his laboratory. This led to several inventions which were later adopted by industry when they began to manufacture the instruments. These consist of the proportional temperature controller and the dual compensating detector.

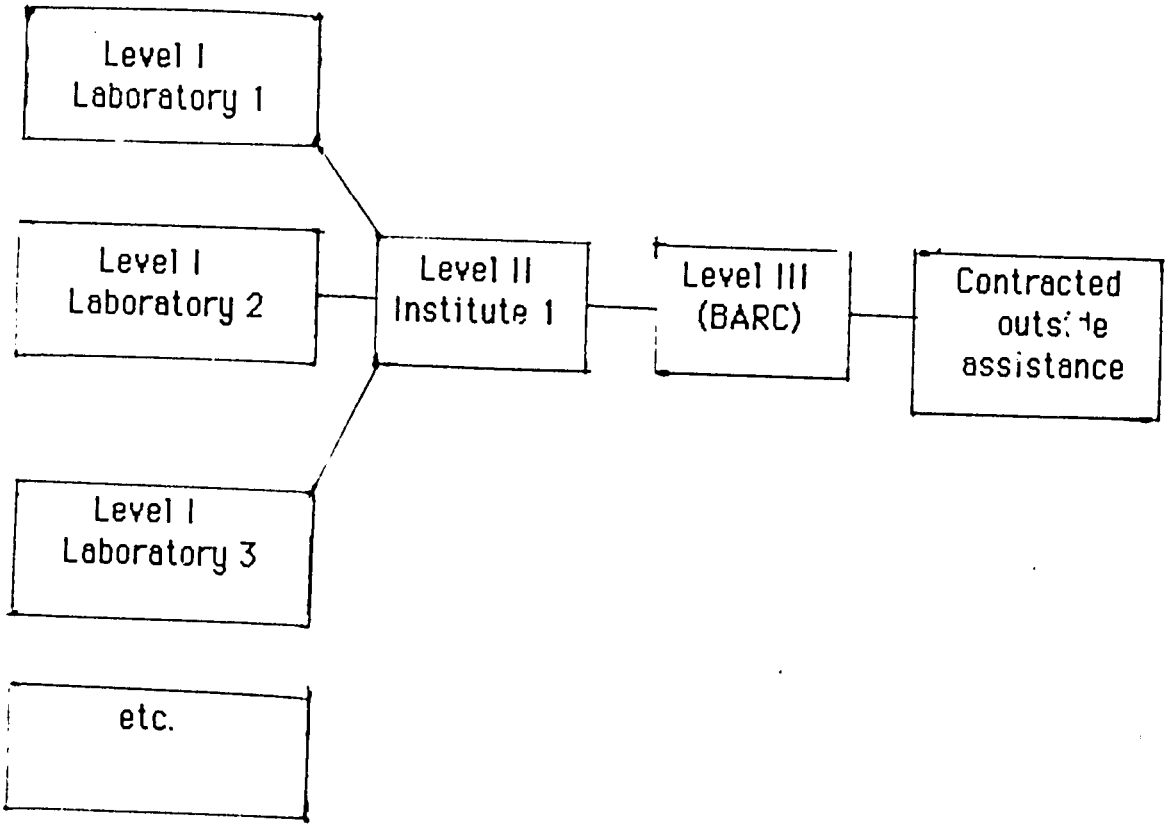
Dr. Mattick has over 30 years experience in the area of Analytical instrumentation and has co-authored several books on Gas Chromatography. He was co-director of the Gas Chromatographic Institute of Canisius College in Buffalo, NY. He set up laboratory exercises and lectures for Agricultural Applications. He has also served as a Scientific Consultant to the Food and Drug Administration of the Department of Health, Education and Welfare. The primary duty of the consultant was to aid the scientists of the laboratories in the interpretation of their results and devise and develop analytical procedures for analyzing food, cosmetics and drugs to ascertain their purity for use by the public. This included nutritional and toxicology studies.

His international experience included an active role in research on soybean beverages. This was performed in conjunction with the University of the Philippines at Los Banos. This is his third consultancy to Bangladesh. He was here previously in April-May, 1984 and March-April, 1985.

Recommendations and Proposals

1. BARC has shown very little interest in following the recommendations of either Mr. R. Clayton (1983) or those presented in the past two consultancies of Mattick (1984 and April 1985). The leadership in this matter will have to be assumed by BARC. It is imperative that BARC, with donor support, make provisions to establish a Center for Instrument and Equipment Procurement and Maintenance with proper personnel and funding. This center when established will be responsible for the following:
   a. Coordination of training and instruction for instrumentation and equipment maintenance and repair at all levels.
   b. Development of a central inventory of all instruments and equipment in the affiliated institutes of BARC.
   c. Procurement and validation of proper equipment when ordering, so that instruments are ordered complete, ready for installation, and that the actual need for the particular instrument or equipment is valid.
   d. Will maintain spare parts for instruments now at the Institutes. Will coordinate and expedite ordering of spare and replacement parts from appropriate agencies.
   e. Will maintain library of operation and service manuals of the various instruments.
   f. Contract "outside" repair personnel when necessary.
2. At present 90% of the performed maintenance is corrective and 10% preventive. In an efficiently operative laboratory these figures will be

reversed. This can be accomplished in Bangladesh by institutionalizing a 3 level system as described below for one institute.




Level I maintenance will be conducted by an individual in each laboratory who will

a. maintain inventory on all equipment
b. develop a "log book" for each instrument
c. do weekly instrument checks and "log" in results
d. do simple diagnosis and repair (fuses, power source, electrodes, etc.)
e. report undiagnosed problems to level II person
f. develop a general maintenance and cleaning system for the laboratory.

Level II personnel will come from the institute and be trained in basic instrument and electronic repair. He will be responsible for following up on problems referred to him from level I personrel of his institute. He will

a. check the laboratory "log books" and maintenance systems
b. follow-up on all repair/assistance requests
c. maintain certain spare parts
d. refer high level problems to the "center" at (BARC)
e. coordinate "outside" repair provided by ((BARC)), within the institute.

Level III personnel will be located at (BARC) and will perform the functions (a-f) listed in item 1, of these recommendations.

3. To do these tasks, three levels of training are suggested.

Level I: Personnel from level I can be adequately trained by the Electronic Service Division of BAU, through GTI. (A course outline is presented in the report).

Level II: Personnel from level II can be adequately trained in Basic Electricity and Electronics and intermediate electronic courses presented by AECD.

Level III: Personnel from level III will be trained at the Institute of Scientific Instrumentation (2 persons) and through day to day contact with the Winrock International Specialist. This training will include not only instrumentation and electronics but also procurement (including evaluation of the actual need for the equipment, the degree of sophistication, storage, inventory, and management systems).

4. "Drop-out Relays" should be installed on all instruments. These will shut off the current in the event of a power failure. The power failure is usually followed by a power surge when the power is restored. Since voltage surges up to 350 VAC have been recorded, these relays are essential to protect the delicate circuits in analytical instruments. The "Drop-out Relays" are available in both manual and automatic units.
5. Constant voltage stabilizers /transformers should be attached to each instrument, or installed on power sources for the laboratories. Power fluctuations can result in large reading errors.
6. Each institute should have a recorder to measure fluctuations in power within laboratories so that the magnitude can be noted and problem areas identified for correction
7. Further short term consultancies for instrument repair should be discouraged. Past experience indicates that the laboratories do not take the initiative to get and keep their instruments operational when they know outside help is available. It has been noted that this delinquency even carried over to the simple task of filling out work orders. Since much of the repair work can be done locally it is suggested that further short term visits may delay (BARC) and the institutes from taking the initiative/responsibility for instrument and equipment procurement, maintenance and repair.
8. A full time maintenance specialist is required to assist BARC/WI in developing and training in a total systems management package involving recomendations 1 -7, above, for both laboratory instruments (the priority) and field and power equipment.

## 1.0 INTRODUCTION:

This consultancy resulted from findings of two previous visits to Bangladesh in 1984 and 1985. The consultancy was scheduled for eight weeks which was programmed to allow the presentation of a one week course on Analytical Chemistry; Instrumentation and Maintenance with the remaining seven weeks used to fulfill the other Terms of Reference of the consultancy.

Visitations were made to Dhaka University, Bangladesh Agricultural University, and Bangladesh University of Engineering and Technology for the purpose of evaluating their curriculum in the teaching of instrumentation. Bangladesh Agricultural University and the Atomic Energy Center, Dhaka were further considered as sites for further training.

The information collected from the interviews and visitations were compiled into a Syllabus for a course in instrument operator training and another for Electronic Maintenance. Location and course content are included in the recommendations.

The consultant was accompanied by several of the course participants from the April and the November 1985 course to the various Institute of BARC for the purpose of instrument repair. This was to allow "hands-on" training of this group, which showed an aptitude for this type of work. These visits also offered the opportunity to determine the impact of the previous three consultancies (Clayton 1983, Mattick 1984 and 1985).

The mission was largely completed. A report of the visitations, interviews and activities may be viewed in the appendix of this report.

## 2.0 TERMS OF REFERENCE:

1. To teach a one week course on Analytical Chemistry and Instrumentation.
2. With six local persons who performed well in past courses, do "hands-on" instrument repair at BJRI, BARI, BRRI, BINA, BAU and RARS Jamalpur.
3. With two best from above do "hands on" instrument repair at RARS Hathazari, Jessore, Ishurdi, STRI, BTRI, DU and BARC.
4. Evaluate Chemistry and Instrumentation training at Universities, and other institutes.
5. Based on 4, develop modules of Syllabus and suggest locations and persons to do in-country training.
6. Develop for BARC a detailed plan of operation including job descriptions, for a BARC Instrumentation and Equipment Center including inventory systems, procurement, spare parts, library and other components.
7. Prepare a report on activities with observations and recommendations based on 1-6 above.

## A. Training:

A six day course was presented on the fundamentals of Analytical Chemistry and Instrumentation for 12 persons from various BARC affiliated institutes and Universities in Bangladesh. A copy of the 170 page training manual prepared previously was presented to each participant. A summary of scores from a baseline and final evaluation examination given to the group is presented below:

| | Faseline | Final | Improvement |
|---|---|---|---|
| Average | 37.75 | 62.00 | 24.25 |
| Range | 20-55 | 34-88 | 2-59 |

While correcting the baseline evaluation papers several trends were noted.

a. The participants did well on the wet or regular Analytical Chemistry.
b. The participants exhibited a very poor knowledge of instrumentation fundamentals, theory and operation.
c. Those participants who held advanced degrees did no better in the instrumentation section than others in the course. This also included several members of the Chemistry faculty of the BUET and two members of the Soil Science faculty at DU.
d. Those participants who held advance degrees did much better on the regular non-instrumental analytical chemistry.

These observations point to a definite lack of training in Instrumentation at the University level in Bangladesh. Todays modern analytical techniques and methodology is based on the use of instrumentation. If this discipline is not taught to the future scientific community of Bangladesh, it can only result in the destruction and deterioration of more instruments and an inefficient use of funds from donor countries. Information on this course is found in Appendix I.

The second phase of training was a "hands on" training experience. Six participants were nominated from the three Analytical Chemistry, maintenance and instrumentation courses (two in the April, 1985 consultancy and one on the

present consultancy). The six nominated were:

Azizul Hoque, S. O., BARI, RARS, Jamalpur

Abdul Latif, Res. Assist., BARI, Joydebpur

Malik Akhter Hamid, S. O., BARI, Joydebpur

Md. Momen Miah, S› O., BJRI, Dhaka

Md. Shafiqullah, S. O., BINA, Mymensingh

Dr. Imamul Huq, Assist. Prof., DU, Dhaka

Abu Saleque, S. O., BRRI, Joydebpur

Md. Khorshed Alam, S. O., SDRI, Dhaka

A total of eight were nominated with the possibility of two persons being alternates in the case of a position vacated by another person. However, Mr. Hoque is content in his position at Jamalpur and did not journey to Mymensingh; Dr. Huq and Messrs Saleque and Alam would not attend the training, since only expenses were authorized and no monies for incidental or pocket money would be paid. Therefore, only four participants took part in this training. The group spent four days in Mymensingh. The first two were at BINA and the second two at BAU.

At BINA, the various laboratories were visited and the instrumentation exhibited. Mr. Shafiqullah, their electronics specialist, had assembled the instrumentation which was in need of repair. The units were tested and their problems diagnosed with the replacement parts being noted. It was shown and demonstrated how the procedure for detecting problems is accomplished.

During the morning of the second day at BINA, the test equipment in the electronics laboratory was demonstrated. This exercise acquainted the participants with the various electronic test instruments, such as the Volt - Ohm meter, Vacuum tube volt meter, oscilliscope, power supplies, and frequency generators. The operation and use of these units were demonstrated. Their use in trouble shooting was explained.

Mr. Rezaul Huq Khan of Centra Enterprises, Dhaka which is a dealer distributor for Fisher Scientific Co. (Jarrell Ash) and his electronic engineer came to Mymensingh to examine the troublesome Jarrell Ash Diatom III Atomic Absorption Spectrophotometer. They were very helpful in explaining their procedures to the participants and explaining what components he was checking with his tests.

The next two days in Mymensingh were spent at BAU. The initial hour was spent with Mr. Sakdat Hussain, PSO of the Electronic Service Division and Mr. M. I. Khalilullah, Senior Instrument Engineer. They discussed the functioning of their section and its relation to the University. I also had a opportunity to discuss the syllabus for a basic electricity and electronic course for laboratory maintenance and repair. This syllabus appears in the Appendix III.

The Soil Science Department was visited. Dr. Hoquo made arrangements for the opening of the laboratories. Mr. Khalilullah accompanied us. the participants worked with Mr. Khalilullah and the consultant to repair and diagnose several pieces of equipment as listed in the Appendix II. In the two days, the Department of Soil Microbiology, Food Technology, Soil Science, and Biochemistry, as well as the Electronic Service Section were visited and the instruments were repaired or their faulty operation diagnosed.

The next day the group traveled to BARI, RARS, Jamalpur. This station received a shipment form BARC in July. The participants had the opportunity to install, test, and evaluate the instrumentation and apparatus which was sent. There were also several other units which required repair or corrective maintenance. This was accomplished.

This "hand-on" training ended in Dhaka at BJRI. The participants aided in repairing and diagnosing the faulty equipment at this institute. The final day was spent at BARI, Joydebpur, where their activities were reviewed.

