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# EDUCATION IN CARTOGRAPHY IN INDIA



BY

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SURVEYOR GENERAL OF INDIA

AND

PRESIDENT OF THE NATIONAL ORGANISATION

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NATIONAL REPRESENTATIVE  
ON COMMISSION I—EDUCATION IN CARTOGRAPHY  
OF THE INTERNATIONAL CARTOGRAPHIC ASSOCIATION

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## I. HISTORICAL BACKGROUND

1.1. Out of different branches of Surveying, land surveying is the oldest practised profession in India.

1.2. Though Todar Mal made a beginning with fairly accurate land surveys, the first map of India appears to have been made by a Frenchman, Monsieur D'Anville, in 1752. With the arrival of Europeans in India in 18th Century, era of map making in India started. In 1767, Captain James Rennel, an Engineer Officer of the East India Company, was appointed as Surveyor General of Bengal, and in 1788, a Map of Hindustan was produced which marked the beginning of accurate map making in India.

1.3. The first surveying school in India was set up at Madras in 1794. In 1804, Lord William Bentinck founded the Military Institution at Madras for the education of selected military cadets in mathematics, drawing, surveying and military fortifications.

1.4. With further developments, all Survey Units were combined under one authority—the Surveyor General of India; the organisation was named 'Survey of India'. Survey of India assumed responsibility of meeting its own need for technical man-power, since at that time (18th and early 19th Century) there were hardly any technical institutions in India. A training unit thus became an integral part of the Department. The activities of land surveying profession being confined mainly to Government Organisations, the training facilities have also been primarily developed in the Government Organisations.

1.5. However, with the evolution of better and more scientific techniques of surveying and training methods, the need for both intensive and extensive training of a high uniform standard in theoretical and practical aspects of surveying are evident. Institutional training in the Survey profession has begun to develop gradually. Still, there is no institutional training in certain disciplines like Map printing and 'on-the-job' training is being therefore imparted in these.

1.6. The Indian Universities do not have any regular course leading to a degree in Surveying or Cartography. However, there are some universities which impart post-graduate education in some aspects of Cartography, such as Land Surveying/Photogrammetry in their curriculum for Civil Engineers. Attempts are, however, being made to include more of Surveying and Cartography including aerial photo-interpretation and its allied subjects, in institutions of higher learning in India both at the graduate and post-graduate level.



## II. LEVELS OF SURVEY EDUCATION

2.1. In any productive complex, personnel are required at different levels of education and intelligence.

The intake of land surveyors is generally at three levels, viz.

- (a) The Survey technicians.
- (b) The middle supervisory level.
- (c) The professional surveyors.

2.2. The survey technicians consist of various tradesmen like Plane-tablers, Air Survey Draftsmen, etc. They join after minimum academic education of High School or equivalent, and are required to do their assigned jobs. After receiving necessary technical training for about 1 to 2 years in any particular trade, they are absorbed into the profession as Survey technicians. They form the bulk of those who are involved in day-to-day survey operations. They have to pass trade tests to get promotions.

2.3. The middle supervisory level staff is recruited with the minimum academic education of 'Intermediate'. After having undergone a training of about 2 years, they are absorbed as Surveyors either to carry out individual work requiring high skill, e.g., control work or to supervise the work of technicians and ensure their smooth functioning. They are also employed for work as operators on stereophotogrammetric machines.

2.4. The professional surveyors are trusted with policy making, organising and planning, and maintaining efficiency at all levels. They take the key decisions and are responsible for gearing up the entire structure with the aim of an efficient and quality production. They are recruited with the minimum basic qualification of Post-Graduation or Graduation in Engineering. They are required to undergo an exhaustive training of 2 years and later on to execute almost all production tasks, e.g. control work, Drawing, etc. They are finally placed as in-charge of survey parties, responsible for planning and execution of substantial survey tasks. Later, they fill in the higher posts responsible for policy making. In the same category can also be included professors, readers, and lecturers in Surveying in universities, technical institutions and government organisations. Naval hydrographers are also professional surveyors who have had a thorough grounding in various branches of hydrographic surveying.

## III. METHODS OF SURVEY EDUCATION AND TRAINING

3.1. *Different systems of Survey Education and Training.*—Survey training and education can be imparted under different systems :

- (a) 'On-the-job' training—by attachment to a senior technician/surveyor.
- (b) Training in survey schools of the Survey Departments.
- (c) Survey education in Polytechnics, Colleges and Universities.

3.1.1. In India, most of the training and education is imparted by the Survey Departments either in their survey schools/centres or as 'on-the-job' training. Survey training in Universities is rather limited. The methods of Survey education and training as in India are briefly described in succeeding paragraphs.

### SURVEY OF INDIA

3.2. The Survey of India is the National Survey Organisation of our country, employing the largest number of Surveyors. Almost all aspects of Surveying and Mapping falling within the purview of Cartography are practised for national requirements by this organisation.

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Survey of India has organised survey education either as on-the-job training or in Survey schools as follows :

- ( a ) Centre for Survey Training and Map Production.
- ( b ) Indian Photo-interpretation Institute.
- ( c ) On-the-job training for Map Reproduction.

#### CENTRE FOR SURVEY TRAINING AND MAP PRODUCTION

3.2.1.1. This centre was established with assistance from the United Nations Development Programme ( UNDP ). The training institution came into existence from May 6, 1967 using the existing training facilities under the then Training Directorate of the Department as a nucleus with the following objectives :

- ( a ) to achieve increased output, economy and accuracy for the pre-investment survey and mapping needed for the planning, designing, experimenting and executing of the many developmental projects in the resources sector of the country ;
- ( b ) to offer continuous opportunities for demonstration and introduction of modern mapping methods ;
- ( c ) to modernise training activities to achieve self-sufficiency in the staff, capable of handling the modern equipments provided by the United Nations and successfully executing the modernised survey operations, consisting of Geodetic and other control, field surveying, compilation, photogrammetry, Cartographic mapping and map printing.

3.2.1.2. The training institute which is a part of this centre provides academic education and practical training, not only to impart job-oriented training-cum-education, but also to produce prospective candidates for research and development and teaching activities.

3.2.1.3. The training institution is housed in modern buildings on the outskirts of Hyderābād in Andhra Pradesh, India. Hostel accommodation for a good number of trainees is available. There is a Guest House within the campus for visitors' short stay. Recreational facilities are also provided.

3.2.1.4. Students from foreign countries are also accepted, as also private candidates and employees of Government Departments.

3.2.1.5. The Institution is very well equipped with traditional and modern surveying, cartographic and printing instruments, and with adequate library facilities. The staff is highly qualified and experienced. Students are required to carry out several practical exercises under field conditions. Development of managerial skills and attitudes receives particular attention.

3.2.1.6. The centre runs 29 courses of four types :

- ( a ) Basic training-cum-education for all levels, i.e. Survey technicians, middle supervisors level and the professional surveyors.
- ( b ) Specialised and advanced training-cum-education to cater for various survey specialisations and new technology.
- ( c ) Refresher training-cum-education for all levels.
- ( d ) User oriented courses.

3.2.1.7. The Institution is running advanced courses in photogrammetry and geodesy. The syllabii and the course contents can be very well compared with any post-graduate course



run in the universities abroad. So far, the Centre is not administering any degrees or diplomas after the courses have been completed. Steps are, however, in hand to get the various courses recognised by universities. International Institute for Aerial Survey and Earth Sciences ( ITC ) has agreed to consider the advanced photogrammetric course (710) at par with their B.Sc. Ph.E. course. It is hoped that the basic course for surveyors will be recognised at par with B.Tech course in Surveying and the advanced course after some modification as equivalent to M.Tech ( Surveying Engineering ) course. As and when it happens, the research work with a view to award of Ph.D. degree can be undertaken.

3.2.1.8. In short, it can be said that Survey of India has prepared itself very well to cater for the man-power in surveying profession and has taken sound and imaginative steps in establishing such a Centre to meet the demand of emerging technology. The Centre has been developed by the United Nations in accordance with United Nations Regional Cartographic Congress resolution passed in Bangkok in 1963. It is hoped that all the neighbouring countries in Asia and Far East will be able to utilise the facilities available at this Centre. A copy of prospectus of the Centre for Survey Training and Map Production is appended.

#### INDIAN PHOTO-INTERPRETATION INSTITUTE

3.2.2.1. No country can progress unless the various natural resources available are fully utilised. These become all the more important with the increasing population which is a uniform phenomena throughout the world.

3.2.2.2. With the aim of developing Photo-interpretation techniques in various fields in natural resources, Indian Photo-interpretation Institute ( IPI ) was established within the framework of Survey of India with the help of the Netherlands Government on the same pattern as ITC. This institute has now fully developed into a well recognised training centre imparting training in Photo-interpretation techniques. This has acted as a catalyst in the gradual adoption of Photo-interpretation techniques in various user departments of the Govt. of India. The institution has got Photogrammetric Division, Photo Division, Geology Division, Forestry Division and Soil Division and is running courses in the fields of Photogrammetry ( basic training only ), Geology, Hydrology, Soil Conservation, Geomorphology, Forestry, Urban Planning, etc. Very shortly it is hoped that courses in Photo Division may also be started. It is also hoped that two more Divisions, viz. Remote Sensing and Integrated Surveys may also commence functioning.

3.2.2.3. The Institution has got adequate hostel facilities. Trainees from neighbouring countries can also benefit from the facilities available at this Institute. Various scholarships under Colombo plan and the Netherlands Government are also offered for such trainees from abroad.

3.2.2.4. The Institution offers courses both at basic and advanced levels and provides advanced training and research facilities to other countries. The institute also takes up consultancy projects.

