

INDIAN INSTITUTE
OF
TECHNOLOGY

MADRAS



TENTH ANNUAL REPORT

1968-69

**INDIAN INSTITUTE OF TECHNOLOGY
MADRAS**



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1968-69

Visitor :

PRESIDENT OF INDIA

Chairman, Council of the Indian Institutes of Technology :

Dr. V. K. R. V. RAO

Union Minister for Education and Youth Services,
Government of India,

Chairman, Board of Governors :

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Director :

Dr. A. RAMACHANDRAN

Deputy Director :

Prof. S. SAMPATH

Registrar :

Shri C. V. SETHUNATHAN

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1968-69

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ANNUAL REPORT FOR THE YEAR 1968-69

FOREWORD

GENERAL :

The year under review marks the completion of the First decade for the Institute and is noteworthy for the steady progress made by the Institute with emphasis on the consolidation of its laboratory facilities and the identification of specialized areas of work potentially useful for the country's industrial development.

On 4th January 1969, Dr. A. Lakshmanaswami Mudaliar, Chairman, Board of Governors, was succeeded in this Office by Shri H. V. R. Iengar, Chairman, E.I.D. Parry Group. The Institute is under a deep debt of gratitude to Dr. Mudaliar for his leadership and counsel during its formative years.

In the death of Dr. Zakir Husain, President of India, on 5th May 1969, the Institute lost its Visitor. The nation sustained a grievous blow in the passing away of this far-sighted statesman and educationist.

The Institute suffered another loss in the demise, on 6th April 1969, of Shri T. Muthian, Director of Technical Education, Government of Madras. Shri Muthian was a member of the Board of Governors since January 1966.

EDUCATIONAL EXCHANGES :

Under the terms of the Second Indo-German Agreement, signed in June 1966, the following German Staff took up positions at the Institute during the year: one Professor, two Associate Professors, one Lecturer, seven Senior Scientific Assistants and two members of the technical Staff. Five Professors and three Senior Scientific Assistants left for Germany on completion of their assignments.

Fourteen Indian Staff members of the Institute were deputed to West Germany for training in the laboratories of various Technical Universities. Senior Staff-members paid short-term visits for a study of labora-

tory organization and research techniques in German technical institutes and industry, in the following fields: Chemical Engineering, Civil Engineering, Mechanical Engineering (Turbo-Machines), Metallurgy and Physics. Long-term training facilities in German industrial establishments were made available to two Indian Foremen.

The Government of the Federal Republic of Germany offered, for the first time during the year, two scholarships for study and training in West Germany, to be awarded to meritorious candidates who have gone through the B. Tech. and M. Tech. Degree programmes of study at the Institute. The two selected candidates will proceed to Germany at the end of the academic year.

Under a programme supported by the International Association for the Exchange of Students for Technical Experience (IAESTE) and through the good offices of the German Academic Exchange Service (DAAD), 15 students, from among those awarded the B. Tech. Degree of this Institute in various Engineering disciplines in July 1969, were selected for scholarships which will enable them to spend 8 months in West Germany and work in industrial establishments and acquire practical experience.

The Institute was privileged to receive, during the year, several distinguished Professors and Scientists, on short-term visits: Dr Ing. K. Gersten, University of Bochum, Dr. Ing. H. Brauer, Technical University, Berlin, and Dr. Ing. K. W. Bieger, Technical University, Hannover, from Germany, in addition to others from the U.S.A., U.K., Thailand and the United Nations, and from other parts of the country. These visits were taken advantage of to hold seminars, symposia and discussions with Faculty-members of the Institute in relevant areas.

Special mention may be made of the visit to the Institute, in March 1969, of a team from Germany consisting of Prof. Dr. D. Haupt, Head, Computer Centre, Technical University, Aachen, Dr. W. Ameling, Director, Institute for Telecommunications, Technical University, Aachen, Dipl. Ing. F. F. Diederich and Dipl. Ing. G. Schaefer, Institute for International Technical Development and Co-operation, Technical University, Aachen, to assess the Computer-needs of the Institute in the context of its educational, training and research needs and the potentiality for service to industry. It is hoped that the visit of this team and their report, based on their study of the relevant problems both at the Institute and at other

centres of computer activity that they visited in India, will be the harbinger of a Computer Centre at the Institute, with appropriate facilities, in the not too distant future.

ACADEMIC ACTIVITIES :

Convocation :

At the Fifth Convocation, held on 1st August 1968, with Dr. Vikram A. Sarabhai, Chairman, Atomic Energy Commission, as Chief Guest, 292 students were awarded the B.Tech. Degree, 18 the M.Sc. Degree, 52 the M.Tech. Degree, 19 the D.I.I.T. (in Industrial Engineering) for the first time, and 7 the Ph. D. Degree in Science or Engineering. Taking the five Convocations together, the Institute has awarded 961 B.Tech., 91 M.Sc., 148 M.Tech., 19 DIIT., and 25 Ph. D. Degrees.

New Courses :

The year saw the ushering in of new areas of study at the M. Tech. Degree level: Aeronautical Engineering with specialization in Aircraft Structural Mechanics, Aerodynamics and Propulsion; Mechanical Handling; Thermal Sciences with specialization in the following streams: Thermal Power Engineering, Internal Combustion Engines, Combustion and Propulsion and Turbo-Machines; and Physical Metallurgy. A one-year post-graduate Diploma Course (D.I.I.T.), in Chemical Engineering Practice, was also started during the year.

A significant step was the initiation of research programmes, leading to the Master's Degree (M.S.), in various engineering disciplines. The idea is to induct, into this inter-disciplinary effort, gifted young men, with an aptitude for research and development work, immediately on their graduating with the B.Tech. Degree (Engineering subjects) or the M.Sc. Degree (Mathematics, Physics or Chemistry).

The Institute also admitted, for the first time, a few post-doctoral fellows in Science as well as Engineering.

Publications :

Research Papers: As many as 193 papers covering the investigations carried out in the Science and Engineering Departments of the Institute were published during the year.

Journal of Mathematical and Physical Sciences : This Journal, launched in November 1967, continued to make progress. Three Volumes, each comprising four numbers, have been published so far.

Books : Shri V. D. Muthayya, Lecturer, Department of Civil Engineering, published a Tamil translation of his earlier book on 'Geology'.

Dr. S. K. Srinivasan, Professor, Department of Mathematics, in collaboration with Dr. R. Vasudevan, Matscience, Madras, is writing a monograph on 'Random Differential Equations and other Applications' — to be published, in 1970, by the American Elsevier Company, in the series 'Analytical and Computational Methods in Science and Mathematics'.

Laboratory Manuals : Manuals have been prepared, for Departmental use, by the Hydraulics, Machine Tools and Instrumentation Laboratories.

Brochure : The Institute published a Brochure that contains, in brief, information on equipment, transducers and instruments designed and fabricated at the Institute by its Faculty over the last few years.

Special Courses, Seminars and Symposia :

In December 1968, the Institute conducted, with assistance from the Technical Physics Division of the Bhabha Atomic Research Centre, Trombay, a three-week course in 'High-Vacuum Technology'. There were 54 participants, drawn from academic institutions, research laboratories and industrial establishments. Dr. H. N. Sethna, Director, Bhabha Atomic Research Centre, Trombay, delivered the Valedictory Address for the Course.

In February 1969, the Department of Chemical Engineering organized a Special Course on "Advances in Chemical Engineering". Prof. Brauer, Director, Institute of Process Engineering, Technical University, Berlin, delivered lectures for the benefit of engineers from industry. The Department also conducted, in June 1969, a Seminar on 'Development and Design of Chemical Process

Equipments', together with a discussion on "Teaching Design Effectively". The Department assisted the Metallurgy students of the P.S.G. College, Coimbatore, by running a Course in 'Ore-Dressing — Theory and Practice' in February 1969.

The Department of Metallurgy, in collaboration with the Indian Institute of Welding, organized, in March 1969, a Seminar on 'Recent Developments in Welding Technology'. This Department also extended its co-operation to the Institute of Indian Foundrymen in organizing the latter's Annual Convention at the Institute in March 1969. Prof. J. Ruge, Technical University, Braunschweig and Prof. W. Panknin, Technical University, Berlin, participated in the two Seminars and delivered special lectures in the areas of Metal Joining and Metal Forming.

The twenty-first Annual General Meeting of the Aeronautical Society of India was held at the Institute in April 1969. Over 40 technical papers were presented at this meeting. An exhibition, relative to various aspects of aero-space engineering, was organized at this time.

Summer Schools :

The third and final session of the Sequential School in Mechanical Engineering was conducted during May—June 1969, with Prof. W. J. Feieressen, University of Wisconsin, as the American Consultant. 36 candidates successfully completed the full programme.

The Departments of Electrical Engineering and Civil Engineering offered the first session of their Sequential Summer Schools in May-June, 1969. These two Schools were formally inaugurated on 2nd May 1969 by Shri M. Karunanidhi, Chief Minister, Government of Tamil Nadu. 39 candidates were enrolled in Civil Engineering and 33 in Electrical Engineering.

The Department of Chemical Engineering conducted an Advanced School, in May-June 1969, on the theme: "Development and Design of Chemical Process Equipments". There were 25 participants, with Prof. Wayne C. Edmister, Oklahoma State University, U.S.A., as the American Consultant. Besides Faculty-members of the Institute, Senior Engineers from industrial

concerns delivered lectures on diverse topics — pressure vessels, storage tanks, silos, fabrication techniques, non-destructive testing, standards and codes, piping systems, scale-up, optimization, etc.

The Department of Mathematics played an active role in running a three-week Summer-School programme in Mathematics, for the benefit of a selected group of 50 teachers of Central Schools (Kendriya Vidyalayas).

DEPARTMENTAL PROGRAMMES :

Department of Aeronautical Engineering :

Research activities in the Department gathered momentum in the following areas of aircraft structural mechanics: thermal stress analysis; non-linear analysis of static and dynamic structures ; creep stress analysis ; effect of elastic inclusion in structures; and studies on filament-wound structures. In supersonic aerodynamics, the design of the blow-down tunnel is complete and fabrication work is in progress. Design work has commenced on the induction tunnel. A detailed proposal for setting up a hypersonic tunnel has been formulated. The design of a supersonic combustion test rig has been completed and the fabrication of components is in progress.

Department of Applied Mechanics :

The Elasticity group of this Department has developed a biaxial testing machine to test plates subjected to biaxial tension, as also a few load cells, torque-meter, etc. The Vibration Laboratory has set up the facility of a heavy, isolated foundation bed for conducting precision vibration experiments. The Laboratory has developed a few electrical and mechanical shakers and transducers. The Fluid Mechanics group has completed the erection of the low-speed Wind Tunnel and has also established a test-bench for diffuser studies. The Department has actively participated in working on problems from industry — in particular with the Heavy Vehicles Factory at Avadi, Crompton Engineering Company, Snam Progetti (Contractors for Madras Refineries) and the Madras Atomic Power Project at Kalpakkam.

Department of Chemical Engineering :

The following pilot-plant studies were successfully completed: recovery of methanol from acetone (for Hindustan Photo Films); recovery of tar acids (for Neyveli Lignite Corporation); production of tamarind powder from tamarind seeds; production of instant coffee; and recovery of nicotinic acid from tobacco waste.

Department of Civil Engineering :

Applied research work was carried out in the following areas: concrete; structures; soil mechanics; and hydraulics. Three C.S.I.R. Schemes are in progress in the area of the design of hot-rolled and cold-twisted deformed bars, underwater concrete and flow in channels. For the National Buildings Organisation, an investigation is being conducted in precast reinforced concrete and pre-stressed concrete frames. Several studies of interest to the construction industry were undertaken: notably, on the use of high strength deformed steels and testing of cements (for the Madras Atomic Power Project); materials testing (for the Madras Fertilizers); reinforced concrete railway sleepers, etc. Sub-soil investigations have been carried out for various industries in and around Madras and design data provided on special foundation requirements.

Department of Electrical Engineering :

The Department installed an A.C. Network Analyser and a 1.5 million-volt Surge Generator. In the area of Networks and Systems, useful contributions were made in the analysis and synthesis of multi-port networks. Some new techniques were developed for the detection of noise in the presence of signals. The development of digital instruments for the measurement of voltage, angular acceleration and errors in energy-meters is in progress. Speed change three-phase induction motors designed according to pole-amplitude modulation logic are in industrial use in advanced countries. This concept has been used for the design, in this Department, of efficient and economical two/three speed, capacitor-start or run, and shaded pole type of single-phase induction machines. Also the reversibility of a shaded-pole-single-phase induction motor without any additional main or shaded winding, is realized

through a new concept termed 'component winding modulation'. Work is in progress to extend these concepts to single-layer concentric windings for industrial acceptance of these speed-change shaded-pole motors. In the Power Engineering Section, work is in progress on a fast-acting excitation controller using semi-conductor devices. New analytical methods of arriving at simplified mathematical models of power-systems have been developed to facilitate computer investigations of system stability. In Electronics, investigations are being carried out into the temperature-stability of transistor circuits, negative resistance circuits and their application in audio oscillators, digital techniques, etc. A variety of testing and certification jobs were undertaken by the Laboratories of the Department for manufacturers in and around Madras.

Department of Mechanical Engineering :

The Department intensified its research and development work in the following areas: Combustion process in internal-combustion engines; pulsating combustion; two-phase and phase-change heat transfer; secondary shear during metal-cutting; metal-sprayed surfaces; synthesis of two-degrees-of-freedom linkages; dynamic loads and load spectra in cranes; estimation of the profile and secondary losses of turbine blade profiles with the aid of a two-dimensional cascade tunnel; flow behaviour in centrifugal pumping machines; response optimization of feedback control systems; and friction and wear in sintered bearings. The Department maintained close liaison with local industries and a number of projects were taken up for investigation. A few examples are: the design of accessories for a bench-type milling machine; process analysis, jigs and fixtures and pneumatic comparator; boring bar design; ultrasonic drilling of sintered carbide inserts and electro-chemical machining of punches; optimization of the performance of an indigenous carburettor for the Ambassador automotive engine; rating of commercial fuels; matching and evaluation tests for the blower prime mover for a pesticide sprayer; development of a steam turbine exhaust casing and blades; design and development of a two-stage centrifugal blower; design and fabrication of parts for a track-recording car for the Railways and for a manipulator used in nuclear work.

Department of Metallurgy :

Research activities were concentrated in the following areas : Physical and Mechanical Metallurgy; Extraction Metallurgy; Corrosion; Metal Casting, Metal Joining and Metal Forming. The Department continued to maintain close links with industry and carried out several assignments in Chemical analysis of metals and alloys, mechanical testing metallography and non-destructive testing.

Department of Chemistry :

The Department carried out research work in several areas of interest. Staff-members and research scholars took part in Seminars and Symposia held in Delhi, Hyderabad and Karaikudi. The acquisition of the Mass Spectrometer (Varian CH 7) marks the beginning of a modern Special Instruments Laboratory that will be set up and operated as a special Analytical Service Centre catering to the needs of research and industry alike. In the current research work in all the three branches of Chemistry, viz. Physical, Inorganic and Organic, the bias was towards homogeneous and heterogeneous catalysis. In Physical Chemistry, considerable progress was made in the investigation of transition metal oxide (semi-conductor) catalyst systems, particularly with regard to the correlation of catalytic activity with the electronic properties of the surface, using modern methods of electrical conductivity measurements. Interest continues in mechanistic studies of new catalyst materials. Research problems in polymer chemistry, electro-chemistry and theoretical chemistry receive attention. In Inorganic Chemistry, interest was focussed on Co-ordination and Solid-state Chemistry with special reference to reaction mechanisms, elucidation of structures and thermal behaviour of substances. Homogeneous catalysis by metal complexes and Bio-inorganic Chemistry are new areas of interest. Some of the highlights of the research programme in Organic Chemistry are : mechanistic aspects of dehydration and hydrogen transfer reactions on oxide catalysts, with special emphasis on stereo-chemistry, reaction and synthesis. With the commissioning of the high-pressure catalytic reactor, a beginning has been made in high pressure reaction investigations. The American Petroleum Research Fund was of great help in acquiring new equipment to continue the projects in heterogeneous catalysis.

Department of Mathematics :

The Department continued to be active in the following areas of research: Stochastic Processes and their Applications ; Continuum Mechanics and Graph Theory.

Department of Physics :

The Department continued its research activities in the following areas: X-rays and crystal structure; ionic conductivity and colour centres; semi-conductors ; and lattice dynamics and spectroscopic and optical properties. Dr. C. Ramasastri and Dr. W. Koch participated in an International Conference on Colour Centres, held in Rome, in September 1968. The former presented a paper at the Conference. The Department contributed several papers to the International Symposium on Non-metallic Crystals, held at I.I.T., Delhi, in January 1969.

Department of Humanities and Social Sciences :

Encouraged by the success achieved by the post-graduate Diploma programme in Industrial Engineering, in the context of forging meaningful links between the Institute and industrial enterprises, the Department has plans for starting a two-year M.-Tech. Degree Programme in Industrial Management besides converting the Diploma Course into an M.Tech. Degree programme in Industrial Engineering.

PRIZES AND SCHOLARSHIPS :

The Philips Company and the Banco Foundation instituted Special Prizes to be awarded to students with the best academic record at the Institute in Electrical Engineering (Electronics) and Mechanical Engineering respectively. Burmah Shell announced the institution of a post-graduate scholarship, of the value of Rs. 800/Rs. 400, for a student pursuing the M.Tech. Degree programme at the Institute, with effect from the 1969-70 session.

BUILDING PROGRAMME :

During the year under review, the Administration Building, the Aeronautical Engineering Building, the Automobile Workshop, Hostel 'Mandakini'

(the tenth in the series of Students' Hostels), Hostel 'Sarayu' (the Lady-Students' Hostel), the Post-Office and State Bank of India Buildings and a few residential buildings were duly completed. In April 1969, Shri H. V. R. Iengar, Chairman, Board of Governors, formally opened the new building for Aeronautical Engineering. Earlier, in March 1969, Shri Iengar laid the foundation-stone for the new Chemistry Building.

The following continuing works are in various stages of construction : Machine Elements and Mechanical Handling Laboratory; Structures Laboratory; Hydraulics Laboratory ; Electron Microscope Laboratory ; Solid State Physics Laboratory; Vibrations Laboratory, Chemical Engineering Laboratory (Extension), Computer Laboratory, Library (Reprography Section and other civil works), and a few additional residential buildings.

CONCLUSION :

The Institute is on the threshold of the Fourth Plan Period. On the basis of the foundation laid during the first ten years of its growth, the Institute will move forward toward its twin goals — providing sound technical education and training for all its students ; and fostering creative work that interacts with and facilitates the country's industrial development in many areas. The strength of post-graduate students and research scholars will be progressively increased so as to achieve a higher ratio of their strength to that of the under-graduate students. The Institute will seek facilities in respect of the following : more Faculty-members in senior positions ; adequate financing of recurring costs involved in research and development work ; encouragement for Staff-members to devote their energies to the solution of the problems of industry ; and augmentation of Central facilities like Library, Computer and Special Instruments. The Institute looks forward with confidence to a period of serious and purposeful activity.

A. RAMACHANDRAN

Director

SECTION I

Section I

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AERONAUTICAL ENGINEERING DEPARTMENT

STAFF

Professor

K. A. V. Pandalai, D.Ac.E. (Brooklyn)— (Head)

Assistant Professors

K. Balaraman, M.S. (Purdue)

N. R. Rajappa, Ph.D. (Stanford)

K. A. Damodaran, D.C.Ae. (Cranfield)

P. Venkateswarlu, Ph.D. (Paris)

Lecturers

G. Subramanian, M.E. (IISc, Bangalore)

R. M. Siddaveere Gowda, M.E. (IISc, Bangalore)

T. K. Varadan, M.E. (IISc, Bangalore)

E. G. Tulapurkara, M.E. (IISc, Bangalore)

S. Krishnan, M.E. (IISc, Bangalore)

Associate Lecturers

H. S. Bathla, B.Sc. (Engg.) (Aero) (Punjab)

A. Krishnan, D.M.I.T. (Aero) (Madras)

S. Sampath, D.M.I.T. (Aero) (Madras)

Post-Doctoral Fellow

G. Jayaraman, Ph.D. (Iowa)

RESEARCH WORK

1. Experimental and theoretical investigations of grid works, composite beams, orthotropic materials, layered shells. (G. Subramanian and K. A. V. Fandalai).

Diagrids have been analysed and closed form solutions have been developed for the cases of lateral loading, free lateral oscillations and buckling in the special case of simple supports. The first case has been verified experimentally.

Bonded beams have been examined for their strength and stiffness with special reference to Aluminium and mild steel composite. Theoretical investigations of multi-layered shells and wire wound shells are in progress.

2. Analysis on Non-linear stability problems in Aerodynamics and Fluid Mechanics (N. R. Rajappa).

The growth (or instability) of the imperfection or perturbation on the interface between two superposed fluids is studied. As the linear theory failed to agree with the experimental results, the non-linear effects are found and they agree well with the experiments.

3. Design and development of a supersonic combustion test rig and study of hydrocarbon combustion at supersonic speeds using pilot flame (K. A. Damodaran).
4. Structural analysis of Toroidal shell (K. Balaraman and K. A. V. Fandalai).

This investigation has to be carried out with the shell under the following loading conditions:

- (a) Static loads
- (b) Pulsating (dynamic) loads
- (c) Free Vibration (Breathing modes) and
- (d) Thermal stresses

This investigation may be useful in the design of pressure vessels, tanks, turbine casings, etc.

5. Thermal stresses in plates and shells (R.M.S. Gowda and K. A. V. Pandalai).

This project involves the study of the stresses induced and its effect on the natural frequencies of plates and shells subjected to non-uniform temperature distribution. These shells of revolution as in the case of nose cones are of particular interest.

6. Non-linear Vibration of Plates and Shells (T. K. Varadan and K. A. V. Pandalai).

This project involves the study of the effect of amplitude on period in the case of structures like beams and plates with large amplitudes of vibration. This will be extended to shell structures.

LIAISON WITH INDUSTRY

Static and vibrational analysis was undertaken on a rocket fin for the Space Science and Technology Centre, Trivandrum, with whom close contacts already exist. Contacts have also been established with the Hindustan Aeronautics Ltd. and National Aeronautical Laboratory, with a view to orient the research and teaching programme of the Department to be of benefit to these establishments by way of supplying in regard to their future requirement of technical personnel.

PUBLICATIONS

I. Papers Published

1. "Minimum Weight Analysis based on structural reliability" — G. Subramanian, AIAA, Oct. '68.
2. "On the Motion of a bubble produced by Taylor Instability of Superposed fluids in a Cylindrical tube." — N. R. Rajappa. Journal of the Physical Society of Japan, Vol. 26, No. 1, Jan. '69.

II. Papers accepted for Publication

"A new approach to the study of Standing Surface Waves of Finite amplitude" — N. R. Rajappa, Acta Mechanica.

III. Papers presented at Conferences/Seminars

At the 21st Annual General Meeting of the Aeronautical Society of India at Madras.

1. "Bending of cantilevered Trapezoidal thin plates" — M. Sathyamoorthy & K. A. V. Pandalai.
2. "Limit Analysis of Circular Orthotropic plates" — T. Narayanan & K. A. V. Pandalai.
3. "On Free Vibration of Thin Circular Cylindrical shells" — R. S. Srinivasan & K. A. V. Pandalai.
4. "Non-linear theory of Taylor Instability of Superposed Fluids" — N. R. Rajappa.
5. "Analysis of Diagonally Orthogonal and Isosceles Right Triangular Grids" — N. Subramanian and G. Subramanian.

IV. Papers sent for Publication

"Non-linear deformation of Rectangular and elliptical plates"
M. Sathyamoorthy and K. A. V. Pandalai.

APPLIED MECHANICS DEPARTMENT

STAFF

Professors

- D. V. Reddy, Ph.D. (Liverpool) — (Head)
A. Klein, Dr.Ing. (Braunschweig)
Hans Wagner, Dr.Ing. (Karlsruhe)

Assistant Professors

- N. V. Chandrasekhara Swamy, Ph.D. (IISc, Bangalore)
B. V. A. Rao, Dr.Ing. (Dresden)
R. S. Alwar, Ph.D. (IISc, Bangalore)
Vincent X. Kunukkasseril, Ph.D. (Rensselaer Polytechnic Instt. Troy)

Lecturers

- P. S. Srinivasan, B.E. (Madras)
M. A. Veluswami, M.Sc. (Engg.) (Madras)
S. Venkatesan, M.Tech. (IIT, Madras)
C. R. Subramanian, M.Tech. (IIT, Madras)
M. Balakrishnan, M.Tech. (IIT, Bombay)
P. Krishna Iyer, M.Sc. (Kerala)
T. Narayanan, M.Tech. (IIT, Bombay)
V. Ramamurti, M.Tech. (IIT, Kharagpur)
R. S. Srinivasan, M.Tech. (IIT, Kharagpur)

Senior Scientific Assistants

- J. Geiger, Dipl.Ing. (Stuttgart)
Klaus Hartmann, Dipl.Ing. (Berlin)

Associate Lecturers

- G. Bapaiah, M.Tech. (IIT, Madras)
B. H. Lakshmana Gowda, M.E. (IISc, Bangalore)
P. A. Aswathanarayana, M.E. (IISc, Bangalore)
P. A. K. Murthy, M.Tech. (IIT, Bombay)
A. S. J. Swamidas, M.Sc. (Madras)

RESEARCH WORK**I. SOLID MECHANICS**

1. Stability of anisotropic plates and shells (V. X. Kunukkasseril)
A study on the elastic buckling characteristics of Circular plates, cylindrical and spherical shells are proposed to be investigated by experiments and analytical methods. Experimental specimens to be used are to be of anisotropic materials.
2. Vibration and dynamic response of plates and shells (V. X. Kunukkasseril).

Free vibration and dynamic response of elastically connected plate systems circular rings and ring segments are being investigated. Vibration characteristics of multilayered anisotropic cylindrical shells have been investigated and some experiments on these types of shells are being developed.

3. Application of photoelasticity and finite element methods to determine stresses in composite materials (V. X. Kunnukkasseril).
A study on the effective use of photo elasticity to determine the stress concentration around rigid inserts in a matrix is being initiated. The results of the photoelastic study will be compared with the output from computer programmes based on finite element method.
4. Limit analysis of plates and shells, (T. Narayanan and K. A. V. Pandalai).

The load-carrying capacities of anisotropic plates and shells made of materials obeying the Hill and Modified Tresca criteria are being investigated.

5. Analysis of structures for creep (P. Krishna Iyer & K. A. V. Pandalai).
The analysis comprises of theoretical and experimental study of the effect of creep on bending and buckling of rings and thin shells.
6. Experimental and theoretical investigations in Junction stresses in shells (V. Ramamurthy, R. S. Alwar and D. V. Reddy).

The theoretical analysis of the stress distribution in a conical-cylindrical shell junction is made using the classical thin shell theories and is compared with the experimental results.

7. Buckling of shells (R. S. Srinivasan).

The investigation is concerned with buckling of shell of revolution. A theoretical analysis based on different shell theories is contemplated.

8. Deterioration of contact surfaces (M. A. Veluswami & V. C. Venkatesh).

Wear of profiles on spur gears under various operating conditions are being investigated.

9. Influence of welding on torsional rigidity and damping capacity of welded structures (Ramachandra Reddy & M. A. Veluswami).

Experimental investigation of the torsional rigidity and the damping capacity of structures formed by welding has been done and the effects of altering the welds are further recorded.

10. Design of a mechanical function generator (Krishnan Kutty and M. A. Veluswami).

Mechanical function generators using non-circular gears, Camm and linkages are designed.

11. Vibrational analysis of a pipe subjected to fluctuation of fluid flow (M. A. Veluswami).

Both compressible and incompressible fluids are being taken up for the analysis.

12. Vibration analysis of a swept back wing of an aircraft (C. R. Subramanian, K. A. V. Pandalai and D. V. Reddy).

The problem is in the analysis of Coupled modes of vibration of swept back wing of an aircraft taking into consideration the effect of location of suspended engine masses.

13. Design of an ultrasonic machine tool (K. Narayanan, R. V. R. Sastry and C. R. Subramanian).

An ultrasonic cutting tool is designed for cutting or machining hard and brittle materials which are difficult to be machined by other methods. The unit works on the principle of Magnetostriction and is driven at the resonant frequency of the system (20 KC/sec) by an electronic generator. The machining operation that can be done are drilling, slicing and broaching.

II. FLUID MECHANICS

1. Experimental investigation of incompressible three-dimensional turbulent boundary layers on yawed flat plates (B. H. Lakshmana Gowda and N. V. Chandrasekhara Swamy).

Energy balance equations for mean and turbulent energy components have been set up for the boundary layer on a yawed flat plate. Experiment is in progress.

2. Experimental investigation of incompressible and axi-symmetric turbulent boundary layers (P. A. Aswathanarayana and N. V. Chandrasekhara Swamy).

Energy balance equations for mean and turbulent energy components have been set up for the boundary layer on an axisymmetric body. Measurements are in progress.

3. Experimental and theoretical investigation of incompressible flow in annular diffusers (J. Mathew and A. Klein).

Potential flow analysis using the concept of ring vortices is made. A diffuser has been fabricated and the experiment is in progress.

4. Aerodynamic interference between fuselage and nacelles in the case of rear-mounted engines (M. Balakrishnan and A. Klein).

Theoretical investigation on the interaction between rear mounted engines and fuselage is in progress.

5. Experimental investigation of the drag and lift coefficients of a sphere rotating about its axis in a uniform flow (A. Klein and M.I.T. staff).

The axis of spin is kept normal to the direction of air-stream and the drag and lift exerted on the body are measured.

LIAISON WITH INDUSTRY

The following projects were taken up in collaboration with industry:—

- (i) Efficiency and performance characteristics of a STOCK BRIDGE damper; experimental and analytical study.
- (ii) Vibration of a coolant inlet pipe for M.A.P.P., Kalpakkam; experimental study at I.R.S., Poondi.

- (iii) Tractor seat spring suspension; experimental and analytical study.
- (iv) Manufacture of vibration transducer, (design and testing of equipment).
- (v) Vibration study of a heavy electric motor.

PUBLICATIONS

I. Papers Published

1. "Load carrying capacity of an Edge-Loaded Foundation Slab clamped along the Edges" — D. V. Reddy and T. Narayanan — **Building Science**, Vol. 3, pp. 99-105, Pergamon Press, 1968.
2. "Theory of Hydrostatic lubrication with Power-law fluids in step bearing and Hydrostatic squeeze films — G. Bapaiah and B. V. A. Rao — **Viswakarma Dec.** '68.
3. "Friction Coefficient of turbulent flow through smooth pipes" — P. A. Aswathanarayana, B. H. Lakshmana Gowda and N. V. Chandrasekhara Swamy — **Journal of Technology, India**, Vol. 6.

II. Paper accepted for Publication

Analysis of stiffener rings arounds rotary kilns" — R. S. Alwar and V. Ramamurti — **Institution of Engineers India**.

III. Papers presented at Conferences/Seminars

At the 21st Annual General Meeting of the Aeronautical Society of India:—

1. "Buckling of eccentrically stiffened rectangular plate subjected to linearly varying longitudinal compression" — Hans Wagner.
2. "Performance of a Hydraulic Vibrating Machine" — B. V. A. Rao, V. Ramamurthi and M. N. Siddhanty.
3. "Free Vibration of multi-layered anisotropic cylindrical shells" — V. X. Kunukkasseril.
4. "Remarks on swept back wings" — A. Klein

5. "Linear response of an elastic plate to actual Random load" — Hans Wagner and B. Rama Bhat.

At the Tenth Theoretical and Applied Mechanics Congress:—

6. "Power-law fluids" — G. Bapiah.

IV. Papers sent for Publication

1. "Stress analysis in a cylinder-cone junction subjected to any aximetric berding — R. S. Alwar and V. Ramamurthi — 12th Congress of ISTAM.
2. "Viscous damping of fluids" — B. V. A. Rao, V. Ramamurthi and B. Rama Bhat — Viswakarma.
3. "Study of Automobile Vibration through Analogue Computer" — C. R. Subramanian, B. V. A. Rao and D. V. Reddy — 12th Congress of ISTAM.

CHEMICAL ENGINEERING DEPARTMENT

STAFF

Professors

- D. Venkateswarlu, Ph.D. (IIT, Kharagpur) — (Head)
E. H. Hohmann, Dr. Ing. (Hannover)
R. J. H. Bisanz, Ph.D. (Vienna) (Till 30-4-69)
Herbert H. R. Bock, Dr. Phil (Dresden)

Associate Professor

- A. Seifert, Dr. Ing. (Tech. Univ. Berlin)

Assistant Professors

- P. Bhimeswara Rao, Ph.D. (Missouri)
M. Satyanarayana, Ph.D. (IIT, Kharagpur)
Y. B. G. Varma, Ph.D. (IIT, Madras)
M. Ramanujam, Ph.D. (IIT, Madras)
Venugopala Kubair, Ph.D. (IISc, Bangalore)

Lecturers

- K. Subba Raju, D.Sc. (Andhra)
N. Subramanian, Ph.D. (IIT, Madras)
K. Remananda Rao, Ph.D. (IISc, Bangalore)
T. Venkatram, Ph.D. (IISc, Bangalore)
N. M. Raghavendra, Ph.D. (IIT, Kharagpur)
G. S. Davies, Ph.D. (IIT, Kharagpur)
B. C. Bhattacharyya, M.Tech. (IIT, Kharagpur)
A. Prabhakara Rao, M.Sc. (Tech) (Andhra)
Ch. Durgaprasada Rao, Ph.D. (Andhra)
R. Nagarajan, M.Tech. (IIT, Madras)
C. Sivaprasada Rao, M.Sc. (Tech) (Osmania)
R. Subramanian, M.Sc. (Tech) (Bombay)
V. Nagarajan, Ph.D. (IISc, Bangalore)
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Senior Scientific Assistants

- Bernhard Haedke, Dipl. Ing. (Stuttgart)
Peter Meissner, Dipl. Ing. (Karlsruhe)
Sigfrid Michelfelder, Dipl. Ing. (Stuttgart)

Associate Lecturers

- R. Vedaraman, M.Sc. (Tech) (Andhra)
K. Ramamurthi, M.Tech. (IIT, Bombay)
V. Muthukrishnan, M.Tech. (IIT, Madras)

RESEARCH WORK**I. FLUID MECHANICS**

1. Studies on Non-Newtonian Fluids (R. Nagarajan and S. D. Nigam).

Some polymeric materials in water show tendency to decrease the drag causing the delayed transition to turbulence. The work is under progress to investigate and propose a suitable mechanism for this reduction in drag based on the structure and properties of the various polymers used.

2. Dynamics of Drops in Spray Columns (D. Jegadeesan and N. M. Raghavendra).

The effect of volumetric hold-up of dispersed phase on the drop formation and movement is studied with water — kerosine oil system.

3. Studies on Multistage Fluidization (J Raghuraman, A. Seifert and Y. B. G. Varma).

The pressure drop and residence time distribution studies on multi-stage fluidization using single and multi-size particle systems are being carried out.

4. Rheological and Pressure Drop studies of Bentonite suspensions (Vishnu Sharma and G. S. Davies).

Studies on the Rheological properties of bentonite suspensions in water of concentration ranging from 1 to 7 per cent by weight were carried out in an extrusion Rheometer. The experimental data were carried out with brass Rheometer tubes of length to diameter ratio of 9 to 57.5. Studies indicate that the fluid is Rheopetic and viscoelastic. Pressure drop studies were also carried out in vertical and horizontal brass pipe of diameter 3/4 inch. Considering the fluid to be viscoelastic correlations were developed for friction factor in the turbulent range. A model has been proposed for this type of fluid.

II. HEAT AND MASS TRANSFER

1. Heat Transfer in Annular liquid fluidized beds (K. Ramamurthy and K. Subba Raju).

Investigations are being carried out to study the mechanism of heat transfer at inner and outer walls of fluidized bed in an annular tube. Studies on bed characteristics such as pressure drop and bed expansion in annular fluidized bed are in progress.

2. Film Formation and Heat Transfer in Thin Film Operation (B. C. Bhattacharyya, K. Remananda Rao and R. J. H. Bisanz).

Studies on film formation of a liquid and the heat transfer process between wall and falling film are in progress. An equipment has been fabricated and a special technique has been developed for the measurement of film thickness in a rotary drum. The liquid flow rate is regulated by the slope of the drum. Radiation heating technique is used for heating the drum.

2. Heat Transfer in Rising Film Long Tube Evaporator (D. Maitra, K. Subba Raju and R. J. H. Bisanz)

For the design and operation of the long tube evaporator, the prediction of optimum liquid level in the evaporator tube is of great importance. In order to find out optimum liquid level, investigations to find out temperature distribution along the wall and the film are planned. The equipment for these study is fabricated for visual observations. The tube sections are heated by radiation heating elements and the temperature distribution is measured by using thermocouples at various positions. The design and fabrication of the equipment is under progress.

4. Adsorptive, Regenerative and Evaporative cooling using solar energy for Adsorbent Regeneration (S. G. V. V. Rayapa Raju and H.H.R. Bock).

Design of solar heat collector and the selection of adsorbent are undertaken. Instead of usual adsorption method, the continuous regenerative adsorption using solar energy for the adsorbent regeneration is selected for the laboratory air conditioning.

5. Separation of Methanol-Acedone mixture by extractive distillation (S. Krishnamurthy, K. Subba Raju and R. J. H. Bisanz).

Experiments have been carried out on pilot plant scale for the separa-

tion of methanol and acetone from a mixture obtained from photo film processing plant supplied by Hindustan Photo Films Ltd., Ooty, using water as a solvent in extractive distillation. Based on the result obtained in this investigation, a commercial plant for the separation of 500 litres of mixture per 8 hr. day is designed.

6. Kinetics of the Formation of Calcium Carbonate (C. Chandraprasad, K. Remananda Rao and R. J. H. Bisanz).

Studies are undertaken to investigate the kinetics of formation of calcium carbonate by spraying a slurry of calcium hydroxide in an atmosphere of carbon dioxide. The equipment is designed and the fabrication of experimental set up is in progress.

7. Recovery of Tar Acids and Neutral Oils from Neyveli Middle Oil (G. L. N. Raju, K. Remananda Rao and R. J. H. Bisanz).

Fractional extraction method was investigated to study the feasibility of recovery of tar acids and neutral oil from middle oil of Neyveli Lignite tar. The dual solvents used in these studies are aqueous methanol and normal hexane. The variables studied include the flow rate of hexane and the flow rate of middle oil. The results indicate that the recovery as high as 90% of tar acids in methanol phase is feasible. The purity of tar acids in methanol phase is also very high.

III. TRANSPORT PROPERTIES

Evaluation of physical properties of Ternary Systems (R. Thayumanasundaram and P. Bhimeswara Rao).

The transport property, viscosity, is determined for various binary and ternary liquid mixtures and the validity of the equation available in the literature, for the evaluation of viscosity from pure component viscosities is tested. The refractive index and density of the mixtures are also determined and isorefractive index lines and isodensity lines are drawn in a triangular chart. This chart is useful for the prediction of the composition of the ternary by finding refractive index and density of the mixture interested.

IV. MECHANICAL OPERATIONS

1. Packing characteristics and compaction of solids (C. M. Ramaswamy, Y. B. G. Varma and D. Venkateswarlu).

The effect of size, shape, roughness and container diameter on as-poured and vibrated porosities of fourteen inorganic and organic materials is reported. Correlations of porosities in terms of shape factor and angle of repose are presented.

The porosities and ejection pressures, compressive strengths and tensile strengths of eight organic materials of different particle size in the size range of 3.15 to 0.4 mm. compacted at different pressures in the range of 27 to 2160 Kg. per cm.² are determined. Empirical relationships of the different variables as a function of compaction behaviour of the fine mixtures of materials of equal particle size are determined. The relationship between porosity of the compact and the composition of the mixture is presented.

2. Beneficiation of Ores and Minerals (D. V. Ramana Rao and E. H. Hohmann).

In the present investigation beneficiation studies on low grade Salem iron ore, recovery of potassium chloride from German hard salt under tropical conditions and recovery of potassium chloride from mixed salt obtained from bitterns and enrichment of potash feldspar are carried out.

Beneficiation of Salem ore is carried out using magnetic separation and flotation processes, recovery of potassium chloride from German hard salt and mixed salt and enrichment of potash feldspar are carried out using flotation process.

3. Granulation of Fertilizers (V. Narayana Rao and E. H. Hohmann): Studies on granulation have been carried out in conjunction with a high temperature level. The granulation efficiency (defined as the percentage product in the range 0.8—4.0 mm.) and mean particle diameter of the product are chosen to characterise the process and crushing strength of single granule in the range 2.00—3.15 to assess the product. The studies include the effect of all variables involved in the process and the effect of different solid and liquid binders, using superphosphate as the material. The effect of water content

on different grades and different formulations of mixed complex fertilisers is studied. Water requirements are correlated against granulation efficiency and formulation for mixed complex fertilisers.

4. Size reduction by vibration milling (R. Vedaraman, N. M. Raghavendra and D. Venkateswarlu).

The work has been carried out to study (i) the effect of material characteristics such as density, hardness, surface energy and grindability on the rate of grinding and energy requirements in vibration milling and (ii) the advantages of vibration milling over conventional ball milling.

5. Electrostatic Separation of Indian Minerals (M. Krishnamurthy and E. H. Hohmann):

Studies on the possibility of electrostatic separation as a mineral beneficiation technique in a pilot plant scale for the processing of ilminite, chalcopyrite, barytes, feldspar, quartz asbestos and mica are being carried out.

6. Beneficiation of Ores on Hydrocyclone Pilot Plant (U. Kameswara Rao and E. H. Hohmann):

The present investigation mainly aims at the beneficiation of several important Indian Ores on pilot plant scale hydrocyclone heavy media separation unit. The influence of process variable such as feed pulp concentration, feed pressure, particle size, size of the openings of hydrocyclone and viscosity and specific gravity of the heavy media on the separation performance of hydrocyclone will be studied.

7. Studies in Fluid energy Grinding (B. Pitchumani, M. Ramanujam and D. Venkateswarlu):

Application of fluid energy grinding to materials of different hardness is under investigation. The effect of grinding nozzle pressure, feed rate and size of feed on product size and hold-up are being studied to find optimum operating conditions and develop mathematical model.

8. Studies on compaction of mixed size particles (S. Vijayan and D. Venkateswarlu).

Compaction of mixed sizes of same material has been studied in a 100 tonne hydraulic press for calcite, copper sulphate and naphthalene.

A correlation to predict the porosities of compacts of mixed sizes is proposed. The advantages of compacting mixed sizes are indicated. The possibility of bulk transport of common salt as compacts instead as loose salt is studied.

9. Flow Properties of Solids (P. Viswanathan and D. Venkateswarlu) :

Flow properties of solids of widely differing characteristics are studied. The two important criteria which govern the flow of solids are found to be angle of repose and angle of internal friction. The effect of head, particle size and size of hopper opening diameter on flow rate of solids in discharge hoppers are studied and correlation for predictions flow rates is proposed.

10. Flow and transport characteristics of solids (V. Lakshmana Rao and D. Venkateswarlu):

The effect of various physical properties of solid particles on flow characteristics and pneumatic conveyance of solids are proposed for investigation.

11. Separation Characteristics of Spiral Classifier (G. Jai Shankar, M. Ramanujam and E. H. Hohmann):

The effect of air rate and feed rate on the cut size is studied on the Alpine Centrifugal air Classifier with magnesite of—150 micron size as feed. It is seen that cut sizes obtained are between 14-16 microns agree well with range of 3-18 microns, stated by manufacturers. The effect of density is also studied using charcoal of —150 micron as feed.

V. APPLIED REACTION KINETICS

1. Diffusion and Reaction in solid—solid systems (A. Baradarajan and M. Satyanarayana) :

Combined diffusion and reaction data have been taken in the case of mixed powders with particle size, compaction pressure, reaction time and temperature as parameters. The data have been correlated and suitable theory has been proposed. The work on experimental data for diffusion alone and pellet reaction experiments are under progress.

2. Kinetics of Estrification of Alcohols with Fatty Acids (R. Subramanian and P. Bhimeswara Rao) :

The use of ion-exchange resins as catalyst for estrification reactions has been studied. The effect of particle size, pore distribution ion-

exchange capacity and initial water content in the catalyst and structure of fatty acids and alcohols on the rate of esterification has been investigated.

3. Applied kinetics studies of Trans-esterification of Ethyl Acetate with Methanol (Vinay Kumar and M. Satyarayana):

Vapour-phase trans-esterification of ethyl acetate with methanol has been studied in the presence of silica gel in a four stage series integral reactor. Temperature, feed composition and time factor are taken as variables, conversion rates are calculated. Suitable rate equation and mechanism have been proposed.

4. Study of Ion-Exchange Resin Catalysed Reactions (B. Satyanarayana and Y. B. G. Varma):

Investigations have been carried out on the reactions of (i) inversion of sucrose and (ii) esterification of salicylic acid with methanol using Zeokarb 225, a sulfonic type cation exchange resin. The experimental work consists of the study of the effect of particle size the amount of catalyst the concentration and temperature of reactants on conversion using oven dried and vacuum dried catalysts. Suitable reaction mechanisms are proposed.

5. Studies on Kinetics of Vapour-phase dehydration of Ethanol to diethyl ether (R. S. Krishnan and V. Nagarajan):

The vapour phase dehydration of ethanol to diethyl ether over bauxite as catalyst has been studied with a view to formulate a rate expression on the basis of Langmuir-Hinshelwood model for heterogeneous catalysis as modified by Hougen and Watson. The kinetic data show that the rate controlling mechanism is a surface reaction between two molecules of ethanol absorbed on adjacent-active sites to yield an absorbed molecule each of ether. This result is analogous to conclusions published in literature pertaining to the closely related dehydration of ethanol to ethylene over alumina catalyst.

VI. PROCESS CONTROL

1. Design and Development of a Simple Humidity Regulator (P. S. Pillay, Ch. Durgaprasada Rao and H. H. R. Bock):

A simple humidity regulator is designed and developed to control the humidity in a test chamber using aqueous sulphuric acid solution

as regulating agent. A method is suggested for selecting suitable acid concentrate and heating load for the attainment and maintenance of any desired humidity in the chamber.

SEMINAR

A Seminar on "Development and Design of Chemical Process Equipments" and Discussion on "Teaching Design Effectively" was organised by the department on 7th and 8th June 1969. Engineers from Chemical industries, Faculty members from Universities and Institutes and Scientists from National Laboratories participated in the Seminar. The following were the papers presented in the Seminar:—

1. "Development and design of chemical process project" — Prof. Wayne C. Edmister, Oklahoma State University, U. S. A.
2. "Resistance heating of masscutes" — Dr. K. S. G. Doss, Consulting Technologist, Madras.
3. "Directo fired naphtha vapourisers" — Shri Raja Sundaram and Dr. —Ing. P. C. Sharma, FACT Engineering and Design Organisation, Alwaye, Kerala.
4. "Design of a flat-plate solar heat collector" — Shri S. G. V. V. Rayapparaju and Dr. H. H. R. Bock, I.I.T., Madras.
5. "Mean temperature difference in multipass heat exchangers" — Dr. K. Lakshminarayana, Coimbatore Institute of Technology, Coimbatore.
6. "Design methods for plate-heat exchangers" — Dr. K. Subba Raju, I.I.T., Madras.
7. "Design of sparger heat exchangers" — Dr. V. Kubair, I.I.T., Madras.
8. "Design characteristics of a mechanically formed thin film evaporator" — Shri B. C. Bhattacharyya, I.I.T., Madras.
9. "Design of a ship-borne flash distillation unit of sea water desalination plan" — Shri S. K. Garg and Dr. R. L. Datta, Central Salt and Marine Chemicals Research Institute, Bhavanagar.

10. "Surface effects on the maximum loading in a pulsed sieve-plate column for liquid-liquid extraction" — Shri J. C. Mishra and Prof. D. K. Dutt, Jadavpur University, Calcutta.
11. "Design of crystallisers" — Dr. M. R. Chivate, University of Bombay, Bombay.
12. "Mass transfer rates in liquid-liquid extraction" — Dr. G. S. Laddha, A. C. College of Technology, Madras.
13. "Design and development of a simple humidity regulator" — Shri P. S. Pillay and Dr. Ch. Durgaprasada Rao and Dr. H. H. R. Bock, I.I.T., Madras.
14. "Design of plate type reverse osmosis plant for desatination" — Shri A. S. Kane, Shri D. J. Mehta and Dr. M. V. Chandorikar, Central Salt and Marine Chemicals Research Institute, Bhavnagar.
15. "Design of hydrocyclone" — Dr. P. S. Panesar and Prof. K. J. R. Sarma, Regional Engineering College, Rourkela.
16. "Industrial applications of multistage fluidisation" — Shri J. Raghuraman, Dr. A. Seifert and Dr Y. B. G. Varma, I.I.T., Madras.
17. "Use of jet mills for grinding mica" — Dr. M. Ramanujam and Dr. D. Venkateswarlu, I.I.T., Madras.
18. "Vibration mills and their application"—Shri R. Vedaraman, Dr. N. M. Raghavendra and Dr. D. Venkateswarlu, I.I.T., Madras.
19. "A new co-current type converter for ammonia synthesis" — Fertiliser Corporation of India, Sindri.
20. "Absorption system in the manufacture of nitric acid" — Fertiliser Corporation of India, Sindri.
21. "Some considerations in the design of nitrators" — Dr. D. S. Sastry, Hindustan Organic Chemicals, Bombay.