The third phase of the training took place when two of the participants of the second training were chosen to accompany the consultant on December 7 to 12, 1985 to Khulna, Jessore and Ishurdi. These participants were Mr. Malik Akhter Hamid and Mr. Abdul Latif. During this week of additional training, they visited the BARI, Regional Laboratory ASD, Daulotpur, Khulna; BARI, RARS, Jessore; BARI, RARS, Ishurdi; and STRI, Ishurdi. They had the opportunity to see how a systematic repair was done in the field. Further at STRI, they were able to see audio visual equipment and how defects are located and analyzed.

## 3.0 ACTIVITIES:

BARC:

This should be the central hub or center of maintenance in the agricultural community of Bangladesh, since it encompasses the affiliated institutes and can exercise control over these units. If each institute were to embark on its own maintenance program, the differences would be enormous with no resemblance

of any type of uniformity, this type of action would only result in failure. It must be a concentrated effort by a a central unit such as BARC.

The central facility for scientific maintenance would have a greater responsibility than the repair of instrumentation. A variety of operations would be involved to cause a more efficient operation in agricultural research. These operations will be:

1. Serve as a resource to the institute maintenance specialists in cases of difficult repair operations.
2. Central Inventory of all scientific instruments and apparatus in the BARC affiliated institutes.
3. To facilitate the procurement of instrumentation to insure that the units ordered will adequately perform the operation the investigator wishes to accomplish.
4. To procure the spare and replacement parts for the institute and laboratory maintenance specialists. This will require a close cooperation with the various Donors of the instruments.
5. To serve as a depository for the operation and service manuals of the instrumentation in the affiliated institutes of BARC. A library of technical data information books will be kept at this location.

This Electronic Instrumentation Center will be under the administrative direction of the Member-Director who will be responsible for maintenance within the BARC frame work. The immediate head will be a Principal Scientific Officer (PSO), who will have training in electronics and the use of the various scientific instrumentation. He must not only be familiar with electronic

circuitry, but must have a working knowledge of the various units used in scientific research, since he will oversee the operation previously described. He will be assisted by two persons trained in electronics at the AECD, Intermediate Electronics course. These persons should also have a users knowledge of instrumentation and instrumentation procurement. These persons will have the grade of Senior Scientific Officer (SSO) or Scientific Officer (SO). A secretary trained on the computer word processor and operation, plus a clerk would be required as a base group for the Central BARC Electronic Instrumentation Center.

Central Inventory System:

A system for a central inventory of instruments and apparatus will take time to develop. The accumulation of data may take several months to a year. It will be a slow moving operation, but it is mandatory for the efficient operation of an instrumentation program. An attempt at a central inventory system was initiated last year, but has become non existent on the departure of the IADS Maintenance Specialist. This inventory will have to be reinstated by BARC, which is a central focus point for all the institutes.

This system can be employed in procurement of instruments as well as the dispersement by the commodity officers. It is not uncommon to find one RARS with three to four pH meters, while others have none. The other case is that replacement parts are sent to the wrong laboratory and are lost in the paper work. These practices are not revealed until questions are asked during the visitation at the various laboratories.

The inventory can be computerized in the BARC Electronic Instrumentation Center. An IBM-PC computer or equivalent using software entitled "Database" has been employed by AECD for the inventory of their equipment. A copy of the test print out appears in the Appendix III. The data includes all pertinent information concerning the instrument. Each unit is given a Tag or inventory No which is afixed to the unit. All data on the instrument concerning its purchase, manufacture, and vendor are recorded plus the important information regarding these items, i.e. manufacturer, telex Nos., address, date of arrival, end of warranty, parts list location, service and operation manual location, etc. Other information includes the person responsible for the instrument, the user, and operating accessories used. This gives a complete detail of the instrument plus the location of the log on the repairs and performance checks.

This type of data can be used to exact a yearly inventory of all instrumentation and check of its status. The system can be used to ascertain if a duplication of instrumentation will occur or if an instrument already exists within the make up of BARC which can be used for short experiments rather than purchasing a complete instrument. In many cases, when the time necessary to receive a new instrument is considered, it will be more expedient to use existing units to analyze samples on short term contract research. If duplication does exist and a shortage at another location occurs, this is a rapid method of filling the need. Further, this can be used to predict future purchase of instrumental time dispensible accessories (i.e.: A. A lamps, pH electrodes, buffers, etc.).

Central Purchasing:

The Central Maintenance group will aid in the purchase of equipment. At the present time, equipment is sent to the Regional Agricultural Research Stations on an availability basis and not by proven need. In some laboratories visited, equipment which was received prior to the 1984 consultancy had not been used. Equipment is received which is not requested or related to their program. These units will be installed, repacked and remain packed until finally deterioration due to moisture and/or rodents resulted. The other instance in this case would be instrumentation totally incompatable with the project. This is not only a waste of funding which could be used more productively, but it is deterent to the program. Another instance is the ordering of equipment which arrives and is lacking certain essential pieces which is required to put this into operation. The coordination of the central purchasing by reviewing the requests could eliminate much of this type of error or judgement.

Spare and/or replacement parts is a major concern of all who are interested in the maintenance of the scientific instrumentation. Bangladesh has no "hard" or foreign currency which can be used to purchase spare or replacement parts. The local scientific supply companies will not stock spare parts because they must pay for these and then maintain a rather huge financial investment in inventory. Therefore, the purchase is usually done by donors through their various channels. However, upon arrival in Bangladesh, import duty must be paid on the items. In the case of the United States, they will not pay import tax to another government. Thus, further delay is caused in receiving the parts, which means the instruments are down for excessive periods of time. This

down-time causes further deterioration. It is virtually impossible to accumulate spare parts of all the instruments, because of the wide variety of manufacturer's and models. Therefore, it is imperative that the spare or replacement parts be sent to Bangladesh as quickly as possible. BARC should petition the government to give them the same benefit which is given to the Colleges and Universities that is to allow the passage of scientific goods used for the good of the country to pass through customs, duty free. This would speed the acquisition of spare and/or replacement parts.

A second deterent in the acquisition of spare or replacement parts is the source. There are many donors of equipment in Bangladesh; each has its own manufacturers and suppliers. Certain rules would prohibit the funds from one country's agency to purchase parts or equipment form another country. The Central Maintenance Section with the pertinent information from the Central Inventory can easily isolate the Country and Agency from which these parts may be acquired. This would ensure prompt contact and a more rapid delivery of the parts.

Library of Operational and Service Manuals:

It is next to impossible to install or repair some instruments without a wiring diagram or a service manual. The "company trained" servicemen will not attempt to repair an instrument without a service manual. These are as important as the test equipment or the basic tools. It is discouraging to attempt to repair an instrument without the specifications of the circuitry of the unit. A beginning has been made in collecting and cataloging these instruments. These are located in the BARI, Maintenance section. It was begun by Mr. Harvey Carr.

These should be moved to the Central Maintenance Group. This group should be charged with obtaining the missing operational manuals either by copy or purchase. Any new instrumentation would have its operation manual copied and placed on file in the central office. The service manuals for the various units should also be on file. A copy of this service manual could be obtained by contacting the Central Maintenance Section.

As previously stated; a good start has been made in this phase, but it has come to a halt. It should be reinstated and continued as soon as possible.

The Institutes:

Each institute will have an Institute Maintenance Specialist. A minimum prerequisite would require training in electricity and electronics through the AECD Basic and Intermediate Courses. The person in this position should be familiar with the various types of instrumentation as well as the needs of the particular institute. He will requisition spare and/or replacement parts from the Central Maintenance Section as they are required. It will be his duty and obligation to expedite these requests without delay. He will also serve as a repair person, when a problem is too difficult for a Laboratory Maintenance Specialist. He will report on the status of the instrumentation within his institute to both his Director and to the Central Maintenance Section on a bimonthly basis. This person will be under the direct supervision and responsible to the Director of the Institute. He will hold a grade of SSO or SO.

The Laboratory:

Each laboratory will have a Laboratory Maintenance Specialist. This person would be trained in the Basic Electricity and Electronics course at BAU, GTI. This person must be familiar with the instrumentation in his laboratory. He will conduct weekly performance checks on all the instruments in the laboratory and maintain an accurate log on the use, maintenance, and performance check results on all instruments. If a unit is found to be lacking in the performance check or malfunctioning in use, he will examine and attempt to repair or diagnose the faulty component. If successful in achieving repair or diagnosis, this is noted in the log of the instrument, if replacement and/or spare parts are needed, this information is immediately forwarded with the instrument's pertinent information to the Institute Maintenance Specialist. If the Laboratory Maintenance Specialist is unable to repair the unit to operable condition, the Institute Maintenance Specialist is contacted and is immediately dispatched to the laboratory for repair. The Laboratory Maintenance Specialist will be required to file monthly reports on the status of the instrumentation within his laboratory. He will be under the supervision of, and responsible to the Director of the Laboratory. He will hold a grade of S. O.

Funding of the System:

The funding of this maintenance program at all levels; Central, Institute, and Laboratory should come from BARC. As the accountable agent, it will be BARC obligation to see that the various levels of the program are in compliance with the mandate. It will be a prerequisite that if an Institute or Laboratory fails to fulfill the requirements of the program, funding will be withheld until such time

as the violator is again in compliance. This loss of revenue would serve as an incentive for the successful operation of this program.

Atomic Energy Center, Dhaka:

This facility was visited and their program in Electronic Maintenance and Analytical Chemistry was reviewed. This facility was built between the years 1962-64 as a training center for peaceful users of Nuclear Energy. The building was erected on land owned by Dhaka University. This unit was inherited by Bangladesh at the time of her independence in 1971 from the Pakistan Atomic Energy Commission (PAEC). A new facility is under construction 22 miles from the present site at Jahangirnagar University in Savar. This unit will have residential units and laboratories.

This organization has conducted training courses in Basic, Intermediate and Advanced Electronic Maintenance. They have the trained personnel with expertise in the Electronic Instrumentation maintenance. The Electronic Section is under the direction of Mr. M. Zahur Ali, CSO. General and specialized training courses can be offered in Electronics. Special courses and mechanical workshop practices are designed to impact training to the laboratory technicians. To train mid-level scientific and technical personnel, special courses are offered in Basic and Maintenance Electronics. This could be a source of training for the BARC repair personnel or it may be possible in the interim to contract for repair work with the Atomic Energy Center, Dhaka (AECD).

A preventative maintenance system is taught as part of the electronic training. This system is a three step approach; achieved through the training of the laboratory personnel. This approach is as follows:

1. The user or instrument operator is the first level. The instrument will be checked out each morning as to the response and general operation. If in the case of a prolong period of inactivity, this is done at least once a week. Each instrument has a principle operator and it is his responsibility to check and log the results of this check.

2. If difficulty is found in the first step, the person in charge of the laboratory or assigned group of instruments is notified by the operator in step 1. If satisfactory results are not obtained in step 2, then the person in step 2 will notify the Electronic or Instrument Maintenance Personnel.

3. The Electronic or Instrument Maintenance person will do the work on the instrument.

This method reduces the actual amount of time that the Electronic or Instrument Maintenance group is required. Therefore, less personnel or the repair service can be contracted.

The Electronic section has all instrumentation cataloged by computer using an IBM PC. This is using a "Data Base 3" language. All personnel as described for preventive maintenance and all specifics of the instrument are recorded.

The Analytical Chemistry Section is very diversified and deals with sophisticated instrumentation. This group is under Dr. A. H. Khan, CSO. They have personnel who have the expertise in the use of analytical instrumentation. They are capable of teaching and demonstrating proper use and care of analytical instrumentation. A course on instrumentation could be on a single instrument or on a group of instruments. This course could be as specific or general as one would care to make it.

In summary, the Atomic Energy Center, Dhaka is capable of teaching and training the Instrument Operators and the Electronic Repair personnel for BARC. Further, during the interim, they could do the Electronic maintenance on a contract basis. They have the facilities and personnel to:

1. Teach theoretical aspects of instrumentation.
2. Demonstrate the proper use of instruments.
3. Maintenance on a contract basis.
4. Training electronic repair personnel.

Bangladesh Agricultural University:

On November 3, 1985, the Bangladesh Agricultural University in Mymensingh was visited upon recommendation of Dr. David Daugherty after a conversation with Dr. Ashraf Ali Khan. The initial meeting was with Dr. Ali Khan, who is a Professor of Plant Pathology and Director of Research at the Bangladesh Agricultural University. The discussion during this meeting revealed that there was no instrument training at this institution with the exception of some training in farm mechanics in Agricultural Engineering, but this did not embrace any analytical instrumentation. There is an Electronic Instrumentation Division within the University for the purpose of instrument repair, but there are no courses or training offered at the present time.

Dr. Ali Khan arranged a meeting of several of the interested academic departments namely: Soil Science, Microbiology, Biochemistry, and Agricultural Chemistry as well as the Electronic Instrument Division. The topic of training in instrumentation operation was advanced. General agreement was reached that there was no course in the University or that it was not taught at the present

time. The proposal that a course be initiated which would be open to the University as a whole met with severe opposition. The fact that this has never been done was the major objection. Using a hypothesis supposing it was done, an argument resulted as to who would teach the course. During the argument, it was obvious that at the present time, they had no qualified personnel to teach an instrumentation operations course. A conclusion that it would be impossible to cross the academic departmental lines soon surfaced. The plan that each department teach its own course would be a gross duplication of effort and very inefficient.

The Instrument Repair Division was a very bright spot of this meeting. This group is charged with the instrument repair at the University. Mr. Sakdat Hussain is the Principle Scientific Officer who has been educated and trained in applied physics and electronics at Texas A & M, USA and Cambridge University, U. K. His associate is Mr. M. I. Khalilullah is a Senior Instrument Engineer who was educated and trained at Cambridge University, U. K. A conversation with these gentlemen revealed that they are capable and learned individuals, who have an excellent grasp of the electronic maintenance situation. They do not offer courses at the present time; their major and primary concern is electronic maintenance. They indicated that courses and workshops might be given through the Bangladesh Agricultural University - Graduate Training Institute (BAU-GTI). Types and contents of courses were discussed. The enrollees of these advanced courses should be carefully selected. This will be a difficult course and the person should have the proper prerequisition for such a course as well as the aptitude and interest. These courses will be designed for a level III person in the preventative maintenance schedule. Messrs Hussain and

Khalilullah both felt that the BAU-GTI could be of service by teaching the aforementioned course.