3.2.2.5. In short, IPI is a unique establishment carrying out its basic and applied research programmes, offering possibilities of comparable techniques applied in other countries, executing consultancy projects, imparting training facilities at basic and advanced levels for all the various disciplines in Photo-interpretation.

#### ON-THE-JOB TRAINING AND MAP-REPRODUCTION

3.2.3. For the Map Reproduction techniques, the Department recruits fresh persons after matriculation and trains them in Map Reproduction techniques by attaching them to



senior technicians. Photographers, Retouchers, Litho Provers, Printers, Plate makers, etc., are being trained in the department in this fashion. In addition to the above, the department sends its officers for advanced specialised training abroad as well.

#### NAVAL HYDROGRAPHIC OFFICE

3.3. Indian Navy and Port Trusts meet the requirements of hydrographic surveying. There is a separate training complex which is managed by professionally qualified hydrographic surveyors. The Department also sends its officers for specialised training abroad to keep abreast of latest trends in the technology. It also keeps in close touch with Survey of India.

#### CADASTRAL SURVEY DEPARTMENTS

3.4. In India, Cadastral Survey is the responsibility of the States. States either train their own subordinate staff as on-the-job training or send their personnel to Survey of India for technical training. Four States have also the facilities of training establishments to impart survey education. Survey of India acts as co-ordinating office to streamline the various procedures used by the different States and bring them to a uniform pattern.

#### UNIVERSITIES

3.5.1. In India the university education in the field of surveying is limited. At present the Indian universities do not have any regular course leading to degree in surveying or cartography. There are, however, some universities imparting post-graduate education in some aspects of cartography.

#### UNIVERSITY OF ROORKEE

3.5.2. Only the University of Roorkee offers a post-graduate diploma in photogrammetry. The entry is from the Engineering graduates holding B.Sc. (Engineering) degree. One year further study leads to a diploma in Photogrammetry and two years to M.Tech. (Engineering) degree. The university has facilities of some photogrammetric instruments which have been procured with the assistance of the Survey of India.

#### OSMANIA UNIVERSITY

3.5.3. This university has also got Post-Graduate Diploma course for one year in cartography with a bias on geography and is running with the assistance of the Survey Training Institute and Centre for Survey Training and Map Production; Survey of India, Hyderābād. Osmania University is now trying to finalise M.A./M.Sc. course in cartography in the Geography Department with the active assistance of the Survey of India. This course will necessarily be oriented for thematic cartography.

#### OTHER INSTITUTIONS

3.5.4. There are about 50 Engineering Colleges/Institutions teaching surveying as a part of the engineering curricula, specially with civil engineering and military engineering curricula. There are also polytechnics imparting training in surveying as a part of their diploma courses. In both the courses, the training in surveying is very elementary and is confined to use of simple instruments. They confine their activities to the conventional ground survey methods and do not cater for any photogrammetric techniques. They have also no bias for automation.



## PROFESSIONAL BODIES AND ASSOCIATIONS

3.6. The following professional bodies operate in the field of surveying :

- ( a ) Institution of Surveyors.
- ( b ) Photogrammetric Society of Roorkee ( sponsored by the University of Roorkee ).
- ( c ) Indian Society of Photo-interpretation ( sponsored by IPI ).

The Institution of Surveyors conducts professional examinations in various surveying disciplines which have been recognised for recruitment to certain senior posts by the Government of India. A professional surveyor after completing his training in the Centre for Survey Training and Map Production has also to qualify in the Intermediate Examination held by the Institution of Surveyors before being accepted and confirmed in the Survey of India.

The Photogrammetric Society of Roorkee and Indian Society of Photo-interpretation are in their formative stage.

## CONCLUSION

One of the major reasons of the comparative lack of interest in Survey Education in universities/educational institutions has been due to the fact that there is no system of licenced surveyors for private practice which means that, outside the National Survey and State Departments there are no avenues in which surveyors could practise their profession. There are no private agencies who could employ surveyors and the surveying profession has thus been mainly confined to the national survey and State Governments. Surveying profession is still considered as a departmental profession and hence there is a lack of employment opportunity outside the Department.

Though the existing methods of education and training in the CST & MP and IPI are adequate, it is felt that there is a need to supplement them by introducing appropriate courses in surveying in the universities and polytechnics. In such a case Survey of India and State Survey Departments could accept such graduates for their needs.

It is also felt that for the universities which have practical bias in imparting survey training, though their main role will be to give survey education, detailed practical training could be imparted in the user departments based on their needs.

As soon as the Act of registration of land surveyors comes into existence there is expected to be more and more demand for surveyors and the universities will have no difficulty in finding students in this discipline.

It is also considered essential that the teaching staff and the practising surveyors are interchanged. This will ensure a better understanding of each others needs. The profession is what its members make it. The larger and better the services they provide to outside user agencies, more popular they will become and more need will be felt for them.

There can be no two opinions about the need of dynamic education system for survey education. I am certain that the existing survey education system as supplemented at the universities and technical levels will go a long way in making a better India.



# PROSPECTUS



SURVEY TRAINING INSTITUTE

CENTRE FOR  
SURVEY TRAINING  
AND  
MAP PRODUCTION

*Survey of India*

HYDERABAD-A.P.

INDIA

2nd Edition, 1974



## GENERAL INFORMATION

The "Survey Training Institute" constitutes the training component of the "Centre for Survey Training and Map Production". The Centre was established within the frame-work of the Survey of India Department with assistance from the United Nations Development Programme. The Training Institute was brought into being with effect from May 6, 1967 using the then Training Directorate of the Survey of India Department as a nucleus.

The Institute is housed in modern buildings located in the Centre's 220-acre campus on the outskirts of Hyderabad in Andhra Pradesh, India. Hostel accommodation for a good number of trainees is available. There is a Guest House within the campus for visitors' short stay. Recreational facilities are provided.

The Institute runs basic, refresher and advanced courses in all aspects of Surveying, as detailed in this prospectus. It is well equipped with traditional and modern surveying, cartographic and printing instruments, and with adequate library facilities. The staff is highly qualified and experienced. Students are required to carry out several practical exercises under field conditions. Development of managerial skills and attitudes receive particular attention.

Students from foreign countries are accepted, as also private candidates and employees of Government Departments.

For further particulars, please write to the Director, Survey Training Institute, Centre for Survey Training and Map Production, Survey of India, Uppal, Hyderabad-500039, Andhra Pradesh India.



INSTRUMENTS/EQUIPMENT AVAILABLE AT THE CENTRE

*Photogrammetric Instruments*

- 3 Universal Stereoplotters
- 5 Precision Stereoplotters
- 24 Topographical Stereoplotters for medium scale
- 6 Topographical Stereoplotters for small scale
- 1 Electronic Co-ordinate Printer
- 2 Electric Co-ordinate Printer
- 1 Analogue Computer for block adjustment
- 2 Slotted Templet Cutter Equipment
- 2 Rectifiers
- 1 Reduction Printer
- 1 Sketch Master
- 1 Fixed Ratio Printer with Compensation Plate
- 1 Set of Orthophoto Equipment
- 1 Mono-comparator
- 1 Point Transfer Device

Various other mirror stereoscopes and parallax bars

*Ground Survey Instruments*

- 6 Microwave Distance Measuring Instruments
- 2 Electro-optical Distance Measuring Instruments
- 1 Astronomical Theodolite
- 6 Universal Theodolites
- 38 One Second Theodolites
- 6 Levels, Geodetic Model
- 12 Automatic Levels
- 15 Ordinary Levels
- 12 Invar Staves
- 12 Invar Subtense Bars
- 6 Auto-reduction Tacheometers
- 3 Self Indexing Alidades
- 36 Telescopic Alidades
- 2 Chronometres
- 2 Chronographs
- 12 Altimetres
- 3 25-foot Survey Towers (Vehicle Mounted)
- 1 Quartz Crystal Time Recorder with printing Chronograph
- 1 High Power Wireless Receiver



Various other theodolites, levels, traversing equipment, tacheometers, binoculars, plane-tables and ground survey equipment.

*Computation and Data Processing Equipment*

- 3 Electronic Desk Calculators
- 2 Electromethanical Calculators
- 3 Printing Card Punchers
- 1 Card Verifier

Various other hand-operated calculators. Digital Electronic Computer at Regional Research Laboratory, Hyderabad provides further computer facilities.

*Reproduction and Drawing Equipment*

- 3 Rotary Offset Printing Presses 650 mm x 965 mm
- 2 Flat Bed Proving Presses 1000 mm x 1260 mm
- 1 Cartographic Process Camera 1000 mm x 1000 mm
- 1 Co-ordinatograph 1200 mm x 1200 mm
- 2 Diazo Printers
- 1 Electronic Contact Printer
- 1 Photo Electric Densitometer
- 1 Aerial Photo Contact Printer
- 2 Aerial Photo Print Dryers
- 2 Photo Type Setting Machines
- 1 Wax-proof Coater

Various Cartographic Scribe tools and instruments.

*Training Aids*

- 1 8 mm Cine Camera with Sound Projector
- 3 Cameras 35 mm and 60 mm
- 3 35 mm Slide Projectors
- 2 Overhead Projectors
- 2 Tape Recorders
- 1 Differential Spacing Office Composing Machine

Various other projectors, lettering sets and studio-visual training aid equipment.

COURSES OFFERED AT THE INSTITUTE

*Schedule of Courses*

The courses offered at the Institute, their aim, prerequisites, approximate number of trainees admitted, duration and month of starting are shown in the Schedule in the following pages. The exact date of commencement should be ascertained from the Institute, before the trainees report.