22. "Design of a simple control system" — Dr. Ch. Durgaprasada Rao, I.I.T., Madras.
23. "Scale-up of non-Newtonian fluids" — Shri R. Nagarajan, I.I.T., Madras.
24. "Roll of corrosion in the selection of materials of construction and design of process equipment" — Prof. S. L. Chawla, I.I.T., Delhi.
25. "Some aspects in the design and fabrication of glass lined process equipment" — Shri S. Anantharaman, Gujarat Machinery Manufacturers Ltd., Bombay.
26. "Development and design of chemical process equipment in rayon industry" — Shri R. R. Chawla, Century Rayon, Kalyan.
27. "Development of pilot plants at the Fertilisers and Chemicals Travancore Ltd." — Shri N. Narayanan and Shri R. Rajagopalan, Fertilisers and Chemicals Travancore Ltd., Alwaye.
28. "Teaching process design to chemical engineers" — Prof. Wayne C. Edmister, Oklahoma State University, U.S.A.
29. Human engineering education for the process design engineer" — Shri S. Sundaram, Fertilisers and Chemicals-Travancore Ltd., Alwaye.
30. "What is design and how to teach it" — Dr. T. Gopichand, Birla Institute of Technology and Science, Pilani.
31. "How to teach Chemical Engineering?" — Dr. H. H. R. Bock, I.I.T., Madras.
32. "Training of Chemical Engineers for Indian Chemical Industry" — Dr. D. Venkateswarlu, I.I.T., Madras.

LIAISON WITH INDUSTRY

The Department collaborated with industry in the following problems during the year:—

1. Separation of Methanol-Acetone Mixture (Hindustan Photo Film Ltd., Ooty).

2. Recovery of Tar Acids and Neutral Oils from Neyveli Middle Oil by Fractional Extraction (Neyveli Lignite Corporation).
3. Transport of Salt as compacts (Salt Industry).
4. Production of Ultrafine Particles of Mica in Jet Mills.
The Pilot plant facilities of the Department were made available to Messrs. E. I. D. Parry & Co., Ltd., and Messrs. K. C. P. Ltd.

PUBLICATIONS

I. Papers Published

1. Studies on Grinding in Ball Mill on pilot plant scale — M. Balasubramanian and E. H. Hohmann. Chem. Age of India, 19, 878 (1968).
2. Evaporators of the Day — B. C. Bhattacharyya. Chem. Age of India, 19, 608 (1968).
3. Transport Phenomena — P. Bhimeswara Rao. Chem. Age of India, 19, 637 (1968).
4. Driers — R. J. H. Bisanz. Chem. Age of India, 19, 671 (1968).
5. Heat Regenerators — H. H. R. Bock. Chem. Age of India, 19, 615 (1968).
6. Progress in Freeze drying — H. H. R. Bock. Proceedings of All India Symposium on Refrigeration, Air Conditioning and Environmental Control in the Cold Storage Industry, P.E. 4.3. (1968).
7. Mixing of solids — G. S. Davies. Chem. Age of India, 19, 984 (1968).
8. New Results in continuous vacuum filtration on Drum Filter — D. C. Dorayya and E. H. Hohmann. Chem. Age of India, 19, 901 (1968).
9. Recent Developments in Gas-Liquid Contacting Equipment — Ch. Durgaprasada Rao. Chem. Age of India, 19, 984 (1968).
10. Classification studies on Hydrocyclone pilot plant — S. Koteswara Rao and E. H. Hohmann. Chem. Age of India, 19, 884 (1968).
11. Hydrocyclone heavy media separation of fine iron ore — S. Koteswara Rao and E. H. Hohmann. Chem. Age of India, 19, 891 (1968).

12. Electrical and magnetic methods of separation — A. Prabhakara Rao, Chem. Age of India, 19, 992 (1968).
13. Multiphase flow — N. M. Raghavendra, Chem. Age of India, 19, 580 (1968).
14. Removal of Silica from limestone by differential grinding and screening — S. Raghunadha Rao and E. H. Hohmann, Chem. Age of India, 19, 893 (1968).
15. Beneficiation of limestone by flotation — S. Raghunadha Rao and E. H. Hohmann, Chem. Age of India, 19, 893 (1968).
16. Recovery of Labile Sulphur from Iron Pyrites — K. Rajamani and M. Satyanarayana, Indian J. Technol., 6, 205 (1968).
17. The Mineral Resources of India and their Importance for the Development of Chemical and Mineral Dressing Industries of the country — D. V. Ramana Rao and E. H. Hohmann, Chem. Age of India, 19, 975 (1968).
18. Particle Size Analysis — M. Ramanujam and D. Venkateswarlu, Chem. Age of India, 19, 975 (1968).
19. Recent Developments in Gas-Absorption Process — K. Remananda Rao, Chem. Age of India, 19, 655 (1968).
20. Solid-state Reactions — M. Satyanarayana, Chem. Age of India, 19, 1008 (1968).
21. Recent Advances in Heat Exchangers — K. Subba Raju, Chem. Age of India, 19, 604 (1968).
22. An Experimental Technique for Determination of Bed Densities in Lean Fluidized Bed — N. Subramanian, J. Chem. Engg. Soc. (IIT, Madras), 2, 27 (1968).
23. Fluidisation and Pneumatic Transport — N. Subramanian, Chem. Age of India, 19, 588 (1968).

24. Particle Size Distribution in compact of solid powders — Y. B. G. Varma, T. Gopichand and D. Venkateswarlu, *J. Chem. and Engg. Data*, **13**, 498 (1968).
25. Chemical Reactor Design — Y. B. G. Varma, *Chem. Age of India*, **19**, 1014 (1968).
26. Reclamation of used Crank-case oils — M. S. Venkatanarayana and G. S. Davies, *Indian Chem. Manufacturer*, **13** (1968).
27. Developments in particulate Technology — D. Venkateswarlu, *Chem. Age of India*, **19**, 969 (1968).
28. Chemical Engineering Education in West Germany — D. Venkateswarlu, *Chem. Engg. World*, **3**(6) 37 (1968).
29. Protein for Human Nutrition (Torula Yeast) — R. J. H. Bisanz, *Chem. Age of India*, **20**, 143 (1969).
30. Beryllium — A rare Element and an Important Metal — E. H. Hohmann, *Chem. Age of India*, **20**, 175 (1969).
31. Concentration processes of ores and minerals — D. V. Ramana Rao and E. H. Hohmann, *Chem. Age of India*, **20**, 175 (1969).
32. Dry Magnetic separation of magnetite ore of Salem District — D. V. Ramana Rao and E. H. Hohmann, *Chem. Age of India*, **20**, 183 (1969).
33. The flotation of Salem iron ore and manufacture of iron and steel — D. V. Ramana Rao and E. H. Hohmann, *Chem. Age of India*, **20**, 187 (1969).
34. Recovery of potash from feldspar — D. V. Ramana Rao and E. H. Hohmann, *Chem. Age of India*, **20**, 195 (1969).
35. Manufacture of potassium chloride from German hard salt under tropical conditions and also recovery of potassium chloride from mixed salts obtained from bitters by froth flotation — D. V. Ramana Rao and E. H. Hohmann, *Chem. Age of India*, **20**, 199 (1969).
36. First investigation on Mussoorie phosphate — S. Raghunadha Rao and E. H. Hohmann, *Chem. Age of India*, **20**, 211 (1969).

37. Rotary Granulator for Fertilisers — Equipment details — V. Narayana Rao and E. H. Hohmann, Chem. Age of India, 20, 215 (1969).
38. Variables effecting granulation on superphosphate—V. Narayana Rao and E. H. Hohmann, Chem. Age of India, 20, 223 (1969).
39. Granulation of Superphosphate with binders — V. Narayana Rao and E. H. Hohmann, Chem. Age of India, 20, 231 (1969).
40. Granulation of mixed complex fertilisers — V. Narayana Rao and E. H. Hohmann, Chem. Age of India, 20, 236 (1969).
41. Importance of electrostatic separation in dressing of metallic and non-metallic minerals in India— Meduri Krishna Murthy and E. H. Hohmann, Chem. Age of India, 20, 246 (1969).
42. Chemical Engineering Education — D. Venkateswarlu, Indian Chem. Engineer, 11 (i), 13 (1969).
43. Compaction of Solids with shear — K. S. R. Sastri and Y. B. G. Varma, Indian J. Technol., 6(12), 360, 1968.
44. Removal of traces of Nitric Acid from Nitrobenzene by liquid extraction — K. Satyanarayana Murty and M. Satyanarayana, Indian Chem. Engr., 11, 35 (1969).

II. Papers accepted for Publication

1. Effect of Calcium chloride on the Ternary liquid equilibria of water Phosphoric acid—I-Butanol system at 35°C.—P. Ananthanarayanan and P. Bhimeswara Rao, J. Chem. and Engg. Data.
2. Vapour—phase catalytic Reestrication of Ethyl acetate and Methanol—S. Ramachandran and M. Satyanarayana, Indian J. Technol.
3. Atmospheric Air pollution—M. Satyanarayana, J. Chem. Engg. Soc. (IIT, Madras).
4. Compressive stress distribution in compacts of solids—K. S. R. Sastri and Y. B. G. Varma, Ind. J. Technol.

5. Heat transfer between Axisymmetric jet and a plate held normal to the flow—S. Seetharamiah and K. Subba Raju, *Can. J. Chem. Engg.*
6. Studies on bubble formation in submerged orifices—K. Vaidyanathan and Ch. Durgaprasada Rao, *Chem. Age of India.*
7. Studies on mixing of solids in Double Cone Blender— T. K. Ramanujam., G. S. Davies and D. Venkateswarlu, *Indian J. Technol.*
8. A Simple P-I Level controller, H. H. R. Bock, *Indian Chem. Engr.*
9. Wirtschaftliche Regler—Optimierung—H. H. R. Bock, *Energie.*
10. How to teach Chemical Engineering? — H. H. R. Bock, *J. Chem. Engg. Soc. (IIT, Madras).*
11. Experiments on basic reactor types—Y. B. G. Varma, *J. Chem. Engg. Soc. (IIT, Madras).*
12. Multiple control loops—Ch. Durgaprasada Rao, *J. Chem. Engg. Soc. (IIT, Madras).*

III. Papers sent for Publication

1. Diffusion coefficient of phosphoric acid in water at 35°C.—K. Raghavendra Rao and P. Bhimeswara Rao.
2. Solvent extraction of phenols from sodium hydroxide solutions—A. R. Krishnamurthy and P. Bhimeswara Rao.
3. A simple on and off switch for level control within differential limits — K. Vaidyanathan and Ch. Durgaprasada Rao.

CHEMISTRY DEPARTMENT

STAFF

Professors

M. V. C. Sastri, Ph.D. (Bombay)— (Head)
G. Eutenuth, Dr. rer. nat. (Aachen)

Assistant Professors

J. C. Kuriacose, D. Sc. (Lovain, Belgium)
V. Srinivasan, Ph.D. (IISc, Bangalore)
G. Aravamudan, Ph.D. (IISc, Bangalore)
C. N. Pillai, Ph.D. (Northwestern, U.S.A.)
M. M. Taqui Khan, Ph.D. (Mass)

Lecturers

C. Kalidas, Ph.D. (Jadavpur)
V. Ramakrishnan, Ph.D. (Annamalai)
C. S. Swamy, Ph.D. (IISc, Bangalore)
S. R. Ramadas, Ph.D. (IISc, Bangalore)
V. Mahadevan, Ph.D. (Madras)
K. Narayanan, Ph.D. (IIT, Madras)
J. Rajaram, Ph.D. (IIT, Madras)
M. Ramakrishna Udupa, Ph.D. (IIT, Madras)
R. Narayan, Ph.D. (Bombay)

Associate Lecturer

S. Narayanan, Ph.D. (Madras)

Pool Officer (CSIR)

T. V. Ramakrishna, (Ph.D.) (Birmingham)

Post-Doctoral Fellow

Q. Anwaruddin, Ph.D. (Madras)

RESEARCH WORK**I. PHYSICAL CHEMISTRY**

1. Gravimetric Adsorption Studies (S. Narayanan and M. V. C. Sastri):

A Cahn R.G. Automatic Vacuum Electrobalance has been set up for adsorption studies. This will be used for the study of hydrocarbon adsorption at low pressures on oxide surfaces, pore size distribution of catalysts and in thermogravimetric studies.

2. Inhibition Studies on Electrode Reactions (C. S. Venkatachalam and M. V. C. Sastri):

Polarographic studies on the reduction of various inorganic depolarizers at the dropping mercury electrode have been attempted using organic inhibitors. The amount of these inhibitors present at the Hg/electrolyte interface are being calculated from electrocapillary measurements.

3. Studies on Reduction of Iron Oxide (R. P. Viswanath, V. Srinivasan and M. V. C. Sastri):

Investigations on the reduction of iron oxide at various temperatures with hydrogen are in progress. Preliminary experiments on the kinetics of hydrogen adsorption at temperatures below the reduction temperature, namely less than 400°C, have been completed to characterise the surface.

4. Study of the Effect of Electronic and Structural Factors on the Decomposition of Isopropyl Alcohol on a Mixed Oxide System (B. Viswanathan, V. Srinivasan and M. V. C. Sastri):

The catalytic activity of a mixed oxide system ($\text{ZnO-Al}_2\text{O}_3$) has been evaluated for a typical reaction like the decomposition of isopropyl alcohol making semiconductivity measurements. The structural changes involved at various temperatures have been correlated to the catalytic activity.

5. Thermal Decomposition Studies (B. Viswanathan, V. Srinivasan and M. V. C. Sastri):

A differential thermal analysis unit capable of working under vacuum has been fabricated and a study of the thermal decomposition of oxalates using this unit is in progress.

6. Catalysed Bromination of Aromatic Substrates (J. Rajaram and J. C. Kuriacose):

The role of anhydrous halides of metals such as aluminium, iron, zinc etc. in the bromination reaction is being investigated.

7. Mechanistic Study of Reactions by Electrochemical Techniques (R. Ramaswamy and J. C. Kuriacose):

The polarographic technique has been used to study the kinetics of some fast reactions in solution. The rate constants for the ionisation of various weak acids have been obtained.

8. A Study of the Mechanism of Dehydrogenation on Semi-conductor Oxide Catalysts (R. Venkatachalam and J. C. Kuriacose):

The catalytic dehydrogenation of alcohols and hydrocarbons is being studied on different types of semiconductor oxide catalysts. The nature of products formed and the properties of the catalysts are studied with a view to correlate the type of interaction between the reactant and the catalyst and the nature of the catalyst.

9. A Study of the Nature and Role of Supports in Determining the Catalytic Activity of Supported Dehydrogenation and Dehydration Catalysts (Miss R. Uma and J. C. Kuriacose):

The function of certain supports and how they modify the reactivity of some semiconductor oxide catalysts that are effective for dehydration and dehydrogenation is being studied through investigation of the structure and texture of the catalysts and the nature of products formed from different reactants.

10. Polarographic and Electrocapillary Studies (Mrs. P. Shakuntala and R. Narayan):

The effects of adsorption on electrode kinetics are under study.

11. Studies in Polymer Chemistry (V. Ramamurthy and V. Mahadevan): Kinetics of polymerization of vinyl monomers containing heterocyclic and aliphatic amino functions initiated by radicals are being studied.

12. Studies in Polymer Chemistry (Kum. N. Ganga Devi and V. Mahadevan):

Oxidation mechanisms and kinetics and mechanism of redox poly-

merization initiated by Mn^{3+} plus organic reducing agent systems, leading to free radicals, are being studied.

13. Acid-Base Reactions in Non-Aqueous Media (N. Chattanathan and C. Kalidas):

Equilibrium constant measurements were carried out for the various nitro diphenyl amine indicators in ethylene and propylene glycol using sodium and lithium glycolate as added base.

II. ORGANIC CHEMISTRY

1. Hydrogen Transfer Reactions (C. N. Pillai and D. V. Ramana):

A technique has been developed for the reduction of carbonyl compound by alcohols, catalyzed by alumina. An extensive study of the scope and mechanism of the reaction is in progress.

2. The effect of acidity on the activity and selectivity of dehydration catalysts (C. N. Pillai and S. Santhanagopalan):

The factors affecting activity and selectivity in olefin formation, ether formation, rearrangement, dehydrogenation and stereoselectivity in the dehydration of alcohols over alumina and thoria are under investigations.

3. Carbonyl condensation reactions catalyzed by Alumina (C. N. Pillai and M. P. Krishnan Unni):

A study of the aldol type condensation reactions catalyzed by alumina is in progress.

4. Stereochemical studies of the reduction of carbonyl compounds (C. N. Pillai and Mrs. Jayalakshmi Ramachandran):

A comparative evaluation of the steric effects in the reduction of carbonyl compounds by hydride transfer reactions is in progress.

5. Studies in the synthesis of heterosteroids (S. R. Ramadas and J. Radhakrishnan):

Studies on the development of new routes for the synthesis of Ring B and Ring C-oxasteroids are in progress.

III. INORGANIC CHEMISTRY

1. Studies on Thermal Decomposition of Calcite (M. R. Kini and G. Butenuth):

The rate of dissolution of Calcite crystals in water was measured by electrical conductivity measurements to understand the local defects in the structure of naturally occurring calcite.

2. Studies on Thermal Decomposition of Cadmium Carbonate (B. G. Sejekan and G. Butenuth):

Single crystals of cadmium carbonate, intended to be used in thermal decompositions, were grown from an aqueous solution of CdCl_2 by slow diffusion of ammonium carbonate vapour into the solution and their characteristics studied.

3. Complexes containing Morpholine or Morpholinium ion (D. Venkappayya and G. Aravamudan):

Chlorocomplexes of Co, Cu, Zn, Cd and Hg with the bulky, non-spherical cations, morpholinium and ethylenedi-morpholinium ions, were isolated and their structures elucidated using spectral, magnetic and X-ray methods.

4. Chloramine-T oxidations (V. R. S. Rao and G. Aravamudan):

The reactions of dichloramine-T with Fe(II), Cu(II), Cr(III), and Bi(III) led to the formation of higher valence states of these elements. The extent of formation of the oxidised species and the mechanism of the oxidations were studied.

5. Chemistry of selenium and tellurium (P. R. Sethuraman and G. Aravamudan):

Complexes of thioglycollic acid with selenium and tellurium were formed in aqueous and non-aqueous media. Their composition, thermal and redox behaviour were studied.

6. Catalysed decomposition of ferrocyanide (M. R. Udupa and G. Aravamudan):

S-ligated class-B metal ions were found to catalyse strongly the de-

composition of ferrocyanide solutions. The mechanism of the decomposition was studied.

7. Solid state studies on uranium, chromium and thallium compounds (S. Sampath and G. Aravamudan):

The nature of products obtained during the thermolysis of thallium carbonate, thallium acetate and thallium formate was ascertained and the kinetic parameters associated with the decompositions determined.

8. Inorganic Trace Analysis (T. Subramanian and T. V. Ramakrishna):
The analytical applications of indoxine are being studied.

9. Thermodynamic Properties of metal complexes of substituted purines (C. R. Krishnamruthy and M. M. Taquikhan):

Stability constants determination of complexes formed between 6-Aminopurine, 2:6 diaminopurine, 6-OH purine and bivalent metal ions at different temperatures are being made.

10. Homogeneous catalysis by metal complexes (S. Vancheesan and M. M. Taqui Khan):

Preparation of coordination complexes of platinum metals and their application as homogeneous catalysts for hydrogenation and hydroformylation are being taken up.

Few complexes of ruthenium have been prepared using triphenyl phosphine, triphenyl arsine and 1, 2-bisdiphenyl phosphino ethane as ligands.

11. Homogeneous catalysis by metal complexes (Q. Anwaruddin and M. M. Taqui Khan):

Chloro and triphenylphosphine complexes of quadrivalent rhenium and amine complex of pentavalent rhenium are prepared. The kinetic study of polymerization reaction of acrylamide monomer and similar vinyl monomers using these complexes is under progress.

12. Metal chelates of Tripolyphosphates (P. Rabindra Reddy and M. M. Taqui Khan):

Stability constant determinations of 1:1 chelate of TPP with bivalent metal ions, Cu(II), Zn(II), Mn(II), Ni(II), Mg(II), Ca(II), Sr(II) and Ba(II) at different temperatures are being made.

IV. C.S.I.R. SCHEMES

1. Catalytic Alkylates of Phenols (S. V. Kannan and C. N. Pillai):

A mechanistic study of the alkylation of phenols by alcohols catalyzed by alumina is under progress.

2. Mechanisms of photochemical reactions involving Triplet States (M. Santhanam and V. Ramakrishnan):

From Kinetic studies of photosensitized oxidation of aniline, the various factors affecting the triplet electronic energy factor have been arrived at.

In addition to the above schemes three research scholars are receiving C.S.I.R. Junior Research Fellowships.

PUBLICATIONS

I. Papers Published

1. Kinetics of hydrogen chemisorption by N. Chandrasekharan, B. Viswanathan, V. Srinivasan and M. V. C. Sastri., *Aust. J. Chem.* **21**, 2575 (1968).
2. Evidence of nitrogen chemisorption on iron powder at low temperatures by P. Rukmani, B. Viswanathan, V. Srinivasan and M. V. C. Sastri., *Curr. Sci* **38**, 59 (1969).
3. Surface heterogeneity of iron from temperature variation chemisorption studies by B. Viswanathan, V. Srinivasan and M. V. C. Sastri. *Indian Journal of Chemistry*, **7**, 363 (1969).
4. Thermodynamic consideration of the influence of chemisorption on the physical adsorption of gases by B. Viswanathan, V. Srinivasan and M. V. C. Sastri., *Ind. Jour. of Chem.* **7**, 360 (1969).
5. The choice of catalysts for chemical industries by M. V. C. Sastri., *Chemical Age of India*, **19**, 1003 (1968).
6. Adsorption of nitrogen and argon on Iron-Kieselguhr at low temperatures: Evidence for absence of chemisorption of Nitrogen. Swamy, C. S., *Curr. Science.*, **38**, 188 (1969).

7. Estimation of dimethylsulphoxide with chloramine-T. D. Venkappappa and G. Aravamudan, *Talanta*, **15**, 74 (1968).
8. The system magnesium sulphate-thiourea-water at 30°C. M. Ramakrishna Udupa and G. Aravamudan, *Indian Jr. of Chem.*, **6** 217-8 (1968).
9. Preparation of thiourea complexes by solid-solid interactions. M. Ramakrishna Udupa and G. Aravamudan., *Curr. Sci.* **38**, 14 (1969).
10. On the supposed '4-morpholinyl — (Thiocarbonic) acid amide'. D. Venkappayya and G. Aravamudan., *Curr. Sci.*, **38**, 155 (1969).
11. The determination of calcium and magnesium in acetylene flames. T. V. Ramakrishna, J. W. Robinson and P. W. West. *Anal. Chim. Acta*, **40**, 347 (1968).
12. A catalytic method for determining traces of selenium. T. V. Ramakrishna and P. W. West, *Anal. Chem.*, **4**, 966 (1968).
13. Coordination Compounds of Sulphoxides — A Review. J. Gopalakrishnan and C. C. Patel. *J. Sci. Ind. Res.* **27**, 4475 (1968).
14. A volumetric method for the determination of Sulphoxides, V. V. Savant, J. Gopalakrishnan and C. C. Patel, *Z. Anal. Chem.* **238** 273 (1968).
15. A modified Wolfsberg-Helmholz molecular orbital calculations on octahedral complex ions. J. Gopalakrishnan, D. N. Sathyanarayana and C. C. Patel., *Indian J. Chem.*-**7**, 77 (1969).
16. Polarographic studies in molten $\text{LiNO}_3 + \text{NaNO}_3 + \text{KNO}_3$ — PART I. D. Inman, D. Lovering, R. Narayan, *Trans. Faraday. Soc.* **64**, 2476 (1968).
17. Polarographic studies in molten $\text{LiNO}_3 + \text{NaNO}_3 + \text{KNO}_3$ — PART II. D. Inman, D. Lovering, R. Narayan. *Trans. Faraday. Soc.* **64**, 2487 (1968).
18. Modification of the activity of chromia and chromia-alumina catalysts by adsorbates.
J. C. Kuriacose, C. Daniel and R. Swaminathan.,
J. Catalysis. **12**, 19 (1968).

19. A study of the dual activity of a chromia-alumina catalyst. C. Daniel and J. C. Kuriacose., *Ind. J. Chem.* **6**, 645 (1968).
20. The mechanism of dehydration and dehydrogenation on semiconductor oxide catalysts. J. C. Kuriacose, C. Daniel and N. Balakrishnan. *Ind. J. Chem.* **7**, 367 (1967).
21. Bromination of p-bromophenol. I—Kinetics and Mechanism in acetic acid medium. J. Rajaram and J. C. Kuriacose. *Aust. J. Chem.*, **21**, 3069 (1968).
22. Stereochemistry of the conversion of alcohols to ethers over alumina. S. V. Kannan and C. N. Pillai, *Curr. Sci.*, **37**, 665 (1968).
23. Stereochemistry of the dehydration of threo-3- methyl pentan-2-ol over alumina and thoria. K. Narayanan and C. N. Pillai. *Indian Jour. of Chem.* **7**, 409 (1969).
24. Metal Ion and Metal Chelate Catalyzed Oxidation of Ascorbic Acid by Molecular Oxygen. III. Vanadyl Ion Catalyzed Oxidation. M. M. Taqui Khan and A. E. Martel, *J. Am. Chem. Soc.* **90**, 6011 (1968).
25. Oxidation of Ascorbic Acid by Fe (III) Chelates of Aminopolycarboxylic Acids. M. M. Taqui Khan and A. E. Martell., *J. Am. Chem. Soc.* **90**, 3386 (1968).

II. Papers sent for Publication

1. A solvent extraction-absorpiometric procedure for the determination of niobium in steels using bromopyrogallol red.—T. V. Ramakrishna and T. S. West, *Talanta*, (Belcher Honour Issue) (1969).
2. The determination of molybdenum by atomic absorption spectroscopy. T. V. Ramakrishna, J. W. Robinson and T. S. West. *Anal. Chim. Acta.* (1969).
3. The determination of phosphorus, arsenic or silicon by atomic absorption spectrometry of molybdenum heteropoly acids. T. V. Ramakrishna, J. W. Robinson and T. S. West. *Anal. Chim. Acta.* 1969.
4. Studies on some metal thiobenzeates — V. V. Savant, J. Gopalakrishnan and C. C. Patel, *Journal of Inorganic and Nuclear Chemistry.*

5. Oxidation of diphenylsulphoxide with chloramine-T — V. R. S. Rao and G. Aravamudan. *Current Science*.
6. Catalysed decomposition of ferrocyanide ion by sulphur ligated class b metal ions. M. Ramakrishna Udupa and G. Aravamudan. *Current Science*.
7. Oxidimetric determination of triphenylphosphine. V. R. S. Rao and G. Aravamudan. *Talanta*.
8. Insertion of carbon disulphide into coordinated morpholine. D. Venkappayya and G. Aravamudan, *Journal of Inorganic and Nuclear Chemistry*.
9. Metal complexes of morpholyldithiocarbamate and their adducts with some bases. D. Venappayya and G. Aravamudan. *Australian Journal of Chemistry*.
10. Pyrolysis of Uranium compounds I. Uranyl chromate hydrate. *Indian Journal of Chemistry*. S. Sampath and G. Aravamudan.
11. Metal Ion and Metal Chelate Catalyzed Oxidation of Ascorbic Acid by Molecular Oxygen, IV. Uranyl Ion catalyzed oxidation. M. M. Taqui Khan and A. E. Martell. *J. Am. Chem. Soc.*, 91,000 (1969).
12. Fixation of Molecular Nitrogen by Platinum Metal Ions in Homogeneous Solution. M. M. Taqui Khan and A. E. Martell, *J. Am. Chem. Soc.* 1969.
13. Metal Chelates of Thiamine. M. M. Taqui Khan and Amar Babu. *J. Am. Chem. Soc.* 1969.
14. Metal Complexes of Monosubstituted Purines. M. M. Taqui Khan and C. R. Krishnamurthy.
15. Metal complexes of tripolyphosphate. M. M. Taqui Khan and P. R. Reddy.
16. Homogeneous catalysis by metal chelate compounds. M. M. Taqui Khan. Review submitted to "Chemical and Processing Engineering".
17. Metal Ion Activation of small molecules in Homogeneous Solution. M. M. Taqui Khan and A. E. Martell, Book, Academic Press, New York, 1969.

18. Adsorption of nitrogen on Nickel-Alumina, Australian Journal of Chemistry., S. Narayanan and L. M. Yeddanapalli.
19. Chemisorption and Catalytic Activity of Nickel alumina catalysts, S. Narayanan and L. M. Yeddanapalli. Aust. Jr. of Chemistry.
20. Kinetics of chemisorption of H₂ on Iron-Kieselguhr: Application of the equation of Kodama, et al. C. S. Swamy, Curr. Sci.
21. Chemisorption of nitrogen on supported iron catalysts, C. S. Swamy, Ind. Jour. of Technology. 1968.
22. Hydrogen transfer reactions. I. Reduction of carbonyl compounds by alcohols catalyzed alumina, D. V. Ramana and C. N. Pillai, Canadian J. Chem. 1969.
23. The influence of the physical characteristics of chromia-alumina on its catalytic activity, J. C. Kuriacose and C. Daniel, J. Catalysis.
24. Studies on the ketonisation of acetic acid on chromia. I. The adsorbate—catalyst interaction. J. C. Kuriacose and R. Swaminathan, J. Catalysis.
25. The influence of adsorbates on the electronic character and catalytic activity of chromia and chromia-alumina surfaces, C. Daniel and J. C. Kuriacose, Ind. J. Chem.
26. Kinetics of bromination of p-bromophenol-II. Catalysis by iodine and anhydrous aluminium chloride, J. Rajaram and J. C. Kuriacose, Aust. J. Chem.
27. Catalysed bromination of aromatic substrates, G. Kothandaraman, J. Rajaram and J. C. Kuriacose, Proc. Ind. Acad. Sci.

SEMINARS

Staff members of the Department attended and presented papers at the following Seminars and Symposia:—

1. Surface Chemistry and Solid State Decompositions, Delhi, September, 1968.
2. Ninth Seminar in Electrochemistry, Karaikudi, November, 1968.
3. Joint Convention of the CSIR Chemical Research Committee, Hyderabad, February, 1969.

CIVIL ENGINEERING DEPARTMENT

STAFF

Professors

- P. C. Varghese, Ph.D. (IIT, Kharagpur) — (Head)
Gerhard Rouve, Dr. Ing. (Karlsruhe)
J. Plaehn, Dr Ing. (Hannover)
V. Sethuraman, Dr. Ing. (Toulouse, France)

Assistant Professors

- K. S. Sankaran, Ph.D. (IIT, Madras)
P. Srinivasa Rao, Dr. Ing. (Munchen)
D. J. Victor, Ph.D. (Texas)

Lecturers

- S. Balakrishnan, M.Sc. (Engg) (Madras)
R. Radhakrishnan, M.Sc. (Engg) (Madras)
V. D. Muthaiyya, M.Sc. (Engg) (Madras)
Y. R. Nagaraja, M.Tech. (IIT, Madras)
M. V. Panduranga Rao, M.Tech. (IIT, Kharagpur)
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H. Rama Ayyar, M.Sc. (Engg) (Madras)
T. P. Ganesan, M.Sc. (Engg) (Madras)
B. Ramanathan, M.Sc. (Engg) (Madras)
C. Ganapathy Chettiar, M.Sc. (Engg) (Madras)
P. K. Ninan, M. Tech. (IIT, Kharagpur)
V. Paramasivam, M.Tech. (IIT, Bombay)
M. S. Subramaniam, M.Tech. (Engg) (Madras)
C. S. Krishnamoorthy, M.Sc. (Engg) (Madras)
P. Kalyanasundaram, M.Tech. (IIT, Madras)
N. Rajagopalan, M.Tech. (IIT, Madras)
H. R. Rama Rao, Ph.D. (Grenoble, France)
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Associate Lecturers

K. Muthukrishnaiah, M.Tech. (IIT, Madras)

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K. R. Rajagopal, M.Tech. (IIT, Bombay)

M. G. Srinivasan, M.Tech. (IIT, Madras)

S. Selvaraj, M.Sc (Engg) (Madras)

H. Suresh Rao, M.Tech. (IIT, Madras)

R. Sivasankar, M.E. (IISc, Bangalore)

Y. M. Reddy, M.Tech. (IIT, Bombay)

K. Gopalakrishnan, M.E. (IISc, Bangalore)

Pool Officers (CSIR)

M. Shanmugham, Ph. D. (Iowa)

K. Ramakrishnamurthy, Ph.D. (Dresden)

RESEARCH WORK

1. Strength and behaviour of R.C. hyperbolic paraboloid shell roofs (A. C. Mathai and P. C. Varghese):
Investigation on R.C. hyperbolic paraboloids of different rise/span ratios is continued.

2. Ultimate Load Behaviour of Indeterminate Encased Beam Structures (V. Paramasivam and P. C. Varghese):

A computer programme to generate moment curvature graphs of encased beam sections has been prepared. Experiments on four simply supported beams have been carried out to verify the computer predictions.

3. Behaviour of Conoidal Shells (C. Ganapathy Chettiar and P. C. Varghese):

The study of behaviour of R. C. Conoidal Shells in fixture is in progress.

4. Analysis of Folded Plates (C. S. Krishnamoorthy and P. C. Varghese):

The investigation aims at studying the strength and behaviour of reinforced concrete folded plates. A computer programme is being prepared for the analysis and design of folded plates.

5. Performance of R.C. structures in adverse environments (P. Kal-yanasundaram and P. C. Varghese):

Accelerated testing for corrosion of embedded steel is being continued.

6. Ultimate load analysis of flat plates using soil reaction as loading (for raft foundations) (Sri N. Rajagopalan and P. C. Varghese):

Theoretical work for fixing the yield pattern for slabs with soil reaction as loading was continued for different edge conditions. Theoretical study to arrive at optimum slab thickness for Rafts to have contact with soil at all places is being made to be confirmed with experiments at a later stage.

7. Investigations on Composite action of brickwork and reinforced concrete structures (P. C. Varghese and H. Achyutha):

8. Criteria for Limit State Design of R. C. Hyperstatic Structures (B. V. Subrahmanyam and P. S. Rao):

Effect of shear on the deformation characteristics of R. C. members is being studied. Methods to estimate moment redistribution under working loads taking also shear effects into account are being developed. Theoretical investigation of various factors influencing optimum limit design is under progress.

9. Comparative Studies of crackwidths in concrete beams reinforced with Indian deformed bars (P. S. Rao):

Crackwidths are measured on a number of beams reinforced with ordinary mild steel, Tistrong and Torsteel bars. Apart from the type of steel, other parameters being investigated are the percentage of steel, diameter of bars and cover. Statistical methods are used to analyse the extensive crack-width observation data.

10. Possibility of 'bar cut-off' in welded wire fabric reinforcement (P. S. Rao):

Welded wire fabric can be even more economical if part of the reinforcement could be cut to suit the bending moment diagram. Problems associated with such 'bar cut-off' in tension zone are being investigated.

11. Analysis of Reinforced Concrete frames under various stages of loading (C. S. Krishnamoorthy and P. S. Rao):

A computer programme is being worked out for the analysis of R. C. frames under various stages of loading.

12. Effect of settlement of supports of R.C. continuous beams (P. S. Rao and P. Kalyanasundaram):

Analysis using computers is in progress.

13. Behaviour and Strength of R.C. members subjected to combined Torsion, Moment and Shear (D. J. Victor):

The behaviour and ultimate strength of T-and L-beams of different flange widths and without web reinforcement under combined moment and torsion have been investigated. Study of behaviour of beams with web reinforcement under combined loadings is in progress.

14. Simplified Designs for Highway Slab Bridges (D. J. Victor and C. Ganapathy Chettiar):

Simplified procedures for the design of simply supported slabs for highway bridges are under development. Nomograms leading to speedy determination of design values have been prepared.

15. Bond characteristics of deformed bars made in India (D. J. Victor):

Deformed bars are being increasingly used in R.C. construction in this country. The investigation aims at the evaluation of the bond resistance of deformed bars currently manufactured in India.

16. Long R.C. Columns as part of frames (D. J. Victor):

The behaviour of long R.C. columns as part of building frames is not yet well understood. The investigation attempts to study the

problem both analytically and experimentally with emphasis on the latter.

17. Stability investigations of long R.C. columns (J. Plaehn):

Load capacity of long R.C. columns with rectangular and circular cross-section for small eccentricities is investigated.

18. Stress distribution in anchorage zone of pretensioned prestressed concrete beams (J. Plaehn):

Stress distribution in the transfer zone of pretensioned members has been investigated so far only by photoelasticity. From this method accurate design procedure cannot be proposed in this case. The problem is studied analytically and experimentally in full scale tests.

19. Investigations on prestressed concrete sleepers (J. Plaehn):

Application of prestressing wires manufactured in India for railway sleepers is investigated.

20. Strength and Stiffness of welded joints in steel tubular trusses. (C. Ganapathy Chettiar):

Relative strength of profiled joints and cropped joints in tubular members is studied. The effective length factors for members in trusses with the above joints are being investigated to propose an accurate design procedure.

21. Design of Slabs by yield-line theory (C. S. Krishnamoorthy, P. Kalyanasundaram and N. Rajagopalan):

Design Tables are prepared for the design of slabs by yield-line theory.

22. Study of effect of stiffness of beams on the analysis and design of R.C. frames (C. S. Krishnamoorthy, P. Kalyanasundaram and N. Rajagopalan):

The effect of stiffness of beams on the analysis and design of multi-storeyed frames is being investigated.

23. Economic proportions in the Design of R.C. Slabs (P.C. Varghese, H. Achyutha and K. N. Ramamoorthy):

24. Variation of crack width with time in R.C. beams subjected to sustained loading (K. N. Ramamoorthy):
25. Determination of Buckling Strength of Cylindrical Shells by measuring their natural frequencies (R. Radhakrishnan):
26. An Investigation on the Strength and Behaviour of Reinforced Concrete Vierendeel Girders (T. P. Ganesan and P. C. Varghese): The study included computer and photoelastic studies and tests on forty specimens of Reinforced Concrete.
27. Effect of friction on the stability of hydraulic jump on adverse channel slopes. (G. Badlani and G. Rouve):

Experimental investigation of the effect of bed friction on the stability of hydraulic jump on adverse channel slopes, has been made.

28. Experimental studies on the formation of roll waves in rectangular open channel. (P. Etienne and H. R. Rama Rao):

Experimental investigation have been made on the evolution of the amplitudes of an initial wave of variable amplitude and frequency produced by an oscillating gate at the entrance of the channel. The results have been compared with the theoretical expression for the coefficient of amplification established by linearised theory.

29. Studies on Scour under Three Dimensional inclined circular jet (K. A. Kuppaswamy, R. Sivasankar, and V. Sethuraman):

Various parameters involved in the Scour function for inclined circular jet, have been experimentally determined.

30. Experimental studies on Stationary wave trains in a rectangular channel (V. S. Sampath and V. Sethuraman):

Study of the characteristics of the leading wave of a stationary wave train and the variations in the flow conditions with the channel roughness have been made.

31. Oscillating waves around bridge pier (G. S. Parthasarathy and V. Sethuraman):

An attempt has been made to study the properties of oscillating wave around bridge pier.

32. Flow over a circular crested Spillway (Y. M. Reddy and V. Sethuraman):

Pressure distribution, surface profiles and coefficient of discharge for various (H/D) ratios of head to crest diameter, are studied. It is proposed to extend the work for other crest profiles.

33. Stability Analysis of surge tank systems with aid of Analog computers (S. Meenakshisundaram and V. Sethuraman):

Investigation of throttled and differential surge tank by the Telefunken Analog computer is in progress to find out the range of utility of the computer for the solution of complicated problems of surge tank systems.

34. Studies on sudden Impulse on Laminar Flow in a Pipe (F. G. Rhode):

Investigation on experimental set up to verify theoretical solution is in progress.

35. Two dimensional Flow in a channel Bay (F.G. Rohde):

Study of Turbulence characteristics and energy dissipation in channel bay is being taken up.

36. Fully developed turbulent flow through concentric Annuli (H. Suresh Rao and G. Rouve):

Experimental study of the structure of fully developed turbulent flow in concentric annular passage is contemplated. Friction factors, velocity profiles and pressure drops, with and without the rotation of inner walls, will be determined.

37. Turbulence characteristics of cool and hot water jets (K. Elango and V. Sethuraman):

Quantitative evaluation of production, convection, diffusion, pressure transport and dissipation of turbulent energy in the axisymmetric jet region is proposed to be determined experimentally.

38. Flow over and through rockfill dams (R. Sivasankar and V. Sethuraman):

Theoretical studies are being carried out to develop a suitable equation for turbulent flow through porous media, to be verified experimentally. Attempts are being made to clearly define friction factor and Reynolds Number for flow through rockfill. Aspects on threshold flow and spatially varied flow connected with rockfill are being studied. Experimental set-up is being envisaged.

39. Effect of stress path on strength characteristics of over consolidated saturated Cohesive soils.
(B. Ramanathan and H. Rama Rao):
40. Earth pressures on curved surfaces.
(B. Ramanathan and Rolands Nelson):
41. Some aspects of compacted clays.
(K. Muthukrishniah and Jeevannandhan):
42. Well foundations—Model studies.
(K. Muthukrishnaiah and Krishnakumar):
43. Effect of secondary compression on pore water pressure response.
M. S. Subramaniam and Garata Reddy):
44. Study of conical shell footings.
(K. S. Sankaran and C. Vijayan):
45. Behaviour of well foundations subjected to oblique loads.
(K. Muthukrishnaiah):
46. Strain criterion for failure of soils.
(M. S. Subramaniam):
47. Studies on performance and strength of hyperbolic paraboloid shell footings. (P. K. Ninan):
48. Study of Engineering properties of Madras marine clays.
(B. Ramanathan):
49. Stabilization of beach sand.
(K. S. Sankaran):

50. Studies on swelling soils.
(K. S. Sankaran and V. Dakshinamoorthy.)

C.S.I.R. SCHEMES

51. Bond resistance of deformed and cold twisted deformed reinforcing bars made in India (P. C. Varghese and D. J. Victor):

The project which has been sanctioned with effect from 1—3—1969 aims at a study of bond stresses to be used in design for the hot-rolled deformed and cold-twisted deformed bars currently manufactured in this country. Some basic studies on the bond phenomenon are also planned.

52. Study on underwater concrete (P. C. Varghese):

The project which aims at studying the effect of various factors on the strength and density of concrete cast under water through a tremie is in progress.

53. Experimental studies on Flow around bends in lined open channel (V. Sethuraman and S. Subramaniam):

54. National Buildings Organisation Scheme.

Investigation of joints in precast R. C. and prestressed Concrete frames (P. C. Varghese and V. Paramasivam):

The project aims at development of suitable joints for a R.C. gable frame of 25 feet span and a prestressed concrete portal frame of 30 feet span. Experiments on three different types of joints have been carried out.

LIAISON WITH INDUSTRY

The following investigations of interest to the construction industry were undertaken:—

- (a) Consultation work for Madras Atomic Power Project, Kalpakkam regarding use of high strength deformed steels and testing of cements.
- (b) Materials testing for Madras Fertilisers Ltd.

- (c) Practical problems in connection with the use of welded wire fabric as reinforcement for concrete.
- (d) Reinforced concrete railway sleepers.
- (e) Composite floors and slabs of clay products and reinforced concrete.

Sub-soil investigations have been carried for various industries in and around Madras City and design criterion have been suggested based upon the special requirements of the foundation problem.

The department will undertake a joint research investigations with the Defence R. D. establishment to develop quick construction of Air field landing strip for emergency landing along the coastal beach.

Electrical resistivity survey has been carried out during the different seasons at the site of Madras Atomic Power Project, Kalpakkam.

PUBLICATIONS

I. Books

1. Essentials of FORTRAN Programming by Dr. D. J. Victor, under Publication by M/s. Orient Longman's Ltd., Madras. The book is due for release by the end of June, 1969.
2. 'PAYAN THARUM KANIC CHELVAM'—by V. D. Muthaiah. A book on Indian economic minerals in Tamil. New Century Book House, Madras-2.

II. Papers Published

1. 'Über die spannungsumlagerungen des ausmitting gedruckten kurzen, geraden staves in bdge nicht linearen Werhstoff-Kriechens' ('on the stress Distribution of Short straight members subjected to eccentric load considering the non-linear creep of material')—Plaehn, J., Hab.-Thesis - Technical University, Hannover, 1967.
2. 'uber die spannugs—Dehnungs—Linie von Beton bei kurzzeitiger Lasteinwirkung'.

('On the Stress-Strain Curve of Concrete under short-term Loading) Cordes, H., Technical University, Hannover, 1968.

3. 'Direct Rotation Contribution Method for the Analysis of Continuous Beams and Vierendeel Structures'—Ganesan, T.P. and Paramasivam V. *Journal of the Institution of Engineers (India)*, July 1968 (special).
4. 'Analysis of Balcony Slabs'—Krishnamoorthy, C. S., and Ganapathy Chettiar, C., *The Indian Concrete Journal*, September, 1968.
5. 'Simplified Loadings for Slab Bridge'—Victor, D. J., and Chettiar, C. G., *Proceedings of the National Seminar on Design and Construction of Roads and Bridges, Bombay, October 1968, Vol. II.* published by Govt. of India, Ministry of Transport and Shipping (Roads Wing), New Delhi.
6. 'Determination of Buckling Strength of Cylindrical Shells by measuring their natural frequencies'—Radhakrishnan, R. *Bericht vom Institut für Baustoffkunde und Stahlbetonbau der Technischen Universität, Braunschweig, March 1969.*
7. 'Constructional Aspects of Tall Chimneys'—Hariharan, M. and Victor, D. J., *Proceedings of a symposium on Industrial Structures. College of Engineering, Guindy, 27th and 28th January 1969.*
8. 'Effect of Code formulation in Construction Industry'—Rao, P. S. *Proceedings of a symposium on Industrial Structures, College of Engineering, Guindy, 27th and 28th January, 1969.*
9. 'Discussion closure' Victor, D. J. and Ferguson, P. M., *Disc-65-3, Journal of the A.C.I. July, 1963.*
10. 'Discussion closure' Victor, D. J., and Ferguson, P.M., *Disc. 65-23. Journal of the A.C.I., October 1968.*
11. 'Discussion' Victor, D. J., *Disc 65-48. Journal of the A.C.I., February 1969.*
12. 'Well subjected to horizontal forces' A model study Dr. K. S. Sankaran and Sri K. Muthukrishnaiah—*Journal of Indian Roads Congress, Vol. 32 No. 1, 1969.*
13. 'The effect of surcharge on the subgrade modulus for sand'—Sri P. K. Ninan and Sri N. Waikuntham—*Journal of soil Mechanics and Foundation Engineering, Vol. 7. No. 3 July 1968.*

14. 'Studies on the elastic behaviour of sand and crushed stone under repetitive loads' — Sri P. K. Ninan and Sri P. R. Sahasranamam, Journal of Indian Roads Congress Vol. 32, No. 2, 1969.
15. 'Tectonics of the Deccan plateau and Koyna earthquake'—V. D. Muthayya and S. P. Subramaniam, Indian Engineers, Feb. 1969.

III. Papers accepted for publication

1. 'Cost comparison of reinforced concrete flexural members designed according to ULD and WSD specified in IS : 456—1964'—Srinivasa Rao, P. and Krishnamoorthy, C. S., to be published in The Indian Concrete Journal.
2. 'Zur Frage der bleibenden Verformungen des Betons bei Dauer schwingbeanspruchung'.

('On the inelastic strains of concrete subjected to fatigue loading')
Plaehn, J., to be published in Beton und Stahlbetonbau.

IV. Papers sent for Publication

1. 'Design charts for Highway Bridge slabs'—Victor, D. J. and Chettiar, C. G. Sent for publication in the Journal of the Indian Roads Congress, New Delhi.
2. 'Cracking and ultimate strength of one way slabs reinforced with welded wire fabric' — Srinivasa Rao, P. and Subramanyam, B. V., sent for publication in the Indian Concrete Journal, Bombay.
3. Hydraulic jump on adverse channel slopes S. Rajagopal and M. H. Abdul Khader. Sent for publication, Hydraulic Division, A.S.C.E., New York.

V. Papers presented at Conferences/Seminars

The following papers were presented at the International Conference on Shear, Torsion and Bond in Reinforced and Prestressed Concrete, Coimbatore, January 1969:

1. Bond characteristics and their influence on the behaviour of splices and on shear failure in concrete slabs reinforced with welded wire fabric—(Dr. P. S. Rao).

2. Effect of flange width on the behaviour and strength of reinforced concrete beams without stirrups under combined moment and torsion (D. J. Victor).
3. Strength of Deep Reinforced Concrete Beams under Concentrated Loads (P. C. Varghese and C. S. Krishnamoorthy).
4. On the effect of time on the transmission length of pretensioned prestressed concrete. (J. Plaehn).
5. Experimental and Analog Studies on the stability of throttled surge chambers --(Dr. V. Sethuraman), Conference paper presented at the conference on fluid mechanics and fluid power, Jadavpur. March 8 and 9, 1969, Calcutta.
6. Analogue computer studies on the stability of orifice surge tanks -- (Dr. V. Sethuraman and S. Meenakshisundaram) paper presented at the symposium on computer application in Civil Engineering, January 69, Trivandrum.

ELECTRICAL ENGINEERING DEPARTMENT

STAFF

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- P. Venkata Rao, D.Sc. (Andhra)— (Head)
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V. Subrahmanyam, M.E. (IISc, Bangalore)
P. Sankaran, M.Sc. (Madras)
S. S. Yegnanarayanan, M.Tech. (IIT, Bombay)
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 S. Raman, B.E. (IISc, Bangalore)

Pool Officer (CSIR)

- V. Rajagopalan, Dr. Ingenieur (Toulouse)

German Technical Staff

- H. Ansoerge

RESEARCH WORK

FUNDAMENTAL AND MEASUREMENT SECTION

I. Network and System Theory

1. Analysis and Synthesis of n-port networks (V. G. K. Murti, K. Thulasiraman, V.V. Bapeswara Rao, P. Subbarami Reddy, C. Eswaran) :

A new and general method of synthesis of resistive n-port networks with $(n+1)$ nodes is formulated. Studies are conducted on methods of synthesis with $(n+2)$ and more nodes. Certain criteria for proper interconnection of n-port networks have been identified.