However, maintenance is not given a real budget in the University system. This has created problems in their present repair and maintenance of instrumentation. In most cases, spare parts can not be acquired locally because of lack of local currency. Since foreign currency is completely lacking, no spare parts can be ordered. This situation has caused friction between the Electronic Section and the Academic and Research Departments, who accuse them of "not repairing their instruments". This is a case where we have a potentially viable unit, which is unable to operate because of lack of funds. The need exists for reference materials such as transistors and integrated circuits, specifications, operating characteristics, substitution lists, and data information for all electronic components. The Service Manual for the instruments would be invaluable, expecially the larger more expensive units, since it gives all the wiring diagrams, part numbers, and operating characteristics. Without a proper budget, maintenance can never become a reality. This section at BAU is an excellent example of this statement.

Bangladesh University of Engineering and Technology:
Chemical Engineering Department.

Dr. K. Ikhtyar Omar, the head of the Chemical Engineering Department, was visited. The consultant believed this to be a good beginning point in this University, since chemical engineering employs constant analytical instrumentation procedures in the Process Technology. The analytical instrumentation of this department consisted of a Pye Unicam gas

chromatographic instrument with a thermal conductivity detector, which was inoperative. Dr. Omar asked if I would attempt to repair it. A quick check showed that the filament had been opened in the reference cell. New matched filaments would have to be ordered. The other instruments were a Bausch and Lomb Spectronic 20 and a Fisher pH meter. The other instrumentation was used for thermal measurements namely thermocouples and pyrometers.

They offer only technical courses. Students get on the job training following completion of the course. The department believes most corporations or organizations hiring their graduates have their own training courses.

During the discussions, I asked to see the curriculum for Chemical engineers and found a course Chem 302 Instrument Analysis of Chemistry for 3rd year students. The course description gave a pH meter as the only analytical instrument. The others were Electroplating, Heat Transfer Measurement, Entrophy, Enthalpy, etc., primarily Physical Chemistry measurements.

Chemistry Department:

Dr. N. Islam, Head of the Chemistry Department met with us. This department is strictly a service department for the engineering and technical portions of the University. They have no undergraduate program. M. Phil. program was just instituted and next year the Ph.D. program will begin. These degrees will be in chemistry. They have pH meters, spectronic 20 and 21 (visible only), constant temperature baths, viscosimeters (Brooks), and Mettler Balance. No formal course in instrumentation is taught as well as no course in maintenance or repair.

Dr. Islam was asked if a course was taught which covered the syllabus of the course being offered at BARI, Joydebpur in Analytical Chemistry Instrumentation and Maintenance. He perused the syllabus and the training manual. Dr. Islam then asked if two of his faculty could attend the course given at Joydebpur, since no one in his department had that type of training.

Dhaka University:

Soil Science Department.

A meeting was held with the Chairman of the Department, Professor M. S. Hussain, and several members of the faculty. Those in attendance were Dr. T. H. Khan, Dr. I. Huq, Mr. S. A. Ahad, Mr. A. S. Howalder, and Dr. S. I. Khan. A discussion concerning the teaching of the basic theory and operation of instrumentation was held. The teaching in this department is dependent solely upon the individual Professor's background. It is not a planned syllabus. The general consensus of opinion was that since the soil scientists were being exposed to and becoming dependent upon sophisticated instrumentation, a large gap had developed in their curriculum. Further, if training were available, they would be receptive to the initiation of a course of this nature. Dr. I. Huq had been enrolled in the workshop, November 9-14, 1985. He will be in charge of instrumentation in the Soil Science Department at Dhaka University.

At the present time, there is no instrumentation repair and/or maintenance within the department. There is an "Instrument Repair Section" within Dhaka University. This consists of Electrical Engineer. The section is not an educational or training unit. The general consensus of opinion is that this is primarily for the motors, generators, etc. or power electrical units and not for

the electronic instrumentation. The faculty has had no success with their instruments sent to this unit.

Institute of Scientific Instrumentation.

This institute is located in Dhanmondi. It is administered by the University Grants Commission. Its primary purpose is training. The course is very rigid and exact. Their requirements must be met before a person is allowed to matriculate at the institute. This course would be taken by a person who was going to be a supervisor in a electronic equipment and maintenance center. This course duration is approximately 6 to 9 months with the subsistance being paid by the institute of scientific instrumentation. The prerequisites are as follows:

1. Must be employed by University of Governme..t.
2. Dipl. in Electronics 2-3 years or M.S. in applied physics.

The educational prerequisites listed above are absolute minimum.

BINA - Mymensingh:

This institute showed continuous improvement over the last visit in April 1985. The instrumentation was in very good repair over other units visited. This is due to a capable, full time electronics repair person. His major obstacle is the lack of spare or replacement parts; if the replacement parts were available, a visit to this institute would not be required. This improvement and positive situation can be attributed to Md. Shafiqullah.

The instrumentation which was non operative was reviewed with Mr. Shafiqullah who already diagnosed the problem. A list of the instruments can

be found in the Appendix II with the replacement part which would again have these instruments operative.

BAU - Mymensingh:

Soil Science Department.

Dr. Hoque, Head of the Soil Science Department met with us and worked on several instruments in his laboratory which were malfunctioning. We then went to Dr. M. Eaqub's laboratory. The cleanliness and obvious care given the instruments show a definite respect for the analytical aids. Further, the people associated with Dr. Eaqub have the same attitude towards instrumentation. This is a very impressive laboratory.

Soil Microbiology Department.

We met with Dr. Abdul Jabil Sarker who is Head of the Department. The instrumentation is very scant; most of the malfunctioning equipment is of the autoclave sterilizer oven type. This equipment is antiquated, dating to the late 1940's. Replacement parts are impossible to obtain. There is a definite lack of wall outlets in this laboratory, a pH meter had to be carried to a stool for testing. This causes accidents to the instruments.

Food Technology Department.

Dr. Md. Nazrul Islam, Head of the Department met with us and showed in his laboratories. This was the most impressive laboratory I have seen at the University including Dr. Eaqub's of Soil Science. The cleanliness and neatness with a bright polish and absence of rust on the equipment was befitting of a

Food Science department. There were a few pieces of equipment which were in need of repair and Dr. Islam was aware of their problems and able to describe the malfunctions very concisely. This made the repair job very easy. This was a very impressive operation.

Biochemistry Department.

The Head of the Department met with us and we were able to repair the few instruments which were in need of repair. This department is poorly equipped. It is difficult to understand how a program in biochemistry can be carried out and taught. The basic essentials required for teaching are absent such as spectrophotometers, flame photometers, etc. They have a centrifuge, but no refrigerated centrifuge, which completely eliminates protein isolation work, which is badly needed for the nutritional studies. The department has a single pH meter. This unit is not functional since the electrodes are five years old and have deteriorated. Therefore, we have a Biochemistry Department functioning without a pH meter. It is beyond my comprehension to imagine how a viable program can possible be carried out under the lack of facilities that exist in this facility.

BARI-RARS - Jamalpur:

Dr. N. Vignarajah, Associate Production Agronomist for Winrock International, met and guided us through the laboratory. Mr. Azizul Hoque also was in attendance at the training sessions since this was his place of employment. The laboratory is much cleaner and neater than I remember it to be from the visit in 1984. However, the number of electrical outlets which are

not working on the bench tops is at near maximum. Approximately 85 percent of the electrical outlets are dead. The visit was spent teaching how to use and operate equipment recieved in July of 1985. Not only was it necessary to explain its use and when it should be used, but basic operations were taught as part of the installation procedure. Many of the items had no use whatsoever in this laboratory. For example, the Wiley Mill was entirely foreign to them and they had no reason to grind their samples. Much of the equipment, which was received in June of 1984 was assembled during that consultancy (Mattick - June 1984). It was then disassembled and placed back in the boxes. This is a good example of poor planning concerning the supplying of the RARS of BARI. It is a waste of money, time, and effort. The laboratories should be consulted concerning their needs, and then these needs filled on the basis of performance. In some cases, parts of equipment was sent. In 1984, an EIL pH meter was sent without electrodes. This unit has never been used, since it is still without an electrode. This year, a portable pH meter was sent with two electrodes; however, the electrodes do not fit the EIL instrument and the portable meter is malfunctioning. The meter is being returned for repair or replacement. This unit is under warranty and should be replaced.

BJRI - Dhaka:

Three days were spend repairing instruments at this institution. There were twenty four instruments examined. Two were installed, ten were repaired, and in twelve units, the difficulty was diagnosed and replacement parts requested for five units. The others required parts manufactured outside of the U. S.

Nearly every section of this institute was visited. The physiology section was well kept and showed signs of good housekeeping. It is obvious that they work at maintaining a clean environment. The other sections do not show this careful housekeeping trend. The laboratories are dirty and cluttered. It is difficult to find a workable electrical outlet. The whole atmosphere is not what one would expect to find in a scientific atmosphere. This is not conducive to giving longevity to instrumentation. Several measures should be taken to rectify the situation at BJRI.

a. A thorough house cleaning - get rid of dirt and dust and a concentrated effort to maintain clean surroundings.
b. Reduce the humidity by dehumidifiers and/or air conditioners maintain a constant atmosphere.
c. Self closing doors in place of curtains. The doors should be kept closed.
d. Rodent proof the rooms.

Technical training on instrumentation is lacking. Several pieces of advanced technology equipment such as HPLC, GLC and ultra centrifuges have been received. The personnel involved with this instrumentation have done no preparation prior to receiving the unit. It was obvious that no reading, library research, or effort was expended to understand the units and their operation. Before this equipment is ordered, the donors should be certain of its use and the laboratory personnel's ability to operate it.

SDRI - Dhaka:

This was a pleasure to work in this laboratory. The instruments are of an older vintage; however, they are all well maintained and in good working order

with a few exceptions which were repaired in this consultancy or the problems diagnosed. The security of the laboratory prevents unauthorized personnel from tampering or misusing the instrumentation. A complete inventory of all instrumentation and equipment with the operation manuals and the condition of the units are on file. Upon entering the laboratory, I was met by Mostafizur Rahman, PSO, SRDI, who had a list of all inoperative equipment and the manuals for this equipment. We were able to proceed with our work without any hesitation.

During the course of instrument repair, questions concerning the instrument and its use are asked. It was obvious from the answers that this staff is well trained, technically. Their answers were very well phased in a manner, which would tell the repairer exactly of the malfunction.

This laboratory was exceptionally clean. The doors of the laboratories had self closing devices, with wipers and were air conditioned. It appeared that a great deal of though had gone into the arrangement of the laboratories.

In discussions with the personnel, it was discovered that the laboratories and their efficient operation is the result of Mostafizur Rahman, PSO. He is to be commended in the excellent job he has done.

BARI, RARS - Hathazari:

Fourteen instruments were repaired, installed, checked, and/or the malfunction insolated for replacement parts. These can be viewed in the Appendix II. Two of the instruments will require refrigerant and work orders to have this done have been submitted, two will require replacement parts

which shall be submitted, seven units were new and were installed, while three units were repaired and are now in working order.

A thorough house cleaning is needed. There are potato and carrots strewn about the floors of the laboratory. Birds and other animals have free access to the laboratory. This type of environment can only mean the degradation of equipment and instrumentation. It is difficult to vision any type of analytical work done under these conditions.

BARI, RARS - Jessore:

This is the most improved laboratory of any visited. A concentrated effort has been expended to clean the laboratory and to get rid of the clutter. It was hardly the same laboratory which was visited last April Repair problems were at a minimum. Much of the equipment received was installed. The defunct electrical outlets are being replaced by new units. Everything appears to be in working order and in a clean condition in this laboratory. The supervisory and laboratory personnel should be commended for a job well done. The improvement over the last six months has really lifted this laboratory to a better working environment.

BARI, Regional Laboratory ASD, Daulotpur, Khulna:

The purpose of this laboratory is difficult to understand. The RARS at Jessore is capable of doing the work being done at this laboratory. The equipment is a collection of old derelicts which should be discarded. With the exception of a flame photometer and a pH meter, the older equipment is grossly outdated. Most of the units can not be repaired, because spare or replacement

parts are not available. A decision should be made to properly outfit this laboratory or close it. I would recommend the latter.

BARI, RARS - Ishurdi:

From a housekeeping viewpoint, this is one of the better regional stations. Two major factors are obvious in an evaluation of this laboratory:

1. lack of electrical outlets in the laboratories
2. lack of fundamental training in the technical and basic sciences.

No program has been started to alleviate the shortage of electrical outlets in the laboratory. This shortage was reported in 1984 and 1985. further, in 1985, Recommendation 9 stated "The RARS Ishardi should not receive any further instruments or electrical equipment until proper electrical outlets are installed in the laboratories". Electrical receptacles should be placed every 1.5 meters along the bench walls. It is foolish to send more electrical and electronic units when they sit unused against a wall or carried to a single outlet in the room to a stool or make-shift "bench". This electrical wiring could be accomplished with P. L. 480 monies.

The need for fundamental training of the most basic nature is obvious. This training could have been obtained last March-April, 1985 and ;in November 1985 through the courses held at BARI, Joydebpur. RARS, Ishurdi did not send any individuals.

Before leaving Ishurdi, Mr. Mallick, Winrock International Associate Agronomist and I discussed the electrical problem. Mr. Mallick has discussed this shortage with the PSO and he has agreed to alleviate the shortage at the earliest time with P. L. 480 monies. Mr. Mallick asked for suggestions and

recommendations on this installation. I would recommend surface mounts with surface conduit. There should be two circuits per bench, one for instrumentation and one for power. The instrumentation circuit would initiate from an automatic drop-out relay which would lead to the 10KW voltage stabilizer. This instrumentation circuit would have a "British" type plug which would separate it from the power circuit. The outlets should be every 2 meters apart. The power circuit would have the standard 5 and 15 amp plug, but would not pass through the drop-out relay or the voltage regulator. These would be every 2 meters apart or between the instrument plugs. Plugs on the power and instruments will be changed appropriately.