## SCHEDULE OF COURSES FROM

| Sl. No. | Course No. | Name                           | Aim  |
|---------|------------|--------------------------------|--|
| 1.      | 2.         | 3.                             | 4.   |
| 1.      | 100        | OFFICE PROCEDURES AND ACCOUNTS | To impart basic training in Office procedures, budgeting, accounting and auditing, for employment as Lower Division Clerk in the Survey of India.  |
| 2.      | 120        | RECORDKEEPING                  | To impart basic training in the provision, collection, preparation, storage, preservation, maintenance, accounting and retrieval of technical record, for employment as Recordkeeper in the Survey of India.   |
| 3.      | 130        | STOREKEEPING                   | To impart basic training in the provision, procurement, storage, maintenance and preservation, accounting etc., of all types and kinds of stores, equipment, materials, etc., required of surveying and mapping, for employment as Storekeeper in the Survey of India. |
| 4.      | 140        | DRAFTING                       | To impart basic training in the preparation of cartographic originals for printing maps, for employment as Draftsman in the Survey of India.   |



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| Prerequisites for the course and preference in admission  | No. of trainees | Approximate duration | Month in which the course will normally commence |
|---|-----------------|----------------------|--|
| 5.  | 6.              | 7.                   | 8.   |
| Completed matriculation or equivalent examination, and should preferably know typing; or, Lower Division Clerks in the Survey of India. | 10 to 20        | 6 months             | *  |
| Completed matriculation or equivalent examination; or, Topo Trainees Type 'B' (Recordkeeper) in the Survey of India.                    | 4 to 8          | 6 months             | *  |
| Completed matriculation or equivalent examination; or, Topo Trainees Type 'B' (Storekeeper) in the Survey of India.                     | 4 to 8          | 6 months             | *  |
| Completed matriculation or equivalent examination; or, Topo Trainees Type 'B' (Draftsman) in the Survey of India.                       | 10 to 20        | 1 year               | January  |



## SCHEDULE OF COURSES FROM

| 1. | 2.  | 3.                                 | 4.  |
|----|-----|------------------------------------|---|
| 5. | 150 | SURVEYING, TECHNICAL LEVEL         | To impart basic training in Surveying techniques and methods, for employment as plane-tableter and Air Survey Draftsman in the Survey of India.                         |
| 6. | 200 | CONTROL SURVEYING, TECHNICAL LEVEL | To impart basic training in the provision and computation for tertiary control in surveying, for employment as Topo Auxiliary and Topo Computer in the Survey of India. |
| 7. | 250 | SCRIBING                           | To train Survey supervisory personnel and draftsmen in scribing   |
| 8. | 270 | COMPUTATION                        | To impart intermediate level training in survey computations.   |



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|                      | 5.  | 6.       | 7.       | 8.                                  |
|----------------------|---|----------|----------|-------------------------------------|
| ods,<br>er<br>he     | Completed matriculation or equivalent examination, and possess stereoscopic vision; or, Topo Trainees Type 'B' (P'ter/ASD'man) in the Survey of India.  | 20 to 40 | 2 years  | October                             |
| he<br>,<br>ary<br>ey | Completed matriculation or equivalent examination, and possess good stereoscopic vision; or, Topo Trainees Type 'B' (Topo Auxiliary & Topo Computer) in the Survey of India.                  | 6 to 10  | 1½ years | October                             |
| ribing               | Completed Course 140 or 150, or I.T.I. Diploma Course in Surveying, or equivalent; or, Div.I and Draftsmen Div.II personnel of the Survey of India.   | 10 to 20 | 3 months | January<br>April<br>July<br>October |
| is.                  | Completed Intermediate Science or equivalent examination with mathematics, or completed Course 200 and 5 years' service in a Survey Organisation; or, Trig. Computers of the Survey of India. | 4 to 8   | 1 year   | November                            |



## SCHEDULE OF COURSES FROM

| 1.  | 2.  | 3.  | 4.  |
|-----|-----|---|---|
| 9.  | 300 | JUNIOR LEVEL<br>SUPERVISION                 | To enlarge and update the supervisory and technical knowledge of junior supervisors.                          |
| 10. | 310 | CADASTRAL CON-<br>TROL SURVEYING            | To impart basic training in the provision of tertiary control in Cadastral Surveying.                         |
| 11. | 330 | CIVIL ENGINEER<br>SURVEYING                 | To impart basic training in the provision of tertiary control and survey of details of Engineering Surveying. |
| 12. | 350 | CONTROL SURVEY-<br>ING, SUPERVISOR<br>LEVEL | To train junior supervisors in the provision of tertiary control in surveying.                                |
| 13. | 360 | SURVEY INSTRUCTION                          | To train survey personnel as instructors.   |



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visory  
or

| 5.  | 6.       | 7.       | 8.       |
|---|----------|----------|----------|
| Completed Course 140, 150, 200, or 270 or equivalent, and 7 years' service in a Survey Organisation.  | 10 to 20 | 2 months | April    |
| Completed Intermediate Science or equivalent examination with mathematics, and possess good stereoscopic vision.<br>Preference will be given to persons serving in State Departments of Land Records and Surveys. | 4 to 6   | 6 months | July     |
| Possess qualification equivalent to Sections 'A' & 'B' of A.M.I.E. and possess good stereoscopic vision.<br>Preference will be given to persons serving in Engineering Organisations.                             | 4 to 6   | 6 months | November |
| Completed Course 300 or equivalent; or, Div. II Grade III persons and above in the Survey of India.   | 4 to 6   | 6 months | July     |
| Completed 3 years' service in a Survey Organisation.  | 10 to 20 | 2 months | July     |



## SCHEDULE OF COURSES FROM

| 1.  | 2.  | 3.                                   | 4.  |
|-----|-----|--------------------------------------|---|
| 14. | 400 | SURVEYING, SUPERVISOR LEVEL          | To impart intermediate level training in all branches of surveying.                             |
| 15. | 410 | CADASTRAL SURVEYING                  | To impart comprehensive training in Cadastral Surveying.  |
| 16. | 450 | PHOTOGRAMMETRY, OPERATOR LEVEL       | To impart intermediate level training in photogrammetry.  |
| 17. | 460 | ELECTROMAGNETIC DISTANCE MEASUREMENT | To impart training in the use of Electromagnetic Distance Measurement instruments in surveying. |



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| 5.   | 6.       | 7.       | 8.                 |
|--|----------|----------|--------------------|
| <p>Completed Intermediate Science or equivalent examination with mathematics, or completed Overseer Certificate Examination of a Civil Engineering College, or equivalent; and possess good stereoscopic vision; or, Topo Trainee Type 'A' of the Survey of India.</p> | 10 to 20 | 2 years  | October            |
| <p>Completed B.Sc. Degree with mathematics and possess good stereoscopic vision.</p>   | 4 to 6   | 1 year   | October            |
| <p>Preference will be given to persons serving in State Departments of Land Records and Surveys.</p>   |          |          |                    |
| <p>Completed Course 400 or equivalent, and 3 years' service in a Survey Organisation.</p>  | 6 to 10  | 6 months | March<br>September |
| <p>Completed Course 400, and 4 years' service, or completed Course 500, or equivalent, and 3 years' service in a Survey Organisation.</p>  | 4 to 6   | 3 months | August             |



## SCHEDULES OF COURSES FROM

| 1   | 2.  | 3.                          | 4.  |
|-----|-----|-----------------------------|---|
| 18. | 470 | GEODETTIC SURVEY-<br>ING    | To impart intermediate level training in geodesy.   |
| 19. | 500 | SURVEY ENGINEERING          | To impart comprehensive training in all branches of surveying at the professional level.  |
| 20. | 510 | MAP REPRODUCTION            | To enlarge and update the knowledge of senior supervisors in map reproduction techniques. |
| 21. | 520 | CARTOGRAPHY                 | To enlarge and update the knowledge of cartographic supervisors and instructors.          |
| 22. | 550 | SENIOR LEVEL<br>SUPERVISION | To enlarge and update the supervisory and technical knowledge of senior supervisors.      |



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| 5.   | 6.       | 7/.      | 8.       |
|--|----------|----------|----------|
| Completed Course 400, or equivalent and 3 years' service in a Survey Organisation.   | 6 to 10  | 9 months | *        |
| Possess qualification equivalent to Sections 'A' & 'B' of A.M.I.E. and possess good stereoscopic vision; or, Class I and Class II probationers of the Survey of India.   | 10 to 30 | 2 years. | October  |
| Completed 2 years' service as a senior supervisor in a Map Reproduction Office; or, Assistant Managers and Technical Assistants in Map Reproduction Offices of the Survey of India.  | 4 to 6   | 3 months | November |
| Completed 2 years' service as Supervisor or Instructor in Cartography.   | 6 to 10  | 6 months | June     |
| Completed Course 300 and 15 years' service, or completed Course 400 and 7 years' service, or completed Course 500 or equivalent, and 4 years' service in a Survey Organisation; or, Class I, Class II and Class III Div. I personnel of the Survey of India. | 10 to 30 | 3 months | *        |



## SCHEDULE OF COURSES FROM

| 1.  | 2.  | 3.                                  | 4.   |
|-----|-----|-------------------------------------|--|
| 23. | 560 | PHOTOGRAMMETRY,<br>SUPERVISOR LEVEL | To impart intermediate level training in photogrammetry.   |
| 24. | 600 | SURVEY MANAGEMENT                   | To enlarge and update the managerial and technical knowledge of survey officers.                                       |
| 25. | 700 | ADVANCED GEODESY                    | To impart advanced training in geodesy at the professional level.  |
| 26. | 710 | ADVANCED PHOTOGRAM-<br>METRY        | To impart advanced training in photogrammetry at the professional level.   |
| 27. | 750 | ADVANCED SURVEY<br>MANAGEMENT       | To enlarge and update the managerial and technical knowledge of survey executive officers.                             |
| 28. | 800 | SURVEY APPRECIATION<br>SEMINAR      | To acquaint Senior Officers of 'Map-User' organisations with the optimum utilisation of survey services and materials. |
| 29. | 850 | SURVEY MANAGEMENT<br>SEMINAR        | To acquaint senior Officers of the Survey of India with present trends in management and surveying.                    |