2. Topological Studies of Networks (V. V. Bapeswara Rao, K. Sankara Rao, P Sankaran, V. G. K. Murti).

Efficient methods for the setting up different topological matrices of a network graph like the all cut-set matrix and the all circuit matrix and for the enumeration of all trees are being evolved. Computer programmes for the implementation of some of these methods have also been evolved.

3. Realization of circuit and cut-set matrices (V. V. Bapeswara Rao, V. G. K. Murti, K. P. Rajappan) :

A necessary and sufficient criterion for the realizability of the fundamental circuit or the cut set matrix of a graph has been identified. An efficient and computerizable procedure for the realization of these matrices is being formulated.

4. State-space techniques in network theory (K. Sankara Rao, V. G. K. Murti) :

A study of the application of the methods of state-variable formulation of system equations to the analysis and synthesis of networks is in progress.

5. Active network synthesis (S. Natarajan, V.G.K. Murti) :

New methods of realization of transfer functions by 2-port RC Networks with an amplifier embedded in it are developed.

II. Electrical Measurements and Instruments

1. Compensation networks for instruments (P. Karivaratharajan, V. G. K. Murti) :

Certain types of compensation networks to improve the frequency response characteristics of instruments have been designed. The techniques

have been applied to extend the frequency range of electromagnetic oscillographs and moving iron voltmeters.

2. Transient performance of instrument transformers (P. Sankaran and V. G. K. Murti) :

The performance of current transformers under transient conditions has been further investigated. An electronic error compensation scheme for the faithful reproduction of the primary transient on the secondary side has been worked out, A design procedure for the core and the amplifier is being worked out.

3. Measurement of angular acceleration (H W Meyer, B.V. Seshadri) :

An electronic circuit for the measurement of angular acceleration was constructed. The acceleration is calculated from the values of speed measured by photoelectric methods. For this purpose digital techniques are being employed.

4. Measurement of D. C. Resistance of energised A. C. windings (K. B. Balasubramaniam and H. W. Meyer) :

For the measurement of the resistance, a direct current is injected into the circuit and the D C voltage drop across the injected winding is being measured. Various methods of current injuction and the measurement of small DC values in the presence of large AC quantities are under study using compensating circuits, bridges and integrating type digital voltmeters.

5. Development of Electronic devices for the measurement of power and energy (H.W. Meyer) :

Electronic schemes for the precise determination of power and energy are under investigation which can be used under adverse conditions.

6. Development of testing apparatus for energymeters (H. W. Meyer and M.C. Vaithilingam) :

An error indicator for the testing of energymeters using digital methods has been developed. The testmeter is compared against a standard meter and the errors can be obtained with one multiplication after a short run of the energymeters.

7. Investigations on earthing systems and their performance (M. Chinna Rao, K. Brahmadathan, K. Thulasiraman and H. W. Meyer) :

The determination of the earth resistance in a system where the conductivity of the soil is a continuous function of the depth is under investigation. The analogue representation using resistance networks is being investigated. The methods will be extended for the study of the transient behaviour of earthing systems.

III. Electronic Measurements and Instruments

1. Adaptive Filter (P. C. Majhee and K. P. Rajappan) :

An electronic self-tuning filter for detection of a class of signals in the presence of background noise has been designed, constructed and successfully tested. Here it is assumed that neither the signal nor the noise is known completely. The information needed for the adjustment of the filter parameters is obtained directly from measurements made on the noisy signal itself.

2. Analogue Dividers (P. G. Majhee and K. P. Rajappan) :

Division circuits are usually avoided in Analog Computers because they are a notorious source of error. However, they cannot be completely avoided. The existing methods for division involve essentially multipliers with feedback loops. A four quadrant divider based on an entirely new principle has been designed and constructed and is undergoing test.

3. A Cast averaging device for the measurement of power in a random waveform (P. G. Majhee and K. P. Rajappan) :

In many communication systems it is of interest to measure the average power of a random signal. The existing methods make use of filters as averaging devices. This causes some delay in the measurement of power. Using sampling technique this delay is avoided in the present method.

4. Differential proton magnetometer (G. Bruckmann, P. C. Majee and K. P. Rajappan) :

Conventional proton magnetometers in use are generally very complex both in circuitry and in use. The present design aims at simpler model. A prototype has been built and preliminary tests show satisfactory results.

5. Delta-Sigma modulation systems (G. G. Giri Rao and K. P. Rajappan) :

Delta modulation, characterised by simpler circuitry as compared with PCM, does not always fulfil the purpose of digital transmission of signals. It is intended only for transmission of such signals as speech which do not

contain DC Components. A different approach may be preferable for transmission of telemetry signals and video signals which have generally uniform frequency spectra with D. C. components. A modified version of Delta modulation called Deltasigma modulation system is being designed for telemetry.

6. Development of transistorized operational amplifiers (P. C. Majhee and K. P. Rajappan) :

Operational amplifiers have been developed using indigenous components for analogue circuits and instrumentation. The following data have been achieved : Open-loop gain : 15000 : gain-bandwidth product : 100 kHz, offset voltage drift : less than 30 $\mu\text{V}/\text{degree C}$ and offset current drift : less than 15 $\text{mA}/\text{degree C}$.

7. Photo-electronic circuits for interunit isolation of stray signals (P.C. Majhee and K. P. Rajappan) :

Instruments are being developed to exploit the high degree of isolation possible with photo-electronic coupling.

ELECTRONICS AND TELECOMMUNICATIONS SECTION

IV. Electronics and Semiconductor Devices

1. Negative resistance circuit and its use in an A. F. Oscillator (M. Anthony Reddy, Y. Gopala Rao) :

A negative resistance circuit has been used along with supporting amplifiers to realise a gyrator, which has then been converted into what is essentially an L.C. oscillator in the A. F. range. The possibility of varying frequency in this range, by the variation of a single circuit element, is being investigated.

2. Transformers and Oscillators based on hybrid-connected controlled sources. (M. Anthony Reddy and Y. Gopala Rao) :

Hybrid connected current and voltage sources have been used to realize (a) a transformer and (b) a negative-impedance converter. The use of such an NIC in oscillators is being investigated.

3. Studies on Transistor Operational Amplifiers (B. S. Bhanumurthy and S. Sampath) :

Studies are continuing on the stability of transistor operational amplifiers in the presence of noise.

4. Studies on the temperature stability of transistor circuits. (T. J. Vitto and M. K. Achuthan) :

Studies are continuing on the thermal stability of transistor circuits and the parameters influencing the same.

5. Studies on the current-gain characteristics of transistors: (K. N. Bhat and M. K. Achuthan) :

The effects of the junction shape and surface recombination on the current-gain of transistor are under study.

6. High Q minimum R. C. Network (S. Kaliyugavaradan) :

A High Q minimum R-C network has been developed giving the highest Q factor among R-C networks used in selective amplifiers and R-C oscillators, while providing good frequency-stability and low distortion for feed-back signals.

V. Electrical Communication Techniques and Systems

1. Absorption measurements on the Ionosphere (M. Mukunda Rao and P. Besslich) :

Measurements undertaken for carrying out are those internationally recommended for low latitude areas.

2. Studies on digital correlators (C. S. Sridhar and P. Besslich) :

Correlators for analog signals are difficult to construct. By converting the analog signal into a digital signal and correlating the digital signal, the difficulties are surmounted.

VI. Electronic Computation Techniques and Systems

1. Design and construction of a Demonstration Digital Computer : (A. V. Santhanam, S. S. Reddy and P. Besslich) :

The computer being designed is to have all the facilities of a large-scale computer, but a restricted memory and a word-length of only 8 bits.

2. Studies on Walsh Functions (S. Raman and P. Besslich) :

The analysis of time functions in terms of walsh functions has been known recently, the method being most suitable for digital signals. The generation synthesis and analysis of Walsh functions are under investigation.

ELECTRICAL MACHINERY AND CONTROL SECTION

VII. Electrical Machines

1. Studies on auto-dyne amplifier (S. S. Yegnanarayanan) :

Frequency response and transient response studies are continuing on the auto-dyne assembly, for different connections of the feedback windings.

2. Construction of linear induction motor for demonstration (S. S. Yegnanarayanan) :

A double-stator, sheet-rotor, short-stator linear induction motor has been constructed and is in operation. The structure is 6m. long and weights 15 kg. It is used for the demonstration of special induction machine properties enunciated by Prof. Laithwaite.

3. Phase-symmetrization techniques applied to single-phase p.a.m. machines (P. Sasidhara Rao and V. V. Sastry) :

The symmetrical component theory has since been applied to obtain balanced polyphase windings. This symmetrisation technique has been studied with reference to single-phase pole-amplitude modulated machines. The principle has been found very useful in the design of speed-change machines of certain pole-ratios.

4. Analysis of single-phase induction machines under transient conditions (P. Sasidhara Rao, V. V. Sastry and P. V. Rao) :

The estimation of the transient speed-variation of freely accelerating single-phase induction motors has been attempted by solving the non-linear differential equations using the predictor-corrector approach. The results are seen to agree closely with the experimental results of Miller and Wright. Similar studies on polechanging motors are also under way.

5. **Application of pole-amplitude modulation technique to shaded-pole motors:** (C. Sridhara Rao, V. V. Sastry and P. V. Rao):

The recent non-integral-cycle modulation logic has been applied to the case of shaded-pole motor for pole changing. A design method has been developed for optimizing the ratio of the shaded-pole winding turns to the main winding turns for this class of machines.

VIII. Static Power-Control Devices

1. **Thyristor Control of speed of d.c. motors.** (R. Parimelalagan, V. Rajagopalan and V. Seshadri):

A chopper unit using thyristors has been developed for obtaining variable d.c. output from constant d.c. supply. The performance characteristics of a chopper-fed d.c. motor under separate excitation are under investigation.

2. **Thyristor control of pole-amplitude-modulated single-phase induction motors.** (P. Sasidhara Rao, V. V. Sastry and V. Rajagopalan):

Close and wide-ratio speed change induction motors are feasible with the concept of pole-amplitude modulation. The effect of varying the firing angle in a back-to-back connected thyristor group feeding PAM induction motor is under investigation.

IX. Automatic Control Systems

1. **Signal-stabilization of Non-Linear Sampled-data Control Systems:** (G. T. Manohar and P. V. Rao):

The use of high-frequency signal to quench limit cycles in non-linear sampled-data systems continues to be studied. Different non-linearities and hold circuits with various second and third order systems are considered. In each case, the effect of amplitude and waveform of dither on quenching action is studied.

2. **Signal Stabilization of non-linear sampled-data systems with delay.** (M. V. Chalapathy Rao and P. V. Rao):

Analytical studies are continuing to determine the effect of amplitude variations in square-wave dither signals on the stabilization of non-linear

sampled-data systems with different types or non-linearity and for different amounts of delay.

3. A New Dual-input discrete describing function (P. A. Janakiraman and P. V. Rao):

A new dual-input discrete describing function is calculated for a non-linear sampled-data system with an ideal delay as the non linear element. The modes of oscillations in the system are predicted.

4 Apparatus for demonstration of Sampling Theorem (P. A. Janakiraman, P. S. Krishnaswamy and P. V. Rao):

An equipment has been designed and constructed to study the action of an Electronic sampling switch and zero order hold. This equipment can be used to study qualitatively the Shannon sampling Theorem. It is easily demonstrated, with the aid of this equipment, that it is not possible to retrieve a sinusoidal signal from the sampled values when the sampling frequency is less than twice the signal frequency.

5. Apparatus for study of signal stabilization of non-linear S. D. S. (P. A. Janakiraman and P. V. Rao) :

In an effort to carry out comprehensive studies on non-linear sampled data systems, the following units have been constructed :—

- a) Mechanical sampling device of controllable frequency
- b) Electronic zero-order hold with a buffer
- c) Bang-bang control unit with provisions for injecting high frequency dither.
- d) Dither unit
- e) Synchro error detecting system
- f) Phase-sensitive demodulator
- g) Worm-gear with two ratios etc.

It is proposed to utilise the above items to study the phenomena of signal stabilisation using different types of dithering signals.

6. **Studies in Modern Control Theory:** (K. Ramar and B. Ramaswamy).

Studies under way concern the problems of (i) the transformation of time-varying systems to phase-variable canonical form, (ii) the transformation of the state-equations of a linear system to canonical forms and (iii) the evolution of time-domain methods for evaluating quadratic and time-weighted quadratic indices of performance.

7. **Sub-optimal approach to the time-optimal control problem:** (S. Yuvarajan and B. Ramaswami):

Studies are under way on the application of the sub-optimal approach to the time-optimal control of second-order systems with complex poles.

8. **Non-Linear System Analysis by Incremental Superposition of Step-responses** (R. Parimelalagan and V. Seshadri):

The method of incremental superposition of step-responses as applicable to a class of non-linear systems has been evolved. The areas of its useful application have been studied.

9. **Marginal Stability Assessment from System State Matrix.** (P. S. Krishnaswamy and V. Seshadri):

Procedures have been developed for obtaining the marginal stability conditions of linear systems directly from the A-matrix describing them in state-space in phase variable form or otherwise.

10. **Second order state-space analysis of systems** (P. S. Krishnaswamy and V. Seshadri):

A new method of describing systems in terms of second-order differential equations has been developed. The analysis format terms of state transition matrices, controllability conditions etc. for the new approach have been evolved. The method is found to have many advantages compared to the conventional first-order state-space approach.

11. **Linear Programming applications to control systems synthesis:** (P. S. Krishnaswamy, G. T. Manohar and V. Seshadri):

The use of linear programming for the design of finite-settling-time linear continuous systems for optimality under the ITAE criterion with a constraint on overshoot has been demonstrated.

POWER AND HIGH VOLTAGE ENGINEERING SECTION**X. Power System Engineering**

1. Development and application of pulse techniques to power system protection (K. S. Mehta and M. Venugopal) :

A Ph.D. thesis on the subject has been submitted by Mr. K. S. Mehta in January 1969.

2. Investigations on the dynamic performance of static relays : (J. Balakrishna, A. V. Rao and M. Venugopal) :

Improvements are being made for the effective use of the Dynamic Test Bench for the dynamic testing of protective relays. Also in progress is the construction of new types of static relays with improved transient performance.

3. Development of static relays : (A. Chandrasekaran and M. Venugopal) :

Work has been continuing on the development of protective relays, particularly of the impedance type, using static components.

4. Construction and testing of static over current relays: (M. K. Sateesh and M. Venugopal) :

Static over-current relays with inverse and I.D.M.T. characteristics are being constructed and tested.

5. Investigations on contact phenomena in circuit breakers : (M. Krishnamurthy and M. Venugopal) :

The development of a unified 'performance index' for the choice of optimum contact material for circuit breaker applications is being attempted.

6. Stability Analysis of multi-channel power systems' (S. Elangovan and A. Kuppurajulu) :

Analytical methods, suitable for computer application, are being developed for the analysis of the behaviour of power systems under dynamic conditions.

7. Excitation control of alternators by thyristors. (M. Someswara Rao and A. Kuppurajulu):

A voltage controller for alternators has been developed by using thyristor rectifier for controlled excitation. The firing scheme constructed is suitable for full-wave rectification with a uniform variation of firing angle from 0° to 180° :

8. Fast acting static excitation - and governor - controllers for alternators: (A. Nageswara Sarma, C. Venkateshaiah, A. Kuppurajulu):

Transistorized fast-response measuring devices for quantities like power, speed, frequency and phase angle for alternator and prime-mover control are being developed.

XI. High Voltage Engineering

1. Studies on gas impregnated dielectrics: (C. Narayana Reddy and Y. Narayana Rao):

The effect of surface discharges on the breakdown of gas-impregnated thick dielectrics is under study.

2. Studies on composite dielectrics: (B. V. Dutt, Y. Narayana Rao):

The switching-surge breakdown of composite dielectrics is under study.

3. Studies on triggering impulse generator: (P. Seshasayee and Y. Narayana Rao):

Methods of triggering for a 1.5 MV impulse generator are under study.

LIAISON WITH INDUSTRY

A variety of testing and certification jobs were undertaken during the year under review by most of the laboratories of the Department for manufacturers in and around Madras City. Fabrication of special equipment for specific purposes was also undertaken. With the recent installation of the A. C. Network Analyser and the setting of the High Voltage Equipment the Department is in a position to do testing and simulation analysis for the Electricity Departments of the different states in the Country. The plans for the set up of the high-speed digital computation centre for the Institute include as one of their major objectives, the making of such a facility available for use by the local industry for the solution of their problems relating to design optimization, production control, etc.

Some of the industries and other institutions which utilized our testing and consultancy facilities during the year under review are given below:—

Name of the Institution	Nature of work	Laboratories associated
Indian Standards Institution, New Delhi Standard Electric Appliances, Tuticorn Omega Insulated Cables Best & Company Andhra Pradesh Electrical Construction Corporation Simco Meters Easwaran and Sons Oren and Co.	Testing of instruments, components, energy meters, bridges, standard cells, potential transformers, fuses and steel laminations.	Measurements and Calibration Laboratories
University of Madras— Biochemistry Dept.	Fabrication of Experimental pigeon box for biochemical studies	Control Engg. Lab
Indian Component Suppliers, Madras.	Testing of pneumatic relays	Control Engg. Lab.
Guindy Industrial Estate, Madras.	Consultancy on the design, construction and testing of two speed induction/motors	Machines Lab.
English Electric Co., Madras.	Testing of relays	Machines Lab.
English Electric Co. of India Ltd., Madras.	High Voltage Test for Combination fuse switches	High Voltage Laboratories
Southern Switchgear Ltd. Madras.	Testing of relays	Elec. Machines Labs.
Electric Transformers & Equipments Co. Hyderabad	Impulse testing of 11 kV. transformer	High Voltage Laboratories
Cycle Electric Devices & Services Co. Madras	Electric tests on rubber mats, Puncture test on phenon-formaldehyde disc insulator. Puncture tests on PVC test Prod.	-do-
Mysore Insecticides Private Ltd., Madras.	Power frequency test on transformer and switch gear oil	-do-
Heavy Electricals Ltd., Bhopal	Consultancy on thyristor-control circuitry	Control Engg. Labs.

PUBLICATIONS

I. Papers Published

1. 'On network theorems', P. Sankaran, K. Shankara Rao, V. V. B. Rao, V. G. K. Murti, IEEE Transactions on Education, New York. Vol. E-11. No. 2. 154-155. June, 1968.
2. 'Pseudo-series combination of n-point networks'. K. Thulasiraman, V. G. K. Murti. Proceedings of IEEE., New York. Vol. 56. No. 6. pp. 1143-44. June, 1968.
3. 'Enumeration of all cut sets of a graph'. V. V. B. Rao, K. Sankara Rao, P. Sankaran and V. G. K. Murti. Proc. IEEE., New York, Vol. 56. No. 7. pp. 1247-48. July, 1968.
4. 'Synthesis of a class of resistive 3-port network'. C. Eswaran and K. Thulasiraman. International Journal of Electronics, London. Vol. 24, No. 6. pp. 597- , June, 1968.
5. 'The modified out-set matrix of an n-port network'. K. Thulasiraman and V. G. K. Murti. Proc. IEEE, London. Vol. 115. No. 9. pp. 1263-68. September, 1968.
6. 'Synthesis Application of the Modified cut-set Matrix'. K. Thulasiraman and V. G. K. Murti. Proc. IEEE., London, Vol. 115 No. 9. pp. 1269-74. September, 1968.
7. 'Modified Circuit matrix of an n-port network and its applications'. K. Thulasiraman and V. G. K. Murti. IEEE., Transactions on Circuit Theory. Vol. 16. No. 1 February, 1969.
8. 'Comments on the construction of a pair of M-submatrices of a cut-set matrix'. V. V. B. Rao and V. G. K. Murti. IEEE., Transactions on Circuit Theory. Vol. 16. No. 9. February, 1969.
9. 'Stromwandler mit Fehlerkompensation für Einschwingvorgänge'. H. Bocker and P. Sankaran, Elektrotechnische Zeitschrift-A. Bd. 90 (1969) W. Germany. Vol. 5. pp. 112-114. 1969.
10. 'Improved self-tuning filter for low frequencies'. P. C. Majhee and K. P. Rajappan. Electronics Letters. IEEE., London. March, 1969 -do-reprinted IEE/IERE Proceedings India. January and March 1969.
11. 'Sporadic E classification from Rocket measurements'. M. Mukunda Rao, Journal of Atmos. Terry. Physics (London). 1968.

12. 'On the physical significance of the Esparameters $f_0 E_s$, $f E$ and $f_0 E_s$ '. M. Mukunda Rao. Journal of Geophysical Research. USA. Vol. 73. pp. 215. 1968.
13. 'On the suitability of the compatible SSB Modulation for broadcasting'. P. Besslich. Journal of the Institution of Telecommunication Engineers, New Delhi. June, 1969.
14. 'Two speed single—winding single—phase induction motor using non-integral cycle modulation techniques'. V. V. Sastry and co-author. IEEE., Transactions on Power Appts. & Systems. 1969.
15. 'Transformation to the Phase-variable canonical form'. B. Ramswamy and K. Ramar. IEEE., Transactions on Automatic Control. December, 1968.
16. 'On the Maxima of Transiant Response and Frequency Response of Third order sampled-data control systems'. M. V. C. Rao. International Journal of Control. November, 1968. pp. 483-90.
17. 'Further correlations between time-domain and frequency-domain parameters for linear control systems'. V. Seshadri and C. Easwaran. Journal of the Institution of Telecom. Engineers. New Delhi. Vol. 14. No. 8. pp. 345-51.
18. 'A frequency-domain approach to controlled interaction in linear multi-variable systems'. V. Seshadri and K. Surendran. Journal of the Institution of Telecom. Engineers, New Delhi. Vol. 15, No. 1. pp. 70-75.
19. 'Response optimization of feedback-control systems with reference to single-time-constant ideal'. T. Rajagopalan and V. Seshadri. International Journal of Control, London.
20. 'Application of phase-equivalent reduction in multiple-parameter identification using sinusoidal test signals'. D. V. R. Rao and V. Seshadri, International Journal of Control, London.
21. 'Bifrequency phase-equivalent reduction and applications'. C. Eswaran and V. Seshadri. Journal of the Institutions of Engineers (India). E.T. Section.
22. 'Application of phase-equivalent reduction for two parameter identification by sinusoidal test signals'. D. V. R. Rao and V. Seshadri. Journal of the Institution of Engineers (India). E.T. Section.

23. 'Application of Bifrequency phase-equivalent reduction to system synthesis'. C. Eswaran and V. Seshadri. *International Journal of Control*. London.
24. 'Stochastic optimization of feedback-control systems for mean square—error minimization with single-time constant ideals'. T. Rajagopalan and V. Seshadri. *International Journal of Control*. London.
25. 'State dependent current source stretches linear pulse widths'. M. Venugopal, K. S. Mehta and A. Chandrasekharan. *Electronics Letters*, IEE., London, Vol. 4. No. 24.
26. 'New Static Comparators'. K. S. Mehta. A. Chandrasekharan and M. Venugopal. *International Journal of Electronics*. London. Vol. 23. No. 6. 1967.
27. 'Discussion on "A static Relay with Dual Comparator Principle''. M. Venugopal, K. S. Mehta and A. Chandrasekharan. *Journal of the Institution of Engineers (India)*. EE. Vol. 48. No. 12. August, 1968.
28. 'A transistorized fast-response phase-angle meter for power system study and operation'. A. Kuppurajulu and K. S. Mehta. *International Journal of Electronics*, London. June, 1968.
29. 'Load flow study on d.c. network analyser'. A. Kuppurajulu, *Journal of the Institution of Engineers (India)*. Vol. 49. No. 2. pt. ELL. October, 1968.
30. 'Transient response of power systems'. A. Kuppurajulu, *Proc. IEE.*, London. January, 1969.
31. 'Radio interference from high voltage insulators and methods of measurement'. B. V. Dutt and co-author. *Journal of Power and River Valley Development*. February, 1969.
32. 'Hot-electron Relaxation Times in Insb'. C. Dattatreyan and H. Has-tuagel, *Physica Status Solidi*. March, 1969.

II. Papers accepted for Publication

1. 'Enumeration of all circuits of a graph'. V. V. B. Rao and V. G. K. Murti. *Proceedings of IEEE*. New York.
2. 'R. C. Active Network Synthesis using an amplifier'. S. Natarajan and V. G. K. Murti. *International Journal of Control*. London.

3. 'On Okada's method for realizing cut-set matrices'. K. P. Rajappan and A. H. Stone. Journal of Combination theory. U.S.A.
4. 'Enumeration of all cut-sets of a graph a computer programme. P. Sankaran, K. Sankara Rao, V. V. B. Rao and V. G. K. Murti. Electronics Letters. IEE., London.
5. 'An improved probability density analyser'. S. Ramakrishnan, P. C. Majhee and K. P. Rajappan. International Journal of Electronics, London.
6. 'An adaptive filter'. P. C. Majhee and K. P. Rajappan, Journal of the Institution of Telecommunication Engineers, New Delhi.
7. 'A self-tuning filter for the detection of a class of signals in background noise'. P. C. Majhee and K. P. Rajappan, Proc. of IEEE., Conference on Communication Systems, Boulder, Colorado, U.S.A., June, 1969.
8. 'Rocket observations of electron densities in the night time auroral E region at Ft. Churchill Canada'. M. Mukunda Rao, Planetary and Space Science, London.
9. 'Latitude variation of the lower ionosphere'. M. Mukunda Rao, Radio Science, U.S.A.
10. 'On the use of Walsh functions in Electrical Engineering'. P. Besslich, Journal of the Institution of Telecommunication Engineers, New Delhi.
11. 'Number representation, addition and subtraction methods for small digital computers' (in German). P. Besslich, 'Der Elektroniker' (Switzerland) Europe.
12. 'Generalized theory for the starting performance of single-phase induction motor with asymmetrical windings'. V. V. Sastry and co-author IEEE., Transactions on Power apparatus and Systems. New York.
13. 'Discussion on "Generalized theory of induction motors with asymmetrical windings and its application to the analysis and performance prediction of shaded pole motors'. G. Sridhara Rao, V. V. Sastry and P. V. Rao, Proc. IEE., London.
14. 'Dual-input discrete describing function'. P. V. Rao and P. A. Janakiraman, IEEE., Transactions on Automatic Control, New York.

15. 'Analysis of non-linear sampled-data system with transportation lag'. M. V. C. Rao and P. V. Rao, International Journal of Control, London.
16. 'Self-suppression of limit cycles in non-linear sampled data systems with transportation lag'. M. V. C. Rao and P. V. Rao, International Journal of Control, London.
17. 'Signal stabilization of non-linear sampled data control systems'. P. V. Rao, G. T. Manohar and R. Manickavasagan, IEEE., Transactions on Automatic Control, New York.
18. 'On the transformation of time-variable systems to the phase-variable canonical form'. B. Ramaswamy and K. Ramar. IEEE., Transactions on Automatic Control, New York.
19. 'Empirical parameter correlations for the synthesis of linear feedback control systems'. V. Seshadri, V. R. Rao, C. Eswaran and S. J. Eappen, Proc. of IEEE., New York.
20. 'High Speed phase and frequency measurement'. M. Venugopal and K. S. Mehta, Instruments and Control Systems, U.S.A.
21. 'Pulse circuits for phase-sequence detection and protection against single phasing'. M. Venugopal and K. S. Mehta, Electronic Engineering, London.
22. 'Variable-width low-repetition-rate pulse using Schmidt Trigger Idea for design'. M. Venugopal and K. S. Mehta, Electronic Design, New York, U.S.A.
23. 'Geometrical considerations in realization of cut-set matrices into graphs'. K. P. Rajappan, International Journal of Electronics, London.

III. Papers Presented

1. 'The Modified Circuit matrix of an n-port network and its applications'. K. Thulasiram and V. G. K. Murti, 1968 IEEE., International Symposium on Circuit Theory, Miami Beach, Florida, December 1968.
2. 'An adaptive filter'. P. C. Majhee and K. P. Rajappan, ITE Twelfth Technical Convention, New Delhi, December, 1968.

3. 'A self-tuning filter for the detection of a class of signals in background noise'. P. C. Majhee and K. P. Rajappan, IEEE International Conference on Communications, Boulder, Colorado, U.S.A., June, 1969.
4. 'On the suitability of compatible SSB Modulation for Broadcasting'. P. Besslich, ITE Twelfth Technical Convention, New Delhi, December 1968.
5. 'Implications of Q.L. and Q.T. approximations for Rocket Radio Propagation experiment at the magnetic equator'. M. Mukunda Rao, Third International Symposium on Equatorial Astronomy, Ahmedabad, February, 1969.
6. 'Studies on the Noon bite-out phenomenon of the F_2 region at the equatorial latitudes'. M. Mukunda Rao, Third International Symposium on Equatorial Astronomy, Ahmedabad, February, 1969.
7. 'A transistorized relay for phase-unbalance protection of polyphase motors'. M. Venugopal, K. S. Mehta and A. Chandrasekharan, IEEE., Winter Power Meeting, New York, January, 1969 (paper No. 69 c. p. 59).
8. 'Radio interference from high-voltage insulators and methods of measurement'. B. V. Dutt and co-author, High Voltage Symposium, Calcutta, September, 1969.

IV. Papers sent for Publication

1. 'Precision frequency measurement in the presence of noise'. P. C. Majhee and K. P. Rajappan, IEEE., Transactions on Instrumentation and Measurements.
2. 'Temperature stabilization of a negative resistance characteristic'. M. A. Reddy and Y. G. Rao, IEEE., Journal of Solid State Circuits.
3. 'Transistor d.c. voltage regulator'. M. A. Reddy. International Journal of Electrical Engineering Education.
4. 'A transistorized pulse circuit for thyristor firing'. S. Kaliyugavaradan, Electronic Engineering, London.
5. 'A high Q minimum R-C network'. S. Kaliyugavaradan, Electronic Engg., London.
6. 'Transformation to canonical forms'. K. Ramar and B. Ramaswamy, IEEE., Transactions on Automatic Control, New York.

7. 'Empirical correlations between time domain and closed loop frequency domain parameters in linear feedback control systems'. S. J. Eappen and V. Seshadri, Journal of the Institution of Telecommunication Engineers, New Delhi.
8. 'Synthesis of third order type-1 system for time-domain or closed-loop real frequency-domain specifications'. S. J. Eappen and V. Seshadri, Journal of the Institution of Telecommunication Engineers, New Delhi.
9. 'Graphical procedure for the synthesis of feedback control systems using normalized complex gain chart'. S. J. Eappen and V. Seshadri, Journal of the Institution of Telecommunication Engineers, New Delhi.
10. 'Second-order state-space formulation of systems'. P. S. Krishnaswamy and V. Seshadri, Proc. of IEEE., New York.
11. 'High Speed phase and frequency measuring device'. M. Venugopal and K. S. Mehta, International Journal of Electronics, London.

HUMANITIES & SOCIAL SCIENCES DEPARTMENT

STAFF

Professors

- R. K. Gupta, M.Com., M.B.A. (California) (Management)— (Head)
N. Klein, Dr. Phil. (Tuebingen) (German)
N. K. Datta, M.S. (Illinois) (Indl. Engg.)
A. L. Krishnan, M.A. (Madras) (English)

Assistant Professors

- V. Anantaraman, Ph.D. (Wisconsin) (Economics)
M. S. Vairanapillai, Ph.D. (Illinois) (History)
S. Ramani, M.Sc.(Engg.) (Madras), P.G.Dip. in Business Management,
I.I.M., Calcutta (Management)

Lecturers

- V. S. N. Sarma, M.A. (Poona) (German)
A. V. Krishna Rao, Ph.D. (Andhra) (English)
B. Vasudeva, M.E. (IISc. Bangalore), D.M.S. (Business Management)
(Madras)
T. N. Govindarajan. M.A. (Madras), Dip. in Anthropology (Madras)
Y. Nagendra, B.Sc. (Hons.) (Mysore), M.Sc. (Mysore)
Ph.D. (IIT, Kharaghpur)

Associate Lecturers

- S. G. Asthana, M.A. (Baroda)
V. S. Kumar, M.A. (Andhra)
S. B. Dias, M.A. (Madras)
V. Hamsaleelavathy, M.A. (Vikram)
Padma Jayaraman, M.A. (Delhi), M.A. (Toronto)
A. Abraham Kurian, M.A. (Madras)

RESEARCH WORK**English**

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|-----------------------------------|--|---------------------|
| (1) Contemporary American Fiction | | (A. V. Krishna Rao) |
| (2) Indo-Anglian Literature | | |

- (1) Considerable work has been done in the area of American fiction thanks to a research study grant by American Studies Research Centre, Hyderabad. Work on J. D. Salinger is in progress.
- (2) With a view to publishing in a book form later, number of brief critical reviews of some recent Indo-Anglian Novels have been published in 'The Mail', Madras. A scheme to elaborate and organise this material is being worked out.

Economics**Migration Selectivity and Differentials of Metropolitan Cities in India (V. Hamsaleelavathy)**

Research on 'Migration Differentials in Metropolitan Cities in India' has revealed many interesting findings. Migration is found to be differential of age, sex, marital status and occupation. Young persons are found to be more selective among migrants to all metropolitan cities than old and middle aged people. The youngest are found among migrants to Bombay. Migrant groups of all the four cities are predominantly masculine. Migrants show a tendency to contract marriage or dissolve a marriage in large proportion than non-migrants. Mean age at marriage is lower among migrants than non-migrants of origin. Migrants were found to concentrate on 'services' occupation. Further mathematical enquiry will throw light on actual selectivity and relationship to know how far migration is effective.

Economic History**Economic Policy of the East India Company in Madras Presidency from 1784-1857 (C. Ramachandran)**

After the introductory work done during the year 1967-68 in connection with the Research Project mentioned above much progress was made in various directions during the year under review.

In order to examine the Economic Policy of the Company in a most critical and exhaustive analytical manner it was decided to follow the follow-

ing methodology :

1. Study of the Philosophy of English Political Economy of the early 19th century and the theory of **laissez faire** and its impact on company's economic policy in India especially Madras.

2. Study of the authoritative and useful secondary works including contemporary writings.

3. Examination of the original source material available at the Madras State Archives relating to the subject.

It has been tentatively decided to complete the work at Madras State Archives by December 1969.

Operations Research

Studies in Operations Research (S. Ramani and Dr. S. K. Srinivasan):

The applicability of Stochastic point processes to solve problems in inventory control is being explored. A model was developed to simulate the (S,r) policy. The results are being compared with the theoretical results obtained by using renewal theory and also the product density concepts evolved by Dr. Alladi Ramakrishnan and Dr. S. K. Srinivasan.

Statistics

Working on Sampling Plan for Variables following Edgeworkian distribution (Y. Nagendra)

Management and Psychology

1. Application₁ and Workability of Maslow's Theory of Motivation in Indian Industry (R. K. Gupta, T. N. Govindarajan and S. G. Asthana):

A. H. Maslow, in his book 'Personality and Motivation' has propounded a theory of motivation based on the hierarchy of needs. As the industries gradually recognised the importance of human factor in industry, this theory is often employed to study human behaviour in the area of motivation. It was felt that a cross-cultural study of this theory is needed to understand its reliability. The culture and values of a society, influence and govern an individual's motivation. What may be true and motivating in an American Society may not hold true in our own conditions.

In connection with the verification of the workability of Maslow's theory of motivation, Mr. S. G. Asthana gave a series of lectures. Incidentally it has given the co-authors a bibliography about the studies on motivation. Presently these studies are being carefully perused in connection with the preparation of questionnaire.

2. Engaged in a Study of Accounting Concepts and Procedures and the Price Level Changes (R. K. Gupta):
3. Validation of a mathematical formula to predict Leadership (T. N. Govindarajan):

A mathematical formula has been developed to predict leadership in small task-oriented groups. Selection of a small group from the 1st year student population is being continued in connection with the validation of a mathematical formula to predict leadership in small task oriented groups.

Industrial Engineering

1. Technical and Economic Aspects of Process-Setting in Machine Tools (N. K. Datta):
2. The Statistical Analysis of machine capability and the effect of tool setting on the economy of production are being investigated. An analysis on the effect of the differential cutting between rough and finished tools is being carried out (N. K. Datta):
3. Some aspects of Production Sequencing (N. K. Datta):

Analysis of behaviour pattern of orders and production system for evolving economic sequencing rules.

4. In the area of Production Planning and Scheduling (B. Vasudeva):

The scheduling in a job shop is a complex problem. A large amount of shop interaction exists due to the variety of orders, variable processing times and rush orders. Further the problem is dynamic. What decision rules are to be applied in every day operation so as to meet the delivery dates and what scheduling decisions will ensure the optimum long term operation is the area of current research.

German Grammar

(V. S. N. Sarma)

1. Grammatical Notes and German—English Glossary to Schulz—Grieshach 'Entsche Sprachlehre fur Auslander' Part I.
2. do Part II
3. German Grammar work on following topics completed: (i) German Phonetics, (ii) German Verb, (iii) German Noun, (iv) German Orthography.
4. German Scientific Reader on the subject 'Der Mensch and Sein K orper' (Man and his body).
5. Work on German Grammar is continuing. Work on 'German Conversation Book' and Scientific and Technical Readers.

PUBLICATIONS**I. Papers Published**

1. 'The Changing Role of Accountant in Industry' — R. K. Gupta, 'Spotlight', IIT Madras, 1969.
2. 'Category Sequencing Rule for Job Shop' (jointly with O.P. Sabu) — N. K. Datta, Journal of the Institution of Engineer (India), Vol. 49, No. 3, Part ME 2, Nov. 1968.
3. 'Training of Graduate Engineer — Trainee' — Aspirations and Training Programmes — N. K. Datta, 'Spotlight'. IIT, Madras, May 1969.
4. 'Random Thought on Operations Research' — S. Ramani, 'Spotlight', IIT, Madras, May 1969.
5. 'The Novels of Saul Bellow with special reference to Herzog' — A. V. Krishna Rao, American Studies Research Centre, Hyderabad, December, 1968.
6. 'The Management Man in Fiction' — A. V. Krishna Rao, 'Spotlight', IIT, Madras, May, 1969.
7. 'Leadership and Group Dynamics' — T. N. Govindarajan, 'Spotlight', IIT, Madras, May, 1969.

8. 'Accidents in Industry — a psychological approach to their causes and remedies' — S. G. Asthana, 'Spotlight', IIT, Madras, May, 1969.

II. Books under preparation

'Computer Programming with Industrial Engineering and Business Applications' — S. Ramani, et al.

III. Papers sent for Publication

1. 'Business Leadership and Creativity' — S. Ramani.
2. 'Digital Analogue Simulation' — S. Ramani (Co-author).

IV. Papers presented at Conferences/Seminars

1. 'Training in Behavioral Sciences' — R. K. Gupta, All India Seminar of the Indian Institute of Training Administrators, Bangalore, April, 1969.
2. 'Accounting Concepts and Price Level Changes' — R. K. Gupta, The Southern Regional Centre of the Institute of Chartered Accountants (India), Madras.
3. 'Financial Analysis, Planning and Control'—A five-day course for the Executives from Industry (Madras Productivity Council)—R. K. Gupta.
4. 'Development of Training Manager' — N. K. Datta, All India Seminar in the Indian Institute of Training, Bangalore, April, 1969.
5. 'Role of workstudy in Developing Wage Incentive' — Seminar on Plantwise Wage Incentive (N.I.T.T.E.)—N. K. Datta.
6. 'The Use of Operations Research in the Aviation Field' — S. Ramani, 21st Annual General Meeting of the Aeronautical Society of India, April 1969.
7. 'The Serpant and the Rope' — A point of view A. V. Krishna Rao, Proceedings of the All India English Teachers' Conference, Bangalore, December, 1968.

Management Games

'Computerised Management Game for Executives in Industry' — S. Ramani (Conducted at the ICF Data Processing Centre as a member of the management game panel, Madras Management Association.)

INDUSTRY-ORIENTED PROJECTS

The students of Post-graduate Diploma in Industrial Engineering are carrying on their project work in industry. The project reports are expected to be completed by the end of August, 1969.

1. Process scrap auditing in multi-products with common components manufactured in large batches. Critical components are being identified — pattern of defect analysed and control chart developed for process controlling. — (Adidas Jacob, Dr. Y. Nagendra, Prof. N. K. Datta).
2. An analysis of component shortage in multi-component products. The effect of variation of production rate—the setting time and the mean rate of production are being analysed and a model is being developed to predict the nature of shortages of components— (D. N. Rao, Prof. N. K. Datta).
3. Quality control in machining and assembly operation for determining the permissible variation at each stage of manufacture. The process capabilities at different stages are being established and the effect of these on the accuracy of the final product are being analysed and control limits at each stages of manufacture are being evolved. The effect, of differences in setting of successive tools in finishing operation, was analysed. — (G. Nadimuthu, Dr. Y. Nagendra, Prof. N. K. Datta).
4. Productivity analysis of melting and moulding equipment in foundry. The variation in the demand of each quality of product is being analysed to evolve an optimum loading and scheduling policy. (S. V. Gadad, Prof. N. K. Datta).
5. Production sequencing problems in Steel Mill — (A. S. Grewal and Prof. N. K. Datta).
6. Materials and manufacturing planning for job shop — (Anupam Jana and Prof. N. K. Datta).

7. Inventory control in a multi-product organisation manufacturing in anticipation of sales — (A. N. Narayanaswamy and Prof. N. K. Datta):
8. Production sequencing and in process inventory control in a Textile Mill — (Sudesh Kumar and Prof. N. K. Datta):
9. Optimum replacement batch size studies of looms in the modernisation of a textile mill — (R. S. Bhargava and S. Ramani):

The old looms in the textile mill are being replaced by new and efficient ones. The replacement has to be done in phases taking into consideration the rate of arrival of new looms, the loss of production during the period of installation and the limitations of time and cost as imposed by the Civil Engineering contractor. The optimum batch size is being worked out and a PERT chart for planning, cost and manpower levelling will be attempted.

10. Data processing for maintenance and materials management in a production organisation — (A. Rakshit and S. Ramani):

Flow diagrams are being compiled for the various sections in the maintenance and materials management organization with a view to suggest an integrated data processing system. The 'Paper-work survey' and 'current procedure flow chart' phase of the above study are nearing completion.

11. Multiple regression analysis steam consumption — (R. Srivathsan and S. Ramani):

The pattern of steam consumption in the various sections of a factory are being studied with a view to set up a multiple regression model. This model will serve as a basis for free-casting and future planning regarding steam consumption in the factory.

12. Linear programming and simulation studies in a manufacturing organisation — (K. Ramakrishnan and S. Ramani):

The technique of linear programming is being applied to decide the optimum product mix in a railway coach manufacturing organisation with a view to maximise production. Also, simulation studies using different priority rules are being made to prove the redundancy of one of the two heat-treatment furnaces in the organisation.

13. Studies in Inventory Control — (A. V. R. Joshi and S. Ramani):

Inventory control models are being applied to set reorder levels for certain A class items of inventory.

14. Break-down analysis of machine in the press shop in a metal container manufacturing plant and development of preventive maintenance policies maintenance manpower planning and machinery space. Parts control — (Kumtha Arun Maruthi Rao, B. Vasudeva):

15. Balancing of two new product lines and productivity survey in other departments in a battery manufacturing plant — (H. S. Mohan Rao, B. Vasudeva):

16. Study of the existing lay out and materials handling practices in the machine shop in an electric motors manufacturing plant and the development of a re-lay-out and optimum number of materials handling facilities — (M. R. Madhava Rao, B. Vasudeva):

17. Small parts management in a battery manufacturing organisation — (T. Premkumar and R. K. Gupta):

Investigations are being made to fix re-order level for small parts in the manufacturing section, taking into account the production lead-time and storage space restrictions.

18. Economic analysis in materials handling in a section of a textile mill — (A. H. Poonawala and R. K. Gupta):

Use of trailers for transport of materials is economical under certain conditions. The optimum combination of fork lift trucks and trailers is being investigated with a view to minimise materials handling cost.

MATHEMATICS DEPARTMENT

STAFF

Professors

S. D. Nigam, Ph.D. (Agra)— (Head)

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P. Achuthan, Ph.D. (IIT, Madras)

N. V. Koteswara Rao, Ph.D. (IIT, Madras)

S. Kumaraswamy, M.Sc. (IIT, Madras)

Post-Doctoral Fellow

D. Ramakrishna Rao, Ph.D. (Karnatak)

I. General

RESEARCH WORK

Dr. S. K. Srinivasan, in collaboration with Prof. R. Vasudevan (Mathematics, Madras), is writing a monograph on "Random Differential Equations and their Applications". The monograph will include the recent results obtained by research workers at the Institute and Matscience, Madras. The book will be published under the series "Analytic and Computational Methods in Science and Mathematics" by the American Elsevier Company in 1970.

Four more issues of the Journal of Mathematical and Physical Sciences were brought out during the year. The journal has already attracted the attention of leading workers through its survey and original papers.

II. Stochastic Processes and their Applications

1. Cluster Processes (S. K. Srinivasan and S. Kumaraswamy):

Events occur at instant t_i and each primary event gives rise to a series of secondary events. The complete process is the superposition of the events in the primary and secondary processes. The characteristic function for the Cluster process has been obtained for the age-dependent process. This is expected to be significant since not much headway has been made so far except in the case of the Poisson process.

2. Renewal Point Processes and Neuronal Spike Trains (S. K. Srinivasan and G. Rajamannar):

The interaction between a recurrent process called excitory and another point process (called inhibitory generated by the former) is studied in the light of some of the recent models proposed by the neuronal spike trains. Explicit results for the interval distribution and the moments of the number of effective excitory events have been obtained.

3. Queuing Theory (S. K. Srinivasan and R. Subramanian):

The technique of point processes have been applied to queues and storage theory. By imbedding the queuing process in a suitable renewal process, a number of useful results relating to busy period, number of customers served and the number of cycles have been obtained. The results are being extended to storage theory.

4. Stochastic Processes In Continuum Mechanics (S. K. Srinivasan, R. Subramanian and S. Kumaraswamy) :

Some of the stochastic problems that arise in the disciplines of Fluid Dynamics and Elasticity have been studied in detail. Particularly stochastic flows in pipes and channels arising from the random nature of the boundary conditions and the pressure gradient have been dealt with in considerable detail. Mean square criteria for the arrest and reversal of flows have also been obtained. Other problems like the impact of Projectiles on elastic plates and elastic rods subject to random excitation have been studied. A model for viscous elastic substances has also been proposed in the light of the stochastic point processes.

5. Operations Research (R. Subramanian and K. S. Ramesh) :

The product density technique of point processes has been applied to find the reliability of an equipment and also to find the effect of pulse-campaign advertisement.

III. Continuum Mechanics

Solid Mechanics

Vibration Problems In Elasticity (H. S. Paul and N. Muthiyalu) : Vibrations of elastic half-space and infinite plate which occur in Structural Engineering are investigated for different boundary conditions.

Thermoelasticity (H. S. Paul and N. Muthiyalu) : Dual integral equation technique is utilized to solve some mixed boundary value problems in thermoelasticity.

Piezoelectricity (H. S. Paul and B. Srinivasa Rao) : Wave propagations in piezoelectric plates and cylinders are studied.

Pyroelectricity (H. S. Paul and B. Srinivasa Rao) : The steady state problems for semi-infinite solid and cylinder of pyroelectric crystals are discussed.

IV. Graph Theory

(K. R. Parthasarathy and M. R. Sridharan) Formulae for the number of self-converse and self-complementary oriented graphs were obtained. The enumeration of self dual digraphs was attempted with partial success. When completed this will settle an outstanding unsolved problem in graph enumeration theory. The relation between group representation theory, symmetric function theory and graph enumeration theory is being further explored with a view to break new ground in graph enumeration theory.