# APPENDIX I

# ITINERARY OF DR. L. R. MATTICK

| DATE | LOCATION | DESCRIPTION | LOCAL COORDINATOR |
|---|---|---|---|
| October | | | |
| 25 | Dhaka | Arrival 12:30 PM | Dr. Portch |
| 26 | Dhaka | Prepare Course Material | Dr. Portch |
| 27 | Joydebpur | BARI, Soil Science | Dr. Portch |
| 28 | Dhaka/Joydebpur | BARC, BARI | Dr. Portch |
| 29 | Dhaka | DU, BARC, USAID | Dr. Reza |
| 30 | Joydebpur | BARI, BRRI | Dr. Portch |
| 31 | Joydebpur | BRRI | Dr. Portch |
| November | | | |
| 1 | Dhaka | Weekend | Dr. Portch |
| 2 | Dhaka | AECD | Dr. Reza |
| 3 | Mymensingh | BAU | Dr. Reza |
| 4 | Joydebpur | BARI | Dr. Portch |
| 5 | Dhaka/ Joydebpur | BARC, BARI | Dr. Portch |
| 6 | Dhaka | BUET | Dr. Reza |
| 7 | Dhaka | Holiday | Dr. Portch |
| 8 | Dhaka | Weekend | Dr. Portch |
| 9 | Joydebpur | Anal. Chem., Maintenance, and Inst. Course | Dr. Reza |
| 10 | Joydebpur | Anal. Chem., Maintenance, and Inst. Course | Dr. Reza |
| 11 | Joydebpur | Anal. Chem., Maintenance, and Inst. Course | Dr. Reza |
| 12 | Joydebpur | Anal. Chem, Maintenance, and Inst. Course | Dr. Reza |
| 13 | Joydebpur | Anal. Chem., Maintenance, and Inst. Course | Dr. Reza |
| 14 | Joydebpur | Anal. Chem., Maintenance, and Inst. Course | Dr. Reza |
| 15 | Dhaka | Weekend | Dr. Portch |
| 16 | Mymensingh | BINA | Dr. Reza |
| 17 | Mymensingh | BINA | Dr. Reza |
| 18 | Mymensingh | BAU | Dr. Reza |
| 19 | Mymensingh | BAU | Dr. Reza |
| 20 | Jamalpur | BARI, RARS | Dr. Reza |

| | | | |
|---|---|---|---|
| 21 | Jamalpur | BARI, RARS | Dr. Reza |
| 22 | Dhaka | Weekend | Dr. Portch |
| 23 | Dhaka | BJRI | Dr. Reza |
| 24 | Dhaka | BJRI | Dr. Reza |
| 25 | Dhaka | BJRI, BARC | Dr. Portch |
| 26 | Dhaka | Holiday | Dr. Portch |
| 27 | Dhaka | SDRI | Dr. Portch |
| 28 | Dhaka | BARC | Dr. Portch |
| 29 | Dhaka | Weekend | Dr. Portch |
| 30 | Joydebpur | BARI, Wheat | Dr. Portch |
| December | | | |
| 1 | Hathazari | BARI, RARS | Dr. Porch |
| 2 | Chittagong | FRI | Dr. Portch |
| 3 | Joydebpur | BARI, Agronomy | Dr. Portch |
| 4 | Dhaka | AECD, USAID | Dr. Portch |
| 5 | Joydebpur | BARI, ASD | Dr. Portch |
| 6 | Dhaka | Weekend | Dr. Portch |
| 7 | Khulna | BARI, RLASD | Mr. Villegas |
| 8 | Jessore | BARI, RARS | Mr. Villegas |
| 9 | Ishurdi | BARI, RARS | Mr. Mallick |
| 10 | Ishurdi | BARI, RARS; STRI | Mr. Mallick |
| 11 | Ishurdi | STRI | Mr. Mallick |
| 12 | Ishurdi/Dhaka | BARI, RARS; BARI | Mr. Mallick/ Dr. Portch |
| 13 | Dhaka | Weekend | Dr. Portch |
| 14 | Sylhet | BTRI | Dr. Portch |
| 15 | Sylhet | BTRI | Dr. Portch |
| 16 | Dhaka | Holiday | Dr. Portch |
| 17 | Dhaka | AECD | Dr. Portch |
| 18 | Dhaka | Report writing | Dr. Portch |
| 19 | Dhaka | Debriefing 12:00 N | Dr. Portch/ Dr. Daugherty |
| 20 | Dhaka | Depart 2:00 PM | Dr. Portch |

# LIST OF PARTICIPANTS

in the

Analytical Chemistry, Maintenance and Instrumentation Course

Presented

November 9 - 14, 1985

at

BARI, Joydebpur

| Name | Designation | Organization |
|---|---|---|
| 1. Md. Jolmul Abedin Mian | Research Associate | BAU |
| 2. Abu Saleque | Scientific Officier | BRRI |
| 3. Safiuddin Kaiser Zaman | Scientific Officier | BRRI |
| 4. Md. Khorshed Alam | Scientific Officier | SDRI |
| 5. Bishnu Pada Lakiri | Scientific Officier | BINA |
| 6. Malik Akhter Hamid | Scientific Officier | BARI |
| 7. Zahir Uddin Ahmed | Research Assistant | BUET |
| 8. Kisivar Jahan | Research Associate | BUET |
| 9. Quamrul Ahsan | Scientific Officier | BTRI |
| 10. S. M. Imamul Huq | Assistant Professor | DU |
| 11. Rameswar Handal | Assistant Professor | DU |
| 12. Amir Ali | Senior Scientific Officer | BARI |

SHORT COURSE

On

# FUNDAMENTALS OF ANALYTICAL CHEMISTRY AND INSTRUMENTATION

November 9-14, 1985
BARI, Joydebpur, Gazipur

OBJECTIVES:

Analytical chemistry and instrumentation provide a valuable support to Agricultural Research. Speed and accuracy are of the utmost importance. Laboratory personnel must understand the fundamentals of analytical chemistry, instrumentation installation, basic instrumentation, and simple repair and maintenance of equipment. This short course is designed to give laboratory personnel needed competence in the major analytical methods used in Agricultural Research.

PROGRAM:

| Date/Time | Activity | Responsible Person |
|---|---|---|
| November 9, 1985 | | |
| 09:30-10:00 | Course Inauguration | Director-General BARI or Representative |
| 10:00-10:30 | Tea | |
| 10:30-11:30 | Introduction and Initial Evaluation Examination | Dr. L. Mattick |
| 11:30-12:00 | Tea | |
| 12:00-14:00 | The Analytical Balance | Dr. L. Mattick Cornell University |
| November 10, 1985 | | |
| 08:00-10:30 | Fundamentals of Analytical Chemistry | Dr. L. Mattick |

| Date/Time | Activity | Responsible Person |
|---|---|---|
| November 10, 1985 | | |
| 10:30-11:00 | Tea | |
| 11:00-14:00 | Gravinietric Analysis Volumetric Analysis | Dr. L. Mattick |
| November 11, 1985 | | |
| 08:00-10:30 | Ph and Buffer | Dr. L. Mattick |
| 10:30-11:00 | tea | |
| 11:00-14:00 | Spectrophotometry | Dr. L. Mattick |
| November 12, 1985 | | |
| 08:00-10:30 | Atomic Absorption Spectrophotometry | Dr. L. Mattick |
| 10:30-11:00 | Tea | |
| 11:00-14:00 | Atomic Absorption Spectrophotometry | Dr. L. Mattick |
| November 13, 1985 | | |
| 08:00-10:30 | Gas Chromotography | Dr. L. Mattick |
| 10:30-11:00 | Tea | |
| 11:00-14:00 | High Pressure Liquid Chromotography | Dr. L. Mattick |
| November 14, 1985 | | |
| 08:00-10:30 | Statistical Treatment of Analytical Data | Dr. L. Mattick |
| 10:30-11:00 | Tea | |
| 11:00-12:00 | Final Evaluation Examination | Dr. L. Mattick |
| 12:00-13:00 | Course Closing | Director-General BARI or Representative |

Analytical Chemistry Instrumentation and
Maintenance Course

November 9-14, 1985

Initial Evaluation Examination

1. An instrument room should be

   a. Air conditioned.
   b. Rodent proofed.
   c. Dehumidified.
   d. Dust and dirt free.

2. For an unequal arm balance, the

   a. Weight is added for weighing.
   b. Weight is removed for weighing.
   c. Sensitivity linearly increases as weight decreases.
   d. Sensitivity is uniform over the entire range.

3. When setting up or using a balance.

   a. Load and unload the balance when it is fully released.
   b. Set up balance where it will be free from vibration.
   c. Only turn weight setting knobs with balance semi releases.
   d. Clean balance with organic solvents such as acetone, ether or benzene like substance.

4. A nanogram is

   a. $10^{-3}$ grams
   b. $10^{-6}$ grams
   c. $10^{-9}$ grams
   d. $10^{-12}$ grams

5. Normality and molarity of a solution are the same when

   a. The compound is highly ionizable.
   b. The compound is non-ionizable.
   c. The compound is partially ionizable.
   d. The compound is hydrated and non-ionizable.

6. A part per million (ppm) is

   a. Milligrams/liter.
   b. Micrograms/microliter.
   c. Micrograms/milliliter.
   d. Nanograms/microliter.

7. Methods of gravimetric analysis are

   a. Volatilization method.
   b. Du Bye theory method.
   c. Postulate and prove method.
   d. Precipitation method.

8. Apparatus for accurately measuring volume are

   a. Beaker
   b. Pipette
   c. Buret
   d. Erlenmeyer flask.

9. The liter of a solution is

   a. The weight of a substance that is chemically equivalent to 1 ml of that solution.

   b. The weight of a solution that is equal to the molecular weight of that solution.

   c. The weight of a substance that is equal to the formula weight of that substance.

   d. The volume of a liquid which is needed to make a molar solution.

10. By definition, pH is

   a. Hydrogen ion concentration.
   b. $-\log [H^+]$
   c. $1 \log [H^+]$
   d. $1 \log [H^+]$

11. pH is measured by

   a. Potentiometrically.
   b. Volumetrically.
   c. Titration.
   d. Colorimetrically.

12. When a pH meter is malfunctioning, it is usually because

    a. Meter is sticking.

    b. Electrode is bad.

    c. The meter is not calibrated properly.

    d. The meter has been electronically damaged.

13. By definition, a buffer.

    a. Resists a change in pH.

    b. Is a chelating agent.

    c. Is a weak base or acid together with its salt.

    d. Resists a temperature change.

14. In spectrophotometry, the major difference between a prism and a grating dispersion is

    a. A grating will give a non-linear dispersion and prism a linear dispersion.

    b. A grating will give a linear dispersion and a prism a non-linear dispersion.

    c. A grating will give a better resolution of the wavelength.

    d. The prism is more expensive and delicate.

15. A spectrophotometer is found to be inoperative what could be wrong?

    a. Fuse blown.

    b. Source lamp turned out.

    c. Dead power outlet.

    d. Fine cord not connected to outlet.

16. In using a spectrophotometer you find the readings are not repeatable. What could be the problem?

    a. Line cord not connected to outlet.

    b. Poor analytical technique.

    c. Wavelength calibration error.

    d. Loose sample holder adapter.

17. The discrete radiation of an atomic absorption spectrophotometer is supplied by

    a. Tungsten lamp.

    b. Ultraviolet light.

    c. Hallow cathode lamp.

    d. A prism.

18. A solid in order to be used for atomic absorption must be

a. Digested with acid to give a liquid material.

b. Dissolved in water.

c. Of organic compound origin.

d. Have, C, H, and O in its matrix.

19. In order to obtain good analytical results from atomic absorption, which of the following maintenance steps must be done routinely.

a. Dust the top of the unit daily.

b. Recondition the burner after use with organic compounds.

c. Clean the nebulizer daily.

d. Clean the burner head slot after use with a razor blade.

20. Which of the following are gas chromatographic detectors?

a. Katharometer.

b. Flame ionization detector.

c. Flame photometric detector.

d. Fluorescence detector.

21. The optimum carrier gas flow is determined by

a. Beers lambert plot.

b. Plank's constant.

c. Syzmanski - anino plot.

d. Van deemter plot.

22. An irregular or unstable base line on a gas chromatogram can be caused by

a. Intermittant short in the circuit.

b. Contaminated detector.

c. Dirty syringe.

d. Column bleed or contamination.

23. Which of the following are high pressure liquid chromatography detector.

a. Katharometer.

b. Flame ionization detector.

c. Flame photometric detector.

d. Differential refractometer.

24. A high pressure liquid chromatogram shows signs of base line spiking. What could be a probable cause?

    a. Loose electronic connections.

    b. Air bubbles through the dector.

    c. Inlet system clogged.

    d. Faulty pressure gauge.

25. Measures of central tendency are

    a. Mean or average.

    b. Standard deviation.

    c. Median.

    d. Average deviation.

# FUNDAMENTALS OF ANALYTICAL CHEMISTRY AND INSTRUMENTATION FINAL EVALUATION

This is a multiple choice examination. There are four answers given to each question. Any answer may be correct. The question may be answered with one, two, three, four, or none of the given answers. Circle the correct answer(s) for each question.

1. The difference in the mechanism of weighing between an equal and unequal arm balance is:

   a. The equal arm balance, weight is removed.
   b. The unequal arm balance, weight is removed.
   c. The unequal arm balance, weight is added.
   d. The equal arm balance, weight is added.

2. The advantage of the unequal arm balance over the equal arm balance is:

   a. Speed.
   b. Unaffected by moisture.
   c. Does not need calibration.
   d. Sensitivity the same over entire weight range.

3. A fundamental rule for maintaining accuracy and reproducibility of a balance is:

   a. Load and unload the balance when it is semi-arrested.
   b. Never use soapy water to clean the metal and plastic housing.
   c. Only turn weight setting knobs with the balance in an arrested or semi-arrested position.
   d. Take weighings with the sliding doors open.

4. After release, the balance does not give a smooth movement of the scale and the scale moves jerkily or comes to an abrupt standstill; this can be corrected by:

   a. Leveling the balance.
   b. Oiling the knife-edge.
   c. Cleaning the damping pot.
   d. Arresting the balance and turning the weight knobs to 9 and back again.

5. The term "Stoichiometric" refers to

   a. The concentration of solutions.
   b. Weight relationships among reacting substances.
   c. A type of electronic probe.
   d. A method of expressing concentration.

6. The Formality (F) of a solution always expresses:

   a. The number of gram-molecular weights of a species in Liter of solution.
   b. The number of equivalents contained in 1 Liter of solution.
   c. The number of gram-formula weights of solute present in 1 Liter of solution.
   d. The concentration as a function of weight percent.

7. The primary tool of all analytical analysis is:

   a. Weighing bottle.
   b. Analytical balance.
   c. Desiccator.
   d. Buret.

8. In a gravimetric analysis, the use of ones finger to transfer weights or container to the balance is done.

   a. All the time.
   b. In special cases.
   c. Occasionally.
   d. Never.

9. A standard solution is:

   a. A reagent of exactly known concentration.
   b. A primary standard.
   c. Used only in Acid - base titrations.
   d. None of the above.