Note.-The last column against some courses has been marked with



FROM

JANUARY 1974

|          | 5.   | 6.       | 7.       | 8.                 |
|----------|--|----------|----------|--------------------|
| rain-    | Completed Course 450 and/or 4 years' service in a Photogrammetric Organisation or completed Course 500; or, Class I, Class II and senior Surveyors of Survey of India. | 6 to 10  | 8 months | March<br>September |
| ge-<br>E | Completed Course 550 and 5 years' service, or completed Course 500 and 4 years' service in a Survey Organisation.  | 10 to 20 | 3 months | *                  |
| el.      | Completed Course 500, or equivalent, and 3 years' service in a Survey Organisation.  | 6 to 10  | 1 year   | July               |
| nal      | Completed Course 560 and 4 years' service, or completed Course 500, or equivalent, and 3 years' service in a Photogrammetric Organisation.                             | 6 to 10  | 1 year   | January            |
| e-       | Completed Course 600 and another 5 years' service in a Survey Organisation, or Managers, Map Reproduction Offices with 5 years' service.                               | 6 to 10  | 3 months | *                  |
| ie       | Completed 10 years' service in a responsible capacity in a 'Map-User' Organisation.  | 4 to 8   | 2 weeks  | *                  |
|          | Deputy Directors with 2 years' service, and Directors in the Survey of India.  | 4 to 8   | 2 weeks  | *                  |

th asterisks\*. The scheduling of these courses will be decided later.



## SYLLABI OF COURSES

### 100. OFFICE PROCEDURES AND ACCOUNTS.

*Introductory.*—Organisation of the Survey of India; regional offices, field units. Duties and responsibilities of the clerical section, other sections.

*Receipt and Despatch of Letter.*—Receipt of letter; urgent letter, classified letter. Maintenance of receipt register. File numbering system. Scrutiny of letter before despatch. Despatch of letter; urgent letter, classified letter. Maintenance of despatch register, address book, peon book, stamp register. Disposal of office and file copies; back and forwarding references; noting for reminder. Weeding of file.

*Drafting of Letter.*—Acknowledgement and reminder cards; routine office note. Layout of letters; brevity, clarity and politeness.

*Typing of Letter.*—Various forms of letters, tabular return. Neat execution of work; spelling. Indenting and economy in the use of stationary. Maintenance of typewriter; record of work.

*Reports and Returns.*—Their importance. Maintenance of register, incoming and outgoing returns. Receipt; collection of information, consolidation; punctual submission, interim reply. Returns in connection with records and stores.

*Preparation of Bill.*—Various scales of pay and allowances. Recruitment, increment, service record. Preparation of pay bill; forms and schedules. Advances and recoveries. Submission and encashment of bill; disbursement. Refund. Preparation of bills; travelling allowance, medical, advance.

*Accounting Procedure.*—Preparation of monthly accounts return. Preparation of periodical budget estimates. Survey of India Accounts Pamphlet. Watch on recoveries. Modern trend.

*Rules and Regulations.*—Various publications, up to date corrections. Broad outline of important



rules and regulations; fundamental and supplementary rules; leave, provident fund, medical attendance and pension rules; conduct and appeal rules; security; treasury and financial rules. Manual of office procedure. Departmental circular orders, party order, routine order.

## 120 RECORDKEEPING

*Introductory.*—Organisation of the Survey of India; regional offices, field units. Preparation of map, various stages. Technical records. Duties and responsibilities of recordkeeper. Security of information and records.

*Type of Technical Records.*—Classification; characteristics. Map; scales, numbering system; map catalogue. Photograph; types, scrutiny; photo-index. Field records; control work, detail survey. Office records; aerial survey compilation, fair mapping records. Microfilm, diapositive, other records. Technical publication; departmental book, data pamphlet and forms.

*Preparation of Auxiliary Records, Reports and Returns.*—Plotting of data. Topographical symbol. Enlargement, reduction and tracing of map. Office copy correction to map, chart, publication. Preparation of travelling index, photo index, mounting of map. Technical reports and returns; general correspondence and typing.

*Procurement, Receipt and Issue of Records.*—Indenting of various records; periodical returns. Procedure for receipt of classified and unclassified records. Packing, invoicing and despatch of classified and unclassified records. Book debit and cash accounting; contingent bill.

*Storage and Disposal of Records.*—Safe custody of classified records; policies and instructions. Storage of field and office records; final lodgement. Maintenance of stock register; physical verification. Condemnation and disposal of unserviceable record. Loss statement.



## 130. STOREKEEPING

*Introductory.*—Organisation of the Survey of India; regional offices, field units, Duties and responsibilities of storekeeper.

*Rules and Regulations.*—Various publications, system for updating, Outline of important rules and regulations; General Financial Rules; Security Bond; Delegation of financial powers; Treasury rules. Office procedure and correspondence. Departmental publication; Hand Book of General Instructions; Topographical Hand Book, Chapters I & II.

*Stores Nomenclature.*—Classification of Stores. Codification, vocabulary number, part number. Specifications of stores. Types of stores in the Survey of India and their nomenclature.

*Procedure for Stores Demand.*—Types of demand. Authority and scale, procedure for demand and follow up action.

*Procurement Board.*—Purpose of Procurement Board and role of storekeeper. Opening of quotations. Comparative statement. Testing of sample. Finalisation of sample and rate of purchase.

*Procedure for Stores Issue.*—Scrutiny of demand, authority for issue. Types of issue, procedure for issue, follow up action, documentation.

*Procedure for Direct Procurement of Stores.*—Nature of procurement. Financial sanction. Procurement procedure, calling of tender, procedure for finalisation of rate and firm. Placing of supply order, checking of supply, payment of bill. Contract for supply.

*Procurement of Stores through D.G.S & D.*—General principles. Functions and Organisation of D.G.S & D. Placing of indent and follow up action. Direct demanding authority. Contract; rate, running and lumpsum. Receipt and inspection of stores. Action in case of damage or loss. Inspection note. Liability register. Payment intimation.



*Budget.*—Role of store section in budget proposal and follow up action.

*Contingent Expenditure.*—Types of contingent bills; contingent register. Authority for incurring expenditure. Control register. Preparation of contingent bill. Maintenance of cash book.

*Accounting of Stores.*—Stock and distribution of registers. Individual issue register. Physical verification of stores. Stores account. Vehicle log book. Car diary.

*Disposal of Stores.*—General principles; types of disposals. Condemnation board. Authority for disposal and write-off. Disposal through D.G.S & D. Procedure for disposal of special items; office machine, vehicle, reproduction machine, geodetic and photogrammetric instruments.

*Loss of Stores.*—Nature of loss; procedure for reporting loss. Court of inquiry. Authority for write-off.

*Storage and Maintenance of Stores.*—General principles. Procedure for storage and maintenance of precision, and non-precision instruments. Annual report and history card. Repair of instruments and stores. Store label and bin card. Cleaning, dusting and spraying. Precaution against fire, theft and humidity. Storage of chemical, photogrammetric material, paper and other reproduction stores. Storage of explosive stores.

*Receipt and Despatch of Stores.*—Procedure for taking delivery of store; railway receipt; indemnity bond; demurrage; inspection; open delivery. Packing, invoicing and despatch of stores; credit note.

#### 140. DRAFTING

*Introductory.*—Organisation of the Survey of India; regional offices, field units. Duties and responsibilities of draftsman. Maps.

*Fundamentals of Surveying.*—Principles and methods



of ground and aerial surveying.

*Fundamentals of Cartography and Map Reproduction.*—Projection and plotting of sheets. Types and numbering of maps. Conventional sign; representation of relief; grid. Combination of field sections, mosaicing of black prints. Fair drawing. Preparation of lithographic plate. Colour separation. Proving and printing machines.

*Miscellaneous work in Drawing Office.*—Drawing instruments, use, care and maintenance. Practice in drawing and lettering, use of stencil. Preparation of trace on various material, colour wash. Enlargement and reduction of maps; pantograph proportional compass; transfer of details on maps. Calculation of area, planimeter. Packing and despatch of maps and records.

*Fair Mapping.*—Preparation for fair mapping. Originals for 1:50,000 sheet. Guides; red and blue, others. Special rules for guide map, 1:25,000, 1:100,000 and 1:250,000 sheets. Project map; relaxed rules. Administrative partition on map, boundary riband.

*Map Lettering.*—Transliteration of vernacular names; Imperial Gazeteer, special spelling list, name of railway, locality, etc. Name original. Spaced name. Size and style of type. Border, heading and marginal work, applique slip, standardised and special foot notes.

*Scribing.*—Its history. Instrument and material. Special technique resulting from scribing.

*Special Work in Drawing Office.*—Checking and editing. Relief shading. Special map. Hindi editions of map.

#### 150. SURVEYING, TECHNICIAN LEVEL

*Mathematics and Science.*—Solution of equations. Logarithm. Trigonometrical identities. Solution of plane triangles. Mathematical tables; auxiliary tables of the Survey of India. Elements of optics.

*Fundamentals of Surveying.*—Principles and methods of surveying. Surveying instruments for linear



measurement, planetabing, drawing, etc.; use, care in handling. Chain survey. Large scale survey. Telescopic alidade. Levelling.