PUBLICATIONS

Papers Published

1. Multiple product densities - S. K. Srinivasan with A. Ramakrishnan and R. Vasudevan
J. Mathl. Phys. Sci., 1 (1967), 275.
2. Non-Markovian processes in dams and storage systems-
S. K. Srinivasan and N. V. Koteswara Rao
J. Mathl. Phys. Sci., 1 (1967), 180.
3. Generalised Boltzmann equation and kinetic theory of fluids.
S. K. Srinivasan,
Proc. Symp. Math and Theo. Phys., N. Y. 7 (1968), 206.
4. Photoproduction of eta mesons on nucleons - S. K. Srinivasan
P. Achuthan and R. N. Sarkar
Nuovo Cimento, 59 (1969), 171-180.
5. Sequent correlations in stochastic point processes-III, S. K. Srinivasan
and N. V. Koteswara Rao with R. Vasudevan
Nuovo Cimento, 60 B (1969), 189.
6. On the photoproduction of η meson - P. Achuthan and R. N. Sarkar
Nuovo Cimento 59(1969), 124.
7. Renewal point processes and neuronal spike trains - S. K. Srinivasan
and G. Rajamannar.
J. Math. Biosciences, 3 (1969)

8. Motion of a sphere in a viscous rotating fluid L. V. K. V. Sarma
Archiwum Mechaniki Stosowanej 1, 21, (1969) (Archives of Applied Mechanics)
9. Motion of a circular cylinder in stratified fluid. - L.V.K.V, Sarma
Zastosowania Matematyki Applications Mathematicae, IX, 4, 1968.
10. Invariant elastic constant for crystals T. P. Srinivasan and S. D. Nigam.
Physica Status Solidi, 28, K 71 (1968).
11. Vibrational waves in a thick infinite plate of piezoelectric crystal-H S. Paul.
Jl. of the Acoustical Soc. of America; 44, 478-482 (1968).
12. Rotatory vibration of a rigid circular die on a semi infinite elastic solid-H. S. Paul.
Journal of the Accoust. Soc. of America,
44, 1232-1236 (1968).
13. Vibration in an infinite isotropic elastic plate due to a vertical harmonic load-H. S. Paul and N. Muthiyalu
Jl. of the Acoustical Society of America,
45, 6 (June, 1969).
14. Axisymmetric deformation of a circular cylinder of piezoelectric cadmium selenide crystal-B. Srinivasa Rao and H. S. Paul.
Applied Scientific Research, 20, 251-267 (1968).
15. Propagation of torsional disturbance in an infinite solid of piezoelectric β -quartz-H. S. Paul and B. Srinivasa Rao.
Proc. of the Cambridge Phil. Society, 66, 205-214 (1969)
16. Torsional waves in a circular cylinder of piezoelectric (622) crystal class-H. S. Paul and B. Srinivasa Rao.
International Journal of Engineering Science
7, 737-746 (1969)

17. Stress concentration around a small anisotropic spheroidal inclusion on the axis of a circular cylinder under torsion-R. Subramanian.
Arch. Mech. Stos , 20, 1 (1968), pp 29-35.
18. Rotatory vibration of a composite orthotropic circular cylinder-R. Subramanian
Acta Technica CSAV, 13, 2 (1968), 178-183.
19. Vibrations of a composite orthotropic cylinder-R. Subramanian,
Jl. Sci. and Engg. Res., 12, Pt. 1 (1958), 133-145.
20. A note on the response to shot-noise-R. Subramanian and G. Rajamannar
Proc. I.E.E.E. 56, 7 (1968) 1255-1256.
21. Surface waves in rotating liquids-V Subba Rao
Proc. Cambridge Philosophical Society, 65 1 (1969), 309-318.
22. The effect of temperature on Stoke's drag-A. Avudainayagam and S. N. Venkatarangan
Bulletin de l'Academic Royale de Belgique,
5, Serie, Tome LIV (1968), 1332-1340.
23. Extensions of Opial's Inequality-K. M. Das (with P. R. Beesack)
Pacific Journal of Mathematics, 26, 2 (1968) 215-232.

MECHANICAL ENGINEERING DEPARTMENT

STAFF

Professors

- R. G. Narayanamurthi, D.I.C. (London)— (Head)
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G. Stahl, Dr. Ing. (Braunschweig) (Till 30-4-69)
L. Narjes, Dr. Ing. (Braunschweig)
G. Bechtloff, Dr. Ing. (Braunschweig) (Till 25-1-69)
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T. Rajagopalan, M.Tech. (IIT, Madras)
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V. Sriramulu, M.Sc. (IISc, Bangalore)

- P. Ramachandran, M.S. (Oklahoma State)
- P. K. Philip, M.Tech. (IIT, Kharagpur)
- V. Seshagiri Rao, M.E. (IISc, Bangalore)
- V. N. Rajan, P. G. Dip. (Saskatchewan, Canada)
- K. N. Gopalan, M.Sc. (Madras)
- M. Adithan, M.Sc. (Engg.) (Madras)
- G. Gopalakrishnan, M.E. (Calcutta)
- K. N. Seetharamu, M.E. (IISc, Bangalore)
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- R. Kirmse, Dipl Ing. (Braunschweig)
- H. Conen, Dipl. Ing. (Braunschweig) (Till 19-4-69)
- G. V. D. Kammer, Dipl. Ing. (Braunschweig)
- D. Robertz, Dipl. Ing. (Aachen)

Associate Lecturers

- D. V. Ramalingeswara Rao, M.Tech. (IIT, Madras)
- S. Sukumar, B.E. (Madras)
- M. N. Viswanathan, M.Tech. (IIT, Madras)
- M. Kuppuraj, B.E. (S. V. University)
- N. Venkiteswaran, B.E. (Kerala)
- M. S. Francis, M. Tech. (IIT, Madras)
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- M. Madhusudana Rao, M.Tech. (IIT, Kharagpur)

Workshop Superintendent

- S. S. Mani, B.E. (Mysore)

German Technical Staff**H. J. Ebert****W. Goetz****Post-Doctoral Fellow****M. Nagarajan Ph.D. (IIT, Kanpur)****RESEARCH WORK**

A brief outline of the current research and development activities is given below :

I. MACHINE ELEMENTS AND MECHANICAL HANDLING

1. Interaction of Creep and Fatigue in Metals (V. M. Radhakrishnan, Srinivasa Raghavan, R. G. Narayanamurthi):

An apparatus to incorporate both the alternating and mean stresses has been designed and fabricated for this purpose. The experimental programme is nearing completion.

2. Study of the Properties of Metal Sprayed Surfaces (P. Szlagowski):

A setup for running together metal sprayed cylinders under measured load has been constructed and tests are being run to study the influence of the various factors involved.

3. Synthesis of Two-degree-of-freedom Linkages (K. Lakshminarayana, R. G. Narayanamurthi):

Development of techniques for third and fourth order synthesis as well as five precision point synthesis of plane linkages has been completed. Computational experiments have been conducted to establish the utility of the procedures. The effect of manufacturing errors on the performance has also been investigated. Synthesis procedures for spherical single and two-degree-of-freedom linkages are currently under development.

4. **Study of Friction and Lubrication in Gears (G. V. N. Rayudu):**
A test stand for studying the frictional losses in gears has been designed and constructed. Tests are planned to be conducted to investigate the effect of variation of pertinent parameters like the correction factor.

5. **Optimum design of wheels (A. Ramamohana Rao):**

A test stand for studying the rigidity and strength of wheels under axial loading has been designed and constructed, with the ultimate aim of optimizing the design of gear wheels, crane wheels etc. Three dimensional photo-elastic investigations are currently under way towards the same goal.

6. **Study of Dynamic Loads and Load Spectra in Cranes (M. A. Parameswaran, R. G. Narayanamurthi):**

Dynamic behaviour determines the actual loads and deformations in cranes. The load spectrum, on the other hand, has a great influence on the allowable stresses. Work has been undertaken with a view to arrive at optimum design data taking into account these two aspects.

7. **Strains and Contact Conditions in a Wire Rope Bent over a Pully (K. V. Thyagarajan):**

Theoretical analysis of the strains in the wires has been carried out. Experimental setup for determination of strains and contact patterns is nearing completion.

8. **Design and Construction of a Brake Test Stand (S. Sukumar):**

A test stand for external double shoe brakes has been designed and is nearing completion. This will be initially used for studying the characteristics of various brake linings.

9. **Characteristics of Foam Springs (N. Venkiteswaran):**

Springs made from commercially available foam rubber have been tested, with a view to determine their suitability as a shock absorbing medium.

10. **Design and Construction of a New Type of Epicyclic Drive for Hoisting (P. V. Viswanath, G. Bechtloff):**

A compact epicyclic gear reducer for a hoist drum has been developed. A model on a reduced scale has been designed and its fabrication is nearing completion.

11. **Investigations on Vibratory Conveyors (R. Sreedharan, M. A. Parameswaran):**

A vibratory conveyor with unbalanced mass drive is being designed for construction. It is proposed to study the mechanics of material movement on the conveyor with a view to be able to predict the performance.

II. MACHINE TOOLS AND PRODUCTION ENGINEERING

1. **Evaluation of Criteria for Finely Finished Surfaces (V. Radhakrishnan, V. C. Venkatesh):**

The need for proper expression of surface finish of very finely finished surfaces has been felt all over the world. Existing criteria for general use have been examined. A modified criterion is being established.

2. **Spark Hardening of Tools (S. Vaidyanathan, V. C. Venkatesh):**

Whether electrical deposition of WC and TiC on H.S.S. tools is really beneficial is being investigated. The spark hardener developed there is now being tested for hardening M.S. contact tips from a local industry. Adhesion problems are being solved.

3. **Secondary Shear during High Speed Machining with Carbide Tools (P. K. Philip, V. C. Venkatesh):**

The formation of this highly deformed sub-layer on the underside of the chip is being studied. An explosive quick stop device with very high deceleration has been developed and is being used for obtaining "Frozen Cuts."

4. **Hot Machining (M. S. Francis, V. C. Venkatesh):**

The difficulty of machining high tensile strength materials (like armour plates) is being studied and has been solved to some extent

by hot machining. Heat resistant chip breakers and a simple heating device have been successfully developed.

5. Secondary Shear with H.S.S. Tools (R. Ramaswamy, V. C. Venkatesh):

Similar to the problem under No. 3, this zone has been obtained when machining with H.S.S. tools i.e. at low temperatures, much lower than the strain recrystallisation temperature. A new structure has been identified, strain rate is being measured. A water table for hydraulic analogy studies has been completed. Boundary layer conditions will be studied with respect to chip formation.

6. Ultrasonic Machining (M. Adithan, V. C. Venkatesh):

An optimum transducer shape (logarithmic, stepped, conical etc) for drilling fine holes without taper and for minimum tool breakage is being investigated. Conditions for higher production rate than at present are being investigated.

7. Oscillating Tools (Suresh, V. C. Venkatesh):

Involves determination of ideal conditions for effective chip breaking during production of small components on automats. An electromagnetic oscillator has been successfully developed. A fluidic oscillator for heavier chip removal is being designed.

8. Hydrostatic Bearings for an Electro-Chemical Grinder (J. Chandramouli, H. Heitmann):

Spindle bearings for rotation of grinding wheel without stickslips for eventual use on an ECM machine currently under development has been manufactured, studied, and found suitable.

9. Hydrostatic Nut for an Electro-Chemical Grinder (A. Angamuthu, H. Heitmann).

A power nut without stick slip for feeding the workpiece, as in the above case, for an ECM Machine has been manufactured.

10. Design of Lubrication Pump, Indexing Device and Accessories for Bench Type Milling Machine (P. Radhakrishnan Nair, V. C. Venkatesh):

A piston plunger pump has been incorporated in the Gear box. A simple indexing device, pedestal, special arbor etc. are being fabricated.

11. Test Rigs for the Study of Scuffing and Pitting (M. A. Veluswamy, S. Rajesham, S. Adityan, V. C. Venkatesh):

A test rig for studying surface deterioration of gears is under fabrication. Origin of pitting cracks will be investigated. Cracks which were developed on gears after grinding, in an Aeronautical industry, will be studied.

12. Design of Drilling Unit using Double Bounded Gear (K. Ramamurthy, V. C. Venkatesh):

A mathematical analysis on "Double Binding" (i.e. using one gear to mesh with two others alternatively) with a view to minimising the number of gears was done and an optimum design obtained. The 16 speed gear box has been successfully tried out. A hydraulic table is under fabrication and the whole unit could be used for a transfer line.

13. Design of Press Tools for the manufacture of Loud Speaker Cones (R. Sampath, V. C. Venkatesh):

Five stage press tools have been designed and the 1st stage has been manufactured.

14. Design of Cams and Tools for Index Automat (K. M. Abraham, V. C. Venkatesh):

Cams and some tools for the production of an injection jet component have been manufactured.

15. Design of Jigs and Fixtures for Several Industries (Staff and Students):

Drilling, turning, and milling fixtures have been designed for mass production of components in local industries. Some of these have been manufactured.

16. Design of a Boring Bar for Horizontal Boring and Milling Machine (M.S. Francis, V. C. Venkatesh):

The boring bar has been designed with micro-bore attachment and can be used for boring widely separated holes in the same axis.

17. Design of an Electrical shutter lifting unit (V. K. Krishna Varma, V. C. Venkatesh):

A speed reducer has been designed and is now ready for assembly. Push button controls enable lowering and raising the shutter gates.

III. INTERNAL COMBUSTION ENGINEERING

1. Investigations on the effect of Turbulence Frequencies on the Mixing Processes in a Combustion Chamber (K. V. Gopalakrishnan, B. S. Murthy, R. G. Narayanamurthi):

The test setup has been fabricated and erected for the turbulence measurements using the hot-wire anemometer.

2. Pre-combustion Reactions in Dual Fuel Engines (K. R. Govindamallan, B. S. Murthy, R. G. Narayanamurthi):

A thermodynamic analysis of the energy effects of early combustion reactions, and equations for evaluating the energy release have been developed. The test setup is ready to measure the energy release during pre-combustion reactions, and analysis of the intermediate combustion products; and their effect on the engine performance. Computer programming for the Dual Fuel Engine with energy release during compression stroke with solution of thermochemical equations is in progress.

3. Influence of Heat Release Pattern on the performance of I.C. Engines (K. N. Gopalan, B. S. Murthy):

An attempt is being made to determine the apparent course of heat release with the help of pressure traces taken from 'M' combustion engine. A computer programme is being developed for the above purpose. This will enable quick appraisal of the engine performance and indicate the direction for the possible improvement of the performance.

4. Charge Stratification in I.C. Engines (P. Srinivasa Rao, B. S. Murthy):

The experimental test setup with the engine for the study has been erected and the cylinder heads employing the various principles of charge stratification are designed. The importance of charge stratification on the cycle efficiency and fuel economy and at part load, where the automobile is generally operated is being studied experimentally.

5. Torsional Vibration Dampers for Automotive Engines (R. Ramamoorthy, B. S. Murthy):

A rubber hysteresis torsional vibration damper for a diesel engine crank shaft has been developed. The performance of the damper has been evaluated using electrical strain gauging technique and finding out the resonance curve.

6. Rating of S.I. Engine Fuels (B. Nagalingam and B. S. Murthy):

Various samples from the market were rated for knock intensity. A method is being developed for the standardisation of S.I. engine fuels using secondary reference fuels.

7. Evaluation of Small Two Stroke Engines and Turbine Type Blowers (V. Balabaskaran, R. Ramamoorthy, B. S. Murthy):

A strain gauge torque pick up has been designed, fabricated and calibrated to test small S.I. engine under service conditions. The performance characteristics are being evaluated for both the imported and indigeneous engines.

8. Measurement and Analysis of the Turbulence Spectrum for Mixing Characteristics (V. Ganesan, B. S. Murthy):

The test setup for item 1, is being used for analysis of turbulence frequency. Hot wire anemometer, wave analyser etc. are used for measuring and analysing the turbulence.

IV. HEAT TRANSFER AND THERMAL POWER

1. Experimental and Analytical Study of the Mechanism of Nucleate Boiling (V. N. Rajan, L. Narjes, G. v. d. Kammer):

An experimental set up is provided to investigate the effect of vibrations on the boiling heat transfer coefficient on the outside

surface of a vertical copper tube under constant wall temperature conditions. Temperature distribution is being measured by means of a three directional thermocouple traverse of high accuracy. Photographs of the bubbles flow pattern are provided.

2. Performance characteristics of a Cooling Tower (M. N. Viswanathan, L. Narjes, G. v. d. Kammer):

Investigations are being conducted to determine to performance characteristics of this cooling tower. Keeping the air flow rate approximately constant the water flow rate was varied.

3. Design, Construction and Performance Testing of a Heat Pipe (V. Nagarajan, L. Narjes, G. v. d. Kammer):

The experimental set up completed now will help to investigate the heat transfer per unit mass a few hundred times as much as a solid thermal conductor can do. Investigations

(a) to study the effect of heat pipe performance by orienting it at different inclined positions,

and (b) by varying the mass of the working fluid and its related effect—

are to be taken up.

4. Performance characteristics of Labyrinth Seals (K. V. Chalapathi Rao, L. Narjes, G. v. d. Kammer):

An experimental setup is provided to determine experimentally and analytically the optimum conditions for sealing steam flow in high pressure turbines. For this purpose at first a test stand was erected to observe the performance of labyrinth glands of air flow. Different types of labyrinth glands with adjustable spacing are being tried out to keep the leakage at a minimum.

5. Free Connection heat transfer from surfaces with arbitrary non-uniform wall temperature (M. V. Krishnamurthy, A. Ramachandran):

This analytical investigation deals with heat transfer from a surface whose wall temperature varies in an arbitrary manner. The necessary computations are made in electronic digital computer.

6. Free Convection heat transfer from surfaces with arbitrary non-uniform wall heat flux (M. V. Krishnamurthy, A. Ramachandran):

The heat transfer surfaces are mostly subjected to non-uniform heat flux. Analytical investigation is under progress for the case of free convection.

7. Film boiling on Non-isothermal Surfaces (M. V. Krishnamurthy, K. N. Seetharamu, A. Ramachandran):

Many of the surfaces from which heat transfer takes place are subjected to non-isothermal conditions. Analytical investigation is under progress for the case of free convection and forced convection film boiling heat transfer to consider the effect of various parameters.

8. Combined Convection effects in film boiling (M. V. Krishnamurthy, K. N. Seetharamu, A. Ramachandran):

For low velocity flows, the effect of free convection may exist. The analytical investigation deals with the film boiling heat transfer taking into account the effect of both free and forced convection.

9. Mixed convection heat transfer from continuously moving surfaces (M. V. Krishnamurthy, A. Ramachandran):

This deals with the analytical investigation of the combined effects of free and forced convection from moving surfaces from which heat transfer takes place. The necessary computations are being made.

10. Effects of a Magnetic field on Boiling and Condensation (M. V. Krishnamurthy, A. Ramachandran):

The analytical investigation of film boiling and condensation under the influence of magnetic field is under progress.

11. Forced Convection Heat Transfer from Non-isothermal surfaces (M. V. Krishnamurthy, A. Ramachandran):

The analytical investigation of the above deals with non-isothermal surfaces from which heat transfer takes place under forced convection. The necessary computations are nearing completion.

V. THERMODYNAMICS & COMBUSTION ENGINEERING

1. Ignition Delay by Shock Tube Technique: (K. A. Bhaskaran, M. C. Gupta):

A shock tube is set up to investigate the ignition delay of hydrocarbon fuels. Photo-cells, electronic counter and other devices are used in determining the speed of travel of the shock, the ignition of fuel and other phenomena occurring in the shock tube. Some preliminary data have been obtained and the work is continuing.

- .2 Studies on Flame Quenching: (A. Venkatesh, M. C. Gupta):

Investigations of the combustion phenomenon and the effect of flame quenching are being studied with the aid of closed combustion vessels, operating under controlled conditions.

3. Studies on Pulsating Combustion: (D. Robertz, M. Kuppuraj, V. Sriramulu, M. C. Gupta):

The effect of acoustic oscillations introduced in the supply-stream of Bunsen type burner are being investigated. The flames are photographed by the shadowgraph technique using stroboscopic light.

An ultrasonic combustor using a Hartmann Whistle is set up and is suitably instrumented. Effect of ultrasonic sound on atomization of liquid fuel, heat release, stability of combustion, etc., are being studied. A pulsating combustion chamber operating with an aerodynamic valve is set up and is suitably instrumented to study the effect of the fuel-air ratio of the mixture on frequency, amplitude and heat release.

4. Utilization of Solar Energy: (A. Venkatesh, D. Suresh, M. C. Gupta):

To utilise the energy in thermal radiation from the sun, which is diffuse and at a low potential, flat plate collectors and parabolic concentrators are devised and their effectiveness is being studied. Their successful application to water heating, refrigeration and desalination etc., are being investigated.

5. Optical Method of Flame Temperature Measurement: (Basu John Vetteth, R. G. Narayanamurthi):

Quantitative measurement of flame temperature is done by direct optical method using Schlieren technique. The Schlieren pictures are evaluated using the refractive indices of the hot combustion gases.

6. Thermal conductivity of insulating materials (V. Sriramulu, U. S. Premananda Shet, N. S. Nagaratnam, M. C. Gupta):

An equipment for determining the thermal conductivity of solid materials is set up in accordance with ISI specifications. Industries are utilising this facility for the determination of the thermal properties of their products.

VI. TURBOMACHINES

1. Influence of the shape of the stationary Hub noses on the flow pattern — Different shapes (i.e. circular, elliptic, spear) (M. Ravindran, D. Prithviraj):

This project has, as its objective, the study of the flow situation occurring downstream of the impeller hubs and the effect of hub shapes. The test set up is ready and all the different hub shapes have been fabricated and measurements and investigation are under progress. The flow field upstream and downstream of the hubs has been theoretically determined by numerical methods and is being verified experimentally.

2. Influence of Freely Rotating and braked guide vanes at the inlet of an axial flow fan on its performance characteristics (N. Venkatrayulu, D. Prithviraj, R. G. Narayanamurthi):

The test rig has been completed and the rotating guide blade hub has been designed and fabricated and internal braking arrangement is incorporated. The first design incorporates straight untwisted blades, and has facilities to investigate the influence of different guide blade shapes. The blades have been fabricated and installed. The region off discontinuity in the Head discharge curve of the axial fan at low volume flows due to stalling, restricts the use of it over wide range of flows. And hence the investigation is to find whether the freely rotating inlet guide

vanes could improve the useful operating range of the machine. The experimental investigation is under progress.

3. Study of flow condition through radial impellers with tandem vanes (R. Narayanan, D. Prithviraj, R. G. Narayanamurthi):

The main aim of the project is to study the flow condition through the radial impeller varying the number of vanes and shapes and determine the optimum tandem arrangement. The project is in the initial stages. The performance of the machine with different number of vanes and different shapes is being determined initially to be compared with that of tandem arrangement of vanes later.

4. Study of the flow behaviour in the channels of Centrifugal pumping machines (G. Gopalakrishnan, D. Prithviraj):

A very good understanding of the flow mechanism is needed for such an investigation since the flow mechanism in vane channels of a radial flow machine is very complex. It is intended to make some suitable test arrangements for flow studies in rotating radial flow vane channels and to study the possibilities of eliminating dead zones in the vane channels especially at partial load.

5. Estimation of profile and secondary losses of Turbine blade profiles (D. Prithviraj, R. G. Narayanamurthi):

To estimate experimentally the profile and secondary losses of turbine blade profiles at different stagger angles and pitches, a two dimensional cascade tunnel is being fabricated. The tunnel will have facility to vary the cascade angle of incidence.

VII. INSTRUMENTATION

1. Response optimization of Feedback Control Systems (T. Rajagopalan, V. Seshadri):

The concept optimization with reference to the response of a model has been extended with a single time constant system as the model. Optimum values of the parameters for second and third order systems have been derived. Further extensions to the

case of finite dead-time in the process were investigated. Process optimization considering disturbance inputs is considered at present.

2. Application of Phase Equivalent Reduction Technique for Identification using Sinusoidal Test Signals. (D. V. Ramalingeswara Rao, V. Seshadri):

Phase equivalent reduction has been applied for the derivation of equations of identification using sinusoidal response information. The method has been used for deriving parameters of models having the same relative stability properties as that of a given system. The general problem of identification of processes in the presence of disturbances is at present under study.

3. Friction and Wear in Sintered Bearings (R. Raman, R. G. Narayanamurthi):

A test setup for finding out the frictional characteristics of parallel surface sintered thrust bearings is nearing completion. A vacuum impregnation setup for impregnating the sintered bearings to any desired level of fullness was made. The pendulum dynamometer for instrument sintered bearings was modified to find out if there is any physical contact between the bearing and the shaft under different operating conditions.

LIAISON WITH INDUSTRY

The Department maintained close liaison with local industries and successfully completed a few industrial projects. The following are indicative of the type of work carried out:—

(i) Design of Accessories for Bench Type Milling Machine, Process Analysis, Jigs and Fixtures, and Pneumatic Comparator for English Electric Company, Madras; Boring Bar Design for a local company.

(ii) Ultrasonic Drilling of Sintered Carbide Inserts and Electrochemical Machining of Punches for local industry.

(iii) Recommendations made for optimizing the performance of an indigenous Carburettor for the Ambassador automotive engine on the basis of tests carried out.

(iv) Rating of Commercial fuels for S. I. Engines.

(v) Calibration of a Dynamometer for M/s. Easun Engineering Works.

(vi) Matching and Evaluation Tests for the Blower Prime Mover for a Pesticide Sprayer for M/s. Shaw Wallace & Co.

(vii) Development of an Analogous Electrical Network for Studying Heat Transfer Problems of a 500 MW turbogenerator in collaboration with Heavy Electricals Ltd., Bhopal.

(viii) Performance Testing of Various Types of Pumps for the local industry.

(ix) Design and Fabrication of a Two Stage Centrifugal Blower for M/s. Dietrich Schnebel Co., Madras.

(x) Development of Steam Turbine Exhaust Casing and Blades for Heavy Electricals, Bhopal.

(xi) The Ministries of Defence and Railways, Government establishments and Private undertakings utilised the services of the Central Work-shops for the development and fabrication of Track Recording Car, Dynamometer car (for Railways) and manipulator for Atomic Reactor.

PUBLICATIONS

I. Papers Published

1. Effect of vibration on heat transfer from spheres by C. B. Baxi and A. Ramachandran—American Society of Mechanical Engineers paper No: 68-WA/HT-1.
2. **Compaction** and flowability of clay and oil bonded sands—K. Srinagesh, M. R. Seshadri and A. Ramachandran, Proc. 35th International Foundry Congress, Tokyo, Sept. 1968.
3. Action of chills on soundness of Al—10% Mg. alloy plate castings—S. Seshan, M. R. Seshadri and A. Ramachandran, British Foundryman, VLXI n. 9, 1968 p. 357-365.
4. Feeding Al-Cu-Si alloy—LM4, N. S. Mahadevan, M. R. Seshadri and A. Ramachandran—British Foundryman VLXI, n 10, 1968 p. 385-392 .

5. Influence of solidification gradients on the soundness of Al—4½% Cu. alloy castings—N. S. Mahadevan, M. R. Seshadri and A. Ramachandran, *Trans. American Foundrymen Society* V 68, 1968.
6. Further contribution to a study of the white layer on H. S. S. Tools— V. C. Venkatesh, *Annals of the C. I. R. P.*, Volume 16. No. 2, 1968 (London).
7. Ultrasonic Drilling of glass and porcelain — S. Vaidyanathan, *Journal of the Institution of Engineers (India)* Vol. 49, No. 3, Part ME 2, Nov. 68.
8. On Some Aspects of Ultrasonic Drilling — M. Adithan, *Machine Building Industry's Indian Industries Annual* 1968.
9. Optimizing Machining Parameters using a digital Computer, — R. Ramaswamy, *Indian Engineer*, December, 1968.
10. Computerized Statistical Method for Optimal Cutting Cycle time— R. Ramaswamy, *Machine Building Industry*, Jan-Feb., 1969.
11. Power and Process Steam for Cottage Industries — V. N. Rajan and K. N. Seetharamu — *Steam and Fuel Users' Journal (India)*, December, 1968.

II. Papers accepted for Publication

1. "Wear Propagation in Cutting Tools",—V. C. Venkatesh, V. Radhakrishnan and J. Chandramowli, in vol. XVII of *Annals of C. I. R. P.*, London.
2. "Secondary Shear Phenomenon with H. S. S. Tools" — Proceedings of 2nd All India M. T. D. R. Conference, Bangalore, July 1968.
3. "How to Select and use a Spark Erosion Machine" — Dr. Ing. H. Heitmann and M. Adithan, in *Journal of the Institution of Engineers (India)* (Mech. Engg. Division).
4. "Response optimization of feed back control systems with reference to single-time-constant ideal" — T. Rajagopalan and V. Seshadri in the *International Journal of Control*, London.
5. "Stochastic Optimization of feed back control systems for mean-square-error minimization with reference to single-time-constant

ideal"—T. Rajagopalan and V. Seshadri in the International Journal of Control, London.

6. "Application of phase equivalent reduction for two parameter identification by sinusoidal test signals"—D. V. Ramalingeswara Rao and V. Seshadri in the Institution of Engineers (Automatic Control group) Journal, India.
7. "Application of phase equivalent reduction in multiple parameter identification using sinusoidal test signals"—D. V. Ramalingeswara Rao and V. Seshadri in the International Journal of Control, London.

III. Papers presented at Conference/Seminars

1. "Interaction of Fatigue and Creep" — V. M. Radhakrishnan, K. Srinivasa Raghavan, R. G. Narayanamurthi — Conference on "Materials and Metal Physics" at Munchen, March, 1969.
2. "Some aspects of mixture formation and combustion in injection engines" — P. Srinivasa Rao, B. S. Murthy, Diesel Power Seminar at I. I. T., Kharagpur, November, 1968.
3. "Physical properties of fuels and ignition quantity" — an approach to standardisation of diesel fuels — K. R. Govinda Mallan and K. N. Gopalan at I.S.I. Convention Bhubaneswar, December, 1968.
4. "Hybridisation practice in reciprocating I.C. Engines" — B. S. Murthy, Second All India Convention and Convocation of the Institution of Automobile Engineers, India, at Bangalore, May, 1961.
5. "Quick start-up and shutdown on medium capacity power plants" — M. N. Viswanathan at a Seminar held in Heavy Electricals, Bhopal, August, 1968.
6. Representation of thermodynamic behaviour of superheated steam by means of "QUASIIDEAL VAPOR" — L. Narjes, Seventh International Conference on the Properties of Steam, Tokyo — 9, September, 1968.
7. "Optimization of parallel and Counter-Flow Heat Exchangers in Refrigeration and Air-conditioning Units on the Basis of Exergie"

- L. Narjes, All India Symposium on Refrigeration, Air-conditioning and Environmental Control 7, December, 1968.
8. "Maintenance of paper machinery"—K. N. Seetharamu, at the technical session in connection with the Centenary Celebrations of the College of Engineering, Bangalore, January, 1969.
 9. Optimization Method for Jet-propulsion with respect to EXERGIE" — L. Narjes, Annual Meeting of the Aeronautical Society of India, I.I.T., Madras, April, 1969.
 10. "Fuel Economy-Importance and problems"—V. N. Rajan and K. N. Seetharamu, National Seminar on fuel Efficiency, March, 1969.
 11. "Thermal behaviour of end chills"—S. Seshan, M. R. Seshadri and A. Ramachandran, 73rd Annual A.F.S. Castings Congress, Cleveland, U.S.A. May, 1969.
 12. "Dimensioning of feeders for Al-cu-si-alloy"—N. S. Mahadevan, M. R. Seshadri and A. Ramachandran, 73rd Annual A.F.S. Castings Congress, Cleveland, U.S.A., May, 1969.

IV. Paper sent for Publication

"Effect of the lean mixture operation on the thermal performance and heat transfer rates in I. C. Engines" — D. S. Ranganath, S. K. Datta, B. S. Murthy, Institution of Engineers (India).

METALLURGY DEPARTMENT

STAFF

Professors

- E. G. Ramachandran, Ph.D. (Met.) (Sheffield) — (*Head*)
H. E. D. Zuern, Dr. Ing. (Stuttgart)
H. W. Wagener, Dr. Ing. (Hannover)

Associate Professor

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Assistant Professors

- R. Vasudevan, Dr. Ing. (Aachen)

K. Srinivasa Raghavan, Ph.D. (Pennsylvania)
R. K. Srikantakumaraswamy, B.Sc. (Met.) (Banaras)

Lecturers

- S. Sundaresan, M.Met. (Poona).
S. Ramakrishna Iyer, B.Sc., L.I.M.
K. J. Lakshminarayana Iyer, M.Sc., B.E. (Met.) (IISc, Bangalore)
V. Vasantaree, Ph.D. (Chemistry) (IISc, Bangalore)
H. Md. Roshan, M.E. (Foundry) (IISc, Bangalore)
O. Prabhakar, M.E. (Foundry) (IISc, Bangalore)

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F. H. Guenther, Dipl. Ing. (Hannover)

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S. Sridharan, B.E. (Met) (IISc, Bangalore)
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P. S. Raghupathy, M.E. (Foundry) (IISc, Bangalore)
D. R. Gopalakrishna Achar, B.E. (Met) (IISc, Bangalore)

German Technical Staff

E. Fischer

M. Rehkop

RESEARCH WORK

The research activities in the Department received a fillip with the introduction of the M.S. research programme. 6 persons were registered for the M.S. Degree by research, 5 of them being staff members in the Department and one a full-time student. Three staff members of the Department were also registered for the Ph.D. Degree by research.

Brief account of the various research investigations are given below:—

1. Physical and Mechanical Metallurgy

1. Studies on stabilisation of austenite (E. G. Ramachandran and K. J. Lakshminarayana Iyer):

Data on the amounts of hydrogen retained in 18-8 austenitic stainless steel on cathodic impregnation under varied conditions as well as its migration speed are being examined and experimentally obtained. Simultaneously the effect of hydrogen on some aspects of the reactivation of austenite is being examined.

2. Investigations on stacking of faults and work hardening of metallic metals (R. Vasudevan):

Work commenced earlier was continued and the results presented as a paper, accepted for publication in Current Science. Investigations relative to stainless steel are being continued.

3. Deposition and structural aspects of metallic thin films (K. J. Lakshminarayana Iyer and E. G. Ramachandran):

The fabrication of small vacuum coating unit for the deposition of thin metal and alloy films is practically complete. After trial experiments, it is proposed to take up the study of the mechanical properties and structural aspects of some thin films.

4. Fatigue Properties (S. Kumaran and E. G. Ramachandran):

As a preliminary to investigating fatigue properties, of aircraft and other metallic materials, particularly at elevated temperatures, a de-

tailed survey of technical literature has been undertaken. A paper was presented at a recent conference of the National Aeronautical Society, on the results of such survey.

II. Extraction Metallurgy

1. Improvement in properties of vacuum treated steels (R. K. Srikantakumaraswamy):

As previously indicated the object of this long term investigation is to find out whether acceptable high grade properties are obtainable without elaborate vacuum treatment and to fix lower minima for alloying elements as vacuum treatment enhances physical and mechanical properties. The procedure for making satisfactory refractory crucibles in the vacuum-induction furnace has been standardised, after many experiments. Procedures for making the required steels without vacuum treatment, in the Tammann furnace, have been standardised. Similar procedures for vacuum melting are to be standardised.

2. Investigation on low carbon ferro-chrome (R. K. Srikantakumaraswamy, S. K. Seshadri and B. Natarajan):

A few experiments have been performed to lower the carbon content of high-carbon-ferro-chrome by mixing the latter with chrome ore and treating at about 1100°C at a pressure of about 10-1 mm mercury. A reduction of carbon to about 1.5 per cent has been achieved. Further experiments are in progress.

III. Metallurgical Analysis, Electro Metallurgy and Corrosion

1. Structure and properties of electrodeposited nickel-cobalt alloys (V. Vasantasree and M. Viswanathan):

The effects of addition agents, including colloids, in acid and alkaline electrolytes are being investigated.

2. Recovery of nickel from low grade silicate ores (S. Ramakrishna Iyer and S. Kumaran):

The Dunite rocks from Salem which contain small percentages of nickel are being used for the investigations. Concentration of the ore, with regard to nickel by floatation is being tried. A floatation cell has been rigged up in the department for the purpose.

IV. Metal Casting

1. Thermal properties of resin bonded mould material and their influence on solidification problems (H. Md. Roshan and E. G. Ramachandran):

Thermal properties of resin bonded sand are being determined by the line-heat source method. The requisite experimental apparatus was set up and thermal properties of resinbonded sand with a resin content of 5 percent have been determined under different baking conditions and over a wide range of temperatures. Other proportions of resin and baking conditions will be studied. A core drying oven of nearly 40 cubic feet capacity and operating at a maximum temperature of about 350°C has also been designed and fabricated in connection with this investigation.

2. Riserling of non-ferrous alloys (O. Prabhakar):

Work has just been taken up on this problem, initially using aluminium—silicon alloys. At a later date, alloys with different freezing and other characteristic will be studied.

3. Effect of trace elements in malleable iron (T. M. Bhat and H. Md. Roshan):

The study of the effects of addition of bismuth and traces of boron and aluminium on the kinetics and mechanical properties of malleable iron has been taken up.

V. Metal Joining

1. Investigation of weldability of dissimilar metals (D. R. Gopalakrishna Achar and H. E. D. Zuern):

The weldability by the MIG process, of mild steel with stainless steel, aluminium with copper and with brass, copper with nickel and with mild steel and by the TIG process of mild steel with stainless steel, has been taken up for investigation.

2. Fundamental studies in welding of steel with electrodes made in India (S. Sankaranarayanan and H. E. D. Zuern):

Investigations of the characteristics of a few selected types of covered arc welding electrodes with respect to their applicability to the welding of certain widely used types of steel in India, have been taken up.

3. Strength of welded steel at low temperatures. (H. R. Raghavan and H. E. D. Zuern):

The impact strength of welded joints of mild steel, stainless steel and nickel steel produced by various processes will be studied to work out optimum welding procedures. The design and fabrication of a suitable testing equipment for impact strength determination at low temperatures have been taken up.

VI. Metal Forming

1. Cold Extrusion (P. Venugopal and H. W. Wagener):

This is a design-oriented investigation, regarding a press tool for cold extrusion.

LIAISON WITH INDUSTRY

The Department continued to maintain a close link with industries, and carried out several assignments in the fields of chemical analysis of metals and alloys, mechanical testing, metallography, non-destructive testing etc.

Under the scheme of close links between academic institutions and industry initiated by the Tata Iron and Steel Co., Jamshedpur, Sri R. K. Srikantakumaraswamy, Assistant Professor spent five weeks in Jamshedpur, on an invitation from the company, from 20th April '69 to 28th May '69. The metallurgical practices followed in the blast furnaces and the steel melting shops were studied and a few suggestions to improve the productivity were made. Five special lectures on iron and steel making were given by him to the Technical Officers of the Tata Iron and Steel Company.

CONFERENCES AND SEMINARS

The Department was actively associated with and played an important role in the Annual meeting of the Indian Institute of Welding and the Annual Convention of the Institute of Indian Foundrymen, which were held at the Institute in March 1969. Besides contribution of technical papers, by staff of the Department, Prof. E. G. Ramachandran and Dr H. E. D. Zuern were invited to deliver special lectures at these conferences.

Two visiting Professors from Germany worked in the Department for four weeks each during February-March 1969. Prof. J. Ruge

from the Technical University, Braunschweig delivered a series of special lectures on Metal Joining and Prof. W. Panknin from the Technical University, Berlin on metal forming. They also participated in the two conferences mentioned above and delivered invited lectures.

PUBLICATIONS

I. Papers Published

1. "New Developments in Welding Technology" H. E. D. Zuern Design, Process and Materials — PSG College of Technology, Coimbatore, 1968, 63/82.
2. "Contribution of Welding Technology, especially explosive welding to Chemical Engineering" H. E. D. Zuern, Design, Process and Materials—PSG College of Technology, Coimbatore, 1968, 293/312 also in Chemical Age of India, Vol. 20, No. 2, 1969 255/262.
3. "Future developments in welding Technology" H. E. D. Zuern, Engineering Times, May 1969 (177):
4. "Fundamentals in Ultrasonic Welding and the industrial applications" H. E. D. Zuern, Zeitschrift fur Schweisstechnik — Journal deta Seudure—Zuerich, Vol. 59 (1969), No: 3.
5. "Applications of ultrasonic welding in nuclear engineering" H. E. D. Zuern, Zeitschrift fur Atomenergie and Kerntechnik, Muenchen, May 1969.
6. "Methods of non-destructive testing" H. E. D. Zuern, Werkstatt und Betriab, Vol. 102 (1969) No: 2.
7. "Hydrogen in Steel" R. K. Srikantakumaraswamy, Tool and Alloy Steels, Vol. 2, No. 5, Nov.-Dec. '68, and Indsearch, Vol. III, Nos. 4 and 5 July/Aug. '68.
8. "One of my experiences as a furnaceman" R. K. Srikantakumaraswamy, Indian Industries, Vol. XII, Nos. 11 and 12, Nov./Dec. '68 and Indsearch, Vol. III, No. 9, Dec. '68.
9. Influence of Mould Coating on the casting characteristics of Light Alloys — H. Md. Roshan, Dr. M. N. Srinivasan and Dr. M. R. Seshadri. Indian Foundry Journal 1969 Annual Convention Number Vol. 14, No. 10 March '69.

II. Papers accepted for Publication

1. "Metallurgical principles and industrial applications in welding technology with special referençe to ultrasonic and electron beam welding" H. E. D. Zuern, The Indian and Eastern Engineer, 1969.
2. "(a) Technical and economical aspects of casting and welding,
(b) Some repair methods of cast pieces by welding" H. E. D. Zuern, Journal of the Institute of the Indian Foundrymen, 1969.
3. "Metal-working in vacuum-Electron beam welding" H. E. D. Zuern, Short term course in High vacuum technology, I.I.T. Madras/BARC Trombay, Madras 1968.
4. "Some studies on the work hardening of a chromium-nickel austenitic stainless steel" R. Vasudevan. Current Science, Bangalore.
5. "Solidification of Metals" E. G. Ramachandran Institute of Indian Foundrymen Journal, Annual Convention, 1969..
6. "Fatigue properties of aircraft materials at elevated temperatures" S. Kumaran and E. G. Ramachandran, National Aeronautical Society of India, Annual Conference, 1969.
7. "Studies on the effect of phosphorus on the Malleabilizing process and Mechanical properties of Malleable Iron" O. Prabhakar and Dr. M. R. Seshadri, Institute of Indian Foundrymen Journal, Annual Convention 1969.

PHYSICS DEPARTMENT

STAFF

Professors

- C. Ramasastry, D.Sc. (Andhra) — (Head)
W. Koch, D.Phil. (Gottingen) (till 30-4-69)

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- R. Srinivasan, Ph.D. (Madras)
B. V. Ramanamurthy, D.Phil. (Allahabad)
V. Sivaramakrishnan, Ph.D. (Bombay)

Lecturers

- C. K. Narayanaswamy, Ph.D. (Madras)
J. Sobhanadri, D.Sc. (Andhra)
S. Swaminathan, Ph.D. (IISc, Bangalore)
R. Ramji Rao, M.Sc. (Banaras)
S. B. S. Sastry, Ph.D. (IIT, Madras)
V. Ramabhadran, M.Sc. (Madras)
Y. V. G. S. Murthy, Ph.D. (IIT, Madras)
C. Santaram, Ph.D. (Andhra)
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B. S. V. S. Ramachandracharyulu, M.Sc. (Andhra)
S. Srinivasan, M.Sc. (IIT, Madras)
K. Viswanatha Reddy, M.Sc. (Andhra)
A. V. Narasimham, M.Sc. (Andhra)

RESEARCH WORK**I. Solid State Physics**

The Department of Physics maintained a steady tempo of research in Solid State Physics in the year 1968-69 despite the fact that no new equipment was received from Germany during this period. The investigations in Solid State Physics embraced the areas of crystal structure analysis, electrical and optical properties of defect crystals, semiconductors, and theoretical work on lattice dynamics, thermal and elastic properties of crystals. The progress achieved in each of these areas during the year under review is summarised below.

1. X-ray Crystal Structure analysis (B. V. Ramanamurthy and S. Swaminathan) :

Continuing the investigations to unravel the structure of not too complicated organic compounds, the following heavy atom structures have been solved. (i) Bromo veratric acid and (ii) Bromo-oxo-Ishwarone. The stereochemistry of the latter compound has been established by these studies. Morpholine perchlorate and morpholine nitrate are being currently investigated to find out if the morpholine ring has the chair or boat structure. An attempt is being made to fix the positions of the hydrogen atoms in copper ethyl sulphate by x-ray structure studies. This would reveal the nature of the hydrogen bonds present in this crystal. Similar studies on monochloroacetic acid are in progress. It is difficult to determine light atom structures with x-rays. But serious attempts are being made to determine the light atom structures morpholine nitrate and orthoveratric acid.

2. Studies on ionic conductivity and radiation damage (C. Ramasastry, S. B. S. Sastry, Y. V. G. S. Murthi and J. Sobhanadri) :

Experimental studies on the ionic conductivity of Thallous and potassium sulphates are in progress. The influence of lattice defects on the band edge absorption of KClO_3 crystals has been investigated. The growth problem of F centres in alkali halides has been studied. A mechanism for the structure sensitive production of colour centres has been suggested. A quantitative study has been completed on the number of cation and anion vacancies taking into account interactions with divalent impurities in either sublattice of a NaCl structure.

Electron spin resonance and optical absorption investigations have been carried out on single crystals of x-irradiated sodium sulphate containing strontium as an impurity. E.S.R. spectra of coloured sodium chlorate crystals are under analysis.

An optical absorption cell for measurements at liquid nitrogen temperature has been constructed and measurements on the fundamental edge absorption at low temperatures are in progress.

3. Semiconductor Physics (C. Ramasastry):

One carrier space charge limited currents in graded p-n junctions were studied. The temperature dependence of field effect mobility and fast surface states has been investigated in Germanium.

4. Lattice Dynamics and theory of thermal expansion of crystals (R. Srinivasan and R. Ramji Rao):

Further to the report of last year, the following work has been done. The Keating's approach to the lattice dynamics of crystals has been applied to the case of magnesium, zinc and beryllium. The force constants involved were determined by fitting the measured dispersion curves. The theory was extended to take into account the third order anharmonic terms. In magnesium these third order terms were evaluated from the measured pressure derivatives of the second order elastic constants. The thermal expansion of magnesium has been worked out in detail. The analysis of the experimental specific heat and thermal expansion data according to the procedure of Barron and Munn has been carried out. In zinc the measurements of Driokamer on the pressure variation of the lattice parameters have been analysed and shown to be not inconsistent with Banon's analysis of the low temperature expansion data of zinc.

In lead fluoride, which belongs to the calcium fluoride structure, the Gruneisen parameter for the various acoustic branches were evaluated on Axe's shell model. It was shown that the thermal expansion coefficient of this crystal would become negative at very low temperatures.

The third order elastic constants of copper and aluminium are being worked out on a pseudopotential approach. The propagation of Rayleigh waves on the (110) face of a cubic crystal has been studied in detail and calculations have been made for Germanium.

5. Spectroscopic and Optical Properties (C. K. Narayanaswamy, V. Sivaramakrishnan and R. Srinivasan):

The Infrared spectra of benzophenone and some formates and citrates both in the single crystal and polycrystalline state have been analysed in detail using groups theoretical methods and the frequencies assigned. The temperature variation of refractive index of Barium and strontium fluorides has been studied for wavelengths in the visible region of the spectrum. These studies are being extended to ultraviolet.

II. Molecular Spectroscopy (C. Santaram):

This field of research has been started since the last one year. A modest spectroscopic laboratory is being set up. Meanwhile work has been initiated leading to the evaluation of true potential curves of diatomic molecules, r -centroids and Franck condon factors for molecular band systems. A method yielding accurate r -centroids has been developed. The spectra of ZnTl and CdTl have been analysed and interpreted.

III. Nuclear Physics (V. Sivaramakrishnan):

In continuation of last year's report the placer deposits from Manavalakurichi area, have been studied to determine the effect of acid leaching on their alpha activity, the Th/U ratios and their Beta activity. The age of some minerals from this area has been determined by lead-alpha and alpha-helium methods.

IV. General

An ultrasonic method is used to study the variation of the elastic constants of nickel alloys as a function of temperature. (B. Subramanyan).

A theoretical and experimental study of molecular laser systems is in progress (B. M. Sivaram).

The theoretical study on the viscosity of liquids is being continued. (A. V. Narasimham).

PUBLICATIONS

I. Papers Published

1. Crystal structure determination of 5-Bromo-veratric acid — (G. Sreenivasamurthy and S. Swaminathan) *Current Science*, **37**, 491 (1968).
2. The structure of Bromo-oxo-Ishwarone — (S. Swaminathan and G. Sreenivasamurthy) *Current Science*, **38**, 135 (1969).
3. The Crystal structure of Phenyl Hydrazine — (S. Swaminathan and S. Srinivasan) *Zeitschrift fur Crystallographie*, **127**, 442 (1968).
4. Effect of a large number of heavy atoms on the intensity distribution of x-ray reflections. for centric (G. D. Nigam) *Indian Journal of Pure and Applied Physics*, **6**, 256 (1968).
5. Electrical conduction in sodium nitrate crystals — (C. Ramasastry and Y. V. G. S. Murthy) *Proceedings of the Royal Society (London)* **A 305** 441 (1968)
6. Electron spin resonance in x-irradiated potassium sulphate, (J. Sobhanadri and N. Hariharan) *Current Science*, **37**, 400 (1968).
7. Electron spin resonance studies of paramagnetic centres in irradiated lithium sulphate — (J. Sobhanadri and N. Hariharan) *Journal of Physics and Chemistry of Solids* **30**, 778 (1968).
8. Colour Centre studies in alkali sulphate crystals, Part II — (J. Sobhanadri and N. Hariharan) *Indian Journal of Pure and Applied Physics*, **7**, 240 (1969).
9. One carrier space charge limited currents in graded p-n junctions. — (B. S. V. Gopalam and J. Majhi) *Current Science* **37**, 693 (1968).
10. The low temperature limit of the effective Gruneisen parameter in the fluorides of calcium, strontium and barium on Axe's shell model — (R. Srinivasan) *Journal of Physics C, (Proc. Phys. Soc.)* **1**, 1138, (1968).

11. Calculation of generalised Grauneisen parameters for acoustic waves in uniaxial crystals, from the third order elastic constants — (R. Ramji Rao and R. Srinivasan) *Physics status solidi*, 29, 865 (1968).
12. The third order elastic constants and pressure derivatives of the second order elastic constants of Magnesium—(R. Ramji Rao and R. Srinivasan) (*Physica status solidi*) 31, K39 (1969).
13. Invariant elastic constants for crystals, (T. P. Srinivasan) *Physica status solidi*, 28, K71 (1968).
14. Study of radioactivity of separated minerals of beach sands of Manavalakurichi, Madras State—(C. S. Sastry and V. Sivaramakrishnan) *Current Science*, 37, 550 (1968).
15. Comparison of the efficiency of different formulae in predicting elastic constants of polycrystals, (B. Subramanyam) (*Indian journal of Pure and Applied Physics*, 10, 577 (1968).
16. Ultrasonic absorption in mixtures of non-associated liquids—(A. V. Narasimham) *Indian Journal of Pure and Applied Physics* 6, 484 (1968).
17. Infrared spectra of Benzophenone in the Solid state (K. M. Rao and C. K. Narayana Swamy), *Indian Journal of Pure and Applied Physics*, 7, 243 (1969).
18. A simple design of a specimen holder for an alpha scintillation counter (C. S. Sastry and V. Sivaramakrishnan) *Indian Journal of Physics* (1969).