10. The end point of a titration is:

   a. When the weight of the reactants are equal.
   b. When the gram-molecular - weights of the reactants are equal.
   c. When the volume of the reactants are equal.
   d. When the equivalents of the reactants are equal.

11. pH is a measure of

    a. Titratable acidity.
    b. Dissociated acid.
    c. A measure of $[H_3O^+]$
    d. Buffer capacity.

12. pH is measured.

    a. Colorimetrically.
    b. Potentiometrically.
    c. With a standard solution.
    d. With an indicator.

13. If a pH meter was acting errotically, you would first isolate whether the cause was the meter or the electrode. This would be done by disconnecting the electrodes from meter and

    a. Measure the potential across the cells.
    b. Short out the leads of the electrode.
    c. Short out the input to the meter.
    d. Reverse the leads of the electrode.

14. Absorbance is

    a. Linear arithmetrically.
    b. Linear logrithmically.
    c. Log %T
    d. Curvilinier.

15. In spectrophotometric, gratings are preferred to prisms because

    a. Less wavelength error.
    b. Easier to handle.
    c. Less expensive for the quality received.
    d. Gratings give a linear wavelength despersion.

16. The physical law which is used to describe the absorbance of light by a solution is called

    a. Henderson - Hasselback.
    b. Bayle - Charles.
    c. Beer - Bouger.
    d. Lambert - Dubye.

17. You turn the spectrophotometer on and the instrument does not function. This problem is caused by:

    a. Not plugged in.
    b. Fuse blown.
    c. Light source burned out.
    d. Dead power outlet.

18. You have an inorganic solid partially soluble in water. How could you prepare this solid for analysis in a flame atomic absorption spectrophotometer.

    a. Grind it very fine and place in the flame.
    b. Wet ashing.
    c. Dissolve in water.
    d. None of the above.

19. The Graphite Furnace Atomic Absorption Spectrophotometry is_____ sensitive than the flame.

    a. The same
    b. 5 times more
    c. 5 times less
    d. 100 times more

20. The light source in a atomic absorption spectrophotometer is called.

    a. Tungston lamp.
    b. Ultra violet lamp.
    c. Hollow cathode lamp.
    d. Deuterium lamp.

21. Gas chromatography utilizes a gas as the mobile phase. These gases usually are either.

    a. Oxygen or Acetylene.
    b. Hydrogen or Nitrogen.
    c. Nitrogen or Helium.
    d. Argon or Methane.

22. Which of these detectors are not used in gas chromatography.

    a. Katharometer.
    b. Flame ionization detector.
    c. Differential refractive index detector.
    d. Electron capture detector.

23. Your duplicate analysis shows that you have a lower peak height and a longer retention time ($t_r$). What are possible causes of the difficulty.

a. Leaky system.

b. Absorption of sample by column, glass wool or tubing.

c. Low carrier gas flow.

d. Incomplete sample injection.

24. The heart of a gas chromatograph is

a. The injector.

b. The column.

c. The detector.

d. The electrometer.

25. Which of these detectors are used in liquid chromatography.

a. Katharometer.

b. Flame ionization detector.

c. Differential refractive index detector.

d. Electron capture detector.

26. Air bubbles in the detector will cause.

a. An unsteady base line.

b. Ghost peaks.

c. High pressure with little flow through the system.

d. Spiking at random internal.

27. The pressure gauge on your pump shows exceedingly high pressure with very little flow through the system. The problem could be.

a. Air lock in the pump.

b. Particulate matter clogging the head of the column.

c. System leak.

d. Air bubbles in the line.

28. What are measures of central tendencies

a. Mean.

b. Medium.

c. Average deviation.

d. Standard deviation.

29. What are measures of dispersion

    a. Mean.
    b. Medium.
    c. Average deviation.
    d. Standard deviation.

30. A normal - error curve is

    a. Skewed right.
    b. Skewed left.
    c. Bell shaped.
    d. None of the above.

31. The types of errors found in analytical results are

    a. Absolute.
    b. Relative.
    c. Determinate.
    d. Probable.

32. Instrument rooms in Bangladesh should have the following conditions:

    a. Dehumidified.
    b. Dust free.
    c. Air conditioned.
    d. Rat proofed.

33. You have just received a new atomic absorption unit in your laboratory. The first thing you should do is

    a. Assemble it.
    b. Plug it in and check it out.
    c. Read instruction manual.
    d. Adjust the nebulizer for accurate flow.

34. You have been requested to prepare 20 ml of solution containing 100 ppm K. You have a solution of 1000 ppm K. Which of the following formulas would you use for the calculations.

    a. $X + Y = r^2$
    b. $V \times N = V \times N$
    c. $V \times \Lambda = W$
    d. $V + N = V \times N$

cp

# APPENDIX II

BARI:

SOILS TESTING LABORATORY:

Pure Water System.

1. Changed filter on the water inlet line. Cleaned filter housing
2. Repaired mounting screw on filter housing head; attached filter housing to wall by means of a board . This made the mounting steadier.
3. Changed mixed bed resin tanks. Spare tanks were found in chemical storage.
4. Replaced socket and switch for the pump power supply - switch on the old unit was defective.
5. Pumped up to 25 psi in the air ballast tank to prevent chattering of the motor at the cut-off switch.

Mettler Balance Model H31R, S/N 329349. Scale was misaligned and out of focus - realigned and refocused. The 10 gram weight knob had been forced, which actually placed 120g on the unit when it read 0. This is caused by attempting to place weight on the balance in the full release position. This should never be done on any balance. Weights should only be place on the balance in the semi-released or full arrested position. The full release on this balance locks the weight knobs, and the only method of placing weights in this position is to force the knobs, which causes a misalignment of the weight readings. The indicator was realigned with the weights. The balance also required leveling. Unit was checked for accuracy and sensitivity.

Ainsworth Balance Model 10N, S/N 59921. This balance is to be operated only on 115 VAC. THe balance required repair to the zero adjustment; A spring had lost its tension and would not allow a full scale for zero. This spring was repaired and the zero was operational. The balance required leveling and adjusting of weight and sensitivity. The accuracy and sensitivity were checked.

Chyo Jupiter C3-200 Analytical Balance, S/N 31194. This unit was severly out of level. The projection scale was misaligned and out of focus. The unit was leveled, aligned, and focused. The accuracy and sensitivity were checked.

Automatic Transistorized AC Voltage Stabilizer Model SPS102, S/N 2200. No output was observed from the unit. A check of the circuit indicated that a wire from the secondary winding of the tramsformer was loose. This had been soldered and a "cold joint" developed. This wire was repaired and a new fuse was placed in the holder. Unit was operational.

SOIL MICROBIOLOGY:

New equipment was received by this laboratory. The equipment was unpacked and checked for shipment damage, then installed.

Eberbach Model 6140-25 Shaker. Installed plug and checked motor operation This unit was received without several optimal units which are necessary for operation. These are:

Cat. No. 6161 Carrier plate large, 32 X 20 1/2 inches

Cat. No. 6090-50 Flask holder 500 mL.

Cat. No. 6090-60 Flask holder 1000 mL.

They may be obtained from

Eberbach

Post Office Box No. 1024

Ann Arbor, MI. 48106

The 125 mL. flask holder plate from a Lab Line shaker was fitted make shift so that the unit could be used.

Lab Line Orbit Shaker Model 3591, S/N 0884-0092. Installed plug and placed the 250 mL. flask holder in place. Checked operation at speeds over the entire range. Unit performed satisfactorily.

Lab Line Imperial II Incubator Model 401, S/N 0384-0482. Installed 5; amp. plug. Power to the 5 amp. receptacle was lacking; problem was found to be in the switch. Repaired the receptacle and checked the operation of the thermostat and safety control. It cycled as per specifications. Laboratory personnel were informed that they would have to construct a graph of the thermostat setting vs the temperature, since the numbers on the thermostat dial are arbitrary.

Fisher Isotemp 400 Series Oven Model 418F, S/N 247. This unit was in the Soil Science Laboratory. It was moved to the Soil Microbiology Laboratory.

The unit was connected and placed in operation and its performance checked over a period of time. The operation was satisfactory.

Bausch and Lomb Spectronic 88 Spectrophotometer, S/N 0605023. Installed plug and changed voltage to 220 VAC. Experienced dificulty with this unit in as much as it failed to operate. The trouble was not in the unit, but in the manner in which the receptacle was wired. This unit was wired much the same as those in Australia. Following an adoptive wiring of the plug, the unit was checked for operation in the percent T mode. The zero setting was checked, then 100% T was set using water in the cuvette. The unit was then shifted to 0-1 absorbance. Unit operated as per specifications.

Labconco Rapid Distillation Apparatus Model 65000. Installed stepdown transformer since this unit is to be operated on 115 VAC. Assembled the distillation unit. Connected 5/16" tygon tubing to the cooling condenser inlet and aspiration outlet. Also connected 5/16" tygon tubing to the water supply inlet and the flow control valve. The laboratory personnel were instructed on the use of the unit and told to use only distilled or deionized water for the steam generator.

BRRI:

SOIL SCIENCE:

GCA Precision Science, Thelco Oven, S/N 22A18. Replaced plug; changed polarity of plug. Oven was working and mantained temperature.

Mettler H20T, S/N 373807. This unit appeared in the report of April, 1985. The indicator wheel and gear are missing. No attempt to order this part has been made. Checking further, this balance was reported to have this defect in the Clayton Report of 1983. The Balance can not be read without this gear and wheel. Must have the mechanism to repair.

Fume Hood - The acid digestion fume hood was not working. Removed the fan and motor and found that the motor had an open winding. This can be rectified by either a new motor or taking the old motor to Old Dhaka and having it rewound. I would favor the rewinding of the motor.

Rice Technology:

Cahn Electrobalance DTL Model 7500, S/N 70477. This unit appeared in the April, 1985 report. It was received inoperable. The parallelogram/flexture support for weighing does not align. This is extremely delicate and should be done only by a factory trained person. The unit should be packaged and returned to the suppliers for repair, since in its present condition it's useless. Special tools are required to align and repair this unit. Any attempt to repair other than at the factory could result in unrepairable damage.

Numigral Seed Counter Type No. CMT. This instrument appeared to be working. However, extensive taping had been done in the circuitry. It will operate for a time then blow a fuse. A check of the circuitry indicates that the Durant Solid State 1800 Counter, Model 1800-521, produced by Durant, Watertown, WI, USA is the problem. When we were able to question the

investigator, the complaint was that the unit when placed on a speed of 8 - 10 would not count accurately. This is when an attempt was made to repair the underside, which resulted in a short that caused problems in the Durant counter circuit. If greater accuracy was required the speed should have been lowered, since one must sacrifice speed for accuracy.

Mettler PC2000 Electronic Pan Balance. This unit had its plug removed. The plug was replaced and the unit operated satisfactorily. A complaint was also made that variations in the readings were observed; however, when the unit was placed on a stable surface, which was free of vibrations, the variations were not present.

Physiology:

Gallenkamp Oven/sterilizer Cat. No. OV8-00. Adjusted door closure.

Corning Model 3 Portable pH Meter, Cat. No. 475074, S/N 7343. This unit is two years old and the batteries have never been changed. It required 2 - 9V transistor batteries. The voltage of the two batteries in the unit were 5 and 7 volts. New batteries would make this unit operable. Further, the electrode shows signs of crystallization and should be regenerated as per the directions in Analytical Chemistry, Instrumentation, and Maintenance by Mattick and Portch.

Salinity Meter Model 33, Yellow Springs Instrument Co., S/N 8506. Batteries missing. Required 2 - D cells (1.5V). When batteries were replaced; Instrument checked out to specifications.

Gallenkamp Illuminated Cooled Incubator List No. 1H287. App. No. 5B8666C. The timer motor was stuck and nonoperable. Disassembled timer and released motor and reassembled. Unit operated as per specifications.

Lab Line Refrigerator Cat. No. 3550, S/N 0374. This is a 115VAC unit. From appearances, this refrigerator was placed across 220VAC, which burned out the compressor control relay circuit. This unit has been removed from the refrigerator and the lines are connected directly to the compressor. Continuity tests indicate the compressor is shorted. This unit is being used as a storage cabinet, as a refrigerator it should be removed from inventory.

Agronomy:

Cleland International Germinator, No Model No. or S/N. This unit is operable but needs a door gasket. An exact replacement can be ordered from:

Cleland International Inc.
Seed and Processing Equipment
2800 Washington Ave No.
Minneopolis, MN 55411

or heat resistant gasket material may be purchased locally and a gasket made.

Torsion Balance Model DWM2-1, S/N 131568. This balance was checked and found to work satisfactorily. The weighing is linear and reproducible. In order to use this balance or any balance, it must be level. Further, this type of balance is leveled to the null point. Care must be taken to make sure that the gross weight index is engaged. This will be accomplished by a click of the indexing ball. The balance was extremely dirty. It was cleaned and its operation rechecked.

Sybron Muffle Furnace. This unit is new and installation was requested. A muffle furnace requires a great deal of current or amperage. This unit at 240 VAC would require 17 amps to operate. Therefore, this unit should be wired on its own line, in this case, using an AWG 10 wire to a 25 amp breaker. This inlet line should be installed by electricians. However, even with the power line, it would have been impossible to install this unit, since the controller for the furnace was not ordered and will be required before it can be properly installed.

Agricultural Engineering:

Townsend and Mercer Oven S/N 780220. SCR T470000 (772G) is open. This open caused the 10 ohm resistor, which was in series to burn out. These parts can be obtained locally.

BINA--Mymensingh:

Turner Flame Photometer Model 510, S/N 41153. Compressor pump is frozen and using the usual procedures, unable to free the pump. The unit will

need a new compressor pump. This is a pump replacement Kit, Part No. 510-016. The blue sensitive photoconductive cells which regulate the flame are also defective. It will require 2 Clairex CL702 units, which are in the Flame detector and ignitor circuit. The electromotive amplifier is faulty due to non use and moisture (mold). This is part Assembly 510-335J; Drill 510-336J.

YSI Conductivity Bridge Model 31, S/N 4447. The conductivity cell is defective and does not allow the full use of the instrument. It requires a new conductivity cell Part No. YSI 3401 with a cell constant (K) = 1.0

Corning pH Meter Model 7, S/N 2762. The meter was unstable even when shorted. Defective capacitor to ground replaced, which rectified the situation. However, the electrodes are in a very poor condition. An attempt to regenerate the electrodes was unsuccessful. Needs a new Fisher Combination Electrode - Catalog No. 13=639-90.