*Topographical Survey.*—Topographical survey on medium and small scales. Planetabing methods, survey of detail and contouring, accessory information. Revision of map. Blueprint, colourprint and verification surveys.

*Air Survey Compilation.*—Basic definitions and geometry of the aerial photograph. Graphical extension of control, slotted templet assembly. Use of stereoscope; parallax equation. Contouring under stereoscope. Map compilation by simple methods and use of approximate instruments. Field procedure using aerial photograph; verification, revision surveys. Mosaic, Modern trend.

*Cartography.*—Map Projection. Types and numbering of maps. Conventional sign; representation relief; grid. Pair drawing procedures; originals, guides, names. Scribing manuscript and final colour separation sheet.

*Map Reproduction.*—Photography, preparation of lithographic plate. Colour separation. Proving and printing machines.

*Unit Administration.*—Administration in field units. Civil service rules; departmental circular orders. Duties and responsibilities in the field and recess. Personnel management.

### Schedule

The programme for this course includes 49 weeks of field instructions spread over a period of 2 years with 2 weeks' break in training in the first year and 4 weeks' break in training in the second year.

### 200. CONTROL SURVEYING, TECHNICIAN LEVEL

*Mathematics and Science.*—Solution of equations. Binominal theorem. Logarithm, use of slide rule.



Trigonometrical identities. Solution of plane triangles. Mathematical tables; auxiliary tables of the Survey of India. Elements of optics.

*Fundamentals of Surveying.*—Principles and methods of surveying. Surveying instruments; use, care in handling. Adjustment of theodolite, level, other instruments. Large scale survey. Measurement of area, planimeter. Outline of planetabling methods, aerial survey compilation by graphical method and by stereo-plotter.

*Fundamentals of Cartography and Map Reproduction.*—Projection and plotting of sheets. Change of scale. Numbering of map. Conventional sign; representation of relief, grid. Outline of fair mapping procedures, scribing. Outline of map reproduction process.

*Levelling.*—Double tertiary and single tertiary levelling. Computation and simple adjustment. Provision of meshwork of spot heights; interpolation of contour on large scale survey. Provision of spot heights on aerial photograph for contouring on medium scale.

*Tacheometry.*—Stadia and tangential systems. Autoreduction tacheometer. Provision of control for large scale surveys.

*Traverse.*—Traversing of third and fourth order; field-work, use of subtense bar, azimuth from sun and polaris; computation and simple adjustment, record volume. Establishment of points of given co-ordinates. Theodolite resection. Postpointing of control on aerial photograph. Rectangulation.

*Triangulation Computation.*—Computer's chart; checking and abstract of data from angle book; satellite correction. Computation of grid co-ordinates and heights. Computation of latitude, longitude and height in spherical terms. Compilation of record volume.

*Astronomical Computation.*—Elements of field astronomy celestial co-ordinates, time systems. Computation of astronomical latitude, longitude and azimuth from sun and polaris.



*Hand Operated and Electric Desk Calculators.*—Hand operated desk calculator; basic arithmetical operation. Electric desk calculator; basic arithmetical operation, successive mixed operations. Computation on departmental form. Introduction to electronic desk calculator and use of computer. Care and maintenance ; of calculator.

*Unit Administration.*—Administration in field units. Civil service rules; departmental circular orders; duties and responsibilities in the field and recess. Personnel management.

### Schedule

The programme for this course includes 26 weeks' field instructions and 2 weeks' break in training.

#### 250. SCRIBING

*Introductory.*—Review of map reproduction techniques. Scribing and its history.

*Material and Instruments.*—Material and instruments. Scribing technique. Templet. Prepunching registration.

*Scribing, Lettering and Editing Procedures.*—Organisation of a cartographic office. Collection and scrutiny of source material, mosaicing. Preparation of scribing guide. Colour separation scribing. Preparation of open-window negative for tint plate. Stick-up lettering and name plate. Heading and marginal items. Name negative. Preparation of final specimen. Run-on-proving on plastic, and editing.

*Special Technique.*—Use of spacing guide and stick-up symbol. Scribing packed and dotted lines. Sequential image for critical register. Edge joining. Etching process. Precaution in scribing. Introduction to colour troll technique for preparation of thematic map. Modern trend.

#### 270. COMPUTATION

*Introductory.*—Organisation of the Survey of India; role of computer. Review of mathematics, matrices linear



equations, numerical analysis.

*Fundamentals of Surveying.*--Principles of surveying. Surveying instruments for linear and angular measurements, planetabling, drawing, etc.; use, care in handling. Large scale survey; auto-reduction tachometer. Tertiary and secondary spirit levelling. Tertiary theodolite traversing; field work; computation, record volume. Theodolite resection. Rectangulation. Outline of planetabling methods, aerial survey compilation by graphical method and by stereo-plotter.

*Fundamentals of Cartography and Map Reproduction.*--Projection; classification, construction. Types and numbering system of maps. Grid; layout, computation. Outline of fair mapping procedures, scribing. Outline of map reproduction process.

*Triangulation and its Computation.*--Planning and reconnaissance, field observation. Computation of grid coordinates and heights. Computation of latitude, longitude and height in spherical terms. Compilation of record volume.

*Astronomical computation.*--Field astronomy, celestial coordinates, time systems. Computation of astronomical latitude, longitude and azimuth from sun and stars.

*Adjustment Computation.*--Purpose of adjustment; observational error; measure of precision. Observation equation; condition equation; normal equation. Adjustment of triangulation, figural and circular adjustment. Adjustment of traverse and level nets, trigonometric heights.

*Hand Operated, Electric and Electronic Desk Calculators.*--Hand operated and electric desk calculators; basic arithmetical operation, successive mixed operations. Electronic desk calculator: control, arithmetic, function and vector keys; control, storage and recall. Programming; entering, recording, verifying and correcting programme. Introduction to the use of electronic desk calculator and computer. Care and maintenance of calculator.



*Introduction to Computer Programming.*—Digital computer. Programming language; flow chart; programme operation.

*Unit Administration.*—Administration in field units. Civil service rules; departmental circular orders. Duties and responsibilities in the field and recess. Personnel management.

### Schedule

The programme for this course includes 15 weeks of field instructions.

## 300. JUNIOR LEVEL SUPERVISION

*Fundamentals of Supervision.*—Basic supervisory tasks. Principles of organisation. Interpreting policy; supervisory role, planning of work. Personnel relation, supervision and control. Reports and returns.

*Office Organisation and Procedures.*—Organisation of field units and regional offices in the Survey of India. Distribution of duties. Administrative and technical inspections. Duties of section and Camp Officers; correspondence, accounts, stores and equipment. Financial powers. Disciplinary powers and procedures.

*Review of Technical Advance.*—Review of existing procedures in the department in geodesy, photogrammetry, field surveying, cartography and map reproduction. Modern trend. Planning and execution of various survey tasks using latest methods.

## 310. CADASTRAL CONTROL SURVEYING

*Introductory.*—Historical background of cadastral survey, types of surveys; tax, real property, legal cadastre, pictorial, graphical and administrative operations.

*Fundamentals of Surveying.*—Basic mathematics. Principles and methods of surveying. Measurement of distance and angles. Survey instruments; use, care in handling. Adjustment of theodolite, level, other instruments Chain survey. Measurement of area,



planimeter. Outline of planetabling and aerial survey compilation by graphical method.

*Levelling.*—Double tertiary and single tertiary levelling. Provision of meshwork of spot heights, interpolation of contour on large scale survey.

*Tacheometry.*—Stadia and tangential systems. Auto-reduction tacheometer. Provision of control for large scale survey.

*Traverse.*—Traversing of third and lower order; field work, use of subtense bar, azimuth from sun and polaris. Computation of co-ordinates and heights, record volume. Theodolite resection. Establishment of points of given co-ordinates. Rectangulation. Precise distance measurement. Allowable error of closure and adjustment.

*Triangulation.*—Triangulation as control for large scale survey; field work, use of Hunter Short Base, azimuth from E & W stars; computation, record volume. Allowable error of closure and adjustment.

*Re-establishment of Boundary.*—Numerical data. Graphical data; witness or reference land mark. Tolerance in position. Boundaries of land holding, village, state, international.

*Fundamentals of Cartography and Map Reproduction.*—Map projection. Plotting of control and map sheet. Standard map format and grid. Conventional map symbol. Change of scale. Classification of maps. Outline of map reproduction process.

*Introduction to Photogrammetric Control.*—Principles of photogrammetric survey. Control requirement for each photograph, aerial triangulation pre-pointing and post-pointing.

*Survey Specifications.*—Survey control pillar. Standards of accuracy of different orders of control. Density and distribution of control. Specification for accuracy.

*Organisation and Management.*—General principles, field and office management. Supervision and control. Planning and production control. Time and cost estimates.



*Survey Scheme.*—Assignment of independent work to assess capabilities.

### Schedule

The programme for this course includes 15 weeks of field instructions.

#### 330. CIVIL ENGINEER SURVEYING

*Introductory.*—Fundamentals of surveying.

*Triangulation.*—Triangulation as control for medium scale survey; field work; use of Hunter Short. Base, azimuth from E & W stars; computation, record volume, identification of control point on map and photograph. Allowable error of closure and adjustment.

*Traverse.*— Traverse of third order and lower orders; field work, use of subtense bar, azimuth from Sun and Polaris; computations, record volumes. Establishment of points of given coordinates. Theodolite resection. Postpointing and pre-pointing of control on aerial photographs. Allowable errors of closures and adjustments.