II. Papers accepted for Publication

1. Crystal structure of copper Ethyl sulphate Tetrahydrate—T. M. Vimala and S. Swaminathan, *Current Science*.
2. Temperature dependence of fast surface states of Germanium—C. Ramasastry and J. Majihi, *Indian Journal of Pure and Applied Physics*.
3. Invariant elastic constants for crystals—T. P. Srinivasan, *Journal of Mathematics and Mechanics*.

4. The effect of a rotating magnetic field on a conducting fluid in a spherical container, G. D. Nigam, Journal of Mathematical and Physical Sciences, I.I.T. Madras.

III. Papers presented at Conferences/Seminars

1. Structure sensitive colorability of alkali halides C. Ramasastry and Y. V. G. S. Murthy. International Symposium on Colour Centres, Rome, September, 1968.
2. Energies of formation of point defects in sodium nitrate—C. Ramasastry and Y. V. G. S. Murthy. International Conference on Non-metallic Crystals. I.I.T., Delhi, January, 1969.
3. Fundamental band edge absorption of KClO_3 crystals C. Ramasastry and S. B. S. Sastry, International conference on non-metallic crystals, I.I.T. Delhi, January, 1969.
4. Electrical conductivity of Thallous sulphate—C. Ramasastry and Y. V. G. S. Murthy, International conference on non-metallic crystals, I.I.T. Delhi, January, 1969.
5. Effect of crystal growth temperature on the ESR spectra of irradiated sodium and lithium sulphates. Solid State Physics Symposium (BARC), I.I.T. Bombay, December 1968.
6. Effect of temperature dependence on the field effect mobility of germanium, C. Ramasastry and J. Majhi. Solid State Physics Symposium (BARC), I.I.T., Bombay, December 1968.
7. Third-order elastic constants in crystals—R. Srinivasan, N.I.S. Symposium on lattice dynamics, II. Sc. Bangalore, August, 1968.
8. Calculation of generalised Gruneisen parameters for the acoustic branches in uniaxial crystals—Application to alpha quartz, R. Ramji Rao and R. Srinivasan, N.I.S. Symposium on lattice dynamics, II.Sc. Bangalore. August, 1968.
9. Third—order elastic constants and the low temperature limit of the Gruniesen parameter of cubic lead fluoride on Axe's shell model—V. Ramachandran and R. Srinivasan, Solid State Physics Symposium (BARC), I.I.T., Bombay, December 1968.

10. The lattice dynamics of magnesium using Keating's approach—R. Ramji Rao, and R. Srinivasan, Solid State Physics symposium (BARC), I.I.T. Bombay, December, 1968.

IV. Papers sent for Publication

1. Band spectra ZnTl and CdTl, C. Santaram and J. G. Winans.
2. True potential energy curves of diatomic molecules—A simplified procedure—V. K. Vaidyan and C. Santaram.
3. A rapid method to construct true potential curves of diatomic molecules, V. K. Vaidyan and C. Santaram.
4. r -centroids of diatomic molecules from true potential curves, V. K. Vaidyan and C. Santaram.

AWARD OF DOCTORATE DEGREES

During the year under review, the undermentioned 19 candidates completed their work leading to the award of the Ph.D., Degree of the Institute. The titles of the Theses are noted against each :

Name	Title of Thesis	Supervisor
CHEMISTRY		
C. Daniel	An investigation of the dual activity of Chromia-Alumina for the reactions of isopropyl alcohols	Dr. J. C. Kuria-cose
S. V. Kannan	Conversion of alcohols to ethers and alkylation of phenols by alcohols over alumina	Dr. C. N. Pillai
V. R. Satya-narayana Rao	Oxidations with Chloramine-T and Dichloramine-T	Dr. G. Arava-mudan
R. Swaminathan	An investigation of the catalytic properties of chromia for the dehydration and de-hydrogenation of alcohols and the ketonisation of aliphatic acids	Dr. J. C. Kuria-cose
D. Venkappayya	Metal complexes of Morpholine 1, 2- Dimorpholinoethane and their derivatives	Dr. G. Arava-mudan
B. Viswanathan	Physico-chemical studies on catalysts	Dr. M. V. C. Sastri and Dr. V. Srinivasan

AWARD OF DOCTORATE DEGREES—(Contd.)

Name	Title of Thesis	Supervisor
CIVIL ENGINEERING		
Kolinjuvadi Sambamurthi Sankaran	Time dependent deformation of partially saturated cohesive soils	Dr. P. C. Varghese
N. Sukesan Nayar	An investigation on the elastic stress distribution and ultimate strength of reinforced concrete rigid frame corners	Dr. P. C. Varghese
ELECTRICAL ENGINEERING		
Kantilal S. Mehta	Development and application of pulse technique to power system protection	Dr. M. Venugopal
MATHEMATICS		
A. V. Gopala Krishna	Relativistic hydrodynamics and propagation of weak discontinuities	Dr. S. D. Nigam
D. V. Krishna	Motion of bodies in stratified fluid	Dr. L. V. K. V. Sarma
S. Kumaraswamy	Stochastic processes and continuum mechanics	Dr. S. K. Srinivasan
R. Seetha- ramaswamy	A study in cross-field effects in Magnetohydrodynamics	Dr. L. V. K. V. Sarma
Rathindra Nath Sarkar	Studies on some aspects of electromagnetic interactions of hadrons	Dr. S. K. Srinivasan

AWARD OF DOCTORATE DEGREES—(Contd.)

Name	Title of Thesis	Supervisor
Surenbra Nath Majhi	Slow viscous drag	Dr. S. D. Nigam

MECHANICAL ENGINEERING

Kalluri Lashmi- narayana	Synthesis of plane lower pair mechanisms for bivariate function generation	Prof. R. G. Narayana- murthi
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PHYSICS

S. Natarajan	Crystal structures of some thiou- rea complexes of cadmium	Dr. B. V. Ramana- murthy
G. D. Nigam	Studies in X-Ray crystallography	Dr. B. V. Ramana- murthy
S. Vijayalakshmi	Asymmetric creeping jets	Dr. S. D. Nigam

TECHNICAL TEACHERS' TRAINING PROGRAMME

During the year, 5 Technical Teachers were enrolled for undergoing the training. Of these, one trainee discontinued from the course in December 1968. 12 trainees completed the prescribed period of training. There are 33 trainees on rolls as detailed below:

Sl. No.	Name	Date of joining	Name of Supervisor	Remarks
I. Applied Mechanics				
	Shri K. N. Rama-chandran	16- 9-1968	Dr. Vincent X. Kunukkasseril	Enrolled for the M.Tech. Degree Course.
II. Chemical Engineering				
1.	Shri K. Ethirajulu	10- 7-67	Dr. E. Hohmann	-do-
2.	Shri C. Chandraprasad	10- 7-67	Dr. R. J. H. Bisanz	-do-
3.	Shri V. S. Ramachandra Rao	18-12-67	Dr. H. H. R. Bock	-do-
III. Civil Engineering				
1.	Shri C. Vijayan	1- 9-66	Dr. K. S. Sankaran	-do-
2.	Shri S. Chokkalingam	10- 7-67	Dr. G. Rouve	-do-
3.	Shri S. V. K. Gnaneswar	14- 9-68	Dr. J. Plaehn	-do-
IV. Electrical Engineering				
1.	Shri K. Narayana Bhat	8- 8-66	Dr. M. K. Achuthan	-do-
2.	Shri M. C. Vaithilingam	8- 8-66	Dr. H. W. Meyer	-do-
3.	Shri P. Karivaratharajan	9- 8-66	Dr. V. G. K. Murti	-do-
4.	Shri S. Yuvarajan	5-10-66	Dr. B. Ramaswami	-do-
5.	Shri R. Parimelalagan	10-10-66	Dr. V. Seshadri	-do-
6.	Shri R. Saravanam	11- 7-67	Dr. V. Seshadri	Completed the M.Tech. Degree Course in July 1968.

Sl. No.	Name	Date of joining	Name of Supervisor	Remarks
Electrical Engineering (Contd.)				
7.	Shri S. Kannan	10- 7-67	Dr. M. Venugopal	Enrolled for M.Tech. Degree Course.
8.	Shri T. S. Balasubramanian	10- 7-67	Dr. P. Venkata Rao	-do-
9.	Shri Nirmal Ratnakumar	10- 7-67	Dr. M. K. Achuthan	-do-
10.	Shri B. Rama Mohan Rao	26- 7-67	Dr. B. Ramaswami	-do-
11.	Shri Y. Gopala Rao	10- 7-67	Dr. M. K. Achuthan	-do-
12.	Shri K. Raja Reddy	26- 7-67	Dr. H. W. Meyer	-do-
13.	Shri P. C. Baby	16- 9-68	Dr. K. P. Rajappan	-do-
14.	Shri Raju Cherian Mathai	13- 9-68	Dr. H. W. Meyer	-do-
V. Mechanical Engineering				
1.	Shri M. Ravindran	9- 8-66	Dr. W. Scheer	-do-
2.	Shri K. Ramamurthy	9- 8-66	Dr. V. C. Venkatesh	-do-
3.	Shri V. Nagarajan	10- 9-66	Dr. L. Narjes	-do-
4.	Shri N. Venkatarayulu	18- 8-66	Dr. W. Scheer	-do-
5.	Shri T. Nagarajan	9- 9-66	Shri M. A. Parameswaran	-do-
6.	Shri P. Radhakrishnan Nair	20- 7-67	Dr. V. C. Venkatesh	-do-
7.	Shri U. S. Premananda Shet	17- 7-67	Dr. M. C. Gupta	-do-
8.	Shri N. S. Nagarathnam	20- 7-67	Dr. M. C. Gupta	-do-
9.	Shri V. Ganesan	7- 8-67	Dr. B. S. Murthy	-do-
10.	Shri V. Balabaskaran	19- 7-67	Dr. B. S. Murthy	-do-
11.	Shri S. Sampath	4- 9-67	Dr. L. Narjes	-do-
12.	Shri Thomas Mathew	16- 9-69	Dr. W. Scheer	Discontinued in December 1968

SUMMER SCHOOLS AND TRAINING PROGRAMMES

I. Sequential Summer Schools for Technical Teachers :

The Departments of Civil Engineering and Electrical Engineering were entrusted with co-ordinating the programme of the Sequential Summer School for the teachers in Civil Engineering and Electrical Engineering Faculties of the different engineering and technical institutions in the Southern and Western Zones. This programme was inaugurated by Shri M. Karunanidhi, Chief Minister of the Government of Tamil Nadu, on the 2nd of May 1969.

The third and final session of Sequential Summer School in Mechanical Engineering was also conducted during May—June 1969.

Particulars of each programme are detailed below :—

(a) *Civil Engineering* :—The first session of the sequential course commenced on 2-4-1969 and ended on 30-5-1969. 39 candidates participated in the programme.

(b) *Electrical Engineering* :—This Programme was started on 1-5-1969 and completed on the 28-6-1969. 33 candidates participated in the first session of the course.

(c) *Mechanical Engineering* :—The final session in Mechanical Engineering commenced on 1-5-1969 and concluded on 28-6-1969. 36 candidates participated in the programme. At the end of the prescribed period, these candidates were given a certificate of having successfully completed the programme during the three continuous sequential summer vacations. Of these, six were declared eligible to be enrolled direct in the second year of the M. Tech. Degree Course at this Institute, during the 1969-70 session.

II. Summer Schools :

(a) *Chemical Engineering* :—The Department of Chemical Engineering organised an Advanced Summer School on “Development and Design of Chemical Process Equipments” from the 19th May to 14th June 1969. Twenty-five Faculty Members from the Departments of Chemical Engineering all over India participated in the Summer School. This school was financed by the Indian Society of Technical Education and assisted by the National Council of Science Education of India and USAID and National Science Foundation of the U.S.A.

The inaugural lecture on "Creative Chemical Engineering" was delivered by Prof. Wayne C. Edmister, P.E., (Nicholas Professor of Chemical Engineering, Oklahoma State University, U.S.A.), the U.S. Consultant for the school. Professor Edmister gave a series of 25 lectures for the school. The other lectures for the school were delivered by the Faculty Members of the Department of Chemical Engineering and other Departments of the Institute, Professors from other Institutes and Universities, Scientists from National Laboratories and Engineers from K. C. P. Ltd., FACT, FEDO, EIL, Chemch, etc. The programme of the school included lectures on design of pressure vessels, storage tanks, silos, materials of construction, methods of fabrication, non-destructive methods of testing, standards and codes, process and mechanical design of selected process equipments, piping systems, scale-up and optimization.

(b) *Mathematics*:—The Department organised the Summer School in Mathematics for the teachers of the Central Schools for a period of three weeks. Fifty teachers participated in the programme.

III. Refresher Course in Chemical Engineering :

A Refresher Course in "Advanced in Chemical Engineering" was conducted by Prof. Dr.—Ing. H. Brauer, Director, Institut für Verfahrenstechnik, Technische Universität, Berlin, from the 10th to 21st of February 1969. The subjects covered in the course included Flow in Pipes and Channels, Gas-Liquid Flow, Packed Columns, Particle Movement, Transport of Solids in Fluids, Energy Requirements in Mixers, Fundamentals of Heat and Mass Transfer, Mass Transfer in Forced and Natural Convection, Mass Transfer with Chemical reaction, Mass Transfer in Gas-Liquid Flow and Fluidized beds.

IV. Special Course :

The Department of Chemical Engineering conducted a Course in Ore Dressing (Theory and Practical) for Metallurgy students of the P. S. G. College of Technology, Coimbatore, in the first and second weeks of February 1969.

V. Short-term Course in 'High Vacuum Technology':

A short-term Course in High Vacuum Technology was conducted at the Institute during the period 2nd—20th December 1968. The Course was jointly organized by the Institute and the Bhabha Atomic Research Centre, Trombay. The major part of the equipment needed to set up the laboratory exercises for the Course was furnished by the Bhabha Atomic Research Centre.

There was a good response for the Course from applicants working in academic institutions, research laboratories and industrial establishments, as shown below:

No. of applications received		277
No. of applications after preliminary screening		149
	No. of applications.	No. admitted.
(a) Academic Institutions	66	17
(b) Research Laboratories	19	18
(c) Industrial Establishments	64	20
	—	—
Total	149	55
	—	—

The Course was inaugurated on 2nd December 1968, by Shri M. Ramabrahmam, Managing Director, Madras Refineries, Ltd.

The Course consisted of lectures, laboratory exercises and report-writing, technical films and visits to a selected number of industrial establishments in and around Madras.

The lectures comprising instruction in theory, were given by Prof. C. Balakrishnan, Head of the Department of Electrical Engineering, Indian Institute of Technology, Bombay and a team of scientists from the Bhabha Atomic Research Centre led by Shri C. Ambasankaran and including Shri P. Vijendran, Shri P. K. Nayak and Shri A. K. Gupta. Shrimati K. Balaraman and Shri Varghese, also from the Bhabha Atomic Research Centre, together with Staff-members of the Physics Department of the Institute organized and supervised the laboratory programme in the Course.

The following programme of special lectures was arranged :

<i>Speaker</i>	<i>Topic</i>
1. Dr. (Mrs.) Edith Butenuth, Department of Metallurgy, I.I.T., Madras.	Vacuum Techniques in Electron Microscopy.
2. Dr. H. E. D. Zuern, Department of Metallurgy, I.I.T., Madras.	Metal working in High Vacuum and Electron Beam Welding in Reactor Technology.
3. Dr. C. Ramasastry, Department of Physics, I.I.T., Madras	Semi-conductor Surface Studies.
4. Dr. W. Koch, Department of Physics, I.I.T., Madras,	Applications of High Vacuum Technology in Science and Industry.
5. Dr. V. Srinivasan, Department of Chemistry, I.I.T., Madras.	Vacuum Techniques in Chemistry.
6. Dr. R. J. H. Bisanz, Department of Chemical Engineering. I.I.T., Madras.	Vacuum Techniques—Application, Equipment and Accessories.
7. Prof. S. Sampath, Deputy Director, I.I.T., Madras.	Vacuum Techniques and Electron Tubes.

Dr. M. Ramakrishna Rao, Central Instruments and Services Laboratory, Indian Institute of Science, Bangalore and Shri A. V. Ramachandra Rao, Senior Engineer (Electron Tubes Division), Bharat Electronics Ltd., Bangalore, who are both specialists in High Vacuum Techniques visited the Institute, on invitation, and addressed the participants.

The participants visited the following establishments :

Central Leather Research Institute, Adyar; King Institute, Guindy; Scientific Glass Apparatus Factory in the Guindy Industrial Estate; Instrumentation Faculty, Madras Institute of Technology,

Chromepet; TOVAC Equipment Private Ltd., in the Ambattur Industrial Estate; Integral Coach Factory, Perambur; Hackbridge, Hewittics and Easun Ltd., Transformer Factory at Tiruvottiyur.

Special mention may be made of the visit to the Madras Atomic Power Project at Kalpakkam.

On the basis of their academic performance, as judged by the tests, laboratory-work and viva-voce examination, 43 candidates were awarded Pass Certificates and 11 received certificates of attendance. One of the candidates discontinued from the course for personal reasons. The Certificates were presented to the participants by Dr A. Ramachandran, Director, Indian Institute of Technology, Madras at the valedictory function held on 21st December, 1968. Dr H. N. Sethna, Director, Bhabha Atomic Research Centre, delivered an address on this occasion.

LECTURES/SEMINARS BY VISITING SCIENTISTS AT THE INSTITUTE

Name of visiting Scientist	Dates	Topic of Seminar/Lecture
Aeronautical Engineering & Applied Mechanics		
Dr. Thein Wah, Staff Scientist, South West Research Institute, San Antonio, Texas, U.S.A.	5- 8-1968	Applications of Finite Difference & Equations in Structural Analysis.
	6- 8-1968	
Dr. M. A. Badrinarayanan, Department of Aeronautical Engineering, Indian Institute of Science, Bangalore.	5- 8-1968	Transition and Reversed Transi- & tion in Two-dimensional Channel Flow. On the Criteria for Re-laminariza- tion of the Boundary Layer.
	6- 8-1968	
Prof. T. N. Krishnaswamy, Department of Aeronautical Engineering, Indian Institute of Science, Bangalore.	7- 2-1969	Windtunnel Techniques.
	8- 2-1969	
Prof. Anatol Roshko, Department of Aeronautics California Institute of Technology, Pasadena, U.S.A.	14- 2-1969	Fluid Mechanics — Separated & Flows, Shock Tubes.
	15- 2-1969	
Dr.-Ing. K. Gersten, University Bochum, West Germany.	12- 3-1969	Research in Slender Wing Theory.
	13- 3-1969	
	14- 3-1969	Introduction to Hypersonic Flow.
	18- 3-1969	
	19- 3-1969	
	20- 3-1969	
	21- 3-1969	Wall Jets.
	25- 3-1969	Prediction methods of incompressi- & ble turbulent boundary layers.
	26- 3-1969	
	18- 3-1969	Higher order boundary layers.
	25- 3-1969	
	14- 3-1969	Influence of outer-flow turbulence & level on heat transfer.
17- 3-1969		

Name of visiting Scientist	Dates	Topic of Seminar/Lecture
Chemical Engineering		
Prof. Dr.-Ing. H. Brauer, Technical University, Berlin.	10- 2-1969 to 21- 2-1969	Advances in Chemical Engineer- ing. Development of Chemical equip- ments.
-do-	March 1969	Development of Compact Heat Exchangers, Mixers, Fluidized beds, Permeameters and Spray Dryers.
Prof. Wayne C. Edmister, Oklahoma State University, U.S.A.	19- 5-1969 to 14- 6-1969	Development and Design of Che- mical Process Equipments.
Chemistry		
Dr. M. M. Taqui Khan, Department of Chemistry, Osmania University, Hyderabad.	27- 7-1968	Activation of the Pi-bond by metal ions and metal complexes in homo- geneous solution.
Dr. Thirunamachandran, University College, London.	9- 8-1968	d-orbital participation in higher covalent compounds containing phosphorus and sulphur.
Dr. S. S. Krishnan, Nuclear Chemistry Adviser, United Nations Development Programme, Rangoon.	14- 8-1968	Nuclear Chemistry in Forensic Science.
Dr. S. Kalyanaraman, Neuro-Surgeon, Government General Hospital, Madras.	25-10-1968	Depth surgery of the human brain and allied research.
Dr. M. Anantharaman, Prof. of Parasitology, Madras Veterinary College, Madras.	20-11-1968	Parasites and human health.
Dr. R. Srinivasan, Ohio State University, U.S.A.	16-12-1968	Photo-chemistry of non-conjugated dienes.

Name of visiting Scientist	Dates	Topic of Seminar/Lecture
Chemistry—(Contd.)		
Prof. Herbert L. Strause, IIT, Kanpur.	21- 1-1969	Inter molecular interactions in Carbon tetrachloride as seen by far infrared and Raman spectroscopy.
Dr. K. P. Gopinathan, Tata Institute of Fundamental Research, Bombay.	30- 1-1969	Nuclear spectroscopic studies on the decay of medium Mass odd-A nuclei.
Dr. Dinker Motlag, Lecturer in Bio-Chemistry, A. C. College of Technology, Madras.	28- 2-1969	Enzymes and their reaction mechanisms.
Dr. H. Jayaraman, Pool Officer, Madras Christian College, Tambaram.	12- 3-1969	Some Kinetic and Thermodynamic aspects of Amide Hydrolysis.
Dr. M. Dharmarajan, Visiting Prof. of Genetics, Osmania University, Hyderabad.	14- 4-1969	Genetics and man.
Dr. C. N. R. Rao, Senior Professor of Chemistry and Dean of Research and Development, IIT, Kanpur.	23- 4-1969	Mechanism of conduction in metal Oxides: Localised versus Collective Electron Behaviour.
Dr. P. T. Narasimhan, Professor of Chemistry, IIT, Kanpur.	24- 4-1969	Molecular structure and magnetic resonance.
Civil Engineering		
Dr. Walter Beckman, Soil Scientist, Hamburg University, United Nations.	5- 8-1968	Soil testing by means of Micro Sections of Undisturbed Samples.
C. T. Bhaskaran, Chief Engineer, Madras Port Trust.	16- 9-1968	Coastal works and shore line processes with particular reference to Madras Harbour.

Name of visiting Scientist	Dates	Topic of Seminar/Lecture
Civil Engineering--(Contd.)		
Dr.-Ing. F. Leonhardt, Professor of Structural Engineering, University of Stuttgart, West Germany.	11- 1-1969	Long span structures.
Prof. R. B. L. Smith, Asian Institute of Technology, (Thailand) Bangkok.	21- 1-1969	Yield line theory of slabs.
Prof. G. A. Leonards, Professor of Soil Mechanics, Purdue University (U.S.A.)	29- 1-1969	Pile foundation on granular soils.
Mr. J. D. McIntosh, Head, Technical Directorate, Cement and Concrete Association London.	10- 2-1969	Shrinkage and wacking in concrete.
Dr. V. S. Kulandaiswamy, Professor of Hydraulic Engineering, College of Engineering, Madras.	17- 2-1969	Studies on Infiltration in Drainage Basin.
Dr.-Ing. K. W. Bieger, Professor, Technical University of Hannover, West Germany.	24- 2-1969 to 18- 3-1969	Special Structures and small scale model's testing.
A. Muthukumaraswamy, Director, Highway Research station, Madras.	13- 3-1969	Stabilisation of Highway in the Eastern Seaboard.
Mr. Oelmann (United Nations) Drilling Superintendent, (Ground water Investigation in Tamil Nadu), U.N.D.P., Madras.	7- 4-1969	Drilling systems and Bore Well constructions.

Name of visiting Scientist	Dates	Topic of Seminar/Lecture
Civil Engineering—(Contd.)		
Dr. Klimacki (United Nations) Hydrogeologist, U.N.D.P., Madras.	17- 4-1969	Ground water investigation in Tamil Nadu.
Mr. V. A. Barashov and Mr. Sarotchan, Russian Scientists, U.S.S.R.	23- 4-1969	Swelling properties of clays.
Electrical Engineering		
Shri M. Ramamurthy, Assistant Professor, Electrical Engineering, I.R.S. M.E.E. Jabalpur.	25- 7-1968	Electrification schemes on the Indian Railways.
	27- 7-1968	Developments of Electric Traction the world over. Controls applied to Diesel Electric Locomotives.
Mr. K. S. Krishnamoorthy, Department of Physiology, Kings College, London. (alumnus of IIT. Madras.)	19- 8-1968	Medical Engineering. — A myth or a marvel.
	20- 8-1968	Applications of Engineering Techniques in Medical Research.
Dr. S. R. Seshadri, Professor, Wisconsin University, U.S.A.	28- 8-1968	Antennas and Plasmas and their application to Space Communication.
Dr. B. Ramamurthy, Professor of Neurosurgery, Madras Medical College, Madras.	13- 9-1968	Activity in Human Brain.
Dr. P. V. Indiresan, Professor of Electrical Engineering, I.I.T., Delhi.	4-11-1968	Bose Choudhury Codes.
Shri J. P. Char, District Controller of Stores, Southern Railway, Madras.	9-11-1968	Introduction of Tensor Analysis of Electrical Networks.

Name of visiting Scientist	Dates	Topic of Seminar/Lecture
Electrical Engineering—(Contd.)		
Dr. K. S. Narendra, Professor of Applied Sciences, Yale University, U.S.A.	23-12-1968 & 24-12-1968	Modern Control Theory.
Prof. B. M. Tareev and Prof. V. I. Gusakov UNESCO experts, Regional Engineering College, Warangal.	18- 1-1969 & 21- 1-1969	Dielectrical Polarization and its practical significance. Some optimal problems in Electric Devices.
Dr. Dros, Director, Components Division, Philips Limited, Eindhoven, Holland.	18- 2-1969 & 19- 2-1969	Some aspects of ferrite technology and applications. Some new developments in design and manufacture of capacitors.
Prof. A. Srinivasan, Research and Development Engineer, Hackbridge Hewettic and Easun Limited, Madras.	7- 4-1969	Problems in Transformer Manu- facture.
Dr. Karl N. Reid, Junior Associate Professor of Aeronautical and Mechanical Engineering, Oklahoma State University, U.S.A.	9- 4-1968	Fluidics.
Dr. D. E. Pearson, Bell Telephone Laboratories, U.S.A.	30- 6-1969	Picture Telephones.

Humanities and Social Sciences

Prof. Kuzmin, U.S.S.R.	16-10-1968	Economic Planning.
Dr. F. Weitz, Sociologist, West Germany.	17- 2-1969 & 18- 2-1969	The problem of leisure-time activities.

Name of visiting Scientist	Dates	Topic of Seminar/Lecture
Mathematics		
Dr. N. E. Joshi, Nagpur University.	28-10-1968 to 7-11-1968	Theory of Distributions and Partial Differential Equations.
Mechanical Engineering		
Prof. Anioutine, UNESCO Expert, Maulana Azad College of Technology, Bhopal.	7-10-1968 to 9-10-1968	Selected topics in Turbomachines.
Prof. Dr. Kurt Talke, Technical University, Stuttgart.	8-11-1968	Involute Gear.

**DEPUTATION OF INSTITUTE FACULTY MEMBERS/
RESEARCH SCHOLARS TO CONFERENCES, SYMPOSIA,
SUMMER SCHOOLS ETC.**

Programme	Venue	Date	Name of Staff Member/ Research Scholar
1. Applied Mechanics			
Sequential Summer School in Civil Engineering.	I.I.T., Bombay	May-June 1969	Mr. K. N. Rama- chandran, Technical Teacher Trainee
2. Chemical Engineering			
Conference on Chemical Engineering Education — Organised by European Federation of Chemical Engineers.	Churchill College, Cambridge, U.K.	10- 7-1968 to 12- 7-1968	Dr. D. Venkates- warlu
Annual Session of German Chemical Engineers.	University of Stuttgart	1-10-1968 to 3-10-1968	Dr. K. Subba Raju
All India Symposium on Refrigeration, Air Condition- ing and Environmental Control in the Cold Storage Industry.	I.I.T., Kanpur	29-11-1968 & 30-11-1968	Dr. H. H. R. Bock
Annual Session of Indian Institute of Chemical Engineers.	I.I.T., Bombay	28-12-1968 to 30-12-1968	Dr. D. Venkates- warlu Dr. H. H. R. Bock Dr. M. Rama- nujam
Annual Session of Indian Institute of Mineral Engineers.	I.I.T., Bombay	2- 1-1969	Dr. D. Venkates- warlu

Programme	Venue	Date	Name of Staff Member/ Research Scholar
3. Chemistry			
Seminar on Surface Chemistry and Solid State Decomposition.	I.I.T., Delhi	23- 9-1968	Dr. M. V. C.
		to 25- 9-1968	Sastri Dr. J. C. Kuria- cose Dr. V. Srinivasan & Shri B. Viswa- nathan
Ninth Seminar in Electro-Chemistry.	CECRI, Karaikudi	26-12-1968 to 29-12-1968	Dr. R. Narayan
Joint Convention of the CSIR Chemical Research Committee.	Hyderabad	7- 2-1969	Dr. C. N. Pillai
		to 9- 2-1969	Dr. V. Rama- krishnan
4. Civil Engineering			
Visit of Technical Institutions.	Israel, Greece, Yugoslavia and Austria	} August to November, 1968	Dr. Ing. G. Rouve
Lectures in Technical Universities.	West Germany		
Bureau of Reclamation in Denver and Hydro- Projects.	Universities of IOWA, U.S.A.		
Coastal Engineering Conference.	London		
International Conference on Shear, Torsion and Bond in Reinforced and Prestressed Concrete.	P.S.G. College of Technology, Coimbatore	14- 1-1969	Dr. P. C. Var- ghese
		to 17- 1-1969	Dr. J. Plaehn Dr. P. S. Rao Dr. D. J. Victor Shri C. S. Krishna- moorthy

Programme	Venue	Date	Name of Staff Member/ Research Scholar
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5. Electrical Engineering

Symposium on Antennas.	Bangalore	24- 8-1968 to 26- 8-1968	Dr. P. Besslich Dr. D. K. Banerjee
Symposium on Electrical Insulating Materials.	Warangal	10-10-1968 to 12-10-1968	Shri C. Narayana Reddy
Twelfth Convention of the Institution of Telecommunication Engineers.	New Delhi	December 1968	Shri P. C. Majheo
Annual Convention of the Institution of Telecommunication Engineers	New Delhi	14-12-1968 & 15-12-1968	Dr. P. Besslich
Intensive Course on Solid State Power Controllers and Frequency Converters.	Kanpur	24- 3-1969 to 29- 3-1969	Shri C. Venkateshaiah
Intensive Course on Computation Techniques in Control Systems Design.	Kanpur	8- 5-1969 to 5- 6-1969	Shri P. Sasidhara Rao
Summer School in Solid State Devices.	CEERI, Pilani	5- 5-1969 to 31- 5-1969	Dr. C. Dattatreyan

6. Humanities and Social Sciences

All India Conference in Psychology.	Indian Academy of Applied Psychology, Mysore	27-12-1968 to 29-12-1968	Shri T. N. Govindarajan
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Programme	Venue	Date	Name of Staff Member/ Research Scholar
Humanities and Social Sciences (Contd.):			
English Teachers' Conference.	Bangalore	29-12-1968 to 31-12-1968	Prof. A. L. Krishnan Dr. A. V. Krishna Rao
Seminar on Management Education in India under the auspices of the V. L. Mehta National Institution of Co-operative Training and Management.	Poona	22- 1-1969 to 24- 1-1969	Prof. R. K. Gupta
7. Mathematics			
Thirteenth Conference of the Indian Society of Theoretical and Applied Mechanics (ISTAM).	CMERI, Durgapur	26-12-1968 to 29-12-1968	Prof. S. D. Nigam Shri S. N. Majhi
Summer School in Advanced Numerical Analysis.	I.I.T., Delhi	20- 5-1969 to 15- 6-1969	Dr. N. V. Koteswara Rao
8. Mechanical Engineering			
Second All India M.T.D.R. Conference.	Bangalore	July 1968	Dr. V. C. Venkatesh
Small Tools Seminar, ASTME, India Chapter.	Bombay	September 1968	Dr. V. C. Venkatesh
Seminar held in Heavy Electricals.	Bhopal	August 1968	Shri M. N. Viswanathan
Seventh International Conference on the Properties of Steam.	Tokyo	September 1968	Prof. L. Narjes
All India Symposium on Refrigeration.	I.I.T., Kanpur	December 1968	Prof. L. Narjes

Programme	Venue	Date	Name of Staff Member/ Research Scholar
9. Metallurgy			
Seminar on Foundry Fluxes.	Madras	2- 9-1968	Shri H. Md. Roshan
		3- 9-1968	Shri O. Prabhakar
Annual Convention of the Institute of Indian Foundrymen.	I.I.T., Madras	8- 3-1969	Shri H. Md. Roshan
		10- 3-1969	Shri O. Prabhakar
10. Physics			
International Conference in Colour Centres.	Rome	September 1968	Dr. W. Koch Dr. C. Ramasastry
Lattice Dynamics Symposium.	I.I.Sc., Bangalore	August 1968	Dr. R. Srinivasan Shri R. Ramji Rao
Solid State and Nuclear Physics Symposium (BARC).	I.I.T., Bombay	December 1968	Dr. C. Ramasastry Shri R. Ramji Rao Shri S. Srinivasan Shri V. Ramchandran Shri J. Majhi Shri N. Hariharan
International Symposium on Non-metallic Crystals.	I.I.T., Delhi	January 1969	Dr. W. Koch Dr. C. Ramasastry Dr. S. B. S. Sastry Dr. Y. V. G. S. Murthi Sri B. S. V. S. R. Acharyulu

Programme	Venue	Date	Name of Staff Member/ Research Scholar
Physics (Contd.) :			
Summer School in Quantum Chemistry at the Centre of Advanced Study in Biophysics.	University of Madras	25- 5-1969 to 14- 6-1969	Dr. S. B. S. Sastry Shri V. S. Murthy Sri Tripathi

**SPECIAL LECTURES DELIVERED BY FACULTY MEMBERS
ON INVITATION FROM OUTSIDE BODIES**

Organisation	Date	Subject	Name of the Speaker
Chemical Engineering			
Indian Institute of Science, Bangalore.	26- 3-1969	1. Characteristics of Powder	Dr. D. Venkateswarlu
	27- 3-1969	2. Some problems on Particulate Technology	
Chemistry			
University of Madras (A. C. College) (Summer School in Organic Chemistry)	20- 8-1968	& Chromatography	Dr. C. N. Pillai
	21- 8-1968		
-do-	22- 8-1968	Organic Photo-chemistry	Dr. V. Ramakrishnan
	23- 8-1968		
Indian Institute of Technology, Delhi, (Symposium on Surface Chemistry and Solid State Decomposition).	25-10-1968	Mixed Gas Absorption	Dr. M. V. C. Sastri
Vivekananda College, Madras (Chemical Society)	25-11-1968	Electron Transfer Reactions	Dr. G. Aravamudan
-do-	29-11-1968	New frontiers in Inorganic Chemistry	Dr. M. M. Taqui Khan

Organisation	Date	Subject	Name of the Speaker
Civil Engineering			
College of Engineering, Guindy, Madras.	28- 1-1969	Shell Structures	Dr. P. C. Varghese
		Effect of Code formulations on Construction Industry	Dr. P. S. Rao
		Constructional Aspects of Tall Chimneys	Dr. D. J. Victor
Indian Institute of Science, Bangalore.	Jan. 1969	Technical Lectures	Dr. G. Rouve
Institute of Engineers (India), Bangalore.	Jan. 1969	Technical Lectures	Dr. G. Rouve
Electrical Engineering			
Madras Institute of Technology, Chromepet.	17- 3-1969	Colour Television	Dr. P. Besslich
Neyveli Lignite Corporation & Institution of Engineers (India), Neyveli Centre.	22- 6-1969	Use of Computers in Process Control	Prof. S. Sampath
Humanities and Social Sciences			
Loyola College, Madras.	30- 1-1969	The Psycho-Dynamics of Leadership	Shri T. N. Govindarajan
Association of Textile Technologists.	11- 2-1969	Industrial Psychology	Shri T. N. Govindarajan
	13- 2-1969		

Organisation	Date	Subject	Name of the Speaker
Mathematics			
Matscience, Madras.	Jan. 1969	Stochastic Theory and Application (course of six lectures)	Dr. S. K. Srinivasan
		Recent Develop- ments in Theore- tical Physics and Mathematics	Dr. S. K. Srinivasan
Mechanical Engineering			
Indian Institute of Science. Bangalore.	Feb. 1969	Application of Exergy to Com- bustion and Heat Transfer Exergie and Optimization Procedures for Airconditioning and Refrigeration Units Optimization Method for Jet- Propulsion with respect to Exergie	Prof. L. Narjes
Metallurgy			
Institute of Indian Foundrymen Annual Convention, 1969.	8- 3-1969	Technical and economic aspects of casting and welding	Dr. H. E. D. Zuern
	10- 3-1969	Solidification of Metals	Dr. E. G. Ramachandran
Physics			
Indian Institute of Science, Bangalore.	26- 5-1969	Lattice Dynamics to and Thermal Pro- 4- 6-1969 perties of Crystals	Dr. R. Srinivasan

SECTION II

Section II

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THE BOARD OF GOVERNORS

The Board of Governors met three times during the year. The following were the members on the Board during the year:

Chairman

- Dr. A. L. Mudaliar, Vice-Chancellor, University of Madras, Madras
(till 3—1—1969)
- Shri H. V. R. Iengar, Chairman, The E.I.D.-Parry Group, Madras
(from 4—1—1969)

Members

- Dr. A. Ramachandran, Director, I.I.T., Madras.
- Shri T. R. Doss, Director of Technical Education, Government of Andhra Pradesh, Hyderabad.
- Dr. B. L. Shantamallappa, Director of Technical Education, Government of Mysore, Bangalore.
- Prof. K. C. Chacko, Director of Technical Education, Government of Kerala, Trivandrum. (till 31—10—1968)
- Dr. D. S. Reddy, Vice-Chancellor, Osmania University, Hyderabad. (till 31—10—1968)
- Dr. K. S. G. Doss, Chemicals & Plastics India Limited, Madras. (till 31—10—1968)
- Shri P. M. Reddy, Hyderabad. (till 31—10—1968)
- Prof. Samuel Mathai, Vice-Chancellor, Kerala University, Trivandrum. (till 31—10—1968)
- Shri T. Muthian, Director of Technical Education, Government of Tamil Nadu, Madras. (till 6—4—1969)
- Shri C. B. Cariapa, General Manager, Bharat Heavy Electricals Limited, Unit: Ramachandrapuram, Hyderabad. (from 1—11—1968)
- Prof. V. K. Gokak, Vice-Chancellor, Bangalore University, Bangalore. (from 1—11—1968)
- Shri A. K. Kaderkuty, The Western India Plywoods Limited, Balia-patam, Cannanore District, Kerala. (from 1—11—1968)
- Dr. Y. Nayudamma, Director, Central Leather Research Institute, Adyar, Madras. (from 1—11—1968)
- Shri S. Peer Mohammed, General Manager, ALIND, Kundara, Kerala. (from 1—11—1968)

The Board of Governors (contd.):**Members (Contd.)**

Dr. P. C. Varghese, Head of the Department of Civil Engineering,
I.I.T., Madras.

Dr. R. J. H. Bisanz, Professor, Department of Chemical Engineering,
I.I.T., Madras. (till 30—4—1969)

Dr. Hans Wagner, Professor, Department of Applied Mechanics,
I.I.T., Madras. (from 1—5—1969)

Secretary

Shri C. V. Sethunathan, Registrar, I.I.T., Madras.

BUILDINGS AND WORKS COMMITTEE

The Buildings and Works Committee met two times during the year. The following were the members of the Buildings and Works Committee during the year.

Chairman

Dr. A. L. Mudaliar, Chairman, Board of Governors, I.I.T., Madras
(till 3—1—1969)

Shri H. V. R. Iengar, Chairman, Board of Governors, I.I.T., Madras
(from 4—1—1969)

Members

Dr. A. Ramachandran, Director, I.I.T., Madras.

Shri M. E. Hussain, Chief Engineer, Public Works Department,
Madras (till 24—7—1968)

Shri D. Henry David, Chief Engineer (General), Public Works Department,
Madras (from 25—7—1968)

Shri V. Narayanan, Superintending Engineer, Central Public Works
Department, Madras.

Shri S. Nagarajan, Superintending Engineer, I.I.T., Madras.

Dr. P. C. Varghese, Head of the Department of Civil Engineering,
I.I.T., Madras.

Secretary

Shri C. V. Sethunathan, Registrar, I.I.T., Madras.

FINANCE COMMITTEE

The Finance Committee met once during the year. The following served on the Committee during the year.

Chairman

Dr. A. L. Mudaliar, Chairman, Board of Governors, I.I.T., Madras
(till 3—1—1969)

Shri H. V. R. Iengar, Chairman, Board of Governors, I.I.T., Madras
(from 4—1—1969)

Members

Dr. A. Ramachandran, Director, I.I.T., Madras.

Shri G. N. Vaswani, Deputy Educational Adviser, (Tech.), Ministry of
Education & Youth Services, Government of India, New Delhi.

Dr. (Miss) Kaumudi, Deputy Financial Adviser (Education), Govern-
ment of India, New Delhi.

Shri P. M. Reddy, Hyderabad (till 31-10-1968).

Shri C. B. Cariapa, General Manager, Bharat Heavy Electricals
Limited, Hyderabad (from 1-11-1968).

Shri T. Muthian, Director of Technical Education, Government of
Tamil Nadu (till 6-4-1969).

Secretary

Shri C. V. Sethunathan, Registrar, I.I.T., Madras.

THE SENATE

The Senate met 6 times during the year. The following served on the Senate during the year under review :

Chairman

Dr. A. Ramachandran (*Director*).

External Members

Prof. T. Balakrishnan Nayar, "Chitra", Kilpauk Gardens Road,
Madras-10.

Dr. P. L. Bhatnagar, Vice-Chancellor, University of Rajasthan, Jaipur.

Dr. G. S. Laddha, Director, A. C. College of Technology, Madras

Internal Members

Dr. M. K. Achuthan

Dr. D. K. Banerjee

Dr. G. R. Bechtloff
(*Till 25-1-1969*)

Dr. P. Besslich

Dr. R. J. H. Bisanz
(*Till 30-4-1969*)

Dr. H. H. R. Bock

Prof. N. K. Datta

Mr. E. J. Ebert
(*From 9-3-1969*)

Dr. (Mrs.) Edith Butenuth
(*From 3-10-1968*)

Dr. Gottfried Butenuth
(*From 3-10-1968*)

Dr. M. C. Gupta

Prof. R. K. Gupta

Dr. E. Hohmann

Dr. A. Klein

Dr. N. Klein

Dr. W. Koch

Prof. A. L. Krishnan
(*Till 10-5-1969*)

Prof. F. W. Lohr
(*Till 31-8-1968*)

Mr. S. S. Mani

Dr. H. W. Meyer

Dr. B. S. Murthy

Dr. V. G. K. Murthi

Prof. R. G. Narayanamurthi

Dr. L. Narjes

Mr. V. S. Nazir Ahmed

Dr. S. D. Nigam

Dr. K. A. V. Pandalai

Dr. J. Plaehn

Dr. E. G. Ramachandran

Dr. C. Ramasastry

Dr. D. V. Reddy

Dr. G. Rouve

Prof. S. Sampath (*Deputy Director*)

Dr. M. V. C. Sastri

Dr. W. Scheer

(*Till 29-4-1969*)

Dr. A. Seifert

(*From 7-2-1969*)

Dr. V. Sethuraman

Dr. S. K. Srinivasan

Dr. G. Stahl

(*Till 30-4-1969*)

Dr. P. C. Varghese

Dr. P. Venkata Rao

Dr. D. Venkateswarlu

Dr. M. Venugopal

Dr. H. Wagner

Dr. H. W. Wagener

Dr. H. E. D. Zuern

Secretary

Shri C. V. Sethunathan (*Registrar*)

STAFF

Dr. A. Ramachandran, Prof. S. Sampath and Shri C. V. Sethunathan continued in the posts of Director, Deputy Director and Registrar respectively.

During the year under review, the Institute had the privilege of welcoming German staff members, assigned to the Institute under the Second Indo-German Agreement, as detailed below:—

(1) Professor	...	1
(2) Associate Professors	...	2
(3) Senior Scientific Assistants	...	7
(4) Lecturer	...	1
(5) Technical Staff	...	2

Five German Professors and three Senior Scientific Assistants left for West Germany on completion of their assignments. Details are furnished in **Annexure I** to this Section.

During the year, fifteen Assistant Professors, seventeen Lecturers and nineteen Associate Lecturers were appointed. These include the appointment of four Lecturers as Assistant Professors, five Associate Lecturers and one Senior Technical Assistant as Lecturers and three Senior Technical Assistants as Associate Lecturers. Three Assistant Professors, three Lecturers and seven Associate Lecturers resigned, while one Professor and one Assistant Professor retired from service in the Institute. Details regarding the staff position are given in **Annexure II** to this Section.

Under the provisions of the Second Indo-German Agreement, the Institute deputed fourteen Indian members of the staff for training in West German Technical Universities on long-term visits, while five Indian members of the staff were deputed for training on short-term visits. Eight members of the staff have gone abroad under different schemes. Details are given in **Annexure III** to this Section.

Shri C. V. Sethunathan, Registrar, visited West Germany on a short-term information-cum-study tour.