Packard Tri-Carb Liquid Scintillation Spectrophotometer. The automatic control and sampling unit is in good working order. The Tri-Carb Scintillation Spectrophotometer Model 3330 has been excessively damaged by rodents! Components and the wiring are badly chewed. This unit is beyond repair.

Fisher Accumet Model 420 Digital pH/Ion Meter, S/N 382. Meter function is as per specifications. The unit requires a new electrode ( Fisher Combination Electrode Cat. No. 13-639-90).

Beckman Model 25 Spectrophotometer Model 1331 Cat. No. 133101, S/N 1200503. The vibrating mirror which acts as a chopper is not vibrating and needs to be replaced. This unit is used to split the beam for double beam operation. Also the stepper motor employed to program the slits for recording spectra is malfunctioning and should be replaced.

Jarrell Ash Dial Atom III Model 82/720, S/n 21671. This instrument has not operated satisfactorily since its purchase in 1977. At least eight electronic persons have examined and attempted to repair this unit ( Consultancy report of Mattick - April, 1985, Page II-5). The Jarrell Ash Company has been purchased by the Fisher Scientific Company. Fisher was contacted and advised Mr. Rezaul Huq Khan, Executive Director of Centra Enterprises in Dhaka, who are agents for Fisher in Bangladesh, of the situation. Mr. Khan and his electronic repairman came to BINA in Mymensingh and examined the unit. They viewed the circuit boards which had been replaced and examined the circuits and found no new malfunctions as per the service manual. They have decided to have the unit shipped to Dhaka, where extensive testing would be done. They were informed that the unit must be in working order before it is returned.

Bangladesh Agricultural University - Mymensingh:

Soil Science Department:

Bosch Balance, Model P1200, S/N 921. The optics of this balance were extremely dirty. The mirrors and lens were cleaned. Balance was then operating and in good repair.

Bosch Balance, Model P1200, S/N 922. The one gram weight removal mechanism was rusted and would not operate and the zero adjust cord was fouled. Both units were released and the balance was recalibrated after proper leveling.

International Instruments Conductivity Bridge Model RC16B2, S/N 32447. The power transformer was burned-out. This is a 115 VAC instrument which uses a step down transformer. The step down transformer shorted placing 220VAC across the 115VAC transformer. This is a very old instrument for which parts are not available. Fortunately, in June 1984, we used parts from another unit to repair this one. The older unit was saved and had the transformer required. The transformer was replaced and the conductivity bridge was checked and found to operate satisfactorily.

Pye Unicam SP9-400 Atomic Absorption Spectrophotometer, S/N 323211. An exhaustive check of the electronic circuit revealed the Autozero and Dampening printed circuit board F291 was defective. The defect is in one of the integrated circuits, but since it is impossible to check these boards without PC extensions; it is advisable to replace the whole board. This product is made in Cambridge , England and will have to be ordered by the Von Humbolt Organization in West Germany. Dr. Eaqub has been given the part no. for ordering purposes. Mr. Khalilullah of the Electronic Services will install it.

Beckman Double Beam Spectrophotometer Model DBGT. S/N 42001. In the April, 1985 consultancy, it was found that the grating was fogged and would not function properly. A new grating was ordered and received. The unit was dissassembled and the new grating installed. The unit was recalibrated and its operation checked.

Soil Microbiology Department:

Corning Model 7 pH Meter, S/N 1131. The meter was checked by shorting the electrode inputs and found to be in good wooking order. The electrodes require replacing. A Fisher Combination Electrode Cat. No. 13-639-90 is needed.

Equal Arm Balance - Origin Unknown. The rider for the mg and 0.1 mg weight is missing. Unable to ascertain make, model, or origin of the unit in order to replace the rider. The right hand pan was placed on the balance backwards. Placed the pan in the proper position, adjusted the balance, and leveled. The balance can be used to measure ±0.001 g. accuracy. If an appropriate rider is found, then it can be used to measure to ±0.0001g.

Food Technology Department:

pH Meter Elpo Type N-5111, NR644. Electrode is missing, which has a BNC to standard plug and pin. Requires and adapter (Fisher Cat. No. 13-64-155) and a Fisher Combination Electrode (Cat. No. 13-639-90).

Bausch and Lomb Model 20 Spectrophotometer, S/N 0516292. Light source is open. Requires a lamp for series 33.31.72, Cat. No. 33-33-85. When a substitute lamp was placed in the unit to check operation, severe meter drift was observed. The phototube is weak and requires a Blue Phototube Cat. No. 33-29-71.

Gdansh Balance (Polish made) Type WR-35, S/N 61427. Fuse blown, continuity indicates a short in the circuit. Checked the step down transformer (220 VAC to 6VAC) and found the primary winding shorted. Purchased a step down transformer locally and repaired the unit. The reading of the unit was off by one gram. Adjusted the unit gram reading wheel. Checked balance after leveling and adjusting. Balance was repaired and in working order.

Biochemistry:

Fisher Accumet Model 320 Expanded Scale Research pH Meter, S/N 164. pH meter on test position was satisfactory. A check of the electrodes indicates they deteriorated with age and need replacing. Require a Fisher Combination Electrode Cat. No. 13-639-90.

Labconco Lyophilizer (Freeze Drier) Cat. No. 75305-54265, S/N 37254. This unit was purchased believing it was a self contained freeze drier. However, the freezing source is "dry ice". The operation was explained that dry ice is required for the operation of the unit and that a dry ice maker would be required.

Electronic Services Section:

There are eight pH meters which are out of order for the lack of electrodes. Some have been broken, others have deteriorated. An attemp to rejuvinate the electrodes was not successful. These meters were checked by me and found to be inoperable; except for the electrodes. It will require eight Fisher Combination electrodes Cat. No. 13-639-90 to make these units operable.

BARI - RARS, Jamalpur:

Cole Palmer Hygrothermometer Model 8368-00, S/N 93067. Received in July, 1985 from BARC. Repaired latch, assembled and checked operation for 24 hours.

Extech Portable pH Meter Digital Model 607, S/N 9213/04. Checked operation; meter would not respond properly - gave a constant reading of 19.95. Shorted the electrode inputs and the meter still read 19.95. Applied a potential to the inputs - no response. After checking the circuit, still was unable to detect the cause of the problem. This unit was received in July, 1985 and should still be under warranty. Wrote receipt for unit and returned it to the commodities officier for repair or replacement by the vendor.

Arthur H. Thomas Intermediate Lab Mill. Assembled the unit and checked all parts. The unit operated as would be expected. This unit was received in the July, 1985 shipment.

Fisher Counter Scale Model 02-116, S/N 158737. Unpacked and set up the scale as per the directions by removing all wicks and restraints. Unit did not work as would be expected. Cloth wicks were used on the knife edges in shipping. These retained moisture and caused rusting at the knife edge, which resulted in a sticking and inaccuracy in the scale. This should be treated with WD-40 or some other rust remover.

Sheldon Manufacturing Convection Oven Model 1320E, S/N 8841320. Installed plug and thermometer. Checked operation of the unit for a two hour period. Performed satisfactorily.

Lab Line Frigid Cab Cat. No. 3552-11, S/N 1184-002. Installed plug and placed unit in operation. Allowed to operate for two hours. The unit worked perfectly. Laboratory Personnel wanted to control the temperature to 5°C. This unit is an upright freezer and can only operate below -2°C, since the refrigerant is R-12. The temperature control is a numerical load control. The task of explaining this was further complicated by the inventory which had this unit listed as a refrigerator.

Barnstead Distilled Water Still Model A1007, S/N 422D. Requires (2) gaskets, Evaporator steam cover (Part No. 06271) also requires 1/2 inch and 1/4 inch I. D. Tygon tubing.

Fisher Accumet pH Meter Model 620, S/N 199. Installed 220V, 5Amp. plug. Checked meter operation and electrode. The unit was in perfect operating condition.

EIL (Kent) pH Meter 7020, S/N 7020/4276. This unit was delivered in 1984 without an electrode. The absence of the electrode was reported at that time and to this date no electrode has been sent. I have been informed that this electrode can be purchased locally at the Bangladesh Scientific Supply Co, in Dhaka. The model No. of the electrode is 1160-200 and the part No. 33-1160-200.

Day-Night, Maximum-Minimum Thermometer; No manufacturer; No Model or S/N. Mercury column was split and the alcohol above the mercury had bubbles of air in it. Removed the split in the mercury and the bubbles from the alcohol. The unit was in perfect working order.

BJRI - Dhaka:

Soils Department:

Pye Unicam SP2900 Atomic Absorption Spectrophotometer. Autozero has malfunctioned since 1981. This unit was purchased from the Bangladesh Scientific and Surgical Equipment Co., Dhaka. They wanted to be paid to repair the unit even though it was within the warranty period. Since it was not causing any real problems; the repairs were never made. At the present time, the autozero is malfunctioning and causing erronious readings. The Bangladesh Scientific and Surgical Equipment Co. should be notified and confronted with the

correspondence on this instrument. They should be required to correct the malfunction.

Mettler Top Loading Balance Model PL200, S/N 747201 ES43702. This unit was returned to the US in 1983 for repairs. When it was returned it was nonoperable. THe coupling was broken (Part No. 43898).

Fisher Series 200 Thermix Magnetic Stirrers; Two Units Model 220T Cat. No. 14-493-221T, both units have the same S/N 110. Speed at maximum does not reach specifications. If the motor speed control is shorted from the circuit, the motor achieves proper speed. Problem is in the motor speed control circuit. Wiring diagram shows I.C. Quad 2 input N and Gate RCA * CD4011BE (Part No. 37222, ICI). Two are required, one for each unit. The speed control was manufactured with the wrong unit, namely MC14011B.

Gallenkamp Regulated Hot PLate Cat. No. 600-010Q, A/N 9B4017G. Loose wire to the switch and thermal control, light bulb loose. Repaired loose connections and replaced light bulb. Checked operation. Unit operated satisfactorily.

Cenco Digestor Cat. N. 34202, Lot No. A0702. Needs operation and service manual. Short in the triad * 24015-L5, 20 Amps. This controls the heating circuit in the block. A voltage of 220 VAC at the cathode and gate indicated that a short existed between these two connections within the triad. The triad needs to be replaced.

Hewlett Packard Calculator HP33E, S/N 1932A66411. Repaired battery contact and placed back in operation.

Hewlett Packard Calculator HP32E, S/N 2216S31630. Repaired battery contact and placed back in service.

Microbiology:

Knauer HPLC System. Last April , this unit was set up to operate using the differential refractometer detector. This unit remained in the same condition as when it was installed, it has never been used. The variable UV detector was not connected, since the cell for the unit was not found. After a thorough serach, a rough sketch of the cell was shown to the laboratory personnel, and the cell was found in an adjoining laboratory. The unit was completely set up. It was tested with water of questionable purity. Ultra pure solvents specifically labeled for HPLC must be used. Column specificity in separations never was considered in the purchase. The unit operated as best as could be expected under the conditions. Three and a half to four hours were spent explaining the functions and operations of the unit.

pH Meter Phillips Model PW9418, S/N 9436. Meter was subject to drift. Electrode inputs shorted; meter functioned normally. Electrodes rejuvinated with 0.1N HCl ans 0.1N NaOH. Fault was corrected and instrument worked satisfactorily.

Gallenkamp Oven Model No. 8E1960E, No S/N listed. Unit did not operate. Repaired broken connection. Unit was slow in heating, but after achieving temperature, performed satisfactorily.

Entomology:

Gallenkamp Oven with Humidifier, No Model No. or S/N Listed. Manual was missing. Checked wiring and controls. Installed the unit. Operated satisfactorily.

Chemistry:

Oven, Gallenkamp, Model 8433, S/N missing and was not operable. Thermostat required repair because of a broken connection. Heater connection was also broken, both repaired; unit is now working.

Technical Chemistry Department:

Stantor Balance Model A49 S/N none listed. Poor resolution of scale. Optics were dirty. Cleaned and refocused. Unit was functionable.

MSE Centrifuge Code No. 8.64 MK111 S/N 961270 040. The timer would not set and a check of the timer revealed that the timer was completely demolished. The timer will have to be replaced. This is an older unit and I doubt if the component can still be purchased.

Mettler H-6 Balance S/N 280401. This unit was sent to a local firm for repair. It was returned and has not functionrd since, according to as person in

the laboratory. A lens which focuses the light on the scale is missing, the damper is misaligned, and the full arrest position was eliminated. This unit at the present time is worthless, the product of a poor job by the local repair firm.

Stantor Unimax CLX4 Balance. Optical projection scale was ceacked and the etching removed from the unit. This part should be replaced; other than this the balance is in good working order.

Corning pH meter Model 5, S/N 005/4497. The pH meter functions properly but the electrodes are damaged and have been left to deteriorate. Requires Series 500 pH electrodes Cat. No. 476 10500X; Series 500 Reference Electrodes, Cat. No. 476 11000A ordered from:

Corning Medical and Scientific
Corning Glass Works
Midfield, MA 02052 USA

Compound Microscope, Karl BKolb Focusing mechanism was jammed. Released and cleaned the unit. Unit is performing satisfactorily.

Drying and Finishing:

Cecil Spectrophotometer UV - visible. The visible and tungsten bulb operated satisfactorily. The UV and Deuterium lamp did not operate. The deuterium lamp has been burned out and needs to be replaced.

Technical Microbiology:

Mettler H3111 S/N 668121 Scale off center. The unit was out of focus, not leveled, and filthy. The unit had dirt caked on it. The unit was cleaned, refocused and leveled. The unit operates satisfactorily.

pH meter, W. G. Pye Model 290 S/N none listed. Would not adjust with buffers. The meter was not controlable with the electrode inputs shorted. This indicated a faulty meter. A check of the power supply indicated this to be functional. A check of the amplifier section indicated a malfunction within the amplifier. Did not have adequate instruments to continue the diagnosis.

Physiology:

Li Cor Integrating Quantum/Radiometer/Photometer Model LI-188B S/N 1QRB330-816. Sensor is bad. Requires sensor to match serial number on connector Q4356 model Quantum LI-1905B Quantum Sensor.

SDRI - Dhaka:

Mettler Model H5 Balance S/N 139001. Completely out of focus. Bulb was changed and a 6 volt bulb was put in place of a 3 volt bulb. Requires a 3 volt bulb. The bulb was realigned and the unit was refocused. Unit was still dim, but a three volt bulb would operate better. Unit was functioning properly.