*Levelling.*—Levelling as control for traverse and triangulation heights; double tertiary and single tertiary levelling. Provision of mesh work of spot heights; interpolation of contour with and without reference to details of 1:1,000 and 1:5,000 scale surveys. Provision of spot heights on aerial photograph for contouring on 1:15,000 scale survey. Annotated mosaic; controlled and uncontrolled.

*Tacheometry.*—Review of stadia and tangential systems. Autoreduction tacheometer; provision of control for large scale surveys.

*1:1,000 Scale Survey.*—Plotting by use of autoreduction tacheometer; telescopic alidade. Chain survey; framework, procedure, plotting. Planetabling methods; resection, radiation, intersection.

*1:5,000 Scale Survey.*—Survey of detail and



contour by telescopic alidade. Survey by planetabing method. Use of clinopole. Interpolation of contour from a mesh of spirit-levelled spot heights.

*1:15,000 Scale Survey by Photogrammetric Method.*—Principles of photogrammetry. Terminology. Orientation concept. Photo-control requirement. Plotting.

*1:15,000 Scale Survey by Air Survey Method.*—Photo verification, blue print verification and height control. Aerial survey compilation by graphical method, slotted templet assembly; contouring with the use of stereoscope.

*Engineering Survey.*—Setting out works. Measurement of area and volume. Survey of dam, reservoirs and comma ded area; specification; cost estimate, planning and production control. Application of photogrammetry in Engineering Survey. Elements of hydrographical surveying, tunnelling, mine surveying. Photo interpretation.

*Survey Scheme.*—Assignment of independent work to assess capabilities.

*Preparation of plan.*—Fair drawing and tracing of plan. Printing of plan.

### Schedule

The programme for this course includes 13 weeks of field instructions.

### 350. CONTROL SURVEYING, SUPERVISOR LEVEL

*Introductory.*—Review of mathematics.

*Levelling.*—Levelling as control for traverse and triangulation heights; double tertiary and single tertiary levelling; adjustment of level. Provision of spot heights on aerial photograph for contouring on medium scale survey.

*Tacheometry.*—Stadia and tangential systems. Auto-reduction tacheometer. Provision of control for large scale survey.



*Traverse.*—Adjustment of theodolite; use, care in handling. Traversing of third and fourth order; field work, use of subtense bar, azimuth from sun and polaris; computation, record volume. Establishment of points of given co-ordinates. Theodolite resection. Postpointing of control on aerial photographs; prepointing. Planning and reconnaissance for traverse network.

*Triangulation.*—Topographical triangulation; planning and reconnaissance; field observation, use of Hunter Short Base, azimuth from E & W stars. Computation of coordinates in grid and spherical terms; record volume. Postpointing of control on aerial photograph. Control requirement for photogrammetry.

#### Schedule

The programme for this course includes 18 weeks of field instructions.

#### 360. SURVEY INSTRUCTION

*Introductory.*— Aim of instruction, theory of learning, methods of instruction.

*Principles and Practice of Instruction.*— Stages of instruction; preparation; selection of material, choice of method, planning sequence of instruction, lesson plan. Transmission; personal characteristics and attitude of the instructor, use of training aids. Reception; psychology of the student, motivation. Assimilation; test technique. Assessment of instruction. Planning of courses of instruction.

*Training Aids.*—Necessity of training aids; types, preparation and use.

#### 400. SURVEYING, SUPERVISOR LEVEL

*Fundamentals of Surveying.*—Classification of surveys, maps. Principles of surveying; methods of surveying; field and office work, errors. Surveying instruments for linear and angular measurements, planetabling, drawing, etc.; use, care in handling.



Optics of telescope; adjustment of theodolite, level, other instruments. Chain survey. Large scale survey; telescopic alidade, autoreduction tachometer. Tertiary spirit levelling. Tertiary theodolite traversing; theodolite resection.

*Topographical Survey.*—Triangulation; planning and reconnaissance, field observation. computation, record volume. Planetabling; methods, medium and small scales. Revision of map; blue print, colour print and verification surveys. Barometric levelling. Topographical survey; specification; provision of control, survey of details; out-turn; cost and time estimates.

*Geodesy.*—Field astronomy; celestial coordinates, time systems. Determination of astronomical longitude, latitude and azimuth; combined determination. Deflection of the vertical; astronomical and geodetic coordinates. Introduction to geodetic triangulation, precise traversing and levelling. Electromagnetic distance measurement; geodimeter; tellurometer. Adjustment computation; method of least squares. Electric and electronic desk calculators. Allowable error of closure.

*Photogrammetry.*—Geometry of an aerial photograph, basic definitions. Graphical extension of control, slotted templet assembly. Map compilation by simple methods and use of approximate instruments. Mosaic. Elementary photogrammetric optics, theory of image formation. Stereoscopic vision; elementary stereophotogrammetry. Elementary techniques of photo-interpretation; field procedures using aerial photograph, photo verification; revision survey.

*Cartography.*—History of mapping; conventional sign, representation of relief. Map projection; Numbering system of maps. Grid; layout; computation. Fair mapping procedures; material, originals, guides. Scribing; field manuscript and final colour separation sheet. Compilation of geographical map. Thematic map.

*Map Reproduction.*—Principles of lithography for



cartographic map reproduction. Process photography. Preparation of lithographic plate by surface and deep etch process. Proving and printing machines.

*Cadastral Survey.*—Registration law and procedure. Provision of control; connection to national framework. Establishment of boundary from survey and other records. Survey and fair drafting of plan. Revision of plan. Computation of area. Rectangulation. Application of photogrammetry in cadastral survey.

*Engineering Survey.*—Setting out works; road and railway, curve. Measurement of area and volume. Survey for dam, reservoir and commanded area; specification; cost and time estimates. Introduction to hydrographical surveying, tunnelling, mine surveying.

*Administration and Management.*—Role and organisation of the Survey of India; composition of services. Unit and camp administration and accounts; administrative and technical returns, Office procedures; pay and allowances; civil service rules. Cost estimates; production control. Leadership; morale, discipline. Personnel relation. Supervision and control.

#### Schedule

The programme for this course includes 51 weeks of field instructions spread over a period of 2 years with 2 weeks' break in training in the first year and 4 weeks' break in training in the second year.

#### 410. CADASTRAL SURVEYING

*Introductory.*—Historical background. Classification of cadastral survey; tax, real property, legal cadastre, political, graphical and numerical surveys. Legal aspect of cadastral records. Connection to national frame-work. Demarcation; establishment of boundary. Cadastral survey operations, legal, technical and administrative.

*Fundamentals of Survey.*—Basic mathematics. Broad classification of surveys, maps. Principles of surveying; methods of surveying; field and office work; Surveying instruments for linear and angular measurements,



planetabing, drawing, etc.; use, care in handling. Optics of telescope; error and adjustment of theodolite, level, other instruments. Modern trend.

*Large Scale Survey.*—Surveys on 1:1,000 and 1:4,000 scales. Chain survey. frame-work, procedures, plotting. Stadia and tangential systems of tachometry; autoreduction tachometer. Double tertiary and single tertiary levelling. Provision of meshwork of spot heights, interpolation of contour. Planetabing methods; survey of detail and contour; accessory information. Telescopic alidade.

*Traverse.*—Traversing of third and lower order; field work, use of subtense bar, azimuth from sun and polaris. Computation of coordinates and heights, record volume. Theodolite resection. Establishment of points of given coordinates. Rectangulation. Misclosure, tolerance, and adjustment.

*Revision and Re-survey of plan.*—Introduction, necessity, choice of methods. Blue print and colour print surveys. Re-survey of plan.

*Triangulation.*—Triangulation as control for large scale survey; field work, use of Hunter Short Base, azimuth from E & W stars; computation, record volume. Base establishment, precise distance measurement. Misclosure, tolerance, adjustment.

*Re-establishment of Boundary.*—Numerical data. Graphical data, witness or reference land mark. Tolerance in position. Re-establishment of boundary; land holding, village; state, international.

*Preparation and printing of plan.*—Fair mapping procedure. Scribing. Change of scale. Principle of lithography. Process photography. Preparation of lithographic plate by surface and deep etch process. Diazo printing. Proving and printing machines.

*Registration Law and Procedure.*—Systems of land registration in general. Record of land rights. Registration procedures. Indian Registration Act. Torrens system, principles, advantages and disadvantages. Codes affecting registration and land revenue surveys in the different states of India. Modern trend.



*Application of photogrammetry in Cadastral Survey.*—Aerial photograph and its application. Specification for aerial photography and processing. Methods; practical, graphical, numerical, rectification, aerial triangulation, full ground control. Photogrammetric control requirement. Pre-pointing, post-pointing. Autoreduction plotting machine. Coordinate recording devise. Computation and adjustment. Field completion.

*Organisation and Management.*—Organisation of field and recess work; planning and production control; cost and time estimates. Personnel management; supervision and control. Automated data processing. Internal and external communications. Public notice, mass media, personnel notification, announcement. Organisation Chart, functional Chart, flow Chart.

*Cadastral Survey Specification.*—Demarcation; pillar, control pillar, standards of accuracy, map scale, projection, cartographic process. Details to be shown on the map.

*Record of Right and Classification.*—Area computation: graphical, numerical, Use of planimeter. List of claimants. Occupants. Numerical list of land holdings, survey number. Land classification and settlement, Issue of certificate, or patta

#### Schedule

The programme for this course includes 30 weeks of field instructions.

#### 450. PHOTOGRAMMETRY, OPERATOR LEVEL

*Introductory.*—Aims and principles of photogrammetry.

*Basic Mathematics.*—Review of algebra, Trigonometry and geometry.

*Elementary Photogrammetry.*—Geometry of a single photograph. Stereoscopy and floating marks. X and Y parallax. Measurement of relief by parallax bar. Radial line plotting. Principles and procedure of slotted templet combination. Stereo-templet and its use.