GERMAN STAFF MEMBERS

Name	Department/Laboratory	Date of joining
Incoming Staff Members		
Professor		
Dr. G. Butenuth	Chemistry Department— Inorganic & High Polymer Laboratory	3-10-1968
Associate Professors		
1. Dr. (Mrs.) Edith Butenuth	Metallurgy Department	3-10-1968
2. Dr. Albrecht Seifert	Chemical Engineering Department	7 -2-1969
Senior Scientific Assistants		
1. Mr. Jurgen Geiger	Applied Mechanics Department— Fluid Mechanics Laboratory	9 -7-1968
2. Mr. Peter Meissner	Chemical Engineering Department— Mechanical Process Engineering Laboratory	18- 9-1968
3. Mr. Sigfrid Michelfelder	Chemical Engineering Department— Chemical Process Engineering Laboratory	24- 9-1968
4. Mr. Klaus Hartmann	Applied Mechanics Department— Machine Dynamics & Vibrations Laboratory	3- 10-1968
5. Mr. Manfred Marckmann	Electrical Engineering Department— Electric Power Engineering Laboratory	7- 10-1968
6. Dr. Heiner Cordes	Civil Engineering Department— Structures Laboratory	11-12-1968
7. Mr. F. H. Guenther	Metallurgy Department— Hot & Cold Working of Metals Laboratory	21- 2-1969

Name	Department/Laboratory	Date of joining
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Lecturer

Mrs. Ortraud Narjes	Mathematics & Applied Mechanics Departments	1- 7-1968
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Technical Staff

1. Mr. Manfred Rehkop	Metallurgy Department — Hot & Cold Working of Metals Laboratory	8- 5-1968
2. Mr. Heinz Ansorge	Electrical Engineering Department— Electronic & Precision Instrument Workshop	20-12-1968

Outgoing Staff Members

Name	Department/Laboratory	Date of leaving
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Professors

1. Prof. F. W. Lohr	Mechanical Engineering Department— Machine Tools Laboratory	31- 8-1968
2. Dr. G. R. Bechtloff	Mechanical Engineering Department— Machine Elements & Mechanical Handling Laboratory	26- 1-1969
3. Dr. W. Scheer	Mechanical Engineering Department— Turbomachines Laboratory	29- 4-1969
4. Dr. G. Stahl	Mechanical Engineering Department— I.C. Engines Laboratory	30- 4-1969

Name	Department/Laboratory	Date of leaving
5. Dr. R. J. H. Bisanz	Chemical Engineering Department— Heat & Mass Transfer Laboratory	30- 4-1969
Senior Scientific Assistants		
1. Mr. Hartwig Peter	Metallurgy Department	27-12-1968
2. Mr. Helmut Conen	Mechanical Engineering Department— I.C. Engines Laboratory	19- 4-1969
3. Mr. W. Rohrbach	Civil Engineering Department— Hydraulics Laboratory	2- 5-1969

APPOINTMENTS, RESIGNATIONS & RETIREMENTS

APPOINTMENTS

Assistant Professors

- | | |
|------------------------|----------------------------------|
| 1. Dr. K. Thulasiraman | 9. Dr. R. C. Raichura |
| 2. Dr. A. Kuppurajulu | 10. Dr. (Miss) Jyoti Chauduri |
| 3. Dr. M. Ramanujam | 11. Dr. D. Prithviraj |
| 4. Dr. M. M. Taquikhan | 12. Sri. M. A. Parameswaran |
| 5. Dr. Y. Narayana Rao | 13. Dr. Vincent X. Kunukkasseril |
| 6. Dr. V. G. Kubair | 14. Dr. P. Venkateswarlu |
| 7. Dr. K. M. Das | 15. Dr. C. Dattatreyan |
| 8. Sri K. A. Damodaran | |

Lecturers

- | | |
|-------------------------|------------------------------|
| 1. Sri V. V. Sastry | 10. Dr. Y. Nagendra |
| 2. Sri K. N. Seetharamu | 11. Sri K. N. Ramamurthy |
| 3. Sri O. Prabhakar | 12. Sri B. Venkateswara Dutt |
| 4. Sri P. C. Majhee | 13. Dr. B. M. Sivaram |
| 5. Sri H. Achyutha | 14. Sri M. Anthony Reddy |
| 6. Sri G. T. Manohar | 15. Dr. M. V. Krishnamurthy |
| 7. Sri S. Krishnan | 16. Dr. M. Mukunda Rao |
| 8. Dr. R. S. Srinivasan | 17. Sri G. Sridhara Rao |
| 9. Sri K. Elango | |

Associate Lecturers

- | | |
|-----------------------------|-----------------------------------|
| 1. Sri K. Ramar | 11. Sri G. John Sundar Rao |
| 2. Sri A. Venkatesh | 12. Miss. V. Hamsaleelavathi |
| 3. Sri C. Eswaran | 13. Sri D. R. Gopalakrishna Achar |
| 4. Sri P. S. Raghupathi | 14. Mrs. Padma Jayaraman |
| 5. Sri K. V. Chalapathi Rao | 15. Sri A. Abraham Kurian |
| 6. Sri A. Visweswara Rao | 16. Sri V. Muthukrishnan |
| 7. Sri C. Venkateshaiah | 17. Sri S. Sampath |
| 8. Sri P. Niranjana Reddy | 18. Sri S. Raman |
| 9. Sri S. Kaliyugavaradan | 19. Sri K. Gopalakrishnan |
| 10. Sri M. Madhusudana Rao | |

RESIGNATIONS**Assistant Professors**

1. Dr. K. Sivaprasad
2. Dr. G. N. Garud
3. Dr. R. C. Raichura

Lecturers

1. Sri V. Krishnamurthy
2. Sri A. C. Gangadharan
3. Sri S. K. Jain

Associate Lecturers

1. Sri H. V. Lakshminarayana
2. Sri A. C. Radhakrishnan
3. Sri P. K. Poulouse
4. Sri S. K. Seshadri
5. Sri G. John Sundar Rao
6. Dr. E. M. Gopalakrishna
7. Sri A. Abraham Kurian

RETIREMENTS**Professor**

Prof. A. L. Krishnan

Assistant Professor

Dr. M. S. Vairanapillai

STAFF POSITION

Staff	No. at the beginning of the year	No. joined	No. relieved	No. at the end of the year
A. Academic				
1. Director	1	—	—	1
2. Deputy Director	1	—	—	1
3. Professors	20	—	1	19
4. Assistant Professors	34	15	4	45
5. Lecturers	113	17	7	123
6. Associate Lecturers	50	19	11	58
7. Others	5	1	—	6
B. Technical	333	78	42	369
C. Technical Supporting	121	7	—	128
D. Maintenance				
1. Technical	17	—	—	17
2. Technical Supporting	9	—	—	9
3. Others	16	1	—	17
E. Construction (Temporary)				
1. Technical	19	—	2	17
2. Technical Supporting	1	—	—	1
3. Others	34	—	—	34
F. N.C.C.	12	—	1	11
G. Administrative				
Officers :				
1. Registrar	1	—	—	1
2. Assistant Registrars	2	—	—	2
3. Accounts Officer	1	—	—	1
4. Audit Officer	1	—	—	1
5. Stores Officer	1	—	—	1
6. Technical	3	—	—	3
7. Technical Supporting	57	6	1	62
8. Others	301	24	8	317

253

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DEPUTATION OF INDIAN STAFF-MEMBERS TO WEST GERMANY

Name	Duration	Institutions in Germany
Short-term Visits		
1. Dr. E. G. Ramachandran, Professor and Head of the Department of Metallurgy.	August- November 1968	Stuttgart University, Aachen, Berlin, Dusseldorf, Hannover and Industrial Establish- ments.
2. Dr. C. Ramasastry, Professor and Head of the Department of Physics.	August- November 1968	Stuttgart University, Frankfurt, Berlin, Aachen, Hamburg, Gottingen and Karlsruhe.
3. Dr. K. Subba Raju, Lecturer, Department of Chemical Engineering.	September 1968- March 1969	Stuttgart University, Berlin, Aachen, Karlsruhe.
4. Dr. D. Prithviraj, Assistant Professor, Department of Mechanical Engineering.	September- December 1968	Pfleiderer Institute, Braunschweig, Aachen, Institut fur Dampf Braunschweig, Hannover, Aachen.
5. Dr. P. C. Varghese, Professor and Head of the Department of Civil Engineering.	June- August 1969	Universities of Hannover, Braunschweig, Berlin, Hamburg, Munchen, Stuttgart, Karlsruhe, Mannheim, Zurich, Bassel, Frankfurt, Dusseldorf, Aachen and London.
6. Shri C. V. Sethunathan, Registrar.	June- July 1969	Stuttgart, Aachen, Berlin and Braunschweig Universities and Industrial Establishments.

Name	Duration	Institutions in Germany
Long-term Visits		
1. Shri P. K. Philip, Lecturer, Department of Mechanical Engineering.	September 1968- June 1970	Stuttgart University, Institut für Werkzeugmas- chinen.
2. Shri S. Vaidyanathan, Lecturer, Department of Mechanical Engineering.	December 1968- June 1970	Stuttgart University
3. Shri A. Chandrasekaran, Lecturer, Department of Electrical Engineering.	December 1968- March 1970	Technische Universtat Braunschweig Lehrstuhl für Energietechnik.
4. Shri G. V. N. Rayudu, Assistant Professor, Department of Mechanical Engineering.	December 1968- March 1970	Max-Planck-Institut für Stromungsforschung, Göttingen.
5. Dr. N. M. Raghavendra, Lecturer, Department of Chemical Engineering.	June 1969- September 1970	Stuttgart University, Institut für Verfahrenstechnik und Dampfkesselwesen.
6. Dr. Ch. Durgaprasada Rao, Lecturer, Department of Chemical Engineering.	June 1969- September 1970	Stuttgart University, Institut für Meb. und Regelungstechnik.
7. Shri V. Sriramulu, Lecturer, Department of Mechanical Engineering.	June 1969- September 1970	Technische Hochschule, Aachen
8. Shri T. Rajagopalan, Lecturer, Department of Mechanical Engineering.	June 1969- September 1970	Stuttgart University, Institut für Verfahrenstechnik und Dampfkesselwesen.

Name	Duration	Institutions in Germany
9. Shri T. P. Ganesan, Lecturer, Department of Civil Engineering.	June 1969- September 1970	Technische Hochschule Munchen Lehrstuhl and Institut fur Mechanik und Spannung- soptik.
10. Dr. V. Seshadri, Assistant Professor, Department of Electrical Engineering.	June 1969- September 1970	Braunschweig Technical University, Institut fur elekt- rische Antriebe und Regelungstechnik.
11. Shri C. Narayana Reddy, Lecturer, Department of Electrical Engineering.	June 1969- September 1970	Braunschweig Technical University, Institut fur Hochs- pannungstechnik und elektrischeanlagen.
12. Sri M. Krishnamurthy, Lecturer, Department of Electrical Engineering.	June 1969- September 1970	Braunschweig Technical University, Lehrstuhl fur Energietechnik.
13. Sri V. Subramanyam, Lecturer, Department of Electrical Engineering.	June 1969- July 1970	Technische Hochschule Aachen. Institut fur Hochfrequenz- technik.
14. Dr. P. Achuthan, Associate Lecturer, Department of Mathematics.	June 1969- September 1970	Karlsruhe University, Lehrstuhl fur Theoretische Kernphysik.

VISIT OF STAFF MEMBERS ABROAD

Name	Duration	Scheme
1. Dr. V. Anantaraman, Assistant Professor, Department of Humanities and Social Sciences.	28- 7-1968 to June 1969	International Teachers Programme, Graduate School of Business Administration, Harvard University, U.S.A.
2. Prof. R. G. Narayana- murthi, Professor and Head of the Department of Mechanical Engineering.	3 -8-1968 to 25-11-1968	Visit to Universities in the U.S.A. under the National Council for Science Education Programme.
3. Dr. B. V. Aswatha- narayana Rao, Assistant Professor, Department of Applied Mechanics.	1-10-1968 to 31- 7-1969	Alexander Von Humboldt Fellowship, Karlsruhe, West Germany.
4. Dr. R. Vasudevan, Assistant Professor, Department of Metallurgy.	11-11-1968 to 31-10-1969	-do-
5. Sri R. Ramaswamy, Senior Technical Assistant, Department of Chemistry.	26- 3-1969 to 25- 3-1970	Research Fellowship, Nuclear Research Establish- ment, Julich, West Germany.
6. Dr. S. Swaminathan, Lecturer, Department of Physics.	31- 3-1969 to 30- 3-1971	Research Fellowship, Cornell University, Ithaca, U.S.A.
7. Dr. N. Subramanian, Lecturer, Department of Chemical Engineering.	2- 5-1969 to 15- 7-1970	International Seminar in Physical Chemistry and Chemical Engineering —Karlsruhe, West Germany.
8. Dr.(Miss)V.Vasantasree, Lecturer, Department of Metallurgy.	14- 5-1969 to 9- 7-1971	Research Fellowship, Imperial College of Science and Technology, London.

DISTINGUISHED VISITORS TO THE INSTITUTE

The Institute had the honour of welcoming the following during the year:

- 6- 8-1968 Mr. Marcel Vacal, Trade Commissioner, Czechoslovak Trade Representation, Madras.
- 31- 8-1968 Mr. L. S. Chandrakant, Joint Secretary, Ministry of Education, New Delhi.
- 7-10-1968 Prof. A. Anioutine, UNESCO Expert, Maulana Azad College of Technology, Bhopal.
- 11-10-1968 Dr. S. A. Kuzmin, Chief of Department, Central Economic Mathematical Institute, Academy of Sciences, U.S.S.R.
- 14-10-1968 Dr. Max Hellmann, Head, Co-operative Sciences Activities Division, National Science Foundation, Washington.
- 23-10-1968 Dr. Ahmed El Zeiny Abid El Salam, Dean of the High Industrial Institute, Port Said, U.A.R.
- „ Dr. Medhat El Alaily, Director-General of Scientific Instruments Centre, U.A.R.
- „ Dr. Mohamed Abdou El Said, Professor of Electrical Communications, Cairo University, U.A.R.
- 7-11-1968 Dr. K. Wyneken, Head of the Department of Technical Training for University Students, German Academic Exchange Service, Bonn.
- 15-11-1968 Prof. D. C. White and Prof. Cook, Massachusetts Institute of Technology, U.S.A.
- 1-12-1968 Mr. M. Ramabrahmam, Managing Director, Madras Refineries Ltd., Madras.
- 17-12-1968 Prof. I. L. Bratchikov and Prof. I. M. Souchtchinski, UNESCO Experts, Indian Institute of Technology, Bombay.

- 21-12-1968 Dr. H. N. Sethna, Director, Babha Atomic Research Centre, Bombay.
- 23- 1-1969 Mr. S. Madhavan, Minister for Law and Co-operation, Government of Tamil Nadu, Madras.
- 21- 2-1969 Dr. Helmut Hormann, Max Planck Institute, West Germany.
- 3- 3-1969 Computer Delegation—From Technical University, Aachen, West Germany.
- (1) Prof. Dr. D. Haupt,
 (2) Dr. W. Ameling,
 (3) Dipl. Ing., F. F. Diederich and
 (4) Dipl. Ing., G. Schaefer.
- „ Prof. H. A. Havemann, Technical University, Aachen.
- 4- 4-1969 Dr. S. Dhawan, Director, Indian Institute of Science, Bangalore.
- „ Air Marshal P. C. Lal, Managing Director, Hindusthan Aeronautics Ltd., Bangalore.
- 2- 5-1969 Mr. M. Karunanidhi, Chief Minister, Government of Tamil Nadu, Madras.
- „ Mr. W. B. Russell, Director, Education Division, Commonwealth Secretariat, London.

SECTION III

Section III

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ADMISSIONS TO THE COURSES OF STUDY FOR THE 1968-69 SESSION

The number of students admitted to the various under-graduate and post-graduate courses for the 1968-69 session is given below.

Admissions to the first year of the five-year B.Tech. Degree course were regulated by the provisions of the ~~Joint~~ Entrance Examination, in which all the Indian Institutes of Technology participate.

Data pertaining to the Joint Entrance Examination (1968) are included in **Annexure I** to this Section.

Admission to the M.Sc., M. Tech. Degree Courses and the Post-graduate Diploma Courses in Chemical Engineering Practice and Industrial Engineering and for research work leading to the award of the M.S. Degree in Engineering and Ph.D. Degrees in Science/Engineering were made on the basis of the candidates previous academic records and their performance at the interviews. Staff members of the Institute were registered for research work leading to the award of M.S. and Ph.D. Degrees, on a part-time basis. Details are given below.

	Number admitted
<hr/>	
Five-Year B.Tech. Degree Course:	
Aeronautical Engineering	... 13
Chemical Engineering	... 43
Civil Engineering	... 27
Electrical Engineering (H.C.)	26 } 60
Electrical Engineering (L.C.)	34 }
Mechanical Engineering	61
Metallurgy	25
Total	229

	Number admitted
M.Sc. Degree Course:	
Chemistry	13
Mathematics	21
Physics	15
	Total
	49

	Full time	Part-time
M.Tech. Degree Course:		
Aeronautical Engineering	11	2
Chemical Engineering	22	1
Civil Engineering	23	1
Electrical Engineering	28	4
Engineering Mechanics	7	2
Mechanical Engineering	36	5
Metallurgy	5	1
	Total	
	132	16

D.I.I.T. Course :

Chemical Engineering Practice	9
Industrial Engineering	20
	Total
	29

REGISTRATION FOR RESEARCH WORK

	Number Registered	
	Full-time	Part-time
M.S. Degree :		
Aeronautical Engineering	3	2
Chemical Engineering	6	—
Civil Engineering	1	—
Electrical Engineering	1	1
Mechanical Engineering	14	—
Metallurgy	1	5
Total	26	8

Ph.D. Degree :

Aeronautical Engineering and Applied Mechanics	4	3
Chemical Engineering	5	—
Chemistry	11	1
Electrical Engineering	4	8
Humanities and Social Sciences	—	2
Mathematics	7	—
Mechanical Engineering	1	1
Metallurgy	—	3
Physics	7	1
Total	39	19

Post-Doctoral :

Aeronautical Engineering	1
Chemistry	1
Mathematics	1
Mechanical Engineering	1
Total	4

STUDENT POPULATION OF THE INSTITUTE (1968-69 SESSION)

For the academic session 1968-69, the strength of the students and research scholars in the different courses was as follows :—

Sl.No.	Course	Full-time	Part-time
1.	B. Tech. Degree	1353	...
2.	M.Sc. Degree	75	...
3.	M.Tech Degree	163	58
4.	Post-Graduate Diploma :—		
	(a) Chemical Engineering Practice	8	...
	(b) Industrial Engineering	18	...
5.	M.S. Degree	24	8
6.	Ph.D. Degree	68+7*	107+2*
7.	Post-Doctoral Fellows	4	...
*Completed	Total	1720	175

The above figures include 24 students from abroad :

Ceylon	9	Tanzania	2
Malaysia	2	Thailand	1
Nepal	10		
		Total	24

A statement giving particulars of the research scholars working at the Institute is included as **Annexure II** to this Section.

The number of students on the rolls in the various courses of study is set out below :—

Course and Year	Number
Five-Year B.Tech. Degree Course :	
I Year	217
II Year	229
III Year	222
Aeronautical Engineering	20
Chemical Engineering	30
Civil Engineering	32
Electrical Engineering	47
Mechanical Engineering	63
Metallurgy	30

Course and Year	Number
Five-Year B.Tech. Degree Course (Contd.) :	
IV Year :	241
Aeronautical Engineering	21
Chemical Engineering	30
Civil Engineering	47
Electrical Engineering	52
Mechanical Engineering	61
Metallurgy	30
V Year :	204
Aeronautical Engineering	14
Chemical Engineering	39
Civil Engineering	21
Electrical Engineering	42
Mechanical Engineering	69
Metallurgy	19
Total	<u>1113</u>
Three-Year B.Tech. Degree Course :	
II Year :	118
Chemical Engineering	20
Civil Engineering	22
Electrical Engineering	49
Mechanical Engineering	27
III Year :	122
Chemical Engineering	29
Civil Engineering	9
Electrical Engineering	55
Mechanical Engineering	29
Total	<u>240</u>
5 year & 3 year B.Tech Total	<u>1353</u>

Course and Year		Number
M.Sc. Degree Course :		
Chemistry :		
I Year		13
II Year		7
Mathematics :		
I Year		18
II Year		10
Physics :		
I Year		14
II Year		13
	Total	75

Course and Year	Number	
	Full-time	Part-time

M.Tech. Degree Course :**Aeronautical Engineering :**

I Year	11	3
II Year	...	

Chemical Engineering :

I Year	18	4
II Year	12	

Course and Year	Number	
	Full-time	Part-time
Civil Engineering :		
I Year	17	5
II Year	18	
Electrical Engineering :		
I Year	21	17
II Year	9	
Engineering Mechanics :		
I Year	6	3
II Year	6	
Mechanical Engineering :		
I Year	32	25
II Year	8	
Metallurgy :		
I Year	5	1
Total	<u>163</u>	<u>58</u>
D.I.T. :		
Chemical Engineering Practice	8	
Industrial Engineering	18	
Total	<u>26</u>	
Research Scholars :		
M.S. Degree :		
Aeronautical Engineering	3	2
Chemical Engineering	6	...
Electrical Engineering	...	1
Mechanical Engineering	14	...
Metallurgy	1	5
Total	<u>24</u>	<u>8</u>

Course and Year	Number	
	Full-time	Part-time
Research Scholars (Contd.):		
Ph.D. Degree :		
Aeronautical Engineering	...	4
Applied Mechanics	3	8
Chemical Engineering	9	8
Chemistry	16+4*	4+1*
Civil Engineering	3	17+1*
Electrical Engineering	7	19
Humanities & Social Sciences	...	2
Mathematics	15+1*	4
Mechanical Engineering	2	22
Metallurgy	...	4
Physics	13+2*	15
* Completed	Total	68+7*
		107+2*

Post-Doctoral Fellows :

Aeronautical Engineering	1
Chemistry	1
Mathematics	1
Mechanical Engineering	1
Total	4

PROMOTION PATTERN

Results of the Examinations held during the 1968-69 Session

Course and Year	No. appeared	No. passed
1. Five-Year B. Tech. Degree Course:		
I Year	216	211
II Year	230	218
III Year		
Aeronautical Engineering	20	20
Chemical Engineering	29	28
Civil Engineering	31	27
Electrical Engineering	47	46
Mechanical Engineering	64	56
Metallurgy	30	29
	221	206
IV Year		
Aeronautical Engineering	20	20
Chemical Engineering	30	29
Civil Engineering	47	41
Electrical Engineering	52	48
Mechanical Engineering	58	57
Metallurgy	30	29
	237	224
V Year		
Aeronautical Engineering	14	14
Chemical Engineering	39	39
Civil Engineering	21	20
Electrical Engineering	41+1*	38+1*
Mechanical Engineering	69	66
Metallurgy	18	18
	203	196

*completed the course in August 1968

Course and Year	I Term		II Term	
	No. appeared	No. passed	No. appeared	No. passed
2. Three-Year B.Tech Degree Course :				
II Year				
Chemical Engineering	20	20	20	20
Civil Engineering	23	20	22	21
Electrical Engineering	46	42	48	34
Mechanical Engineering	27	23	27	24
	<hr/>	<hr/>	<hr/>	<hr/>
	116	105	117	99
	<hr/>	<hr/>	<hr/>	<hr/>
III Year				
Chemical Engineering	29	29	29	29
Civil Engineering	9	8	9	8
Electrical Engineering	57	52	55	51
Mechanical Engineering	28	27	29	28
	<hr/>	<hr/>	<hr/>	<hr/>
	123	116	122	116
	<hr/>	<hr/>	<hr/>	<hr/>
3. M.Sc. Degree Course :				
I Year				
Chemistry	13	12	13	11
Mathematics	21	16	18	13
Physics	13	12	14	14
	<hr/>	<hr/>	<hr/>	<hr/>
	47	40	45	38
	<hr/>	<hr/>	<hr/>	<hr/>
II Year				
Chemistry	9	6	7	5
Mathematics	9	7	10	9
Physics	14	10	13	10
	<hr/>	<hr/>	<hr/>	<hr/>
	32	23	30	24
	<hr/>	<hr/>	<hr/>	<hr/>

Course and year	I Term		II Term	
	No. appeared	No. passed	No. appeared	No. passed
4. M.Tech Degree Course :				
I Year:				
(a) Aeronautical Engineering	10	10	10	7
(b) Chemical Engineering	19	15	16	12
(c) Civil Engineering	17	12	16	14
(i) Structural Engineering	7	5	7	7
(ii) Hydraulics	5	3	4	2
(iii) Soil Mechanics and Foundation Engineering	5	4	5	5
(d) Electrical Engineering	17	11	17	15
(i) Control Systems	4	4	4	4
(ii) Measurements	4	1	4	3
iii) Power Systems	5	3	5	4
(iv) Electronics	4	3	4	4
(e) Engineering Mechanics	6	5	6	4
(f) Mechanical Engineering	30	27	30	20
(i) Machine Design	7	7	7	5
(ii) Machine Tools	5	5	5	5
(iii) Mechanical Handling	6	6	6	4
(iv) Thermal Sciences	12	9	12	6
(g) Metallurgy	5	5	5	5
II Year:				
(a) Chemical Engineering	12	12	12	12
(b) Civil Engineering	8	8	18	18
(i) Structural Engineering	5	5	7	7
(ii) Hydraulics	1	1	5	5
(iii) Soil Mechanics and Foundation Engineering	2	2	6	6

Course and Year	I Term		II Term	
	No. appeared	No. passed	No. appeared	No. passed
II Year (Contd.) :				
(c) Electrical Engineering	12	12	14	14
(i) Control Systems	1	1	4	4
(ii) Measurements	3	3	4	4
(iii) Power Systems	4	4	3	3
(iv) Electronics	4	4	3	3
(d) Engineering Mechanics			6	6
(e) Mechanical Engineering	6	6	19	19
(i) Machine Design	3	3	13	13
(ii) Machine Tools	3	3	6	6
			No. appeared	No. passed
5. D.I.T.				
Chemical Engineering Practice (1968-69)			4	4
Industrial Engineering (1967-68)			20	20

NUMBER QUALIFIED FOR THE DEGREES/DIPLOMAS

The following number of students/scholars qualified themselves for the award of various Degrees/Diplomas at the Sixth Convocation of the Institute :

Degree	Number			Total
	I Class with distinction	I Class	II Class	
B. Tech. (Five-Year Course)	7	136	53	196
B. Tech (Three -Year Course)	1	83	41	125
M.Sc.	3	17	10	30
M.Tech	2	60	14	76
D.I.T.				
Chemical Engineering Practice		3	1	24
Industrial Engineering		14	6	
Ph.D.				
Chemistry	6			19
Civil Engineering	2			
Electrical Engineering	1			
Mathematics	6			
Mechanical Engineering	1			
Physics	3			
			Total	470

PATTERN OF GRADUATION
(1964-69)

The Institute has held five Convocations so far. The Sixth Convocation representing the culmination of the academic activities for the year 1968-69 will be held in August, 1969.

The number of candidates who were awarded Degrees/Diplomas at the first five Convocations and the number to be awarded at the Sixth Convocation are as follows:

	Awarded at the First Five Convocations (1964-68)	To be awarded at the Sixth Convocation (1969)	Total
B.Tech.	961	321	1282
M.Sc.	91	30	121
M.Tech.	148	76	224
D.I.I.T.	19	24	43
Ph.D.	25	19	44
Grand Total	1244	470	1714

Details of the number of candidates under each field of specialisation are given in the following Table.

TABLE :

Field of specialisation	Number upto Fifth Convocation (1968)	Number for Sixth Convocation (1969)		Total
		5 Year	3 Year	
1. B.Tech. Degree :				
(a) Aeronautical Engineering	12	14	...	26
(b) Chemical Engineering	165	39	30	234
(c) Civil Engineering	135	20	12	167
(d) Electrical Engineering	229	39	54	322
(e) Mechanical Engineering	304	66	29	399
(f) Metallurgy	116	18	...	134
Total	961	196	125	1282
2. M.Sc. Degree :				
(a) Chemistry	28	...	5	33
(b) Mathematics	23	...	13	36
(c) Physics	40	...	12	52
Total	91	...	30	121
3. M.Tech. Degree :				
(a) Chemical Engineering	38	...	12	50
(b) Civil Engineering	43	...	18	61
(c) Electrical Engineering	44	...	17	61
(d) Engineering Mechanics	...	...	6	6
(e) Mechanical Engineering	23	...	23	46
Total	148	...	76	224
4. D.I.T.:				
(a) Chemical Engineering Practice	...	...	4	4
(b) Industrial Engineering	19	...	20	39
Total	19	...	24	43
5. Ph. D. Degree:				
(a) Chemical Engineering	3	...	...	3
(b) Chemistry	4	...	6	10
(c) Civil Engineering	1	...	2	3
(d) Electrical Engineering	3	...	1	4
(e) Mathematics	8	...	6	14
(f) Mechanical Engineering	2	...	1	3
(g) Physics	4	...	3	7
Total	25	...	19	44
Grand Total	1244	...	470	1714

Annexure I
JOINT ENTRANCE EXAMINATION 1968
 Number of applications received from candidates
 in the Southern Zone for admission to the I Year Class
 of the five-year B.Tech. Degree Course.

Serial no.	State	First choice of Institute					Total
		Bombay	Delhi	Kanpur	Kharagpur	Madras	
1.	ANDHRA	47	22	36	192	523	820
2.	ASSAM	...	...	...	...	...	...
3.	BIHAR	...	...	...	...	...	...
4.	DELHI	1	5	...	...	5	6
5.	GUJARAT	4	...	...	...	...	9
6.	GOA	...	...	...	...	...	...
7.	HARYANA	...	1	1	...	...	2
8.	KERALA	36	13	12	85	430	576
9.	MADHYA PRADESH	...	...	...	...	...	...
10.	MADRAS	19	13	12	85	1487	1616
11.	MAHARASHTRA	6	2	2	2	4	16
12.	MYSORE	200	22	20	86	330	658
13.	ORISSA	...	1	...	2	...	3
14.	PONDICHERY	...	...	...	2	15	17
15.	PUNJAB	1	2	3	...	1	7
16.	RAJASTHAN	3	...	...	2	3	8
17.	UTTAR PRADESH	...	1	9	...	...	10
18.	WEST BENGAL	...	...	1	5	5	11
19.	FOREIGN COUNTRIES	...	1	...	3	21	25
Total		317	83	96	464	2824	3784

STATEMENT No. 2: Number of candidates who actually appeared for the Joint Entrance Examination in the various centres in the Southern Zone

Sl. No.	Centre	GROUP-A				GROUP-B		
		Maths.	English	Physics	Chemistry	Phy. & Chem.	Drawing	Drawing
1.	ANANTAPUR	25	25	21	21	3	3	3
2.	HYDERABAD	213	208	188	180	9	9	9
3.	KAKINADA	95	95	92	89	2	2	2
4.	SECUNDERABAD	57	55	53	46	2	2	2
5.	TIRUPATI	35	34	33	33	1	1	...
6.	VIJAYAWADA	112	108	108	102	...	...	...
7.	WALTAIR	70	70	61	59	5	5	5
8.	GUNTUR	72	70	66	62	1	1	1
9.	CALICUT	47	45	42	37	...	...	...
10.	TRICHUR	64	64	61	59	1	1	1
11.	TRIVANDRUM	162	161	152	150	3	3	3
12.	ERNAKULAM	155	151	147	134	1	1	1
13.	CHIDAMBARAM	56	56	56	56	...	...	...
14.	COIMBATORE	122	118	113	109	3	3	3
15.	MADRAS							
	(A. M. Jain College)	238	238	230	220	5	5	5
16.	MADRAS							
	(Pachaiyappa's College)	269	265	236	226	21	21	21
17.	MADRAS							
	(Sir Theagaraya College)	63	62	57	56	5	5	5

Sl. No.	Centre	GROUP-A			GROUP-B		
		Maths.	English	Physics	Chemistry	Phy. & Chem.	Drawing
18.	MADRAS (Vivekananda College) ...	383	377	352	345	24	23
19.	MADURAI ...	183	180	168	160	1	1
20.	SALEM ...	64	63	59	58	4	4
21.	TIRUCHIRAPPALLI ...	206	206	200	195	4	4
22.	BANGALORE (National College) ...	130	130	128	120	3	3
23.	BANGALORE (St. Joseph's College) ...	160	157	152	149	6	6
24.	DHARWAR ...	161	156	152	138	1	1
25.	MANGALORE ...	65	65	61	59	1	1
26.	MYSORE ...	50	50	46	45	4	4
		<u>3257</u>	<u>3209</u>	<u>3034</u>	<u>2908</u>	<u>110</u>	<u>108</u>

STATEMENT NO. 3: Branch-wise and State-wise distribution of the candidates admitted

State	Mech.	Aero.	EE(LC)	EE(HC)	Chem.	Met	CE	Total
I. Through the Joint Entrance Examination :								
1. Andhra	5	—	2	3	—	3	1	14
2. Bihar	1	—	—	—	—	—	—	1
3. Delhi	3	—	—	2	1	—	1	7
4. Goa	—	—	—	1	—	—	—	1
5. Gujarat	—	—	1	—	—	—	—	1
6. Haryana	—	—	—	1	—	—	—	1
7. Kerala	11	3	4	5	6	—	3	35
8. Madhya Pradesh	1	—	—	—	—	—	—	1
9. Madras	16	3	15	4	20	10	14	82
10. Maharashtra	7	1	1	2	6	—	2	19
11. Mysore	9	5	8	5	8	8	3	46
12. Orissa	1	—	—	—	—	—	—	1
13. Punjab	1	—	—	—	—	1	—	2
14. Rajasthan	—	—	—	1	—	—	—	1
15. Uttar Pradesh	1	1	—	—	—	—	1	3
16. West Bengal	2	—	—	—	—	—	—	2
17. Foreign Nationals	—	—	—	1	—	—	1	2
II. Through Quota for Rank Holders :								
Mysore	58	13	31	25	41	25	26	219
Andhra	—	—	2	—	1	—	—	3
III. Foreigners sponsored by the Government of India								
...	3	—	1	1	—	—	1	6
61	13	34	26	43	25	27	229	

STATEMENT No. 4: Number of candidates admitted Branch-wise

Sl. No.	Branch	Admitted through Joint Entrance Examination	Admitted under Rank Holders category	Admitted under Foreign sponsored seats
1.	Aeronautical Engineering	13	—	—
2.	Chemical Engineering	41	2†	—
3.	Civil Engineering	26**	—	1*
4.	(a) Electrical Engineering (HC)	25	—	1*
	(b) Electrical Engineering (LC)	31	2‡	1*
5.	Mechanical Engineering	58	—	3*
6.	Metallurgy	25	—	—
		219	4	6

** All the candidates have been admitted outside the All India Merit List

* Ceylonese students

† Includes 1 each from Andhra Pradesh Board of Secondary Education and Bangalore University

‡ Includes 1 each from Jammu and Kashmir Board of Secondary Education and Mysore University

LIST OF RESEARCH SCHOLARS

Annexure II

Ph.D. Degree Programme

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
---------------------	----------------------	----------------------------	-------------------

Aeronautical Engineering

Part-time:

- | | | | |
|--|------------|-----------------------|---|
| 1. Sri R. M. Siddaveere Gowda,
Lecturer | 16- 2-1968 | Dr. K. A. V. Pandalai | Aeronautics—
Structural
Mechanics |
| 2. Sri T. K. Varadan,
Lecturer | 16- 2-1968 | Dr. K. A. V. Pandalai | Structural
Mechanics |
| 3. Sri K. Balaraman,
Asst. Professor. | 26- 4-1968 | Dr. K. A. V. Pandalai | Shell Theory |
| 4. Sri G. Subramaniam, Lecturer | 1- 8-1968 | Dr. K. A. V. Pandalai | Structural
Mechanics |

Applied Mechanics

Full-time:

- | | | | |
|---------------------|------------|------------------|--|
| 1. Sri J. Mathew | 17-10-1966 | Dr. A. Klein | Flow in Annular
Diffusers |
| 2. Sri B. S. Prabhu | 28- 8-1967 | Dr. B. V. A. Rao | Instabilities due to
liquid and gas
films in journal
bearings |
| 3. Sri B. Rama Bhat | 24- 7-1968 | Dr. Hans Wagner | Random
vibrations |

Part-time:

- | | | | |
|-----------------------------------|------------|--------------|-------------|
| 1. Sri P. S. Srinivasan, Lecturer | 12- 2-1966 | Dr. A. Klein | Wing Theory |
|-----------------------------------|------------|--------------|-------------|

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Applied Mechanics (Contd.):			
2. Sri V. Ramamurti, Lecturer	12- 4-1967	Dr. D. V. Reddy	Theory of Elasticity — Junction Stress in Shells
3. Sri B. H. Lakshmana Gowda, Associate Lecturer	16- 8-1967	Dr. N. V. C. Swamy	Three-dimensional Turbulent Boundary Layer Theory
4. Sri P. A. Aswatharayan, Associate Lecturer	16- 8-1967	Dr. N. V. C. Swamy	Axially symmetric boundary layer Theory
5. Sri T. Narayanan, Lecturer	28- 9-1967	Dr. D. V. Reddy	Dynamics of Shells
6. Sri M. Balakrishnan, Lecturer	21-11-1967	Dr. A. Klein	Aerodynamics of rear-mounted engines
7. Sri C. R. Subramanian, Lecturer	16- 4-1969	Dr. K. A. V. Pandalai & Dr. D. V. Reddy	Vibration studies on swept wings with attached Masses
8. Sri P. Krishna Iyer, Lecturer	16- 4-1969	-do-	Creep Stress Analysis

Chemical Engineering

Full-time:

1. Sri C. M. Ramaswami	1- 9-1965	Dr. D. Venkateswarlu & Dr. Y. B. G. Varma	Compaction of and flow properties of solids
2. Sri D. V. Ramana Rao	6-10-1965	Dr. E. H. Hohmann	Flotation of Inorganic Minerals

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Chemical Engineering (Contd.):			
3. Sri S. Raghunadha Rao	13- 9-1967	Dr. E. H. Hohmann	Metallic and non-metallic processing by different techniques
4. Sri S. G. V. Rayapa Raju	2- 4-1968	Dr. H. H. R. Bock	Refrigeration
5. Sri D. Maitra	19- 4-1968	Dr. R. J. H. Bisanz & Dr. K. Subba Raju	Long tube Evaporation of liquids
6. Sri M. Krishnamurthy	23-11-1968	Dr. E. H. Hohmann	Electrostatic separation
7. Sri B. Pitchumani	7-12-1968	Dr. D. Venkateswarlu & Dr. M. Ramanujam	Fluid energy grinding
8. Sri U. Kameswara Rao	1- 1-1969	Dr. E. H. Hohmann	Hydrocyclone separation
9. Sri V. Lakshmana Rao	21 3-1969	Dr. D. Venkateswarlu	Flow characteristics of solids
Part-time:			
1. Sri R. Vedaraman, Associate Lecturer	11-11-1963	Dr. D. Venkateswarlu & Dr. N. M. Raghavendra	Vibration milling
2. Sri K. Ramamurthy, Associate Lecturer	11-11-1963	Dr. K. Subba Raju	Heat Transfer in fluidized beds
3. Sri R. Subramanian, Lecturer	11-11-1963	Dr. P. Bhimeswara Rao	Kinetics of esterification of Alcohols

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Chemical Engineering (Contd.):			
4. Sri B. C. Bhattacharyya, Lecturer	16- 3-1966	Dr. R. J. H. Bisanz & Dr. K. Remananda Rao	Thin film Evaporation
5. Sri R. Nagarajan, Lecturer	25- 8-1966	Dr. S. D. Nigam	Non-Newtonian fluids
6. Sri A. Baradarajan, Lecturer	25- 8-1966	Dr. M. Satyanarayana	Reaction and diffusion in solid systems
7. Sri R. Ramakrishnan, Senior Technical Assistant	25- 8-1966	Dr. R. J. H. Bisanz	Thin Film Evaporation
8. Sri T. K. Ramaniyam, Senior Technical Assistant	25- 8-1966	Dr. D. Venkateswarlu & Dr. G. S. Davies	Mixing of Solids

Chemistry

Full-time:

1. Sri M. Santhanam	1- 9-1965	Dr. V. Ramakrishnan	Mechanism of Photo-sensitised Oxidations
2. Sri S. Santhanalogan	23- 8-1966	Dr. C. N. Pillai	Reactions catalysed by oxide catalysts
3. Sri J. Radhakrishnan	29- 8-1966	Dr. S. R. Ramadas	Approaches towards the synthesis of oxa-analogues of Oestrone and equilenin

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Chemistry (Contd.):			
4. Sri S. Sampath	5- 9-1966	Dr. G. Aravamudan	Solid State studies on Uranium, Chromium and Vanadium Compounds
5. Sri P. R. Sethuraman	22- 8-1967	Dr. G. Aravamudan	Chemistry of Selenium and Tellurium
6. Sri M. P. Krishnan Unni	22- 7-1968	Dr. C. N. Pillai	Condensation and hydrogen transfer reactions catalysed by oxide catalysts
7. Sri V. Ramamurthy	25- 7-1968	Dr. V. Mahadevan	Polymerisation of Vinyl monomers containing aliphatic and aromatic amino function
8. Kumari R. Uma	1- 8-1968	Dr. J. C. Kuriacose	A study of nature and role of supports in determining the catalytic activity of supported dehydrogenation and dehydration catalysts
9. Kumari N. Ganga Devi	4- 9-1968	Dr. V. Mahadevan	Redox polymerisation initiated by metal ion by reducing agent system

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Chemistry (Contd.):			
10. Sri R. Venkatachalam	5- 8-1968	Dr. J. C. Kuriacose	A study of the mechanism of dehydrogenation on semi-conductor oxide catalysts
11. Smt. Jayalakshmi Ramachandran	2- 1-1969	Dr. C. N. Pillai	Stereochemical studies of the reactions of carbonyl compounds
12. Sri Raghuchandra Kini	3- 1-1969	Prof. G. Butenuth	Decomposition of Calcium Carbonate
13. Sri B. G. Sejekhan	3- 1-1969	Prof. G. Butenuth	Decomposition of Cadmium Carbonate
14. Sri P. Rabindra Reddy	20- 1-1969	Dr. M. M. Taqui Khan	Co-ordination Chemistry
15. Smt. A. P. Shakuntala	15- 2-1969	Dr. R. Narayan	Polarographic studies
16. Sri E. L. R. Dayananda	20- 3-1969	Dr. V. Srinivasan	Heterogeneous Catalysts
Part-time:			
1. Sri D. V. Ramana, Senior Technical Assistant	22- 8-1966	Dr. C. N. Pillai	Mechanistic study of condensation reactions over oxide Catalysts
2. Sri R. Ramaswamy, Senior Technical Assistant	2- 9-1966	Dr. J. C. Kuriacose	Mechanistic study of reactions by electrochemical techniques

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Chemistry (Contd.):			
3. Sri C. S. Venkatachalam, Senior Technical Assistant	19- 9-1966	Dr. M. V. C. Sastri	Kinetics of electrode reactions by polarography
4. Sri R. P. Viswanath, Senior Technical Assistant	3- 9-1968	Dr. V. Srinivasan	Reduction of oxides by Hydrogen, Carbon monoxide etc.
Civil Engineering			
Fall-time:			
1. Sri B. V. Subramaniam	20- 8-1968	Dr. P. S. Rao	Reinforced Concrete structures
2. Sri A. C. Mathai	16- 9-1968	Dr. P. C. Varghese	Shell Structures
3. Sri A. V. Gopalakrishna	2- 1-1969	Dr. V. Sethuraman	Hydraulic Engineering
Part-time:			
1. Sri R. Radhakrishnan, Lecturer	3- 6-1965	Dr. P. C. Varghese	Structural Engineering
2. Sri T. P. Ganesan, Lecturer	11- 2-1966	Dr. P. C. Varghese	Structures
3. Sri P. K. Ninan, Lecturer	11- 2-1966	Dr. P. C. Varghese	Soil Mechanics and Foundation Engineering
4. Sri H. Rama Iyer, Lecturer	19- 5-1967	Dr. G. Rouve	Fluid Mechanics. (Coastal Engineering)
5. Sri C. Ganapathi Chettiar, Lecturer	9-10-1967	Dr. P. C. Varghese	Behaviour of R. C. Conoidal shells

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Civil Engineering (Contd.):			
6. Sri P. Kalyanasundaram, Lecturer	9-10-1967	Dr. P. C. Varghese	Influence of environmental factors on performance of R. C. structures
7. Sri C. S. Krishnamoorthy, Lecturer	9-10-1967	Dr. P. C. Varghese	Strength and behaviour of reinforced concrete folded plates
8. Sri N. Rajagopalan, Lecturer	9-10-1967	Dr. P. C. Varghese	Ultimate Load behaviour of R. C. Plate and Slab with elastic loading
9. Sri V. Paramasivam, Lecturer	9-10-1967	Dr. P. C. Varghese	Limit design of cased composite beams
10. Sri H. Suresh Rao, Associate Lecturer	21- 3-1968	Dr. G. Rouve	Hydraulics
11. Mr. F. G. Rohde, Senior Scientific Assistant	25- 3-1968	Dr. G. Rouve	Hydraulics
12. Sri M. G. Srinivasan, Associate Lecturer	22- 6-1968	Dr. P. C. Varghese	Shear strength of flat plates
13. Sri S. Selvaraj, Associate Lecturer	22- 6-1968	Dr. P. C. Varghese	Circular cylindrical shell
14. Sri K. R. Rajagopal, Associate Lecturer	22- 6-1968	Dr. J. Plahn	Prestressed concrete

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Civil Engineering (Contd.):			
15. Sri H. Achyutha, Lecturer	22- 6-1968	Dr. P. C. Varghese	Composite action of brick work and reinforced concrete structures
16. Sri B. Ramanathan, Lecturer	22- 6-1968	Dr. P. C. Varghese	Engineering properties of Marine clays
17. Sri K. Muthukrishniah, Associate Lecturer	22- 6-1968	Dr. P. C. Varghese	Effect of impact loads on the foundations of structures.

Electrical Engineering

Full-time:

1. Sri M. V. Chalapathi Rao	16- 1-1968	Dr. P. Venkata Rao	Non-linear Sampled Data Systems
2. Sri T. J. Vitto	26- 7-1968	Dr. M. K. Achuthan	Transistor Electronics
3. Sri S. E. Elangovan	29- 7-1968	Dr. A. Kuppurajulu	Power System Stability
4. Sri J. Balakrishnan	10- 9-1968	Dr. M. Venugopal	Power System Protection
5. Sri M. Chinna Rao	26- 9-1968	Dr. H. W. Meyer	Power System Measurements
6. Sri K. B. Subramaniam	5- 4-1969	Dr. H. W. Meyer	Electrical Instrumentation

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Electrical Engineering (Contd.):			
7. Sri C. S. Sridhar	9- 4-1969	Dr. P. W. Besslich	Use of digital devices in the detection of weak signals
Part-time:			
1. Sri S. S. Yegnanarayanan, Lecturer	26-11-1963	Dr. M. Venugopal	Transient Analysis of Electrical Machines working as Amplifiers
2. Sri P. Sankaran, Lecturer	27- 8-1966	Dr. V. G. K. Murti	Compensating Network for Instrument Transformers
3. Sri A. Chandrasekharan, Lecturer	18- 2-1967	Dr. M. Venugopal	Computer Methods in Power System Studies
4. Sri B. S. Bhanu-moorthy, Lecturer	18- 2-1967	Prof. S. Sampath	Transistor Operational Amplifier Stability with regard to noise and drift
5. Sri Vedam Subrahmanyan, Lecturer	19- 5-1967	Dr. H. W. Meyer	Axial Forces in Induction Machines
6. Sri T. A. R. Bhat, Lecturer	23- 8-1967	Dr. G. N. Garud	Pulse Techniques
7. C. Venkatase-shiah, Associate Lecturer	3- 9-1967	Dr. M. Venugopal	Transient Stability of Power Systems

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Electrical Engineering (Contd.)			
8. Sri V. V. Bap- eswara Rao, Lecturer	9-10-1967	Dr. V. G. K. Murti	Network Synthesis and Linear Graph Theory
9. Sri K. Sankara Rao, Lecturer	9-10-1967	Dr. V. G. K. Murti	Network Synthe- sis and Linear Graph Theory
10. Sri P. C. Majhee, Associate Lecturer	23-11-1967	Dr. K. P. Rajappa	Studies in Instru- mentation
11. Sri V. Subrah- manyam, Lecturer	29- 5-1968	Dr. K. Sivaprasad	Microwave Techniques
12. Sri K. Ramar, Associate Lecturer	5- 9-1968	Dr. B. Ramaswami	Control System- Optimisation of Linear Systems
13. Sri G. T. Manohar, Lecturer	7- 9-1968	Dr. P. Venkata Rao	Signal Stabilisa- tion of non-linear sampled data systems
14. Sri C. Eswaran, Associate Lecturer	9- 9-1968	Dr. V. G. K. Murti	Network Theory
15. Sri P. Subbarami Reddy, Lecturer	16-11-1968	Dr. K. Thulasiraman	Network Synthesis Semi Conductor device graph theory
16. Sri C. N. Reddy, Lecturer	2- 1-1969	Dr. Y. Narayana Rao	Breakdown Pheno- mena in gas solid dielectrics

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Electrical Engineering (Contd.):			
17. Sri G. Sridhara Rao, Associate Lecturer	2- 1-1969	Dr. P. Venkata Rao	Electric Machines
18. Sri B. V. Dutt, Lecturer	1- 4-1969	Dr. Y. Narayana Rao	Discharge and Breakdown Phenomena in dielectrics
19. Sri M. Krishna-murthi, Lecturer	1- 4-1969	Dr. M. Venugopal	Problems of switchgear Testing and Development
Humanities and Social Sciences			
Part-time:			
1. Sri C. Rama-chandran, Technical Assistant	12- 6-1968	Prof. R. K. Gupta	Economic policy of the East India Company 1784-1857 in Madras Presidency
2. Sri B. Vasudeva, Lecturer	23- 9-1968	Prof N. K. Datta	Production planning and Controls
Mathematics			
Full-time:			
1. Sri G. V. Prabha-kara Rao	7- 9-1966	Dr. V. Subba Rao	Wave Propagation in Non-homogeneous Media
2. Sri M. R. Sridharan	14- 9-1966	Dr. K. R. Parthasarathy	Enumeration problems in Graph Theory

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Mathematics (Contd.):			
3. Sri G. B. Narasimha Rao	20- 9-1966	Dr. S. D. Nigam	Studies in Boundary Layer Theory
4. Sri A. Rangan	22- 9-1966	Dr. S. K. Srinivasan	Stochastic Processes
5. Sri A. Avudainayagam	24- 9-1966	Dr. S. D. Nigam	Application of Variational Methods to Compressible Flows
6. Sri K. S. Ramesh	24-10-1966	Dr. R. Subramanian	Operations Research
7. Kumari S. Kalpakam	22- 8-1967	Dr. S. K. Srinivasan	Statistical Mechanics
8. Sri N. Muthiyalu	6-12-1967	Dr. H. S. Paul	Elasticity
9. Smt. R. Kalyani	16- 1-1968	Dr. S. D. Nigam	Fluid Dynamics
10. Sri K. Balabadra Naidu	8-11-1968	Dr. L. V. K. V. Sarma	Hydrodynamics
11. Sri C. Anandam	29- 1-1969	Dr. H. S. Paul	Piezo-electricity
12. Sri K. Manobhai Mehata	30- 1-1969	Dr. S. K. Srinivasan	Stochastic Processes
13. Sri A. S. Ananda Kumar	5- 2-1969	Dr. S. K. Srinivasan	-do-
14. Kumari A. S. Vatsala	21- 2-1969	Dr. K. M. Das	Boundary Value Problems in ordinary differential equations.
15. Sri K. Krishnan	22- 3-1969	Dr. S. K. Srinivasan	Stochastic Processes and Statistical Physics.