Corning pH meter Model 7 S/N 007/3105. Meter fluctuates during pH measurement. Checked meter with shorting strap and meter operated normally.

This unit requires new electrodes. It can use Fischer electordes, but Corning electrodes can also be obtained from Fisher.

Corning Electrodes:

| | |
|---|---|
| Calomel Reference Electrode | Corning No. 476001 |
| pH Glass Electrode | Corning No. 476022 |

pH Meter Radiometer (Copenhagen) Model 26 S/N 236584. Meter drifted slowly. The electrode had been rejuvinated several times and further rejuvination showed no improvement. The meter check was satisfactory when the unit is shorted. Requires a new glass and colomel reference electrodes. These can be ordered only from Radiometer Copenhogen Glass Electrode G202C; Colomel Electrode K401.

Industrial Instruments Soler Bridge RD-152, S/N 98471. Amplifier tube (RCA) 6F5 defective. This is listed as part No. 108TU and can be obtained from Beckman Instruments, Cedar Grove, N. J. or locally.

Industrial Instruments Soler Bridge RD-152, S/N 95010. Electronic unit checks satisfactory, when checked with resistors. Conductivity cell is defective. Cell is Cel-Go5 X 2, K=0.50 from Beckman Instruments, Cedar Grove, N. J.

Gallenkamp Water Bath Cat. No. WF 220, A/P 4A2653A. Heating element is open and has no continuity. Requires new element.

Memomert Oven TV40, S/N 621019. Thermostat control mercury switch was sticking. Lossened switch and repaired thermostat. Oven operated in satisfactory condition.

Gallenkamp Muffle Furnace FR-560. Would not control temperature properly. Found loose connection between the control and power relay.

BARI-Wheat- Joydebpur:

Udy Dye Method for Protein Analysis system. Set up the system which includes cyclone sample mill, analytical balance, reagent dispensing carboy and automatic pipette, React-R-Mill/React-R-Shaker, and color computor. Taught a member of the laboratory the method and procedure for conducting the analysis by grinding a wheat sample, and then demonstrating the procedure. Following the demonstration, the Scietific Officier in the laboratory repeated the analysis several times. He then taught other members of the laboratory to perform the analysis.

Large Polyethylene Sealer, No Model, No S/N. The plug from the unit was not connected to the self-contained step down transformer. Unit operated satisfactorily .

Large Voltage Stabilizer. Resistor on the input side was burned . Part will be obtained locally and replaced.

BARI, RARS - Hathazari:

LEC Deep Freeze Model LT386, S/N SLT314/OA. Gas leak in refrigeration system requires recharging with both F-13 and F-22. A work order has been submitted for this task to be done.

Precision Low Temperature Incubator Model 815, S/N 21AK10. GCA Corp Cat. No. 31212. Transformer (T101, 120/24 VAC, Class 2 Part No. 225215) is defective as well as the IC 101 (zero volt SW CA3059 Part No. 296115). Both of these parts are required to repair this unit.

Light and Dark Seedburo Germinator, S/N 7982. Bulb burned out. 230 V 10W screw type base was replaced. Unit now operable.

EIL pH Meter Model 607, S/N 7020/4227. Installed electrode, Electrode needs KCl solution for the calomel electrode to operate properly. Prepared pH 4.0 and 7.0 buffer. Meter would standardize but would not respond properly because of lack of KCl solution.

Extech pH Meter Model 607, S/N 9213/06. Installed electrode. Checked with buffer. Operates satisfactorily. This unit is useless; I would predict it will be non-working within a week.

Mettler E2000 Balance, S/N 8300N. Balance would not zero because it was not level. Leveled balance, checked operation Unit operated satisfactorily.

White Westinghouse Air Conditioner Model AH151T5C, S/N 00026100. Gas leak at the filling nipple. Requires a leak test and to be recharged. Work order has been submitted for this job.

Lab Line Figid Cab. Cat. No. 3552-11, S/N 1184-001. Installed plug, checked operation, and unit performed satisfactorily.

Gallenkamp Hot Box Oven Cat. No. OVB- 300-010N, A/N 9B 3428E. Installed plug, Checked operation, and unit operated satisfactorily.

Steinlite Electronic Moisture Tester Cat. No. 400, S/N 27136G. Unit operation checked. Unit operated as per specifications.

Hot Plate Sybron Thermolyne Model HP-AP110M Type 1900. Installed plug, Checked operation, unit operated .

Torsion Balance, Model DCM-2, S/N 168747. Unpacked, set up, checked operation.

Torsion Balance Model DWM-5, S/N 168805. Unpacked, set up, checked; operation.

Lab Line Water Bath Imperial III Model 180005-1, S/N 0684-0112. Installed plug, Checked operation, Unit OK.

17

Forest Research Institute, Chittagong:

Mettler AE160 Balance, S/N C10443. Pin 2 to ground was 5 VDC; reading on pin 4 to ground was suppose to be -24VDC, the voltage reading was less than 1 volt. Followed circuit back to transformer, found that transformer was at fault. Requires new transformer Part No. 38739.

Cahn Electrobalance (micro) Model TA-450, S/N 41299. Unpacked, set up, and installed. Performed the required tests. Unit is in good working order.

Bausch and Lomb Model 710 Spectrophotometer Ultraviolet and Visible, S/N 0618317. Unpacked, changed to 220 volt operation. Checked response and zero of instrument. Unit is in good working order.

BARI, Regional Laboratory Asd, Daulotpur-Khulna:

Corning Model 400 Flame Photometer, S/N 400/2680. This unit was said to be malfunctioning. On questioning the laboratory technician, he claimed that it would not standardize. Using a 10 and 100 ppm potassium standard, the unit not only standardized by direct reading but the standardization was linear. A 50 ppm standard gave a reading of 49 ppm by direct reading. There appears to be nothing wrong with this unit. No explanation can be given for the discrepency.

Corning Model 7 pH Meter. Meter Checks out; Electrode needs to be replaced. Suggest a Fisher combination electrode, Cat. No. 13-639-90.

MSE Super Medium Centrifuge Code No. 762, S/N 63729. Motor relay coil burned out. Needs to be replaced. Unit has no operational manual or parts list.

Refrigerator Freezer Combination Model 3166AS, S/N S16027800924. Refrigerant has leaked. The filling nipple has been cut. This unit requires a leak test and refilling with the proper refrigerant, R-12. The compressor has been disconnected, requires some electrical connections before it came be made operational.

Consolidated Stills and Sterilizer Distilled Water Still Model E-2, S/N 8160. Has three heating coils connected in parallel. Two are in working condition, the third is open. The only address listed for this company is on the still; Consolidated Stills and Sterilizers, Boston 35, Massachusetts.

Mettler H54AR, S/N 679761. Projection Scale only allowed one digit to be read. The scale was adjusted. This balance has been used and only one digit was used in the second decimal place; the third digit was omitted, and four decimal places reported. This is a microbalance capable of weighing to 0,01 mg or five decimal places. The semi-arrest knob has been stripped so that the magnet switch for the light will not operate properly. Balance was adjusted so that the light was on constantly and no switch is required. The balance can now be read to five decimal places.

Mettler P2000 Top Loading Balance, S/N 394900. Balance is operable, required leveling.

BARI-RARS- Jessore:

Cole Palmer Hygrothermograph, S/N 93193. Installed and explained operation. The unit came with replacement chart paper, but could use replacement pens (6 per Pkg. Part No. 8368 from Cole Palmer).

VWR Model 1320E Oven, S/N 11241320. Installed plug and checked operation.

Lab Line Frigid Cab Cat. No. 3552-11, S/N 1184-003. Installed plug and checked operation.

Precision Low Temperature Incubator Model 805, S/N 29AK02. A check of the temperature control board indicated that it was operating properly. The compressor would operate for a short time, then stop. A check while the compressor was running showed that the low and high pressure sides of the line were approximately the same temperature. A leak test should be conducted and the unit refilled with refrigerant.

BARI-RARS, Ishurdi:

Wheat:

Universal Moisture Tester, S/N EH2974. Burrows Equipment Company, Evanston, IL. Needs a 1/2 inch socket drive and a 1/2 inch socket for the unit. Also a knob for the 1/4 inch shaft of the selector switch.

Burrows Digital Moisture Computor Model 700, S/N 205705. I was unable to do any repair or diagnosis of problems on this instrument. There were no wiring diagrams, troubleshooting charts, or service manuals. The whole unit is composed of printed circuits and integrated circuits. A service manual should be obtained from Burrows Equipment Co., Evanston, IL.

Plant Pathology:

Fisher Model 3000 Digital Balance, S/N 4890. Unit not operating. Blown fuse, replaced fuse. Unit operating.

Fisher Accumet pH Meter Model 600, S/N 255. Unit would not operate. Check showed it to be the meter. Found loose connection, repaired. Unit worked properly.

Sybron Thermolyne Type 1000. Stir Plate, S/N 27339342. Installed plug. Checked operation. Unit operated properly.

Lab Line Imperial III Water Bath, S/N 0684-0116. Installed plug and checked unit's operation when filled with water. Unit operated properly.

Entomology:

Ainsworth Balance Type 510N, S/N 59710. Installed, leveled, adjusted balance and sensitivity. Checked accuracy. Unit operated satisfactorily.

Light Trap, No Model No. or S/N. Light bulb was burned out. This used a screw type base and is unavailable in Bangladesh. Suggest the electricians replace the base with one from local origin and use the bayonnet style bulb 220 V, 60 watt.

Farm Research Division:

Thermohygrograph, S/N 32983. Unit was purchased from OTA Co. Ltd., Japan. Thermometer operates satisfactorily. Relative humidity portion is damaged. This unit used a sensing cord of a hydroscopic material such as horse hair which expands and contracts at a definite rate with the moisture content. This has been broken and is in pieces. It requires replacing.

Horticulture:

Japanese Incubator Type P-15, Mfg No. 4004. Heating coil is open. Thermostat checks out satisfactorily. Needs new heating coil.

Lab Line Frigid Cab. Cat. No. 3552-11, S/N 184-005. Compressor runs with no cooling effect on the evaporator. A check of the high and low pressure sides by feel indicated no difference in temperature. Requires a leak test and a refrigerant fill.

Soil Science:

Chinese Luchern Spring Scale, Cap. 5 Kg; 20g calibrations. Unit would not zero. Zeroed the balance and checked operation. Unit appeared to operate normally. The technician insisted it would not rezero. He then proceeded to vigorously push and release the pan, which caused the scale to jump zero. I explained that you do not weigh or treat any scale in that manner.

Yamato Scale, S/N 112594. 5Kg to 50 Kg, 100g divisions. Unit was locked. Scale platform was loose and the locking mechanism was releasing. Upon opening the balance, the odor was obviously that of mice. They had built a nest in the unit and their waste products had rusted the mechanism . This unit is completely useless and should be removed from inventory.

Guest House:

GE Air Conditioner Model AF 912WAB2, S/N ZG 181545. Needs a good cleaning. The housing should be removed and the unit thoroughly cleaned. When plugged in and checked the unit operated OK.

Pan Electric Refrigerator Model P10, S/N. 5645349. Compressor works; however, unit does not cool. The evaporator (freezing chamber) has a number of puncture holes which have been caused by a sharp instrument. This was done during a defrosting to get rid of the frost. The refrigerant leaked out and the unit will not cool.

STRI- Ishurdi:

Agronomy:

Kernco Digital pH/MV Meter Model 601A, S/N 100478. A 9 V transistor battery was dead. Replaced battery. The liquid crystal is negative. It appears to have been subjected to moisture.

TPS pH Meter Model P51X, S/N 071901. Nothing was was wrong with this pH meter except the plug was missing. Replaced the plug. The unit then check out at pH 4.0 and 7.0 indicating that the unit operated normally.

TPS pH Meter Model P51, No S/N. Meter operates satisfactorily. Electrode had been allowed to become dry. This electrode should be allowed to soak for at least 24 hours. After 2 hours appreciable calibration control was obtained.

TOA Electronic LTD pH Meter Model HH-5A, S/N 069765F. Requires new discharge tube (OA-2) VR-150MT, and the other tubes in the amplifier section should be replaced. It will require 2 - 12AX7 and 1 - 12BH7A. A check of the 1984 consultancy report listed this meter with the same faults. This list of tubes was given to the Scientific Officier. These parts were never purchased; even though they could be obtained locally.

Lab Line Frigid Cab. Cat. No. 3551-11, S/N 256-183. Partial freeze. It appears as if the gas is low. A leak test should be run and the gas filled to operating capacity.

Bausch and Lomb Spectronic 710 Spectrophotometer, S/N 0318273. Requires cuvettes, Cat. No. 33-17-42 matched set of 2. Square cuvettes 10 mm pathlength, silica 45 mm tall. Need two sets.

Bausch and Lomb Spectronic 20, S/N 01315520E. Needs new amplifier printed circuit board. Number on board 333172-602-2, Rev; 620-3. Assembly c073. Order from Bausch and Lomb; Instrument and Systems Division; 42 East Avenue; P.O. Box 743; Rochester, NY 14603.

Training and Communications:

Overhead Projectors, Henimax, No Model No. or S/N. 2 Units. Lamp holder socket is enlarged. Requires new lamp holder for each unit. The porcelain has been chipped away.

Wollensak Cassette Player Model 2551, S/N 00003360. This unit would not play and would destroy the tapes. The drive wheel is badly distorted which caused it to rip the tapes. Needs new drive wheel and a thorough cleaning.

Wollensak Casette Player Model 2851, S/N 002293. The unit would develop a squeak on playing a cassette. Cleaning the drive mechanism corrected this defect.

Uher Cassette Player type 1642, S/N 39828. The cassette would not play in one direction; this was due to the belt connecting the capsan to the fly-whel was broken. Requires new drive belt.

Portable Public Address System, Lectrosonic, Inc.; Voice Projector 35! Will operate on 6-12 V adaptor, but will not operate on battery. Both batteries were dead; requires 2- six volt lantern batteries.

3M Transparency Copier Model 45FBAA, S/N 648565. Would not turn off the light after the copy. The switching mechanism was out of adjustment. Readjusted the mechanism; unit working.

BTRI- Srimungal-Syhlet:

Pye Unicam UV-Visible Spectrophotometer Model SP500, S/N 702252. Ultraviolet light did not operate. found a broken connection in the power resistor of the UV light source. Repaired; Unit operating.