*Aerial Camera and Aerial Photography.*—Parts of aerial camera and its operation. Use of filter. Image quality and resolution. Camera calibration.

*Photographic Processing.*—Work in photo laboratory. Use of contact and Longetronic Printers. Rectifier.

*Stereo-photogrammetry.*—Photogrammetric bundle of rays. Elements of orientation. Relative and absolute orientation.

*Photogrammetric Instrument.*—Basic optics. Classification, characteristics, Construction and design of instruments; care and maintenance. Testing and adjustment. Multiple and stereotope. Plotting of model.

*Aerial Triangulation.*—Observation procedure on A-7. Strip formation by aeropolygon method. Procedure for independent model observation on A-8, B-8. Principle of connection in independent model aerotriangulation. Use of point marking/transfer device. Nature and source of errors in aerotriangulation. Principles of polynomial adjustment. Procedure for graphical adjustment. General notions about analytical photogrammetry. Mono-and stereo-comparators.

#### 460. ELECTROMAGNETIC DISTANCE MEASUREMENT

*Basic Electronics.*—Alternating energy resistance, inductance, capacitance. Resonant circuits; R.F. oscillator, microwave oscillator, klystron. Frequency mixing; amplitude and frequency modulation. Radio tube; cathode ray tube; photo multiplier tube. Transistor. Phase change and discrimination. Kerr cell. Laser.

*Electromagnetic Wave propagation.*—Direct, surface and reflected waves. Velocity of propagation. Computation of refractive index for microwave and light wave; effect of temperature, pressure, humidity and wave length; nomograph.

*Microwave System.*—Basic principles. Phase analysis. Ground swing. Tellurometer model; operating frequency; range and accuracy. Measuring procedures;



reduction of reading. Other microwave instruments.

*Electro-Optical System.*—Basic principles. Geodimeter models; measuring frequency; measuring procedure, reflector. Null point determination, reduction of reading; sensitivity of null indicator. Frequency and delay line calibration. Use of laser. Other electro-optical instruments.

*Field-work and reduction of observations.*—Geometrical reduction of slant distance; slope correction, reduction to sea level, chord to arc correction. Provision of photogrammetric control. Tellurometer and geodimeter traverses. High precision technique; measurement of base line. Care and maintenance of instrument.

### Schedule

The programme for this course includes 7 weeks of field instructions.

## 470. GEODETIC SURVEYING

*Applied Mathematics and Science.*—Vectors. Matrices. Spherical trigonometry. Interpolation. Gravity potential. Optics of surveying instruments. Basic electronics.

*Geometric Geodesy.*—Geoid and ellipsoid. Coordinate systems. Elementary geometry of ellipsoid. Geodetic instruments: theodolite, level, tellurometer and geodimeter. Geodetic frame-work; triangulation, trilateration, traverse and levelling. Computation of coordinates and heights.

*Adjustment computation.*—Introduction to computer programming. Error in measurement. Method of least squares: adjustment of triangulation, traverse and level nets.

*Geodetic Astronomy.*—Introduction; definitions. Celestial coordinate systems. Star places; star catalogue. Time systems. First and second order determinations of astronomical longitude, latitude and azimuth. Reduction of observation.



*Map projections.*—Classification of projections. Common projections; polyconic, International map, Mercator, Gnomonic, Stereographic and Sinusoidal. Plane coordinate systems: Cassini, Transverse Mercator and Lambert conical orthomorphic.

*Physical Geodesy.*—Gravity field of the earth. Isostasy; normal gravity; gravity anomalies; geoid undulations, Measurement and reduction of gravity observations. Tides. Magnetism.

### Schedule

The programme for this course includes 22 weeks of field instructions.

### 500. SURVEY ENGINEERING

*Applied Mathematics and Theory of Errors.*—Matrix algebra; vector analysis. Interpolation formulae; spherical trigonometry. Introduction to computer programming. Numerical analysis. Theory of errors; adjustment of observations, method of least squares.

*Fundamentals of Surveying.*—Classification of surveys, maps. Principles of surveying; methods of surveying: field and office work; errors. Surveying instruments for linear and angular measurements; planetabling, drawing, etc.; use, care in handling. Optics of telescope; adjustment of theodolite, level, other instruments. Chain survey, large scale survey; telescopic alidade; autoredaction tachometer. Tertiary theodolite traversing; theodolite resection.

*Topographical Survey.*—Triangulation; planning and reconnaissance; field observation; computation, record volume. Planetabling; methods, medium and small scales. Revision of maps; blue print, colour print and verification surveys. Barometric leveling. Topographical survey; specification; provision of control, survey of details; accuracy and suitability; cost estimate; out-turn; planning and production control. Exploration survey.

*Geodesy.*—Field astronomy; celestial coordinates, time systems. Determination of astronomical longitude,



latitude and azimuth; combined determination. Deflection of the vertical, astronomical and geodetic coordinates. Geodetic field procedure, reduction of observation. Electromagnetic distance measurement; geodimeter, tellurometer; reduction. Computation of coordinates for medium lines; direct and inverse problem. Geodetic levelling, orthometric and dynamic heights. Adjustment computation; theory of errors; method of least squares; adjustment of triangulation, traverse and level nets. Determination of the best fitting ellipsoid; astrogeodetic and gravimetric methods. Use of gravity anomalies in geodesy.

*Photogrammetry.*—Projective geometry; properties of central projection. The single photograph, rectification; mosaic. Map compilation by graphical method; slotted templet assembly. Photogrammetric optics and aerial photography. Lens distortion. Photographic process, resolution characteristics, filter, image quality; aerial survey camera. Stereoscopic vision; basic horizontal parallax equation; epipolar theory. Concept of model deformation. Stereo-photogrammetry, double point resection in space, theory of relative and absolute orientation. Photogrammetric instrument orientation procedure and aerial triangulation technique. Photogrammetric adjustment; adjustment of observation, principles and practice. Map production using photogrammetric procedure; revision of map; ground control; flight planning. Photo-interpretation; other applications of photogrammetry.

*Cartography.*—History of mapping; conventional sign, representation of relief. Map projection. Numbering system of map. Grid; layout, computation. Fair mapping procedure, scribing; field manuscript and final colour separation sheet; editing procedure. Compilation of geographical map. Thematic map. Modern trend.

*Map Reproduction.*—Methods of printing. Process photography including colour photographic printing and rectification. Phototype-setting and phototype-placing. Preparation of plate. Proving and printing of map.



*Cadastral Survey.*—Legal requirement; registration laws and procedures. Technical requirements; provision of control, connection to national framework. Establishment of boundary from survey and other records. Survey and fair drafting of plan. Revision of plan. Computation of area. Rectangulation. Applications of photogrammetry in cadastral survey.

*Engineering Survey.*—Setting out works; road and railway; curve; horizontal, vertical and transition. Measurement of area. Measurement of volume; cross section, spot level, contour; mass diagram. Survey for dam, reservoir and commanded area; specification; cost estimate, planning and production control. Hydrographical survey; tide gauge, sounding; stream measurement, Tunnelling, mine surveying.

*Administration and Management.*—Organisation of the Government of India; Organisation; control and delegation; composition of services. Unit administration; accounting procedure; field camp. Office procedure; administrative and technical reports and returns. Civil service rules and regulations; pay and allowances. Cost estimate; budgetting. Leadership; morale, motivation. Personnel management. Concept of welfare state, parliamentary democracy. Process of planning. Roll of civil service. Spiritual and moral value.

#### Schedule

The programme for this course includes 4 weeks of study tour and 48 weeks of field instructions spread over a period of 2 years with 2 weeks' break in training in the first year and 4 weeks' break in training in the second year.

#### 510. MAP REPRODUCTION

*Introductory.*—Method of printing, production control and planning.

*Process photography.*—Line, Half-tone. continuous tone and colour.



*Negative correction and Layout.*—Retouching. Correction of negative. Layout procedure.

*Photo-type Setting.*—Method and technique of type-setting. Photo-type placing.

*Photographic Printing.*—Material and equipment.

*Copying.*—Material and equipment.

*Photo-Mechanical process.*—Material and equipment. Duplicating. Guide line for scri g. Plate-making. Proving. Step and repeat plating.

*Printing.*—Material and equipment.

*Quality Control.*—Control technique. Selection of chemical, paper and ink. Print examination.

*Administration and Management.*—Principles of supervision. Personnel relation. Labour law; labour relation. Organisation and administration. Planning and control of work. Storage and retrieval of data.

## 52 . CARTOGRAPHY

*Introductory.*—Definition of Cartography. History of Cartography.

*Graphic communication.*—Means and conditions. Visual perception. Legibility versus precision.

*Cartographic Principles.*—Definition of map. Map projections. Scales. Symbolization. Generalization.

*Cartographic Drawing.*—Cartographic technique. Material and instrument. Masking. Relief representation name.

*Map Reproduction.*—Photography, duplicating. Photo-mechanical process. Printing.

*Topographic Mapping.*—Data collection. Data recording, Series versus single maps. Derived maps. Indian topographical maps. Selected foreign topographical maps.



*Socio Economic Mapping.*—Data collection. Data recording, with emphasis ;on cartographic method. Regional and national atlases.

*Other Maps.*—Road, tourist, historical, chart, etc.

*Editing and planning.*

*Economics and Management in Cartography.*—Map design. Prof reading. Economics and technology. Controls.

*Unconventional Map.*—Relief map. Photo map. Stereo orthophoto. Special methods.

*Automation and new Trends*

*Cartology and photo-Interpretation.*—Map reading. Photo interpretation.