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Mathematics (Contd.):			
Part-time:			
1. Sri C. V. Raghava Rao, Senior Technical Assistant	4- 8-1964	Dr. L. V. K. V. Sarma	Viscous Rotating Flow Past Bodies
2. Sri S. N. Venkatarangan, Senior Technical Assistant	4- 8-1964	Dr. S. D. Nigam	Variational approach for stability problems
3. Sri A. Ramachandra Rao, Senior Technical Assistant	6- 8-1964	Dr. S. D. Nigam	Wave propagation in rotating liquids
4. Sri G. Rajamanar, Technical Assistant	25- 8-1965	Dr. S. K. Srinivasan	Stochastic Processes

Mechanical Engineering

Full-time:

- | | | | |
|--------------------------|------------|--|---------------|
| 1. Sri Basu John Vetteth | 24- 8-1967 | Prof. Heitland & Prof. R. G. Narayana-murthi | Combustion |
| 2. Sri R. Ramaswamy | 5- 8-1968 | Dr. V. C. Venkatesh | Metal Cutting |

Part-time:

- | | | | |
|--------------------------------------|-----------|---------------------|---------------------------|
| 1. Sri M. A. Veluswami,
Lecturer | 1- 1-1966 | Dr. V. C. Venkatesh | Wear in Metallic surfaces |
| 2. Sri V. Radhakrishnan,
Lecturer | 1- 1-1966 | Dr. V. C. Venkatesh | Surface Finish |

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Mechanical Engineering (Contd.) :			
3. Sri K. V. Gopala-krishnan, Lecturer	1- 7-1966	Dr. G. Stahl	Combustion Problems in I.C. Engines
4. Sri K. S. Padiyar, Lecturer	2- 7-1966	Prof. H. Heitland	Effect of sound on flames
5. Sri K. A. Bhaskaran, Lecturer	2- 7-1966	Prof H. Heitland	Ignition delay of Hydro-carbon fuels by shock-tube technique
6. Sri M. S. Francis, Lecturer	23- 9-1966	Prof. Lohr & Dr. V. C. Venkatesh	Hot Machining
7. Sri V. M. Radha-krishnan, Lecturer	14-11-1966	Dr. K. Srinivasa- raghavan & Prof. R. G. Narayana- murthi	Inter-action of creep and fatigue in metals
8. Sri S. Vaidyanathan, Lecturer	7- 3-1967	Prof. Lohr & Dr. V. C. Venkatesh	Spark Hardening of Tools
9. Sri P. K. Philip, Lecturer	7- 3-1967	Dr. V. C. Venkatesh	Secondary Shear during Machining
10. Sri K. Satyanarayana, Lecturer	24- 8-1967	Prof. W. Scheer & Prof. R. G. Narayana- murthi	Turbomachines
11. Sri K. N. Gopalan, Lecturer	25- 8-1967	Dr. B. S. Murthy	Combustion Problems in I.C. Engines
12. Sri G. V. N. Rayudu, Assistant Professor	4-10-1967	Prof. G. R. Bechtloff	Study of Friction and Lubrication of gears
13. Sri A. Rammohana Rao, Lecturer	4-10-1967	Prof. G. R. Bechtloff	Optimum design of wheels

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Mechanical Engineering (Contd.) :			
14. Sri S. Ramani, Assistant Professor	4-10-1967	Dr. S. K. Srinivasan	Operations Research
15. Sri K. Lakshminarayana, Lecturer	4-10-1967	Prof. G. R. Bechtloff & Prof. R. G. Narayanamurthi	Synthesis of two-degree of freedom linkages
16. Mr. D. Robertz, Senior Scientific Assistant	18-10-1967	Dr. M. C. Gupta	Combustion
17. Sri V. Sriramulu, Lecturer	18-10-1967	Dr. M. C. Gupta	Combustion
18. Sri M. Adithan, Lecturer	26-4-1968	Dr. V. C. Venkatesh	Determination of the optimum shape of the transducer shank and conditions in ultrasonic drilling
19. Sri K. R. Govinda-Mallan, Lecturer	1- 5-1968	Dr. B. S. Murthy	Energy effects on Pre-combustion reaction in the dual fuel engines
20. Sri P. Srinivasa Rao, Associate Lecturer	1- 5-1968	Dr. B. S. Murthy	Charge Stratification in I.C. Engines
21. Sri M. A. Parameswaran, Associate Professor	24- 1-1969	Prof. R. G. Narayanamurthi & Prof. G. R. Bechtloff	Mechanical handling
22. Sri K. A. Damodaran, Assistant Professor	16- 4-1969	Dr. M. C. Gupta	Supersonic Combustion studies

Metallurgy

Part-time :

- | | | | |
|-----------------------------------|-----------|------------------------|---------------|
| 1. Sri S. Sundaresan,
Lecturer | 3- 7-1967 | Dr. H. E. D. Zuern | Metal Fatigue |
| 2. Sri H. Md. Roshan,
Lecturer | 6- 1-1969 | Dr. E. G. Ramachandran | Metal Casting |

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Metallurgy (Contd.):			
3. Sri K. J. Lakshmi-narayana Iyer, Lecturer	31- 3-1969	Dr. E. G. Ramachandran	Physical Metallurgy
4. Sri M. Viswanathan, Senior Technical Assistant	31- 3-1969	Dr. (Miss) V. Vasantasree	Electrometallurgy and Corrosion
Physics			
Full-time:			
1. Sri N. Hariharan Iyer	13- 8-1964	Dr. J. Sobhanadri	Optical and Magnetic properties of Crystals
2. Sri K. Mallikarjunarao	14- 8-1964	Dr. C. K. Narayanaswamy	Spectroscopy
3. Sri C. S. Sastry	10- 9-1964	Dr. V. Sivaramakrishnan	Radioactivity
4. Sri T. P. Srinivasan	9- 9-1965	Dr. S. D. Nigam	Tenser properties
5. Sri M. Veerabhadrarao	23- 1-1967	Dr. B. V. Ramamurthy	Crystal structure analysis
6. Sri K. S. Girirajan	29- 7-1968	Dr. R. Srinivasan	Lattice Dynamics
7. Sri C. V. Ram Mohan	29- 7-1968	Dr. J. Sobhanadri	Nuclear quadrupole resonance
8. Kumari G. Lakshmi	30- 7-1968	Dr. R. Srinivasan	Lattice Dynamics
9. Sri R. B. Tripathi	5- 8-1968	Dr. S. B. S. Sastri	Colour Centres
10. Sri V. K. Vaidyan	5- 8-1968	Dr. C. Santaram	Spectroscopy

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Physics (Contd.):			
11. Sri C. Suryanarayanamurthy	21- 9-1968	Dr. Y. V. G. S. Murthy	Defect energy calculations
12. Sri K. R. Narasimhamurthy	15- 1-1969	Dr. Y. V. G. S. Murthy	Defect properties of ionic crystals
13. Sri V. Viswanathan	8- 5-1969	Dr. S. B. S. Sastry	Photo-conductivity
Part-time:			
1. Sri R. Ramji Rao Lecturer	30-10-1962	Dr. R. Srinivasan	Lattice Dynamics
2. Sri V. Ramabhadran, Lecturer	30-10-1962	Dr. S. K. Srinivasan	Elementary Particles
3. Sri S. Srinivasan, Senior Technical Assistant	30-10-1962	Dr. V. Sivaramakrishnan	Optical and magneto optical rotations
4. Sri B. S. V. S. Ramachandracharyulu, Associate Lecturer	30-10-1962	Dr. W. Koch & Dr. C. Ramasastry	Luminescence
5. Sri B. S. V. Gopalam, Associate Lecturer	30-10-1962	Dr. W. Koch & Dr. C. Ramasastry	Barrier Layers
6. Sri G. Srinivasamurthy, Senior Technical Assistant	10-11-1962	Dr. S. Swaminathan	X-ray crystallography
7. Sri S. Srinivasan, Associate Lecturer	1- 8-1964	Dr. S. Swaminathan	Structure and phase transformations of crystals

Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
Physics (Contd.):			
8. Sri A. V. Narasimham, Associate Lecturer	1- 8-1964	Dr. C. Ramasastry	Ultrasonics
9. Sri K. Srinivasan, Senior Technical Assistant	1- 8-1964	Dr. R. Srinivasan	Optical properties of crystals
10. Sri K. Sarangapani, Senior Technical Assistant	1- 8-1964	Dr. S. Swaminathan	Crystal structure Analysis
11. Sri V. Subramanyamurthy, Senior Technical Assistant	27- 9-1965	Dr. C. Ramasastry	Electron spin resonance
12. Sri J. Majhi, Senior Technical Assistant	29- 9-1965	Dr. C. Ramasastry	Surface states in semi-conductors
13. Sri K. Viswanath Reddy, Associate Lecturer	1-11-1965	Dr. W. Koch	Semiconductors
14. Sri V Ramachandran, Senior Technical Assistant	1- 9-1966	Dr. R. Srinivasan	Lattice Dynamics
15. Sri Shyam Sundara Rao, Senior Technical Assistant	18-12-1968	Dr. C. Ramasastry	Study of Dielectrics of Solids and liquids

M.S. Degree Programme

Name of the Scholar	Date of joining
Aeronautical Engineering	
Full-time:	
1. Sri Amit Kumar Ghosh	10- 1-1969
2. Sri Harigopal Gupta	10- 1-1969
3. Sri R. Balu	17- 1 1969
Part-time:	
1. Sri J. Lakshminarasimhan (Senior Technical Assistant)	10- 1-1969
2. Sri S. Sampath (Associate Lecturer)	10- 1-1969
Chemical Engineering	
Full-time:	
1. Sri Madhavendra Bhatia	10- 1-1969
2. Sri J. Ramakrishna	15- 1-1969
3. Sri P. N. Krishnaswamy	20- 1-1969
4. Sri V. V. Kakodkar	22- 1-1969
5. Sri M. Krishnan	22- 1-1969
6. Sri J. Raghuraman	1- 3-1969
Electrical Engineering	
Part-time:	
Sri S. Raman (Associate Lecturer)	9- 1-1969
Mechanical Engineering	
Full-time:	
1. Sri S. G. Chede	9- 1-1969
2. Sri R. Narayanan	9- 1-1969
3. Sri S. Ramachandran	9- 1-1969

Name of the Scholar	Date of joining
Mechanical Engineering (Contd.) :	
4. Sri S. Satish Rao	9- 1-1969
5. Sri S. C. Solanki	9- 1-1969
6. Sri S. Srinivasa Murthy	9- 1-1969
7. Sri Sureshchandra Shenoy	9- 1-1969
8. Sri V. Venkataraman	9- 1-1969
9. Sri R. Venkatasubramani	9- 1-1969
10. Sri Vinod Kumar Grover	9- 1-1969
11. Sri R. Sreedaran	11- 1-1969
12. Sri Andrew Swamy	15- 1-1969
13. Sri V. S. Ganapathi Addepalli	20- 1-1969
14. Sri J. Agarwal	20- 1-1969

Metallurgy

Full-time :

Sri Tulasidas Bhat Manjeshwar	10- 1-1969
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Part-time :

1. Sri B. Natarajan (Senior Technical Assistant)	9- 1-1969
2. Sri P. Venugopal (Senior Technical Assistant)	9- 1-1969
3. Sri D. R. Gopalakrishna Achar (Associate Lecturer)	9- 1-1969
4. Sri H. R. Raghavan (Senior Technical Assistant)	9- 1-1969
5. Sri S. Sankaranarayana (Senior Technical Assistant)	9- 1-1969

Post-Doctoral Programme

Sl No.	Department	Name	Date of joining
1.	Aeronautical Engineering	Dr. Gopal Jayaraman	27-9-1968
2.	Chemistry	Dr. Q. Anwaruddin	25-2-1969
3.	Mathematics	Dr. D. Ramakrishna Rao	22-1-1969
4.	Mechanical Engineering	Dr. M. Nagarajan	15-2-1969

SECTION IV

Section IV

Receipts & Payments Account	—	215
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INDIAN INSTITUTE OF TECHNOLOGY, MADRAS-36

Receipts and Payments account for the year 1968-69

RECEIPTS	Rs.	PAYMENTS	Rs.
OPENING BALANCE	11,50,905	ON CAPITAL ACCOUNTS	
Grant from Government of India		(i) Works and Buildings	34,55,466
(i) Capital accounts	54,00,000	(ii) Equipment, Furniture and Fittings	
Refund of Customs Duty	6,05,126	(Departments)	
		Civil Engineering	1,18,534
		Mechanical Engineering	1,31,794
		Workshops	57,591
		Electrical Engineering	36,479
		Chemical Engineering	41,588
		Metallurgy	43,785
		Applied Mechanics	46,575
		Aeronautical Engineering	50,675
		Chemistry	1,00,981
		Physics	83,778
		Humanities	4,524
		Mathematics	4,778
		Industrial Engineering	9,082
			<u>7,30,164</u>
		(iii) Customs Duty on West German Equipment	
		Customs Duty paid	9,65,325
		Clearance Charges etc.	15,867
			<u>9,81,192</u>
	<u>71,56,031</u>		<u>51,66,822</u>
	C/o		

RECEIPTS		PAYMENTS	
Rs.		Rs.	Rs.
B/F	71,56,031	B/F	56,66,822
		(iv) Furniture and Fittings (Office, Library, etc)	3,95,403
		(v) Hostels	
		Utensils	...
		Furniture and Fittings	154
		(vi) Others:	154
		Motor Vehicles	31,853
		Cycles	1,495
		Typewriters and Duplicators	9,379
		Acromodelling Equipment (N.C.C.)	968
		Hospital Equipment	4,132
		Telephones	51,655
		Erection plant for Library	1,957
		(vii) Books and Journals:	1,01,439
		(i) Books	1,03,672
		(ii) Journals and Back Volumes.	2,03,318
C/o	<u>71,56,031</u>	C/o	3,06,990
			<u>59,70,808</u>

RECEIPTS	Rs.	Rs.	PAYMENTS	Rs.	Rs.
		1,71,40,323		4,10,631	84,50,747
Hire charges on Institute Vehicles	9,250		Electrical Engineering	2,34,210	
Library overdue collections	7,388		Chemical Engineering	1,88,989	
Interest on fund deposits			Metallurgy	1,18,791	
Governor's Prize and other Prizes	520		Applied Mechanics and Aeronautical Engineering	1,38,572	
Interest on conveyance advances	6,018		Chemistry	1,15,499	
Interest from M.E.S. on security deposits	2,427		Physics	1,69,643	
	8,965		Mathematics	49,006	
			Humanities	36,606	
Sales of tender forms, iron scrap etc.	29,190				14,61,347
Miscellaneous recoveries	75,374				
Re-checking of answer books	15				
Migration Certificate	50				
Breakages from students	1,011				
Hire charges for gowns	972				
Taramani House — Boarding charges	16,734				
Guest House — Boarding charges	7,805				
Subscription to Journal of Maths & Phy, Sciences	1,146				
		1,71,40,323			
C/o			C/o		99,12,094

RECEIPTS	Rs.	Rs.	PAYMENTS	Rs.	Rs.
		1,71,40,323	B/F		99,12,094
Seminar in Chemical Engineering	250				
Short term course in High Vacuum Technology	2,350				
Library membership fee	500	3,48,681			
Receipts from Buildings:					
Rent	2,19,731				
Electricity, Water and Service Charges	1,26,499	3,46,230			
Lawns and Gardens:					
Auction sale of trees and usufructs	5,666				
Sewage farm receipts	241				
General Stores per contra		5,907			
		5,310			4,83,947
		1,78,46,451	C/o		1,03,96,041
(iii) a. Departmental Expenses:					
			Civil Engineering	60,042	
			Mechanical Engineering	1,38,310	
			Electrical Engineering	48,878	
			Chemical Engineering	58,316	
			Metallurgy	57,870	
			Applied Mechanics	38,187	
			Chemistry	52,843	
			Physics	25,419	
			Mathematics	1,186	
			Humanities	2,064	
			Industrial Engineering	832	

RECEIPTS	Rs.	Rs.	PAYMENTS	Rs.	Rs.
B. F.	1,78,46,451		B. F.		1,03,96,041
b. Institute Scholarships:					
			Under Graduates		
			Scholarships	2,98,984	
			Post Graduates		
			Scholarships	6,73,060	
					9,72,044
c. N.C.C. (including					
			pay and allowances)	41,187	
			Athletic and Gym-		
			khana (including		
			pay and allowances)	92,135	
			Excursion and Surveys	490	
			Prizes for academic		
			distinction	2,759	
			Part-time lecturers and		
			and Visiting Professors	16,397	
			Inplant training and		
			special inplant course	17,284	
			Convocation	20,402	
					1,90,654
C/o	1,78,46,451		C/o		1,15,58,739

RECEIPTS		PAYMENTS	
Rs.	Rs.	Rs.	Rs.
B/F	1,78,46,451	B/F	1,15,58,739
(iv)		Other Sections:	
		a. Central Administration:	
		Pay and allowances of Officers	1,47,226
		Pay and allowances of other staff	<u>7,25,187</u>
			8,72,413
		b. Library:	
		Pay and allowances of Librarian	12,772
		Pay and allowances of establishment	1,29,042
		Contingencies—operating cost	8,844
		Binding charges	<u>6,795</u>
			1,57,453
		c. Contingencies:	
		Postage	45,811
		Entertainment	8,740
		Telephones	76,065
		Liveries	4,637
		Stationery	55,724
		Printing	25,665
		Advertisements	79,894
		Sundries (Misc. expenses)	<u>42,538</u>
			3,39,074
C/o	<u>1,78,46,451</u>	C/o	<u>1,29,27,679</u>

RECEIPTS	Rs.	Rs.	PAYMENTS	Rs.	Rs.
B/F	1,78,46,451		B/F		1,29,27,679
			d. Other items:		
			General Stores		
			Payments	10,653	
			Less		
			Issues	15,963	
				<u>5,310</u>	
			Expenditure from		
			Directors discretionary fund	640	
			Technical Bulletins and Journals	3,010	
			Power	4,17,231	
			Oil and Petrol	43,203	
			Security	75,610	
			Repairs and Maintenance—		
			Furniture	11,466	
			Motor Vehicles	47,683	
			Cycles	1,445	
			Typewriters and Duplicators	6,504	
C/o	<u>1,78,46,451</u>		C/o		<u>1,29,27,679</u>

RECEIPTS		PAYMENTS	
Rs.	Rs.	Rs.	Rs.
B/F	1,78,46,451	B/F	1,29,27,679
		Audit charges	8,440
		Fire fighting operating cost	621
		Remuneration to External Examiners	49,922
		Duty, Insurance and Road Taxes	7,217
		Model and exhibits	...
		Hire charges of Furniture	165
		Outside computer facilities	2,303
		Short term course on High Vacuum Technology	791
		Grant to Current Science Association, Bangalore	500
C/o	<u>1,78,46,451</u>	C/o	<u>1,29,27,679</u>

RECEIPTS	Rs.	Rs.	PAYMENTS	Rs.	Rs.
B/F		1,78,46,451	B F		1,29,27,679
			Participation in the Programme and Organisation for Economic co-operative and Development	1,541	
			Scientific Congress and Seminars	1,517	
			Joint Entrance Examination	93,500	
			Customs duty on personal effects of W. G. Experts	3,97,968	
			Legal expenses		
			Honarium to Legal Adviser	2,000	
			Grant to Central School	4,320	
			Travelling allowances:		
			Board of Governors	2,914	
			Staff Committees,		
			Selection Committees, Senate, etc.	16,586	
			External Examiners	20,469	
C/o		1,78,46,451	C/o		1,29,27,679

RECEIPTS	Rs.	Rs.	PAYMENTS	Rs.	Rs.
B/F	1,78,46,451		B/F		1,29,27,679
			Congress, Conferences and Seminars	978	
			Joint Entrance Examination	12,973	
			Candidates called for interview for appointment, etc.	26,825	12,58,342
			Stores:		
			Pay and allowances of Stores Officer	15,663	
			Pay and allowances of establishment	77,711	
			Contingencies, etc.	5,001	98,375
			Workshops:		
			Pay and allowances	6,11,972	
			Contingencies (Instruments, tools and Working expenses)	89,689	
			Stipends for Apprentices	32,536	7,34,197
			Hostels:		
			Allowance to Wardens	15,016	
			Taramani House	14,185	29,201
C/o	1,78,46,451		C/o		1,50,47,794

RECEIPTS		Rs.	Rs.	PAYMENTS		Rs.	Rs.
	B/F		1,78,46,451		B/F		1,50,47,794
Recovery of Advances:				LAWNS AND GARDENS;			
1. Motor car and other conveyances		98,292		Pay and allowances of Horticultural Supervisor		3,002	
2. Customs duty on W.G. Equipment		10,00,218		Wages to labourers, purchase of seeds, etc.		52,657	
3. Customs duty on personal effects of West German Experts		3,94,629					55,659
4. Festival Advances		48,577		Medical — Dispensary			
5. Letter of Credit		...		Honorarium and conveyance allowances to part-time Medical Officer		8,100	
6. Miscellaneous Advances		1,74,982		Purchase of medicines		29,965	
7. On account of UNESCO coupons-Library		13,083		L.S. and P.C. on account of personnel of Foreign service			38,065
Chemistry		1,653		Contribution to C.P. Fund			5,583
			17,31,434	Works and Maintenance (including pay and allowances of Maintenance staff)			3,81,291
Deposits:				Membership fees to outside bodies			7,04,372
External Scholarships		4,06,481					3,578
Contractors' Deposits (Institute)		8,860					
Contractors' Deposits (Works)		4,68,813					
Students' Caution Deposits		16,800					
	C/o		1,95,77,885		C/o		1,62,36,342

RECEIPTS		Rs.	Rs.	PAYMENTS		Rs.	Rs.
	B/F		1,95,77,885		B/F		1,62,36,342
C.S.I.R. Research Scholars	25,864			Water charges—			
Miscellaneous	1,69,787			Corporation of Madras			2,92,862
Technical Teachers' Training Scheme	1,75,000			Property Tax			4,11,699
N.B.O. Grant	7,000			Advances paid:			
American Chemical Society			12,78,605	Motor car and other conveyances		1,30,360	
Account with First National City Bank, New York				Customs duty on German equipment		9,15,000	
Opening Balance	\$ 8,422.16		63,166	Customs duty on personal effects and West German Experts		6,15,000	
Grant Received	\$ 1,000.00		7,500	Other advances:			
Recovery of Advances	\$ 6,577.84		49,334	Festival advances		51,943	
				Other Misc. advances		1,89,455	
				UNESCO Coupons		—	
				Refund of Deposits:			19,01,758
				External Scholarships		3,61,385	
				Contractors' Deposits (Instt.)		6,634	
				Contractors deposits (Works)		4,25,195	
				Students Caution Deposits		10,050	
			2,09,76,490				1,88,42,661
	C/o						C/o

RECEIPTS	Rs.	Rs.	PAYMENTS	Rs.	Rs.
B F	2,09,76,490		B/F		1,88,42,661
			C.S.I.R.	21,100	
			Miscellaneous deposits	2,05,436	
			Technical Teachers		
			Training Scheme	1,80,423	
			N.B.O. Grant (Payments)	548	
					12,10,771
			American Chemical Society account		
			with First National City Bank		
			Consumables	\$ 1,997.21	14,979
			Equipments	\$ 11,272.96	84,547
			Advance paid	\$ 476.00	3,570
			Closing Balance:		
			Cash on hand	56,120	
			With State Bank of India	7,46,938	
			With First National		
			City Bank	\$ 2,253.83	16,904
					8,19,962
Total	Rs. 2,09,76,490		Total	Rs. 2,09,76,490	

INDIAN INSTITUTE OF TECHNOLOGY, MADRAS-36

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31-3-1969.

EXPENDITURE	Rs.	Rs.	INCOME	P.s.	Rs.
EDUCATION EXPENSES:					
Pay Of Teaching Staff:			Grant from Government of India		94,34,000
Departments—			General Income:		
Civil Engineering	3,19,737		Tuition fees	2,76,375	
Mechanical Engineering	4,10,383		Hostel Seat Rent	1,73,927	
Electrical Engineering	3,83,105		Admission Fees	6,027	
Chemical Engineering	2,37,193		Gymkhana and Medical Fees	49,260	
Metallurgy	1,35,483		Fines	4,183	
Applied Mechanics and Aeronautical					
Engineering	3,13,855		Application fees from students	67,931	
Chemistry	1,85,097		Examination fees	25,100	
Physics	2,11,040		Fees for degree in absentia	2,016	
Mathematics	1,39,240		Application fees for		
Humanities	1,86,720		appointments	10,091	
	<u>25,21,853</u>				<u>6,14,910</u>
Pay of Non-Teaching Staff:			Miscellaneous Receipts:		
Departments—			On Gymkhana Account	6,134	
Civil Engineering	1,62,305		Institute Bus Collections	94,763	
	<u>25,21,853</u>		C/o		<u>1,00,48,910</u>

EXPENDITURE	Rs.	Rs.	INCOME	Rs.	Rs.
		25,21,853			1,00,48,910
B/F			B/F		
Mechanical Engineering	2,50,502		Hire Charges of Institute vehicles	7,327	
Electrical Engineering	2,40,872		Rent on buildings	1,99,610	
Chemical Engineering	1,89,393		Electricity, Water and Service Charges	1,08,209	
Metallurgy	1,23,238				
Applied Mechanics and Aeronautical Engineering	1,43,609		Auction sale of trees, usufructs, etc.	5,907	
Chemistry	1,17,482		Taramani House Boarding Charges	13,508	
Physics	1,70,673		Other receipts	1,38,136	
Mathematics	49,122				
Humanities	35,861				
		14,83,057			5,73,594
			Departmental Expenses		
			Industrial Engineering (per contra)		645
			Excess expenditure over income		5,88,852
C/o		40,04,910	C/o		1,12,12,001

EXPENDITURE	Rs.	Rs.	INCOME	Rs.	Rs.
	B/F	40,04,910	B/F		1,12,12,001
Departmental Expenses:					
Civil Engineering	55,076				
Mechanical Engineering	1,27,196				
Electrical Engineering	67,149				
Chemical Engineering	74,272				
Metallurgy	53,758				
Applied Mechanics and Aeronautical Engineering	44,933				
Chemistry	78,229				
Physics	39,830				
Humanities	2,902				
Mathematics	1,307				
Industrial Engineering	2,712				
Less Stock	3,357				
	<u>645</u>	5,44,652			
General Expenses:					
Institute Scholarships:					
Undergraduates	2,97,309				
Postgraduates	7,02,559				
		<u>45,49,562</u>	C/o		<u>1,12,12,001</u>

EXPENDITURE	Rs.	Rs.	INCOME	Rs.	Rs.
			B/F		1,12,12,001
N. C. C. (including pay and allowances)	41,799	45,49,562			
Athletic and Gymkhana (Including pay and allowances)	93,429				
Excursions and Surveys	490				
Prizes for Academic distinctions	2,759				
Part-time Lecturers and Visiting Professors.	16,397				
Convocation	20,402				
Inplant Training and Special Inplant Course	17,284	11,92,428			
Other Sections:					
Central Administration (Pay and allowances)	1,44,443				
Officers	7,36,000	8,80,443			
Establishment					
		66,22,433	C/o		1,12,12,001

EXPENDITURE	Rs.	Rs.	INCOME	Rs.	Rs.
			B/F	66,22,433	1,12,12,001
LIBRARY:					
Pay and Allowances:					
Librarian	12,954				
Establishment	1,32,465				
Contingencies—					
Operating Cost	9,078				
Binding Charges	2,963				
		1,57,460			
Contingencies:					
Postage	42,222				
Entertainment	8,828				
Telephone	1,06,666				
Liveries	4,638				
Stationery	65,560				
Printing	29,381				
Advertisements	55,098				
Sundries (Misc. Expenses)	47,550				
		3,59,943			
OTHER ITEMS:					
General Stores	2,709				
Technical Bulletins and Journals	5,981				
		71,39,836	C/o	C/o	1,12,12,001

EXPENDITURE	Rs.	Rs.	INCOME	Rs.	Rs.
		71,39,836	B, F		1,12,12,601
Directors Discretionary Fund	640				
Power	4,48,133				
Oil and Petrol	43,462				
Security	70,218				
Repairs and Maintenance— Furniture	11,466				
Motor Vehicles	51,157				
Cycles	1,445				
Typewriters and Duplicators	6,441				
Audit Charges	8,640				
Fire Fighting—Operating Cost	467				
Participation in the pro- gramme and Organi- sation for Economic Co-operation and Development	1,541				
Fees to external examiners	50,263				
Duty, Insurance and Road Taxes	5,166				
Models and Exhibits	...				
Hire charges of Furniture (W. G. Experts)	142			C/o	1,12,12,601
		71,39,836			

EXPENDITURE	Rs.	Rs.	INCOME	Rs.	Rs.
			B/F		1,12,12,001
B/F.					
Scientific Congress & Seminars	1,517				
Joint Entrance Examination	93,500				
Customs Duty on personal effects of West German Experts	3,97,968				
Legal expenses	...				
Honorarium to Legal Adviser	2,000				
Grant to Central School	4,320				
Outside Computer Facilities	2,303				
Grant to Current Science Association, Bangalore	500				
Short term course on High Vacuum Technology	791				
Travelling Allowances:					
Board of Governors	2,914				
Staff Selection Committee, Senate, etc.	16,586				
External Examiners	20,469				
Scientific Conferences and Seminars	978				
Joint Entrance Examination	12,973				
Candidates call for interview	26,927				
		12,91,617			
		<u>84,31,453</u>	C/o		<u>1,12,12,001</u>

EXPENDITURE	B/F	Rs.	Rs.	INCOME	B/F	Rs.	Rs.
Stores:							
Pay and allowances of Officers		15,705					
Establishment		78,150					
Contingencies		5,001					
			98,856				
Workshops:							
Pay and allowances		6,20,173					
Contingencies		71,344					
Stipend to Apprentices		32,173					
			7,23,690				
Hostels:							
Allowance to Wardens		15,023					
Taramani House Expenses		10,132					
			25,155				
Lawns and Gardens:							
Pay and allowances to Horticultural Supervisor		3,131					
Daily wages to labourers							
Purchase of seeds etc.		51,387					
			54,518				
	C/o		93,33,672		C/o		1,12,12,001

EXPENDITURE	B/F	Rs.	Rs.	INCOME	B/F	Rs.	Rs.
Medical:			93,33,672			1,12,12,001	
Honorarium and conveyance allowance to Part-time Medical Officer		8,100					
Medical Dispensary		36,088					
Leave salary and pension contribution		5,511					
C.P.F. Contribution		3,85,668					
Works & Maintenance		7,11,639					
Water Charges — Corporation of Madras		3,06,478					
Membership fees to outside bodies		3,578					
Property Tax		4,11,699					
Cost of Stocks lost, damaged or rendered unserviceable							
written off			9,568				
			18,78,329				
Total	Rs.	1,12,12,001			Total	Rs.	1,12,12,001

INDIAN INSTITUTE OF TECHNOLOGY, MADRAS-36.
BALANCE SHEET AS AT 31st MARCH 1969

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	PROPERTY AND ASSETS			
	Rs.	Rs.	Rs.	Rs.
CAPITAL FUND AND LIABILITIES				
Capital Fund :				
Block value of German Aid per contra	2,58,15,633			
Technical Books and journals	2,65,329			
		2,60,80,962		
Block Value of Gift from U.S.A. :				
Analogue computer per contra		2,28,100		
Capital grants and balance of Income and Expenditure account as on 31-3-'68	7,10,66,284			
Add capital grant during '68-69	54,00,000			
			1,30,09,432	
Add adjustments '67-68	7,64,66,284			
	980			
			91,47,978	
				38,61,454
				5,53,21,792
Buildings :				
Cost of completed Buildings as on 31-3-'68		4,23,12,360		
Add Buildings completed during the year		91,47,978		
			5,14,60,338	
Buildings under construction as on 31-3-'68		90,01,162		
Add Expenditure for the year		40,08,270		
			1,30,09,432	
Less Transferred to completed buildings account			91,47,978	
				38,61,454
Equipments, Furniture and Fitting :				
At cost as per Balance Sheet as at 31-3-'68		1,01,64,915		
Add Additions during the year		12,03,767		
			1,13,68,682	
Less Adjustments		4,175		
			1,13,64,507	
				5,53,21,792
				C/o.

CAPITAL FUND AND LIABILITIES PROPERTY AND ASSETS

	Rs.	Rs.	Rs.		Rs.	Rs.
<i>Less adjustments</i>						
(a) (66-67 and '67-68)	7,205				9,147	5,53,21,792
(b) Excess of Expenditure over income for '68-69	5,88,852	5,96,057	7,58,71,207			1,13,55,360
Gymkhana fund			10,21,80,269		2,28,100	
Add adjustments '66-67 and '67-68		42,606	42,606		11,044	2,39,144
Endowment fund (Governors prize etc.) as on 31-3-'68		9,000	9,000			
Add additions during the year		13,350	13,350		2,58,15,633	
Deposits:						
Earnest money, Caution and other Deposits			22,350	Block value of equipment from West Germany as per balance sheet as on 31-3-'68	2,10,35,790	
			7,30,558	Add additions during the year	47,79,843	
			76,409	Clearance charges on equipment from West Germany as per balance sheet as on 31-3-'68	36,68,243	
			5,58,612	Add adjustments	4,175	
Sundry Creditors:						
On works account—purchase			76,409	Add additions during the year	36,72,418	
For supplies made or services rendered to Departments/Section			3,79,866		40,52,284	2,98,67,917
C/o.			10,36,18,009			9,67,84,213

CAPITAL FUND AND LIABILITIES

PROPERTY AND ASSETS

	Rs.	B/F	Rs.	B/F	Rs.	Rs.
Outstanding Expenses Payable :						
(a) Pay and allowances			10,36,18,009			9,67,84,213
(b) Scholarships			5,34,250	Motor vehicles at cost as per balance sheet as at 31-3-'68	3,23,177	
			1,05,252	Add adjustments '67-68	980	3,24,157
(c) Other allowances—Medical			9,545	Add additions during the year	31,853	3,56,010
(d) Wages to N.M.R. labourers, Departments etc.				Library books and scientific journals at cost as on 31-3-'68	15,47,717	
			5,870	Add additions during the year	3,72,206	19,19,923
(e) Audit fees			8,200	Block value of Tech. books and journals from West Germany as per balance sheet as at 31-3-'68	2,26,734	
(f) Trainfare to candidates			102	Add additions during the year	38,595	2,65,329
Fees refundable			28,102	Typewriter and Duplicators at cost as per balance sheet as at 31-3-'68	1,15,842	
C.P.F. contribution payable			7,816			
			10,43,17,146			9,93,25,475
		C/O				
						C/O

CAPITAL FUND AND LIABILITIES		PROPERTY AND ASSETS	
Rs.	B/F	Rs.	B/F
10,44,40,154		9,97,48,536	
		1,030	
		8,52,540	
		16,48,933	
		15,358	
		20,359	
		49,811	
		49,811	
		2,051	
		3,485	
		6,724	
		2,575	
		14,522	
		35,975	
		5,061	
		50	
		1,992	
		6,329	
		49,811	
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		6,329	
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		49,811	
		2,051	

CAPITAL FUND AND LIABILITIES

PROPERTY AND ASSETS

	Rs.	Rs.	Rs.	Rs.	Rs.
B/F	10,44,40,154		B/F		10,24,15,331
			Payments out of grant received from the American Chemical Society		
			Equipments	\$ 11,272-96	84,547
			Advances	\$ 476-00	3,570
			Advances and Deposits :		
			Works advances		31,331
			Others General		2,67,500
			Deposits with Madras State Electricity Board		1,10,180
			Collector of Customs, Madras A/C I		3,76,845
			A/C II		3,12,866
			Closing Balances :		
			Cash on hand	56,120	
			Office Imprest Cash	500	
			With State Bank of India includes refundable deposits of Rs. 7,30,557.77	7,46,938	
			With First National City Bank, New York, \$ 2,253-83	16,904	
			Unpaid cash balance	17,522	
					8,37,984
Total	Rs. 10,44,40,154		Total	Rs. 10,44,40,154	

Note: Value of 619.76 acres of land received as gift from Madras Government in 1959 still remains to be assessed and indicated in the Balance Sheet.

SECTION V

SECTION V

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ENDOWMENTS FOR PRIZES, ETC.

The following Endowments and Prizes, etc. have been instituted during the year :—

- (1) Endowment by Messrs. Philips India Limited.
- (2) Endowment by the Banco Foundation, Baroda.
- (3) Endowment by Sri Kolluri Venkataramana Sarma, father of the late Sri K. V. Rama Sarma, a student of the Institute.
- (4) Endowment founded by Dr. A. L. Mudaliar, first Chairman of the Board of Governors of the Institute, in honour of Prof. B. Sengupto, first Director of the Institute.

The terms and conditions of the awards are detailed below:

(1) Endowment by Messrs. Philips India Limited : This endowment consists of a capital amount of Rs. 10,000 offered by Messrs. Philips India Limited, the annual interest from which is to be utilized for an 'endowment lecture in alternate years and for the award of a prize annually.

(a) *Lecture:* A sum of Rs. 500/- per annum be set apart towards an endowment lecture to be delivered ordinarily once in two years, by a distinguished engineer or scientist.

(b) *Prize:* The Prize shall be called "The Philips India Prize"

The prize shall be of the value of Rs. 150/- to meet the cost of a bronze medal of 2" diameter and books of the value of Rs. 75/-

The medal will bear the emblem of the Institute on one side and the legend "Philips India Prize, etc." on the other.

The prize shall be awarded at the Convocation of the Institute to the student with the best academic record in Electrical Engineering (Electronics) of the Five-year B. Tech. Degree course.

(2) Endowment by The Banco Foundation, Baroda : This endowment has been founded by the Banco Foundation, Baroda, with a capital amount of Rs. 3,000/-, the annual interest from which is to be utilized for the award of a prize annually at the Convocation of the Institute in the form of a medal to

the student with the best academic record in Mechanical Engineering of the B.Tech Degree course.

The prize shall be in the form of a gold medal to be awarded at the Convocation of the Institute every year. The gold medal of $1\frac{1}{4}$ " diameter manufactured in 9 carat gold, will bear the emblem of the Banco Foundation on the obverse side, while on the reverse side it will contain the name of the student, with class and field of study.

The recipient of the prize should have passed all the examinations at the first appearance and should have been placed in the First Class at the end of the prescribed period of study.

(3) Endowment by Sri Kolluri Venkataramana Sarma : Sri Kolluri Venkataramana Sarma, has offered to found an endowment of Rs. 3,000/-, in memory of his son, the late Sri K. V. Rama Sarma, who was a student of this Institute in the Fourth-year B. Tech. Degree Course at the time of his demise. This endowment is for the award of a gold medal to the student with the best academic record at the end of the fourth year of the Five-year B. Tech. Degree Course in Electrical Engineering (Power) commencing from the 1968-69 Session.

(4) Professor B. Sengupto Prize : The endowment offered by Dr. A. L. Mudaliar, first chairman of the Board of Governors, consists of a capital amount of Rs. 2,000/-, the annual interest from which is to be utilized for the award of a prize called the "Professor B. Sengupto Prize", to a post-graduate student in the Faculty of Engineering.

The prize shall be awarded annually to the full-time student with the best academic record, passing the M.Tech. Degree examination at his first appearance. It shall be awarded alternately to the student in Mechanical Engineering and Chemical Engineering disciplines. The prize for 1968-69 is to be awarded to the student in the Mechanical Engineering discipline.

LIBRARY**Librarian :****STAFF**

Sri V. S. Nazir Ahmed, B.A., LL.B., D.L.Sc., M.I.Inf.Sc., A.I.EEE

Assistant Librarians :

Sri V. K. Vedapuri, M.A., D.L.Sc.,
 Sri C. Deenadayalu, M.A., B.Lib. Sc.,
 Sri N. Satyamurthi, B.Sc., D.L.Sc.,
 Sri P. Venkatesan, B.Sc., B.Lib. Sc.,

Technical Assistants :

Sri K. Sankaran, B.A., B.Lib. Sc.
 Mrs. J. Durairaj, B.A., B.T., B.Lib. Sc.,
 Sri N. K. Gopalakrishnan Empranthiry, B.Sc., B.Lib. Sc.,
 Sri P. G. Krishnamurthi, M.Sc., D.L.Sc. ADRTC.
 Miss Baby Girija, B.Sc., B.Lib. Sc.,
 Sri S. Kasiviswanatham, B.Com. D.L.Sc.,
 Sri V. V. V. Satyanarayana, B.Sc., D.L.Sc.,

The Library has entered the 'second year of service from its new building specially planned for modern library services. It has registered an increase in the library membership during the year under review and it stands now at 3120. As envisaged earlier, the membership of the library is now open to industrial organisation on a payment of an annual fee Rs. 250/-. A few important organizations of the city have taken advantage of this scheme.

Readers' Service :

The Library continued to work on all days of the year under review (except for 7 closed holidays for the Library) between 8-00 a.m. and 9-30 p.m. On Sundays and other closed holidays for the Institute, the Library was kept open from 9 a.m. to 4 p.m. During the year, the total attendance of members was about a lakh and an equal number of books and periodicals were issued during the year.

Books and Periodicals :

The number of books and pamphlets rose from 69799 as on 30-6-68 to 76995 consisting of 61905 books and 15090 pamphlets. 1232 periodicals were

subscribed for during the year. 140 bound volumes of periodicals in all subjects have been so far acquired. Some of the sets of periodicals for the years 1967 and 1968 which were not received in the Library due to lapse on the part of the subscription agents have now been obtained by entering subscriptions direct with the publishers. Similarly the supplies for some of the periodicals have been resumed after the interregnum of 1967/1968.

Text Book Collection :

The Text Books Collection consisting of multiple copies of recommended text books has been further strengthened by the addition of more books.

Gifts and Exchange :

The Library is grateful to the various organizations and other Government agencies for their gifts of publications. Mention may be made specifically of 1498 German publications (including 1479 DIN Standards) and 113 periodicals received during the year under the Indo-German Agreement. Arrangements were made for regular exchange of publications with the Libraries of five German Technical Universities co-operating with the Indian Institute of Technology, Madras. Of these, Technical University Library, Berlin is supplying us free Xerox copies of any article of periodicals available in its holding.

Books, pamphlets, circulars and other reading materials have been received as free gift from the following :

GAWI, Frankfurt

British Council, Madras

USIS, Delhi

American Embassy, New Delhi

Association of Commonwealth Universities, London

Central Board of Irrigation & Power, New Delhi

Asia Foundation, New Delhi

Books and journals were obtained on Inter-Library Loan System from the following Libraries :

National Aeronautical Laboratory, Bangalore

Tata Institute of Fundamental Research, Bombay

Indian Institute of Technology, Bombay
 Indian Institute of Technology, Kanpur
 Madras University Library, Madras
 College of Engineering, Madras
 American Cultural Centre Library, Madras
 British Council Library, Madras
 National Science Library, New Delhi

Reclassification of Books :

Books on Sciences and Technology, Text Books and Reference Books have been reclassified according to UDC. Only a part of the collections of books on Social Sciences & Humanities is to be reclassified.

Library publications :

The Library has brought out the fortnightly 'Library Information Bulletin' regularly during the year under review. It has also issued a Handbook on the Library Administration with a supplement of standardized forms and letters for the guidance of the staff and academic departments.

Translation work :

Translation service from German into English was rendered by the library staff. It has also procured and supplied 158 translations and photocopies of scientific articles from INSDOC, New Delhi, Technical University, Berlin and outside agencies for the use of the research workers at the Institute.

Microfilming and photocopying service :

This service is being rendered with the help of a Library Photographer at nominal rates. Photographic equipment worth about Rs. 82,000/- has been received for installation in the Reprographic Section as soon as its construction is over.

Bindery :

A bindery with the required machinery is catering to the binding needs of the Library and other Departments of the Institute. 3027 periodicals were got bound or reconditioned during the year.

Deputation :

Shri V.K. Vedapuri, Assistant Librarian, has been deputed to undergo training in Documentation & Reprography at INSDOC, Delhi, from August 1968 to September 1969.

Seminar :

The Librarian attended the Seminar on Automation Problems in University Libraries and special libraries at INSDOC, Delhi, during May 1969.

ENGINEERING UNIT**STAFF :**

Sri S. Nagarajan, B.E. (Hons.), C.E.S., Superintending Engineer
 Sri C. S. Subramaniam, Executive Engineer
 Sri K. V. Ananthanarayanan, Assistant Engineer
 Sri Y. S. Nagaraja Rao, B.E., Assistant Engineer
 Sri K. Shankar, B.Sc., B.E., Assistant Engineer
 Sri D. Ramanathan, B.E., Assistant Engineer
 Sri Abraham Varghese, Assistant Engineer
 Sri S. G. D. Rozario, Assistant Engineer
 Sri N. Malayalam, Assistant Engineer

The Engineering Unit maintained the tempo of its activity during the year. The multi-storeyed Administration Block, the tallest building of the Institute, was completed with all services and occupied in December '68. The Aeronautical Engineering Building, the construction of which started in December '67, was also completed and occupied by the Department during the year.

The work on the second floor over the rear wing of Mechanical Sciences Block was also completed with all amenities and occupied.

The following major construction works were in progress to accommodate the machinery and equipments received from West Germany under the Second Indo-German Agreement:

- (i) Extension to Hydraulic Laboratory
- (ii) Structures Laboratory
- (iii) Machine Elements & Mechanical Handling Laboratory
- (iv) Special Scientific Instruments Laboratory
- (v) New Transformer Sub-Stations

Besides, major air-conditioning works for the Library, Special Instruments Laboratory, and the new Senate Room were taken up.

Further, a number of items of machinery and equipments were installed in various departments with such modifications and changes as were needed to suit the requirements of the German planners.

A Fabrication-cum-Carpentry Unit is also functioning for executing steel fabrication works and manufacturing furniture items required by the various departments.

In addition to these, various minor works pertaining to the instructional buildings, hostels and residential buildings were also executed. The maintenance of the various buildings, water supply, drainage and electrification to the campus including upkeep of the campus were also attended to by the Engineering Unit regularly.

FACULTY ASSOCIATION

The Faculty Association comprises the academic staff of the Institute. The following were the members of the Executive Committee for the year 1968-69:—

President	Dr. A. Ramachandran (Director)
Vice-President	Dr. B. S. Murthy
Vice-President	Prof. H. Wagner
Secretary	Sri S. Ramani
Joint Secretary	Dr. A. V. Krishna Rao
Treasurer	Sri M. A. Veluswamy
Auditor	Dr. (Miss) V. Vasantasree
Auditor	Dr. M. Satyanarayana
Member	Dr. D. Johnson Victor
Member	Dr. V. Seshadri
Member	Mr. R. Kirmse
Member	Mr. A. V. Sundaram

During the year under review the membership increased from 208 to 300.

Distinguished speakers, who addressed the Association during the year, included the following:—

29- 8-1968	Dr. M. Krishna Mohan, Director, Indian Institute of Management, Calcutta.	Inaugural Address
23- 9-1968	Prof. A. L. Krishnan Prof. of English I.I.T. Madras.	Functional English
18-12-1968	Professors Igor L. Bratchikov and Igor M. Souchtchinski, Unesco Experts, IIT Bombay.	Computer Languages as means of communication between the user and the Computer; Com- puter Techniques
3- 1-1969	Dr. K. S. Narendra, Professor. Department of Engineering and Applied Sciences, Yale University, USA.	Man and Machine

- 19- 2-1969 Dr. Friedrich Weltz
Sociologist,
West Germany. Leisure Time—Tomorrow's
Problem
- 3- 3-1969 Prof. T. K. Venkateswaran,
Director of Asian Studies Denver,
University of Colorado, USA. Asian awareness and Asian
Studies in the USA
- 19- 3-1969 Dr. Ing. K. Gersten,
Guest Professor from Institute
for Thermo and Fluid Dynamics,
University of Bochum,
West Germany. Non-Aeronautical Application
of Aerodynamics.

ALUMNI ASSOCIATION AND STUDENTS'-PLACEMENT CENTRE

The Alumni Association had the following office-bearers for the year 1968-69 :—

Patron	Dr. A. Ramachandran (Director)
President	Prof. R. G. Narayanamurthi
Vice-President	Sri D. Venkappayya
Secretary	Sri M. R. Sridharan
Joint Secretary	Sri C. S. Sastri
Treasurer	Dr. P. Srinivasa Rao
Auditor	Sri V. D. Muthayya
Members	Sri M. Santhanam
	Sri R. Nagarajan

During the absence abroad of Prof. R. G. Narayanamurthi between August and November 1968, Dr. P. Venkata Rao acted as President.

The membership of the Association increased from 1,050 in July 1968 to 1,366 at the end of June 1969.

The first issue of the News Letter was published in November 1968, and the second issue will be released on the eve of the Sixth Convocation.

Regarding placement, most of the alumni of the previous batches are well-placed—vide **Annexure**. The Section was contacted by 58 firms both in private and public sectors. Screening and interviews were held by 18 companies.

Statement showing placement position of students belonging to 1964, 1965, 1966,

1967 and 1968 batches

Annexure

(B.Tech./M.Tech./D.I.T./M.Sc.)

Year	Total passed out	Studying in India	Studying abroad	Employed abroad	Employed in India		Unemployed	Position not known	Expired
					Private Sector	Public Sector			
1964	106	13	19	5	33	36	—	—	—
1965	163	21	34	14	42	52	—	—	—
1966	246	33	40	7	85	76	3	1	1
1967	319	60	38	7	81	84	15	33	1
1968	383	85	54	4	71	60	8	100	1
Total	1217	212	185	37	312	308	26	134	3

NATIONAL CADET CORPS

(A) No. 4. (Tamil Nadu) Air Squadron (Tech.) NCC.

Sqn. Ldr. C. P. A. Nair

Officer Commanding

Flt. Lt. S. Ganesh Prasad

Administrative Officer

No. 4 Tamil Nadu Air Squadron (Tech.) NCC is one of the Air Wing Units in Tamil Nadu located at this Institute for the benefit of its students. This Unit continued its fourth year of activity during the year 1968-69.

The object of training at this Unit is to—

- (a) broaden the outlook of the students and to inculcate qualities of discipline, leadership, self-reliance, determination and esprit de corps;
- (b) create a nucleus of partially trained technical personnel from whom the country can draw its requirements of technical officers in the event of an emergency; and
- (c) stimulate interest among potential engineering graduates for careers in the I.A.F.

The syllabus covers a variety of subjects. Drill, citizenship, first-aid, weapon-training, organisation and administration, aero-modelling, principles of flight and technical instruction relating to the aircraft, aero-engines, air frames, electrical, armament, instrument and signals are some of the subjects covered during a period of two years of training. The cadets also get an opportunity to handle and fire small-arms and to take part in shooting competitions. Further, there is provision for the cadets to go on annual training camps and special adventure and mountaineering courses.

84 students of the first year B.Tech. course voluntarily joined the Air Wing.

The Unit had during the year a total of 151 cadets including three 3rd and 4th year students of the 5-year B.Tech. Degree course. Training was imparted on Mondays and Thursdays from 1630 hours to 1830 hours. On conclusion of the training, the NCC 'B' and 'C' certificate examinations were held. Three cadets appeared for the 'C' certificate examination and 2 passed

with a grading of 'B' and 1 with a grading of 'C'. Out of the 58 cadets who appeared for the 'B' certificate examination, 50 passed, four with a grading of 'B' and the rest with 'C'.

During the year, the cadets were taken on an instructional visit to the Air Force Station, Tambaram, and Lodger Units, where they saw different types of aircraft and equipment and received information on the various aspects of Air Force activity.

The annual range firing was also held at the Air Force Station, Tambaram.

The cadets of this Unit jointly with the cadets of the Army NCC Unit gave a guard of honour to Dr. Vikram Sarabhai on the Convocation Day and also took part in the Republic Day parade at the Institute when the Director took the salute.