MSE Chilspin Refrigerated Centrifuge, S/N FM1516. Unit would not operate. An examination of the circuit revealed two microswitches which were in an obscure position. These switches were not functioning properly. An adjustment of the unit to allow the proper closing of these switches, which rectified the problem.

# APPENDIX III

# CENTRAL INVENTORY PRINT OUT

## FROM IBM "DATABASE III"

```
. disp struc
Structure for database : B:compm.dbf
Number of data records :       15
Date of last update    : 08/24/85
Field  Field name  Type        Width     Dec
    1  TAG_NO      Numeric         8       2
    2  INSTR_NAM   Character      30
    3  INV_NO      Character      10
    4  MODEL       Character       8
    5  SL_NO       Character       8
    6  PRICE       Numeric         8       2
    7  MNUFAC      Character      12
    8  M_ADDRESS   Character      35
    9  TELEX_NO    Character      15
   10  SUPPLIER    Character      35
   11  S_ADDRESS   Character      35
   12  S_TEL       Numeric         6
   13  DT_ARRVL    Date            8
   14  DT_COMMNG   Date            8
   15  END_WARNTY  Date            8
   16  M_PERSON    Character      15
Press any key to continue...
   17  M_TEL       Numeric         6
   18  PART_LIST   Logical         1
   19  INSTR_USE   Character      20
   20  OPRT_MANL   Logical         1
   21  SRVC_MANL   Logical         1
   22  CRT_DIA     Logical         1
   23  USER_QUALI  Character      10
   24  OPRT_QUALI  Character      10
   25  SPCL_MAINT  Logical         1
   26  INSTR_LOC   Character      15
   27  L_TEL       Numeric         6
   28  MAIN_USER   Character      25
   29  MAIN_OPTR   Character      25
   30  ACCRS       Character      25
   31  PWR_CONSMP  Character       8
   32  OPTR_CON    Character       8
Press any key to continue...
   33  STBLR_USED  Logical         1
   34  DOR_CAP     Character       8
   35  RH          Numeric         5       2
   36  TEMP        Numeric         5       2
   37  SP_TST_REQ  Logical         1
   38  SPARE_AVIL  Logical         1
   39  REF         Character      12
** Total **                      446
```

87

# SYLLABUS FOR BASIC ELECTRICITY AND ELECTRONICS COURSE AT BANGLADESH AGRICULTURAL UNIVERSITY

The Basic Electronic Course for laboratory maintenance and repair personnel can be offered by the Electronic Service Section of the Bangladesh Agricultural University through the Graduate Training Institute (GTI). This would be a three month course which would be held five days a week from 9:00 AM to 5:00 PM.

The candidates would be limited to a maximum of fifteen (15) persons. These candidates would have shown an aptitude for electronics and electricity. The course would not be open to all individuals, but only those who have the an earnest interest in the subject.

## Basic Electricity and Electronics for Laboratory Maintenance and Repair

I. Use of Hand Tools.

A. Proper use of the right tool for the right job.

1. Screwdrivers.
2. Pliers and Diagonals.
3. Wrenches.
4. Files, drills, and bits.
5. Miscellaneous ( Wire strippers, bolt cutters, etc.).

B. Soldering Techniques.

1. Electrical soldering.
2. Soldering guns.
3. Soldering irons.
    a. Macro Irons.
    b. Micro irons.
    c. Printed Circuit Board irons.
        (1) Solder Removers and desoldering techniques.

II Methods of Connecting Wires.

A. Screw Type Connector, Solderless Connections.

1. Barrier Strip
2. Mounting Post
3. Other.

B. Wire Splices.

1. Western Union.
2. Pig Tail.
3. "T" Splice.
4. Other.

C. Solder.

1. Posts.
2. Strip.
3. Circuit Board.
4. Other.

III Basic Electricity

A. Magnetic forces.

1. Current Generation.

2. Magnetic Force and Motion.

a. Finger Law.

b. Theory of Repulsion.

(1). Transformation of Electrical Energy to Mechanical Motion.

3. Basic Laws of Electricity.

a. Ohm's Law.

b. Kirckhoff's Law.

c. Faraday's Law.

IV. Measuring and Test Instruments, Their Use, Operation, and Meaning.

A. VOM (Multimeter) (Volt-Ohm-Meter).

B. VTVM (Vaccuum Tube Volt Meter)..

C. Oscilliscope.

D. Power Supplies.

E. Frequency Generators.

V. Electrical and Electronic Components.

A. Resistors.

1. Wire Wound.

2. Carbon

a. Color Coding.

B. Capacitors.

C. Inductors.

D. Transistors.

E. Semi-Conductors.

F. Transducers.

G. Transformers.

VI. Circuits.

A. Series.

B. Parallel.

C. Combination.

D. Integrated Circuits.

E. Printed Circuits and Boards.

F. Reading Circuit Diagrams.

VII. Regulators.

a. Fuse.

B. Circuit Breakers.

C. Cut-Out Relay.

D. Voltage Regulator.

E. Diodes.

VIII. Trouble Shooting and Diagnosis Practicum Sessions.

This course will require an initial investment of capital for supplies and equipment. It would require enough test equipment for the participants to use and supplies for teaching purposes. This would require US$ 25,000 to initiate plus US$3000 for the first course. Following courses should require US$ 3000.

BANGLADESH ATOMIC ENERGY COMMISSION

P. O. BOX NO. 158, RAMNA

DHAKA

Course I

Title : Intermediate Electronics Course for Maintenance Technicians,

Course II

Title : Basic Electronics Course for Operators and Users of Instruments.

Objectives

The basic objective of this course is to impart training on science graduates in the field of electronics (Intermediate & Basic). The course contents and the proctical experiments are designed in such a way that a trainee after successful completion would acquire a competence required for routine intermediate and basic electronics maintenance of different electronics components.

Participants Qualification in Syllabus (Course) I

Participants should have sufficient background in electronics. Diploma holders in electronic engineering and candidates with a degree in B.Sc. would be encouraged to participate.

Participants Qualification in Syllabus (Course) II

Participants may have an H.Sc., B.Sc. or M.Sc/Ph.D. They are mostly users of electronic instruments who may not have a sufficient background in electronics.

Methodology

A variety of methods and materials may be used in the program. These will include lectures, practicals and demonstrations.

Location of Course

Courses may be conducted at the Atomic Energy Center, Dhaka. The course may be jointly conducted in consultation with IEMS, Savar and Electronics Division, AEC, Dhaka.

Resource Persons

1. Dr. S.M.M.R. Chowdhury, M.Sc.(Dhaka), Ph.D.(Birmingham)
   Chief Scientific Officer, BAEC.

2. Dr. A.H. Khan, M.Sc.(Dhaka), B.Sc.(Hons)(McGill), Ph.D.(McGill),
   Chief Scientific Officer, BAEC

3. Mr. M. Zahur Ali, M.Sc.(Dhaka), M.S.(McMaster),
   Chief Scientific Officer, BAEC

Duration

Classes may take place from 8:30 a.m. to 1:30 p.m. daily from Saturday to Thursday every week.

Cost

In Syllabus I: Tk. 5,000/ - per person

In Syllabus II: Tk 3,000/ - per person

Number of Participants

In Syllabus I and in Syllabus II : 16 persons

Evaluation

The evaluation of the participant's performance will be made in written examinations and oral examinations during the course.

## SYLLABUS I

Title : Intermediate Electronics Course for the Maintenance Technicians

A. Circuits and Devices

Lecture No. 1

Characteristics of diodes

Lecture No. 2

Rectifying Circuits: Half wave, voltage regulation, ripple factor, ratio of rectification, transformer utilization

Lecture No. 3

Full wave rectifier, bridge rectifier, comparison of rectifier circuits etc.

Lecture No. 4

Filter Circuits : Ripple factor, capacitor filter, choke input or LC filter, comparison of filters.

Lecture No. 5

Zener diode

Lecture No. 6

Tunnel Diode

Lecture No. 7

Thermistor

Lecture No. 8

General amplifier characteristics

Lecture No. 9

Basic characteristics of transistors

Lecture No. 10

Low frequency response of transitors

Lecture No. 11

High frequency response of transistors

Lecture No. 12

Transistor power amplifier

Lecture No. 13

Lecture No. 14

Field effect transistors

Lecture No. 15

Lecture No. 16

Lecture No. 17

MOSFET

Lecture No. 18

Lecture No. 19

Lecture No. 20

Operational Amplifier

Lecture No. 21

Lecture No. 22

Lecture No. 23

Lecture No. 24

Lecture No. 25

Integrated Circuits.

B. Instrumentation

Lecture No. 26

Pre-amplifier

Lecture No. 27

Pulse amplifier

Lecture No. 28

Detectors of radiation

Lecture No. 29

Scaler - Timer

Lecture No. 30

pH meter

Lecture No. 31

Lecture No. 32

Lecture No. 33

Oscilloscope

Lecture No. 34

Lecture No. 35

Discriminator and SCA

Lecture No. 36

Radiation monitor, rate meter and survey meter.

Lecture No. 37

Lecture No. 38

Spectrophotometer

Practicals

Approximately 6 - 10

## SYLLABUS II

Title : Basic Electronics Course for Operators and Users of Instruments.

Lecture No. 1

Conductor insulator, Semiconductor, Resistor, Capacitor, Indicator and their units.

Wire gauses, current carrying capacity, fuses, co-axial cables, co-axial cable-characteristic impedance.

Lecture No. 2

Delay, familarization with passive, component-values, composition, ratings, color codes.

Lecture No. 3

Ohm's law, voltage dividers, bridges

Lecture No. 4

Combination of resistors & condensers

(series and parallel networks)

Lecture No. 5

A.C. circuits frequency, amplitude, phase, r.m.s. value, peak value, average value of voltage & currnet, iductive reactance, capcitive reactance.

Lecture No. 6

Series & parallel R.L.C. circuits

Lecture No. 7

Resonance, frequency and bands

Lecture No. 8

Transformers

Lecture No.9

Motors and generators

Lecture No. 10

Semiconductors, N-type, P-type, pN function

Lecture No. 11

Forward bias, reverse bias, transistor action, transistor circuits.

Lecture No. 12

Rectificration, fillering and voltage stabilizing

Lecture No. 13

Amplifier, feedback circuit, Oscillator

Lecture No. 14

Operational amplifier, add subtract, integrator, differentiator, invertor, etc.

Lecture No. 15

Binary numbers.

Basic logic gate concept, AND, OR, NAND, NOR, NOT, etc.,

Truth table, application.

Lecture No. 16

Lecture No. 17

Counting circuits and systems

Lecture No. 18

Transducers & radiation detectors

Lecture No. 19

Biasing, characteristics of detectors and pre-amplifiers.

Lecture No. 20

Measuring instruments: voltmeter, ammeter, multimeter, digital multimeter

Lecture No. 21

Oscilloscope, X-Y, recorder

Lecture No. 22

Instrument Care, log book maintenance, reporting repair, etc.

Lecture No. 23

Power fluctuations: Singe Say, Transiants

Lecture No. 24

Power conditioning: CVT, Isolation transformer, dedicated earth line stabilizer Drop out Relay, etc.

Practicals and Demonstrations

Expt. 1. Demonstration on Multimeter

Expt. 2. Demonstration on Digital Multimeter

Expt. 3. Operation of Oscilloscope

Expt. 4. Fault finding techniques

Expt. 5. Demonstration of active and passive components.

Expt. 6. Logic gate application

Expt. 7. Transistor amplifier

Expt. 8. Construction of a regulated power supply

Expt. 9. Demonstration of a Counter Timer.

# TRAINING IN ANALYTICAL CHEMISTRY: AECD

Title of the Course:

Basic Course in Analytical Chemistry and Instrumental Techniques

Objectives

The basic objectives of this course is to inpart training on science graduates in the field of Analytical Chemistry. The course contents and the practical experiments are designed in such a way that a trainee after successful completion would acquire the competence required for routine chemical analysis of materials of different discriptions.

Methodology

The entire course materials would be presented through theoretical lectures and practical demonstrations. The trainees would be encouraged to clear up their understanding through discussions.

Evaluation

Evaluation would be made through examination. Pass mark is 50%.

Cost per Person

The contents of the course would fairly amount to 80% of a full course covered with 50 lectures (45 minute duration). Accordingly, at the rate of Tk. 80.00 per lecture, the total cost per person would amount to about Tk. 3000.00. The

trainees are to use their own notebooks, papers, pencils, etc. Graph paper, experimental consumables, etc. are to be supplied by AECD

Resource Persons

1. Dr. S.M.M.R. Chowdhury, M.Sc.(Dhaka). Ph.D.(Bir'ham)
   Chief Scientific Officer, BAEC

2. Dr. A.H. Khan, M.Sc.(Dhaka), B.Sc.(Hons)(McGill)
   Chief Scientific Officer, BAEC

3. Mr. M. Zuhur Ali, M.Sc.(Dhaka), M.S.(mcMaster)
   Chief Scientific Officer, BAEC

## SYLLABUS

A. Theoretical Part

| | |
|---|---|
| 1. Sampling and sample preparations | 2 lectures |
| 2. Mass action law, solubility and solubility product | 1 lecture |
| 3. Chemical elements and their groups | 2 lectures |
| 4. Theory of acid and bases | 1 lecture |
| 5. Acidimetry, alkimetry, volumetry, and gravimetry | 2 lectures |
| 6. Separation techniques (Ion exchange, solvent extraction, precipitation) | 2 lectures |
| 7. Complexometric & Oxidation - reduction | 2 lectures |

titrations

8. Recording, data analysis and reporting — 2 lectures

B. Experimental Part

1. Common laboratory operations — 1 lecture
2. Chemical balance and pH meter — 2 lectures
3. Calibration of Glasswares — 1 lecture
4. Ion-selective electrodes — 1 lecture
5. Theory of major instrumental techniques (spectrophotometry, gas chromatography, IR spectrophotometry, atomic absorption spectrophotometry and X-ray fluorescence) — 5 lectures
6. Demonstration Experiments
   - (i) Acid-base titration (strong acid-strong base) — 2 hrs.
   - (ii) Dissolution of a complex material by fusion techniques — 3 hrs.
   - (iii) Ion-exchange separation and measurement by AAS — 3 hrs.
   - (iv) EDTA titration for Calcium measurement — 3 hrs.
   - (v) Spectrophotometric analysis of Iodine — 3 hrs.
   - (vi) X-ray fluorescence analysis of Soil — 3 hrs.

Each lecture is of 1 hour duration (45 minute lecture + 15 minumte discussion.

Total time allocated is 24 + 17 = 41 hours.