#### 550. SENIOR LEVEL SUPERVISION

*Principles of Supervision.*—Role of the supervisor. Defining aim. Division of labour; formal and informal organisation. Command and control; limiting load, span of control. Communication; informal relationship; flexibility; grape vine. Delegation, accountability and control. Discipline; redress of grievance. Incentive; morale, motivation, welfare; adaptability. Supervisor and staff relationship. Planning, programming, control and feed-back. Cost effectiveness. Human relation.

*Office Organisation and Procedures.*—Organisation of field and static offices of the Survey of India; distribution of duties. Administrative and technical inspections. Duties of Section and Camp Officers. Correspondence; dealing and disposal of, standardisation. Accounts; individual and camp. Stores, instruments and equipment; indent, accounting, use and maintenance, disposal. Financial powers. Disciplinary powers and procedures.

*Review of Technical Advances.*—Review of existing procedures and practices in the fields of



geodesy, photogrammetry, field survey, cartography and map reproduction. Modern trend. Planning and execution of various survey tasks using latest methods; cost estimate, maintenance of data. Quality control.

### Schedule

The programme for this course includes 2 weeks of field instructions.

#### 560. PHOTOGRAMMETRY, SUPERVISOR LEVEL

*Introductory.*—Principle of photogrammetry.

*Basic Mathematics.*—Vectors and matrices. Geometry. Theory of errors, and adjustment.

*Photogrammetric Instruments.*—Photogrammetric optics. Classification, characteristics, construction and design of instruments. Testing and adjustment. Care and maintenance.

*Photogrammetric procedure.*—Theory of relative and absolute orientation. Use of point marking/transfer device. Observation procedure for aerial triangulation. Strip formation. General principles of analytical photogrammetry. Mono- and Stereocomparators. Rectification.

*Photogrammetric Adjustment.*—Nature of source of errors in aerial triangulation. Procedure for graphical adjustment. Adjustment of aerial triangulation strips by semi-analytical and analytical methods. Block adjustment. Theory of errors of strips and blocks.

*Planning and Organisation.*—Field control. Flight planning, and photogrammetric Organisation. Choice of instruments and methods. Work study and supervision.

*Miscellaneous.*—Application of photogrammetry and modern trend.



## 600. SURVEY MANAGEMENT

*Principles of Management.*—Principles of organisation; organisational systems. Motivation and morale. Incentive. Delegation, accountability and control. Administrative practices. Maintenance of vitality; adaptability to change. Leadership. Managerial decision making. Public relations. Technical planning, programming, control and feed-back. Net-work analysis systems; work-study; data processing. Cost effectiveness: inventory control; market research. Human relation.

*Office Organisation and Procedures.*—Organisation of various special establishments of Survey of India and their inter-relation with the rest of the department. Office organisation; filing system; duties of Officers-in-Charge of Survey Units. Distribution of duties; administrative and technical orders. Administrative and technical inspections. Check register. Unit accounts; budgeting; financial powers. Stores; forecast, procurement, accounting, maintenance and disposal. Disciplinary powers and procedures. Controlling Officer; duties and responsibilities.

*Technical Advances and Survey Planning.*—Present trend in geodesy, photogrammetry, field survey, cartography and map reproduction; applicability to Indian conditions; ways and means of introduction. Survey planning using latest methods; organisation of field and recess programmes; map design and assessment of accuracy. Quality control.

## 700. ADVANCED GEODESY

*Applied Mathematics in Geodesy.*—Vector analysis. Matrices. Complex variables. Spherical trigonometry. Development in series. Interpolation. Elementary differential geometry. Potential theory. Spherical harmonics. Optics of surveying instruments. Basic electronics.

*Computer Programming.*—Digital computers. Programming language; iteration and decision making; programme operation.



*Geometric Geodesy.*—Geoid and ellipsoid. Coordinate systems. Geometry of ellipsoid. Deflection of the vertical. Geodetic instruments; theodolite, level, tellurometer, geodimeter and other electronic instruments; Observation and its reduction. Geodetic framework; triangulation, traverse, trilateration, levelling; computation. Astro-geodetic determination of the reference ellipsoid.

*Adjustment Computation.*—Errors in measurement. Method of least squares. Observation and condition equations; solution of normal equation. Adjustment of triangulation, trilateration, traversing and levelling nets. Fitting of curves to observed data. Criteria for rejection of observation.

*Map Projection.*—General theory of map projection. Common projections; secant conical, polyconic, International map, Mercator, Gnomonic, Stereographic. Plane coordinate systems; Cassini, Transverse Mercator, Lambert conical orthomorphic.

*Geodetic Astronomy.*—Introduction, Celestial coordinate systems; transformation of coordinates. Star places; ephemerides and star catalogues. Polar motion. Time systems. First and second order determinations of astronomical longitude, latitude and azimuth. Combined determination. Reduction of observation.

*Physical Geodesy.*—Gravity field of the earth. Isostasy; normal gravity; gravity anomalies; geoid undulations. Measurement and reduction of gravity observations. Gravimetric determination of the deflection of the vertical. World Geodetic system. Tides. Magnetism.

*Satellite Geodesy.*—Introduction. Orbit of a satellite. Observational methods. Reductions. Geometric and dynamic uses.

*Survey of Allied Fields.*—Geophysics, photogrammetry, cartography, oceanography, navigation.

#### Schedule

The programme for this course includes 10 weeks



of field instructions, 2 weeks' excursion to various establishments in India and 2 weeks' break.

#### 710. ADVANCED PHOTOGRAMMETRY

*Introductory.*—Review of concepts of photogrammetry, photogrammetric optics, aerial photography, camera and its calibration, photographic processing. Basic electronics.

*Basic Mathematics.*—Vectors and matrices. Higher Geometry. Numerical analysis. Computer programming. Theory of errors, and adjustment.

*Analogue Photogrammetry.*—Geometry of photograph. Stereoscopic perception. Classification, characteristics, construction and design of analogue instruments. Testing and adjustment. Care and maintenance. Theory of relative and absolute orientation. Observation procedure for aerial triangulation. Strip formation by aero-polygon method. Procedure for graphical adjustment. Nature and source of errors in aerial triangulation. Theory of rectification including differential rectification, rectifier, orthophoto system.

*Semi-analytical Photogrammetry.*—Procedure for independent model observation. Strip formation by connection of independent model.

*Analytical Photogrammetry.*—Principles of measurement. Point marking/transfer device. Mono-stereo comparators. Method of relative orientation and strip formation, principles of polynomial adjustment. Adjustment of strip and block by analytical method. Theory of errors of strip and block. Analytical plotter.

*Planning and Organisation.*—Flight planning, organisation and photogrammetric systems. Field control. Pre-pointing and post-pointing, choice of instrument and method. Cartography and map projections. Map accuracy.

*Non-topographic photogrammetry.*—Close-range and terrestrial photogrammetry. Non-topographic applications.



*Recent Trend and Advance.*—Satellite photogrammetry, Radargrammetry. Holography.

### Schedule

The programme for this course includes 1 week of field instructions, 2 weeks' excursions, 9 weeks of project and a mid-term break of 2 weeks.

### 750. ADVANCED SURVEY MANAGEMENT

*Principles of Management.*—Principles of organisation; structure. Objectives; management by objectives, Centralisation and decentralisation. Control; line and staff, span of control. Communication; flexibility. Delegation; accountability, personnel administration; recruitment, training; discipline; promotion. Morale, motivation. Maintenance of vitality of the organisation; staff associations. Adaptation to change, preparatory steps, automation. Management development; pattern of leadership. Public relation. Role of the directing authority. Managerial decision making; management by delegation and by exception. Suggestion scheme; job evaluation. Incentive. Forecast.

*Planning and Production Control.*—Technical planning, programming, control and feed back. Market research. Network analysis systems. Operation research. Work study. Data processing. Performance budgetting. Cost effectiveness. Value analysis. Inventory control. Quality control.

*National Development and Survey of India.*—National plan; survey priorities; forecast and distribution of work load to directorates; pre-investment survey maps and multi-discipline coordination. User satisfaction and cost benefit analysis.

*Technical Advance and Survey Planning.*—Present trend in geodesy, photogrammetry, field surveying, cartography and map reproduction; applicability to Indian conditions; ways and means of introduction. Aerial survey mission. Choice of base map; map design; assessment of accuracy. Impact of latest techniques on survey planning.



## 800. SURVEY APPRECIATION SEMINAR

*Survey Services and Products.*—Organisation of the Survey of India; services and products. Centre for Survey Training and Map Production. Topographical, geographical and special map; scales, contour interval; accuracy standard. Stages of map production; aerial photography, specifications; ground control, instruments and procedures; photogrammetric compilation; cartographic processing; map reproduction; cost and time factors.

*Utilisation of Survey Material.*—Pre-investment requirement of surveying and mapping; scale, contour interval, accuracy standard, map content; effect on cost and time. Economics of map use, matching map specification to job requirement. Surveying method adopted by project engineer and state surveyor. Availability of map consultancy services from initial planning to final completion. Utilisation of various interim material; aerial photograph, mosaic; control data, manuscript material, diazo-print, proof.

## 850. SURVEY MANAGEMENT SEMINAR

*Management and Production Control.*—Problems of senior manager; role of the directing authority; policy framing. Management development; organisation. Morale; communication; welfare. Public relations. Adaptation to change. Performance budgetting; cost effectiveness. Material planning. Control measures. Work study.

*Technical Advances and Survey Planning.*—Present trend in geodesy, photogrammetry, field surveying, cartography and map reproduction; applicability to Indian conditions; ways and means of introduction. Aerial survey mission. Choice of base map; map design; assessment of accuracy. Impact of latest technique on survey planning.