The Unit had, during the year, acquired three aero-engines and various instruments and accessories as training aids. A basic jet aircraft is likely to be added in the near future.

There is a team of technical and non-technical instructors at the Unit capable of giving useful instructions to the NCC cadets in general and the students of the Aeronautical branch in particular.

(B) No. 2 (Tamil Nadu) Composite Technical (Engineers/Signals/EME) Company.

Lt. Col. S. Subrahmanyam

Officer Commanding

This Unit consists of three platoons, namely Engineers, Signals and EME platoons, and is designed to train 200 cadets every year. Though NCC training is voluntary during the first two years of the 5 year B.Tech. Degree course in the Institute, volunteers from among the 3rd, 4th and 5th year students are also on the rolls of this Unit. **Parades were held on every Monday and Thursday from 1630 hours to 1830 hours.** Each parade was divided into three periods. Cadets in the first year of training were given **military training.** During the second year of training, they were allotted to the various platoons, and given military and technical training. Military training consists of drill with and without arms; weapon-training, infantry section tactics, map-reading, etc. All cadets have to complete their annual range classification in .22 rifle/.303 rifle during the academic year. For the year under report, the range classification was completed in September 1968. Some cadets were selected to take part in the EARL ROBERT Shooting Competition. In technical training, the cadets are trained in specific corps-subjects like organisation, employment and equipment.

Lt. Col. S. Subrahmanyam took over command of this Unit from Major S. M. M. Jaffery transferred, with effect from the 17th of November 1968.

During the year, of the 40 students who appeared for Part 'B' NCC Examination, 29 passed (2 with 'A' grade, 14 with 'B' grade and 13 with 'C' grade).

The following trophies were instituted during the year :--

1. Ball Badminton : Rolling Trophy donated by Prof. J. C. Kuria-cose, Assistant Professor of Chemistry, I.I.T. Madras
2. Bridge (Inter-Hostel) : Rolling Trophy donated by Sri C. R. Krishna Rao in memory of his son, Sri K. Sridhar, student of the Institute, who died in an accident
3. Bridge (Open) : Rolling Trophy donated by the Film Club
4. Carroms : Chellappa Memorial Rolling Trophy donated by the Film Club
5. Chess : Rolling Trophy donated by Prof. Butenuth, Professor of Chemistry, I.I.T., Madras.
6. Cricket (Best Cricketer) : Rolling Trophy donated by Sri C. R. Krishna Rao, in memory of his son, Sri K. Sridhar, student of the Institute who died in an accident.
7. Gymnastics : Kulkarni Memorial Rolling Trophy donated by the Film Club
8. Kabaddi : Rolling Trophy donated by the Film Club
9. Shuttle Badminton : Rolling Trophy donated by Prof. N. K. Datta, Professor of Industrial Engineering, I.I.T. Madras
10. Tennikoit : Rama Sarma Memorial Rolling Trophy donated by the Film Club
11. Tennis : Rolling Trophy donated by Dr. A. Ramachandran, Director, I.I.T., Madras
12. Tug-of-War. Rolling Trophy donated by C. V. Sethunathan, Registrar, I.I.T. Madras

The highlights of the year are given below in brief:

1968

- August 20 Election of Class Representatives
 „ 29 Election of Secretaries
 September 9 Annual Quiz. Quiz Master: Sri S. Ramani
 „ 25 Essay Writing Competition --- Talk by Shri E. L. Stracey,
 Inspector-General of Prisons on "Personnel relations"
 October 7 Inauguration of the Gymkhana and Entertainment
 „ 30-31 Inter-Hostel Entertainments Competition
 November 13 Mandolin Concert by Prof. Jacob Thomas

1969

- January 8 Film Show on 'Maharishi Mahesh Yogi' --- The Maharishi
 answered questions on Transcendental meditation
 „ 20 Talk by Dr. N. F. Washburne on 'Social Interactions in
 Human Behaviour'
 „ 25 Jazz from Germany --- Klaus Doldinger Jazz Quartet
 „ 30 General Knowledge Test
 February 6 Open Group Discussion Competition
 „ 8 Inter-Hostel Gymnastics Championship
 „ 10 All India Debate
 „ 11 German Recitation Competition
 „ 12 Group Discussion Competition
 „ 13 Quiz Competition
 „ 14-15 Entertainment Competition
 „ 20 Open Skating Championship --- Dr. Karl Pfauter, Consul
 General of the Federal Republic of Germany presided
 „ 26 Open Boxing Championship

March 1	Sarayu Hostel Sports Day
„ 8	Annual Sports Day
„ 17	Inter-Hostels Debate
„ 21	Love Songs from Nine Centuries — Elena Cardas/Ales Andryszak
„ 22	Institute Day, with Sri H. V. R. Iengar, Chairman, Board of Governors, as the Chief Guest

Participation in Literary and Other Activities

Debates :

Southern India Chamber of Commerce Debate
 Rotary Club of Madras West Debate
 Gandhi Centenary Debate at Loyola College
 A. M. Jain College Debate for Mohanmulji Chordia Rolling Trophy
 Madras Institute of Technology Debate
 Debate held by Toastmaster's Club, YMCA, Royapettah
 South Madras Junior Chamber Debate

Quiz :

Saturday Evening Club Quiz
 A.I.R. Quizzes

Seminars :

Mock General Assembly session at Stella Maris College, Madras

Entertainment :

Light Classical Music Competition held at the College of Engineering, Guindy
 Inter-Collegiate Entertainment in aid of the Red Cross Fund
 Light Classical Music Competition at Madras Institute of Technology

Sports :

Inter-Collegiate league matches in Cricket, Hockey, Volleyball, Tennis, Football, Basketball and Table Tennis.
Jain College Tournaments in Cricket, Hockey, and Basketball.

HOSTELS

Ten Hostels for boys and one Hostel for girls functioned during the year under report. Dr P. C. Varghese, Professor of Civil Engineering, continued to be the Chairman, Council of Wardens. The delegates/participants for various conferences and seminars conducted at the Institute were accommodated in the Hostels. Similar facilities were extended on requisition by the organisers of the conferences seminars in Madras City and to the some of the educational tourist parties consisting of students and Staff members of the different Institutions who visited the Institute during the year.

Soon after the beginning of the academic year, the residents of each hostel elected their student-representatives on the various committees for managing the mess and other activities of the concerned hostels. The hostels organised various tournaments and other extra curricular activities during the year. Detailed reports about each hostel are given below.

The Taramani House, under the charge of Sri S. S. Mani, was made full use of by the Staff-members and the students of the Institute for accommodating their guests. One wing of the Taramani House was reserved for accommodating the staff-members of the Institute.

The Central Supplies Wing carried on its useful work in catering to the needs of the hostels and the residents in the campus of the Institute.

ALAKANANDA HOSTEL

Sri S. S. Mani	Warden
Sri N. Venkiteswaran	Assistant Warden
Sri M. R. Vijaya Raghavan	Assistant Warden
Sri B. S. Mani	General Secretary

The incoming residents were given a warm welcome on 18-7-1968.

180 students of the first year class of the Five-year B. Tech. Degree Course resided in the Hostel during the year. The Hostel inmates took keen interest in the Gymkhana activities. Sri Narendra Kumar secured the individual championship in Athletics, while Sri R. Asokan was adjudged the best scientific Boxer of the year. Sri M. M. Dilip Kumar secured the first prize for his essay-writing in the All India competition. The Hostel was the winner of the Director's Rolling Trophy for the Best Flower Garden for the year.

The Hostel Day was celebrated on 25-2-1969 with the Hon'ble Mr. Justice K. N. Mudaliar, Judge, High Court, as the Chief Guest.

GANGA HOSTEL

Dr. V. Sivaramakrishnan	Warden
Sri. B. H. Lakshmana Gowda	Assistant Warden
Sri. K. N. Gopalan	Assistant Warden (upto 25-9-1968)
Sri. S. Krishnan	Assistant Warden (since 17-10-1968)
Sri. S. Srinivasan	General Secretary

184 students resided in the Hostel during the year as detailed below.—

(i) Five Year B.Tech. Degree Course :

(a) Second year	...	35
(b) Third year	...	34
(c) Fourth year	...	47
(d) Final year	...	34

(ii) Three Year B.Tech. Degree Course :

(a) Second year	...	12
(b) Third year	...	22

Total	...	184
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The Hostel has a collection of 400 books on English Literature and Fiction. It received a gift of books in English and Tamil from the United States Information Service.

In the Inter-Hostel Tournaments, the Hostel was ranked second for overall performance. The Hostel Teams won the Inter-Hostel Championship in Foot-ball, Gymnastics, Ball-Badminton and Carroms, while the Hostel was runner-up in Hockey. It also took part in the Open Boxing Competition securing the maximum number of points.

In the Inter-Hostel Entertainment competition, the Hostel won the Engineering Unit Trophy. It also claimed the Trophy at the Inter-Hostel Quiz Competition.

GODAVARI HOSTEL

Dr. V. Sethuraman	Warden
Sri S. G. Asthana	Assistant Warden
Sri Govardana Giri Rao	Assistant Warden (upto 14-9-68)
Sri J. Majhi	Assistant Warden (since 14-9-68)
Sri Kumar Subramaniam	General Secretary

181 students resided in the Hostel during the year as detailed below.—

(i) Five Year B.Tech. Degree Course :

(a) Second year	...	31
(b) Third year	...	34
(c) Fourth year	...	38
(d) Fifth year	...	40

(ii) Three Year B.Tech. Degree Course :

(a) Second year	...	13
(b) Third year	...	25
Total	...	<u>181</u>

Sri K. V. Ramasarma, a fourth-year class student of the Five-year B.Tech. Degree Course in Electrical Engineering, lost his life in a drowning accident.

The Hostel won the following Prizes :—

- Pioneer Sports Company Rolling Trophy in Hockey;
- Prof. N. K. Dutta Rolling Trophy in Shuttle Badminton;
- Rolling Shield for the March Past.

JAMUNA HOSTEL

Dr. M. C. Gupta	Warden
Sri J. Chandramouli	Assistant Warden
Sri P. A. K. Murthi	Assistant Warden
Sri G. Nellailingam	General Secretary

187 students resided in the Hostel during the year as detailed below:—

(i) Five Year B.Tech. Degree Course :		
(a) First year	...	2
(b) Second year	...	66
(c) Third year	...	50
(d) Fourth year	...	38
(ii) Three Year B.Tech. Degree Course :		
Second year	...	31
<hr/>		
Total	...	187
<hr/>		

The literary activities of the Hostel started with a Hat-Night Debate on 22-9-1968. Dr. M. C. Gupta gave a talk supplemented by colour slides on his impressions gathered during his sojourn in U.S.A. and Germany, Mr. Robertz gave a travelogue of his tours in India.

Sri S. K. Mohanakrishnan won the third prize in the Esso Science Exhibition held at Delhi.

Sri T. L. Palanikumar was placed third in the Eassy Competition conducted by the Institute Gymkhana.

Sri Mohan K. Marcus won the first prize for his oil paintings in the Art and Photographic Competition.

The Hostel won the Table Tennis Trophy. In the Open Boxing Championship, the Bantam weight title was won by Sri Watsa.

The title "IIT's Strongman" was annexed by Sri Kuldip Singh Dabas. The Hostel secured the second place in 100 Metres, 400 Metres and 1,500 Metres Hurdles Races and third place in 5,000 Metres Race.

In the Inter-Hostel Entertainment competition, the Hostel won the second place. The Judges' Special Prize was awarded to the Puppet Show put up by Sri Raju and his friends. The Engineering Unit Trophy for the best flower garden was awarded to the Hostel.

KAVERI HOSTEL

Dr. P. C. Varghese	Warden
Shri B. C. Bhattacharya	Assistant Warden (upto 31-8-1968)
Shri K. Ramar	Assistant Warden (since 23-10-1968)
Shri R. Ravindran	Assistant Warden
Shri S. V. Kannan	General Secretary

This Hostel accommodated the students of the M.Tech., D.I.I.T. Research Scholars, Technical Teachers Trainees and some Staff members of the Institute.

Monthly dinners were a special feature of the Hostel. The Hostel took part in the various sporting activities and cultural programmes as usual.

New volumes of books have been added to the Hostel Library.

The combined Hostel Day of the Kaveri Hostel and the Sarayu Hostel (Ladies' Hostel) was celebrated on the 2nd of March 1969, with Sri J. A. Ambashankar, I.A.S., Director of the Transport Department, Government of Tamil Nadu, as the Chief Guest.

KRISHNA HOSTEL

Dr. M. V. C. Sastri	Warden
Sri P. Krishna Iyer	Assistant Warden
Sri S. K. Jain	Assistant Warden (till 31st October 1968)
Sri C. Eswaran	Assistant Warden (from 1st November 1968)
Sri R. S. Krishnan	General Secretary

187 students resided in the Hostel during the year. On 20th February 1969 a Dinner was arranged, when Dr. Brauer and Dr. Skyford, the Visiting Professors from West Germany, were the Chief Guests. On that occasion, a talk on "Scope of employment of Indian Engineers in Germany" was given.

The Institute Basket Ball team consisting of three inmates of this Hostel won the Somasundara Reddiar Trophy conducted by the A. M. Jain College, Meenambakkam, Madras. The Hostel retained the Cricket and Basket Ball Championships this year. In the Hostel Garden Competition, the Hostel was placed second. Mr. Vijayan, Entertainment Secretary, and

Mr. Rajendran, Ace Vocalist of the Hostel, won the individual prizes in the Inter-Hostel Entertainment Competition.

A Carnival was organised on the 15th of March 1969.

The Hostel Day was celebrated on the 17th March 1969 with Sri M. Ramabrahmam, Managing Director, Madras Refineries Limited, as the Chief Guest. On this occasion Dr. Karl Pfauter, German Consul General, Madras, released the Krishna Hostel Day Brochure.

MANDAKINI HOSTEL

Dr. K. S. Sankaran	Warden
Sri D. Suresh	Assistant Warden
Sri R. V. Ramakrishna Sastry	Assistant Warden
Sri B. Sriram Shastry	General Secretary

32 students of the first year class of the M.Sc. Degree Course and 32 students of the first year class of the Five-year B.Tech. Degree Course resided in the Hostel during the year.

The Hostel was formally inaugurated by Srimathi Susila Ramachandran on the 18th of August 1968.

The Hostel Day was celebrated on the 3rd March 1969 with Dr M. S., Vairanapillai as the Chief Guest.

NARMADA HOSTEL

Dr. D. K. Banerjee	Warden
Sri E. G. Tulapurkara	Assistant Warden
Sri Y. Munivenkata Reddy	Assistant Warden
Sri John L. Stracey	General Secretary

184 students resided in the Hostel during the year as detailed below :--

(i) Five Year B.Tech. Degree Course :

(a) Second year	...	37
(b) Third year	...	27
(c) Fourth year	...	40
(d) Fifth year	...	37

(ii) Three Year B.Tech. Degree Course :

(a) Second year	...	21
(b) Third year	...	22

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Though the activities of the Hostel had begun much earlier, the formal function inaugurating the Hostel activities for the year was held on the 28th of August 1968, with Dr. K. Srinivas, Neurologist, Madras Medical College, as the Chief Guest.

Recreational facilities were widened by increasing the number of periodicals and by purchasing a good number of new gramophone records. Funds were raised in response to appeals by the Red Cross Society, Madras, Round Table Charity Trust and National Institute for Deaf and Blind. Three gramophone records were donated to the St. Louis Institute for Deaf and Blind. The Hostel Library has been steadily increasing in stock of books, which currently stands at 362. This year, a sizeable number of books were received from the United States Information Service and Max Mueller Bhavan, as gifts.

In the field of games and cultural and literary activities the performance of the residents of the Hostel were impressive. Chandran Rathnaswamy, R. D. Chhillar and B. K. Panigrahi won trophies for Athletics. K. Srikumar and Ramamurthi won first prizes for Bridge and Carroms. M. S. Srinivasan and S. Rathneswar were among the five members of Institute Quiz Team. The photograph of V. Jagadeesh was adjudged as the best in the Inter-College Photographic Competition. A Quiz competition was arranged for the inmates of the Hostel with Shri P. N. Narayanan, student of Loyola College, as Quiz Master.

The Hostel Day was celebrated on the 19th February 1969, with Sri V. P. Rajan, Editor, "The Mail" as the Chief Guest.

SARASWATHI HOSTEL

Dr. M. Venugopal	Warden
Sri M. Durgaprasada Rao	Assistant Warden (till 31st October 1968)
Sri S. Selvaraj	Assistant Warden (till 31st October 1968)
Sri G. Venkata Rao	Assistant Warden (from 1st November 1968)
Dr. Y. Nagendra	Assistant Warden (from 1st November 1968)
Shri V. Ramakrishnan	General Secretary

184 students resided in the Hostel during the year as detailed below :—

(i) Five Year B.Tech. Degree Course :

(a) Second year	...	28
(b) Third year	...	37
(c) Fourth year	...	44
(d) Fifth year	...	33

(ii) Three Year B.Tech. Degree Course :

(a) Second year	...	16
(b) Third year	...	26

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The Hostel had the privilege of the largest number of executives in the Institute Gymkhana. Sri K. S. Laganathan, Sri Dalton Eddy and Sri Ranjan Kelly were elected to the Gymkhana as its General Secretary, Social Secretary and Fine Arts Secretary respectively.

In the Inter-Hostel Meet, the Hostel won the Chess championship through the participation by Messrs. Krishna Kumar, E. E. Shivaji and R. G. Ramabhadran. The Hostel also won the Second Prize in Carroms.

Sri V. S. Krishnan won the Gold Medal in the Chamber of Commerce Open Debate. He also won the first prize in the Annual Debate. He took part in the Open Debate Competition conducted by the Madras Institute of Technology and won the Team Trophy. He was also placed second as an individual participant.

Sri M. G. Jayaraman won the first prize in the Institute Open Essay competition. Sri Veeraraghava Raja and Sri V. S. Krishnan annexed the Trophy for the best team in the Open Debate competition conducted by the Rotary Club in September 1968. Sri Ranjan Kelly was awarded the Judges Special Prize in the Inter-Collegiate Competitions held during the Literary and Cultural Week. Sri Charles Ashley Solomon and Sri Ranjan Kelly were awarded the Judges Special Prizes in the Inter-Hostel Entertainment Competition.

The Hostel Day was celebrated on the 31st March 1969 with Dr. F. Krisinawamy, Area Sales Manager, Messrs. Glaxo Laboratories, Madras, as the Chief Guest.

TAPTI HOSTEL

Dr. J. C. Kuriacose	Warden
Sri G. Subramanian	Assistant Warden
Sri Harnam Singh Bathla	Assistant Warden
Sri Balan Nambiar	General Secretary

183 students resided in the Hostel during the year as detailed below:—

(i) **Five Year B.Tech. Degree Course :**

(a) First year	...	3
(b) Second year	...	33
(c) Third year	...	34
(d) Fourth year	...	41
(e) Fifth year	...	38

(ii) **Three Year B.Tech. Degree Course :**

(a) Second year	...	20
(b) Third year	...	14

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In the Hostel Entertainment Competition Sri Corderio and group got the prizes for the best musical group. The Institute Strongman, Sri Panigrahi, also the Chief Gymnast, is from this Hostel. Messrs. Corderio, Allan

John Sathyadev, Rashad Mohamed and Peter Fernandez, made themselves prominent as Guitarist, Drummer, Singers, etc., while Sri H. Shankar exhibited his talent in Carnatic singing. Messrs. K. Kapadia and B. Venkateswaran shared the First Prize with Saraswathi Hostel in the Debating Competition. Sri B. Venkateswaran won prizes in two Inter-Collegiate extempore debates.

Messrs. Godbole and Corderio took part in the Inter-Hostel Quiz. The residents of the Hostel won the coveted Schroeter Cup.

The Hostel Day was celebrated on 26th March 1969 with Dr. K. Srinivas, Neurologist, Madras Medical College, as the Chief Guest.

SARAYU HOSTEL

Miss V. Hamsaleelavathi

Assistant Warden

21 lady students resided in the Hostel during the year. The Annual Sports conducted on the 1st of March 1969 was declared open by Prof. S. Sampath, Deputy Director. This year too, the Hostel joined Kaveri Hostel to celebrate the Hostel Day on the 2nd of March 1969.

MEDICAL CENTRE

Dr. P. M. Palani, M.D. Honorary Consulting Physician.

Dr. Subir Ghosh, M.B.B.S., Medical Officer.

Dr. (Mrs.) K. Shanta, M.B.B.S., D.G.O.—Lady Medical Officer.

The Medical Centre made noteworthy progress in its various activities, namely Public Health Measures, Out-door Medical Facilities, Ante-Natal and Family Planning Clinic. A new Clinical Laboratory commenced functioning from 29-10-1968. It is adequately equipped and a qualified Laboratory Technician has been engaged since 23rd December 1968. This laboratory facilitates quick diagnosis, and helps patients who will otherwise have to go outside the campus for routine tests. A portable ECG apparatus has been acquired. An ambulance van was also made available from this year.

Immunisation Programme.— Of all the normal activities, Immunisation Programme was effectively intensified during the year, especially among the students and children.

The following immunisation programme was carried out during the year.—

Small pox vaccination	...	300
T.A.B. Inoculation	...	741
Triple Antigen	...	54
Polio Vaccination	...	73
Cholera Inoculation	...	61

Ante-Natal and Family Planning Clinics.— Ante-Natal and Family Planning Clinics have proved to be two very useful facets of this Centre's activities. The Ante-Natal Clinic, in particular, has relieved the expectant mothers of the trouble of going all the way to a maternity hospital outside the campus.

97 patients attended the Ante-Natal Clinic.

Infectious Diseases.— The following cases of infective diseases among the students and the residents were treated during the year.—

- (a) Infective Hepatitis
- (b) Chicken pox
- (c) Mumps
- (d) Measles
- (e) Whooping cough

During the epidemic of Influenza in Madras in September-October 1968, a large number of patients were attended to at the out-patient department.

This Centre extended the medical facilities to the participants of two Summer Schools conducted by the Institute and the Kendriya Vidyalaya.

The number of patients treated at the Dispensary during the year was 37,038 which included 8,867 students.

There were 267 emergent cases and 171 cases of minor operations. 159 cases referred to specialists and other hospitals.

KENDRIYA VIDYALAYA

The Kendriya Vidyalaya, located in the Institute Campus since 1964, opened the Primary Section consisting of five classes, during the year under report. It had a strength of 696 pupils as detailed below.—

Class 1 ... 72	Class 7 ... 68
Class 2 ... 69	Class 8 ... 74
Class 3 ... 62	Class 9 ... 70
Class 4 ... 62	Class 10 ... 67
Class 5 ... 50	Class 11 ... 30
Class 6 ... 72	Total ... 696

The Vidyalaya is managed by a Local Committee consisting of —

- (1) Dr. A. Ramachandran, Director, I.I.T., Madras. (Chairman)
- (2) Prof. R. K. Gupta, Professor and Head of the Department of Humanities, I.I.T., Madras.
- (3) Prof. R. G. Narayanamurthi, Professor and Head of the Department of Mechanical Engineering, I.I.T., Madras.
- (4) The Rev. Father L. D. Murphy, C/o. Father's Lodge, Loyola College, Madras.
- (5) The Collector of Madras.
- (6) Sri J. A. Ryan, M.A., B.T., Chief Educational Officer, Madras and Chingleput Districts.
- (7) The Accountant-General, Madras.
- (8) Mrs. V. Hoon, M.A., B.T., Principal, Kendriya Vidyalaya, Gill Nagar, Madras.

- (9) Sri D. Ramaswamy, Scientist, Central Leather Research Institute, Madras.
- (10) Sri N. Vaideeswaran, Principal, Kendriya Vidyalaya, I.I.T., Madras.
(Principal & Secretary)

The Vidyalaya, as usual, conducted its co-curricular activities and intra-mural tournaments. The following trophies were annexed by the Vidyalaya during the year.—

- | | |
|--|-----------|
| (1) Inter-Kendriya Vidyalaya Volley-Ball tournament. | Winner |
| (2) Inter-Kendriya Vidyalaya Foot-Ball tournament. | Runner-up |
| (3) Sub-Junior Table Tennis tournament conducted by Emmessor Sports Council. | Winner |

The Vidyalaya took part in the debates and symposia and All India Radio programmes.

The Annual School Day Celebration was held on the 2nd May 1969 with Dr. A. Ramachandran, Director, I.I.T., Madras and Chairman, School Managing Committee, as the President. The Annual Sports Day was held on the 1st February 1969, when Sri M. Sondhi, General Manager, Heavy Vehicles Factory, presided over the function.

Out of the 25 students who appeared for the All India Higher Secondary Examination, 9 students passed in first class, 14 in second class and 1 in third class.

Five students of the Vidyalaya were successful at the Joint Entrance Examination for admission into the first year of the Five-year B.Tech. Degree Course.

Under the Science Talent Search Examination, 1 student of the Vidyalaya was selected. One pupil got admission into the Marine and Engineering Training Course.

PRIMARY SCHOOL

The Primary School functioned during the year under the guidance of the following Committee :

The Rev. Fr. L. D. Murphy, S.J.
Prof. S. Sampath
Dr. D. Venkateswarlu
Sri N. Vaideeswaran
Miss Tarabai

During the year the working of the school was characterized by disciplined progress. In the temporary absence of the Headmistress, Miss. Tarabai officiated as Headmistress. The school had 450 children and 18 teachers including 2 for Hindi.

A picnic was arranged in the first term and sports well attended by parents and visitors in the second term. In the third term, Parents' Day was observed when diplomas were given away by the Rev. Mother Antony, the Superior of Presentation Convents in South India. A prize distribution followed and the children gave a much appreciated variety entertainment of songs, dances and acting in English, Hindi and Tamil. The school closed for the summer vacation on the 30th of April 1969.

STAFF CLUB

The following members of the staff constituted the Executive Committee of the Staff Club for the year.

President	Dr. K. A. V. Pandalai
General Secretary	Dr. C. K. Narayanaswamy
Treasurer	Dr. N. Subramanian (till 30th April 1969). Sri S. Ramani (from 1st May 1969).
Secretary for Fine Arts and Literary Activities	Sri G. Balasubramanian
Secretary for Sports and Games	Sri C. Narayanan Kutty
Members	Sri K. V. Ananthanara- yanan Prof. Hans Wagner Mr. R. Kirmse Sri T. S. Rajagopalan Dr. S. B. S. Sastry Sri T. Varadarajan

The Staff Badminton Team was adjudged runners-up in the Madras Institute of Technology Badminton Tournament. The Annual Tournaments of the Club drew a record number of entries.

A German Evening, arranged at the Open Air Theatre with a Novel Prize Scheme attached, attracted the staff and students alike and proved a success in itself as well as furthering the Indo-German friendship.

The Staff Club Annual Day was celebrated on the 17th of April 1969 with Sri H. C. Kothari as the Chief Guest.

LADIES CLUB

The year commenced with a general get-together of the members on the 10th of July 1968.

Cooking demonstrations were held through the good offices, of the Mobile Extension Nutrition Programme authorities.

The German ladies were the guests of the Club at a tea party. A Christmas party was given by the German ladies to the Indian ladies, followed by a programme of 'X'mas music and film show. ;

On the "Children's Day" there was a painting and drawing competition for the children of the campus. On the 17th of February 1969, the Sports Day was conducted. Classes in German Language were conducted for the members. The members visited the Modern Bakery, Adyar.

On the 26th of February 1969, the following were elected as new office bearers:

President	Mrs. Mathangi Ramachandran
Vice-Presidents	1. Mrs. Shanta Pandalai 2. Mrs. Tapti Dutta
Secretary	1. Mrs. Annie Kuriacose 2. Mrs. Chudamani Nagaraja Rao
Treasurer	Mrs. Lakshmi Sankaran
Committee Members	Mrs. Vidhya Ramani Mrs. Saroja Ramamurthi Mrs. Janaki Kalyanasundaram Mrs. Prema Banumurthi Mrs. Vijayalaksmi Mrs. Raichura

STAFF CO-OPERATIVE CANTEEN

The following constituted the Board of Directors for the period under review.

	From 1-7-1968 to 31-3-1969	From 1-4-1969
President	Dr. V. Srinivasan	Sri S. Ramani
Vice-President	Sri J. C. S. Venkatarangam	Sri J. C. S. Venkatarangam
Secretary	Sri K. V. Santhanam	Sri J. Rajasekharan
Treasurer	Dr. C. K. Narayanaswamy	Sri R. Narayanan
Assistant Secretary	Sri J. Rajasekharan	Sri K. Ramaswamy
Member	Sri P. Natarajan	Sri Abraham Varghese
Member	Sri T. Varadarajan	Sri K. V. Santhanam
Member	Miss M. S. Vasantha Bai	Sri K. A. Thomas
Member	Sri V. Srinivasan	Sri K. Sankaran
Member	Sri C. S. Paramaguru	Sri G. Sreenivasalu

Sri P. S. Sivaguru is the Ex-Officio Auditor of the Canteen. A dividend of 60 per cent was declared for the year 1968-'69 and two months' salary was paid as bonus to the staff of the Canteen.

EMPLOYEES CO-OPERATIVE BUILDING SOCIETY

The Society continued its activities during the year 1968-69 and initiated a second phase scheme in its Narayanapuram Colony. The following were on the Board of Directors as on 30-6-1969.

(1) Sri C. V. Sethunathan (Registrar)	President
(2) Sri B. Ramanathan	Secretary
(3) Sri A. V. K. Nambiar	Treasurer
(4) Dr. P. C. Varghese	Member
(5) Dr. V. Sethuraman	Member
(6) Dr. B. V. Ramanamurthy	Member
(7) Sri N. Rajagopalan	Member
(8) Sri S. Pattabhiraman	Member
(9) Sri V. K. Vaidyanathan	Member

The Society allotted plots to its members under the first phase scheme of layout during the year. An additional area of about 6 acres has also been acquired at Narayanapuram for allotment under the second phase layout.

Improvements such as desilting, deepening and construction of a parapet wall, etc. have been carried out for the existing well in the above colony. Steps are also being taken to fence the common areas, levelling the road portions, and constructing an office-cum-watchman's shed. Negotiations are under way to acquire a strip of land to serve as an approach road to the Velacheri-Tambaram main road.

The membership at the end of the year stood at 206.

APPENDICES

FIFTH CONVOCATION OF THE INSTITUTE

1st August 1968

The Fifth Convocation of the Institute was held at 5.00 p.m. on 1st August 1968 at the Open Air Theatre of the Institute. Dr. A. L. Mudaliar, Chairman, Board of governors presided over the Convocation. Dr. Vikram A. Sarabhai, Chairman, Atomic Energy Commission, graced the occasion with his presence as the Chief Speaker.

After invocation, the Chairman declared the Convocation open. After the passing of Grace, the Heads of the concerned Departments presented the candidates for the award of the Degrees and Diplomas. The Director conferred the Degrees and Diplomas on 185 candidates, who attended the Convocation and *in absentia* on 203 candidates who could not be present. The numbers of the graduates in the various categories are given below:

	<i>In person</i>	<i>In absentia</i>	Total
Ph.D. Degree :			
Chemical Engineering	1	...	1
Chemistry	2	...	2
Civil Engineering	...	1	1
Electrical Engineering	1	...	1
Mathematics	1	1	2
	—	—	—
Total	5	2	7
	—	—	—
M.Sc. Degree :			
Chemistry	5	3	8
Mathematics	3	...	3
Physics	6	1	7
	—	—	—
Total	14	4	18
	—	—	—

	<i>In person</i>	<i>In absentia</i>	Total
M.Tech. Degree			
Chemical Engineering	6	7	13
Civil Engineering	4	9	13
Electrical Engineering	12	5	17
Mechanical Engineering	6	3	9
Total	28	24	52

D.I.T. :

Industrial Engineering	1	18	19
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B.Tech. Degree

	<i>In person</i>		<i>In absentia</i>		Total	
	5-Year	3-Year	5-Year	3-Year	5-Year	3-Year
Aeronautical Engineering	3	...	9	...	12	—
Chemical Engineering	19	13	21	10	40	23
Civil Engineering	12	5	14	10	26	15
Electrical Engineering	10	14	22	10	32	24
Mechanical Engineering	31	16	32	14	63	30
Metallurgy	14	...	13	...	27	—
Total	89	48	111	44	200	92

After the conferment of the Degrees/Diplomas the Chief Speaker distributed the prizes to Prize Winners. (Vide **Annexure II**)

The graduates of the year who were present took the customary pledge led by Sri G. Raghavan, winner of the President's Prize.

The Chairman, in a brief speech, paid a tribute to the outstanding contributions made by Dr. Sarabhai to the country's scientific and technological progress and requested him to address the graduates.

Dr. Sarabhai then delivered the Convocation Address. The text of the Address is reproduced in **Annexure I**.

FIFTH CONVOCATION**1st August 1968****ADDRESS BY****DR. VIKRAM A. SARABHAI***Chairman, Atomic Energy Commission*

Mr. Chairman, Mr Director and Friends,

I feel deeply touched by the remarks of Dr. A. L. Mudaliar. Invitations to address Convocations arouse mixed feelings in me. When I received an invitation, a warm invitation, from Dr. Mudaliar, I felt very much inclined to come here, as I hold the Institutes of Technology in high esteem. My ties with Madras, of course, are many: Dr. Swaminadhan whose daughter I married; the Atomic Energy Programme at Kalpakkam; and a satellite-launching station, which we hope to establish soon at a site not far from this place. What is more, Madras and the Southern States have contributed much to our scientific activity all over India and I have many distinguished students who come from this area. The type of collaboration that we see in these Institutes is one of the best that is possible. These Institutes build bridges between our professional people and our academic staff with the best that the west and other advanced countries have to offer. I want to associate myself with the sentiments expressed by Dr. Mudaliar in this connection.

The Diverging Human Function

Five years ago, when you made the choice of enrolling at this Institute of Technology, and today, as you receive your degree, the world is rather different. Jawaharlal Nehru, Kennedy and Khrushchev are gone from the international scene. Nations already armed to the teeth have continued to engage in a spiralling arms-race and bombs rain every day from the skies over North and South Vietnam. Violence is rampant the world over. There is disenchantment with aid and with military alliances. Manned exploration of the moon and, in this country, the pursuit of engineering studies do not have the

same glamour as before. Political life in Red China, in the United States and in India, is chaotic and social goals perceived with cynicism.

What is happening around us? Has the uncertain world come to stay with us? The affliction is not peculiar to us; rich nations and poor ones, large and small, powerful and weak, those in military alliances, the non-aligned and the neutral, all manifest the same symptoms. The scenario is different in France, in the United States, in Poland, in Japan and in India. And so are the methods by which societies try to deal with these problems. But a common thread runs through all these. I wish today to share with you some of my thinking, for, I believe that the present is particularly threatening to those like you who embark on a professional career for the first time.

Every one here is undoubtedly familiar with the expression 'three raised to the power of eighteen'. It is a large number—38,74,20,489, Thirty-eight crores, seventy-four lakhs, twenty thousand, four hundred and eighty-nine, to be exact. What it means in dynamic terms is quite dramatic. If a person spreads a gossip to just three others and the same is passed on by each of them to three others, and so on in succession, in just eighteen steps almost the entire population of India would share the spicy story. Note that if each step takes one hour, 90 per cent of the people hear the gossip for the first time only during the seventeenth and the eighteenth hours. Indeed during the whole of the first 80 per cent of the time, the process affects merely 11 per cent of the population. Even though each individual is partaking in the chain reaction exactly like all the others, who preceded him, that is, he receives information from one person and passes it on to three others, the social impact at a late stage of development hits like an avalanche. When we have a new infection, initially it is barely perceptible, but as the biological organism multiplies through successive generations, at a certain moment it suddenly permeates through the whole system. You can observe this fascinating phenomena in making Dahi, or Yoghurt, or Thayir, as you call it here. In the same way, information, knowledge, innovation, people and things, diverge rapidly and their collective effects appear suddenly even though the basic process in each case has proceeded over a long time-span. When considering the social implications of technological change, one usually mentions the effects of the

machine age on society through automation and imposed conformity. But these are trivial compared to the wider social implications of innovative man, who with curiosity, ingenuity and ambition, tries to reach out from his natural environment, and starts divergent processes.

In Nature, left to itself, control is maintained through an ecological balance. Order is not imposed from above, but arises through the interaction of each unit with its environment in a dynamic equilibrium. On the other hand, inherent in a programme of accelerated development, there is a suppression of some of the natural constraints which prevent divergence. And as the rate of innovation, of discovery and of everything else in the world gets faster and faster, so does the obsolescence of people and things become ever more acute. In contrast, biological development continues at its own pace. The child still requires nine months to develop in the womb. His life-cycle of learning, of adolescence, as a house-holder and as an elder who lays down the law remains essentially unchanged. The situation is aggravated because of the increase in the life-span of the human being. The contradiction between desired longevity in a world of increasing change is obvious. An inevitable result of all this is the disillusionment of the young concerning the understanding and behaviour of the middle aged and the old. Equally serious is the inability of those who wield power and influence over world-affairs to adopt values and behaviour, inherent in an order where accelerating change, rather than stability, is dominant.

I suggest that today we witness a crisis of obsolescence. The qualitative change which has occurred in the last decade with the development of atomic energy, with the exploration and use of space, with the advent of electronics and computer sciences, is a manifestation of the divergent human function which has suddenly overtaken the world. What we have witnessed so far, dramatic as it is, is probably pedestrian compared to what we can expect in the future. We have heard of the feasibility of areas of the earth's surface illuminated during the night with sunlight through giant reflectors attached to satellites. We have also heard of weather modification, by increasing precipitation of rain in certain regions through artificially seeding clouds. There has been a suggestion of putting into orbit a belt of dust particles over the equator such

tion it would change the distribution of solar energy penetrating to different regions of the earth. It is claimed that such a belt could reduce the heat in the tropics and scatter more to high latitudes, providing a temperate climate even in the polar regions. This has many frightening possibilities because the level of the oceans would rise and submerge many inhabited areas. New leads in biology and genetics pursued relentlessly are creating situations with implications few have thought through. Population control using the pill has tied up into knots theologians wishing to interpret the sayings of the holy books in terms of current needs of society and new concepts of life. Just as doctors are faced with the problem of determining what death is before spare-parts surgery would be justified, international lawyers rack their brains to determine an objective criterion for identifying where air space ends and outer space begins in which national sovereignty does not exist.

Affairs in the 1960s were largely in the hands of those who were already grown up when the Second World War broke out. Their learning experience and their theoretical knowledge relate principally to a period when the world was qualitatively different. The concepts of national sovereignty, of international spheres of influence and power politics of the classical type have hardly changed even though we are constantly watched from satellite in outer space above us and our security is threatened not merely by hostile neighbours but by the actions and indiscretions of distant powers. What is the relevance of foreign bases in the context of long-range missiles and nuclear submarines lurking unseen and silent on the ocean floors? Is the Indian Ocean Indian any longer?

How shall we preserve democratic States where the media of mass communications provide means of instantly reaching downwards from centres of authority, but, short of public agitation, there is no authorised channel for the reverse feed-back for controlling the political system between elections? What should be the goals of education in a world of obsolescence?

We find ourselves largely unprepared to meet the new situation, just as the natives of North America who were struck by small-pox infection brought by immigrants. In real life, it makes a lot of difference how we view these occurrences. We have the situation in India, in common with many other

countries, of students challenging the authority of Universities and of the establishment. Those who assume that the students are indisciplined and wayward, suggest that getting them involved in some activity such as the N.C.C. would set matters right. On the other hand, if one regards protests of students at Columbia, at Sorbonne and at Banaras as manifestations of a deeper malaise of society, the powers that be would introspect rather than preach.

There is no easy solution. But there is, I believe, much that we can learn from an analogue that we find in the peaceful applications of atomic energy; more precisely, in the technique of extracting energy liberated in the fission of uranium. As is well-known, when an atom of the 235 isotope of uranium is hit by neutrons, it has a tendency to split into two lighter atoms, the combined weight of the splinters being less than the weight of the original atom. In the process of fission, not only is the difference of mass liberated as energy, but additional neutrons are released. Then these neutrons hit other fissile atoms, a chain reaction occurs and the process can continue like the divergent spread of a gossip. We require a critical mass of uranium before the chain can be self-sustaining and indeed when there is no other control device, the mass explodes through the sudden liberation of a large amount of energy on reaching criticality. This is what constitutes an atom bomb based on fission. When we wish to extract useful power out of the self-sustaining chain reaction of fission, we have to prevent the divergent release of neutrons, and of energy in the mass of the system. This needs the establishment of a large number of control loops which constantly and simultaneously sample the level of the reaction at various points of the re-acting volume and sensitively adjust the position of neutron absorbers strategically placed at various positions in the core of the reactor. Divergent trends are almost instantly compensated. An operator can shut down the reactor by pushing neutron absorbers into the core. But no reactor can be maintained in a steady state of self-sustained activity, necessary for providing useful energy, on the basis of exclusive reliance on gross controls operated with imperfect feedback loops. Indeed, the control of potentially divergent systems relies on sensitive information-loops which operate quickly in response to minute changes of activity.

What can we learn from this analogue in the social context? That control of the divergent human function cannot be maintained through the macro-system.

of a super government. We need a system which permits an infinite number of micro-control loops spread through the fabric of society. An authoritative regime can inhibit the divergent human function, but only at the cost of inhibiting development itself. Ironically, free societies are the ones which are most prone to the social impact of run-away divergencies. It is in such free societies that the power of the Super State, the super-authority in education and for developmental tasks, is most difficult to sustain. I am intrigued by how closely this line of thinking brings us to Vinobaji's and Jayaprakash's ideas on social and political organization.

We are faced with the problem of the divergent human function manifesting itself on the world scene, while in India we are still trying to shake ourselves free from poverty. We have, I believe, to create a social system and a pattern of development which is based not on monolithic organizations operating impersonally at an all-India level or even at the level of the States, but in units, where the feed-back loop has a high fidelity for communication and a quick response. I am convinced, for instance, that our education system would immeasurably benefit if it were liberated from the monopolistic privileges under which Universities take hold of all educational matters at a certain level in allotted territories. There is no way in which a University Grants Commission or an affiliating University can ensure educational standards. In the ultimate analysis, it is only the teacher in the class-room that can do anything in the matter. He has to be provided the freedom to innovate in education in a changing world and, for this innovation, he has to receive the trust of those who back him up. I would suggest that the most effective development of education can take place only when the teacher, the student, his parents and the outside environment can interact with one another, in a series of feed-back-loops, free from regimentation and irrelevant theories and principles preached from the top.

As engineers, you would look forward to play a meaningful role in society. We are nationally poised to formulate a new Five Year Plan for development. Economists, in the past, have been prone to regard investments in hard facilities as necessary for economic growth. This is often true, but in the present context, it is largely fallacious. Twenty years after Independence, we find ourselves

with a broad infra-structure of plants and facilities in the engineering industries which are largely under-utilised. We also find a number of well-established laboratories, without clear-cut developmental tasks which are meaningful in terms of national priorities. What is needed now is a major investment in design and developmental effort directed at indigenous capability for carefully chosen tasks, which are important to us. As an example, I might cite a good transportation system providing an inexpensive scooter or a cheap car; a mass communication system which brings television to every village in a decade; inexpensive power through the countryside based on optimisation of grids, with a combination of hydro-electric, atomic and thermal units; a defence system based largely on hardware related to our own strategic needs rather than one which is reliant on what our friends overseas choose to sell us, gift to us or help produce under their know-how. We can identify sub-systems, under each of these major tasks and we can create design and development groups, which can operate with a wide measure of autonomy. They will require trust to be able to innovate. All this is not a pipe dream. I hope we have the good fortune of realising these programmes before divergent functions in our society blow asunder all that we cherish. I wish you a meaningful participation in this task.

PRIZE-WINNERS**A. Prizes Awarded at the Fifth Convocation of the Institute Held on
1st August 1968****President's Prize***(for the student of the B.Tech. Degree Course with the best academic record)*

Sri G. Raghavan (3-Year B.Tech., Mechanical Engineering)

Governor's Prize :*(for all-round proficiency in the B.Tech. Degree Course)*

Sri George Verghese (5-Year B.Tech., Chemical Engineering)

Institute Special Merit Prize*(for the student of the B.Tech. Degree Course with the best academic record)*

Sri M. Dilip Bhandarkar (5-year B.Tech., Metallurgy)

Institute Merit Prizes*(for the students with the best academic record in each discipline of each course)***M.Tech. Degree**

Sri M. Balasubramanian	Chemical Engineering
Sri B. V. Subrahmanyam	Civil Engineering
Sri T. J. Vitto	Electrical Engineering
Sri S. Sampath	Mechanical Engineering

M.Sc. Degree

Sri G. Kothandaraman	Chemistry
Sri R. Radhakrishnan	Mathematics
Sri B. K. Satyan	Physics

5-Year B.Tech. Degree

Sri Dau Dayal Bansal	Aeronautical Engineering
Sri K. Venkatasubramaniam	Chemical Engineering
Sri V. Kalyanaraman	Civil Engineering
Sri D. Santhanam	Electrical Engineering
Sri K. Chandrasekharan	Mechanical Engineering
Sri M. Dilip Bhandarkar	Metallurgy

3-Year B.Tech. Degree

Sri T. N. Kannan	Chemical Engineering
Sri Ravindar Pal Singh Malik	Civil Engineering
Kumari M. A. Vedavalli	Electrical Engineering
Sri G. Raghavan	Mechanical Engineering

D. I. I. T.

Sri S. R. Thangavelu	Industrial Engineering
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Siemens Prizes

(Endowed by Messrs. Siemens Engineering and Manufacturing Company of India, Ltd., Madras, for award to the students with the best academic record in Electrical Engineering in the M.Tech. and B.Tech. Degree Courses.)

M.Tech. Degree

Sri G. T. Manohar

5-Year B.Tech. Degree

Sri V. Muralidhar (Light-Current Engineering Option)

B. Prizes Awarded at the Institute Day Held on 22-3-1969

(For excellence in academic work during the 1967-68 Session)

M.Tech. Degree Course**I Year**

Civil Engineering	Sri Jacob K. Varghese
Electrical Engineering	Sri P. A. Janakiraman
Engineering Mechanics	Sri R. Seshadri
Mechanical Engineering	Sri J. Pattabhiraman

M.Sc. Degree Course**I Year**

Chemistry	Sri V. Periasamy
Mathematics	Sri A. Thiagaraja
Physics	Sri Rajaram Nityananda

Five-year B.Tech. Degree Course**I Year**

1. Sri K. Nandakishore Rao (First Prize)
2. Sri R. Ram (Second Prize)

II Year

1. Sri V. K. Narayanan (First Prize)
2. Sri P. A. Lakshminarayanan (Second Prize)

III Year**IV Year**

Aeronautical Engineering	Sri S. P. Viswanathan	Sri S. Santha Kumar
Chemical Engineering	Sri M. Srinivasan	Sri R. Mutharasan
Civil Engineering	Sri C. Sankar Kumar	Sri M. Hariharan
Electrical Engineering	Sri V. Srinivasan	Sri Jayant Baliga
Mechanical Engineering	Sri S. Ramakrishnan	Sri J. Srinivasan
Metallurgy	Sri B. Sankaranarayanan	Sri V. Nagarajan

Three-year B.Tech. Degree Course**I Year**

Sri Surinder Mohan

II Year

Chemical Engineering	Sri T. Anantharajan
Civil Engineering	Sri R. Nagaraj
Electrical Engineering	Sri M. Sethuraman
Mechanical Engineering	Sri P. Raghavendran

Rajalakshmi Krishnamurti (English) Prize

(Endowed by Prof. R. Krishnamurti to be awarded to a student of the third-year of the Five-Year B.Tech. Degree Course for proficiency in English in the first two years of the course—1966-68).

Sri V. Jagadeesh

INSTITUTE GYMKHANA

Appendix II

TROPHIES WON BY THE INSTITUTE :

Debating :

Rotary Club of Madras West Trophy :
 (V. S. Krishnan and Veeraraghavan Raja)
 Inter-Collegiate Debate at the Madras Institute of Technology
 Toastmaster's Club, YMCA, Royapettah.
 (G. K. Pillai and B. Venkateswaran)

Photography :

Dr. Koch's Rolling Trophy

Chess :

Bertram Tournament Trophy
 Spade Clover Rolling Shield

Hockey :

Buck Memorial Trophy

Rowing :

Winners : Madras—Colombo Challenge Fours Event,
 Challenge Sculls Event

Comyn mile event for the Fours, Junior Sculls and
 Junior Fours Event

Basketball :

Inter IIT Meet Basket Ball Trophy
 Jain College Basketball Tournament

INDIVIDUAL HONOURS

Cricket :

V. Ashok Selected for the Madras State Junior
 Cricket Team.

Football :

Anupam Sen

Selected for National Training Camp.

Hockey :

K. S. Rao and

D. A. Muthanna

Selected for All IIT XI.

Fine Arts :*Painting :*

Mohan

K. Marcus:

Gnan Chandra

Ranjan Kelly

Oils—First

{	Water colours—Second
	Judge's Special Prize

Judge's Special Prize

7th ANNUAL CULTURAL WEEK**Rolling Trophies :**

All India Debate :

(Institute Trophy)

Loyola College

German Recitation :

(Dr. N. Klein's Trophy)

Loyola College

Group Discussion:

(Prof. M. V. C. Sastri's Trophy) Madras Christian College

Quiz :

(Rao Bahadur Ramachandra
Iyer's Trophy)

Madras Christian College

Photography :

(Dr. Koch's Trophy)

IIT

Entertainment :

(Prof. R. G. Narayanamurthi's
Trophy)

Madras Christian College

Individual Prizes :**All India Debate :**

1. B. Amir Ahmed (IIT)
2. P. N. Narayana (Loyola College)
3. R. Radhakrishnan (Loyola College)

Mrs. Zuern's Prizes for Lady Speakers :

1. Kasturi Nagarajan (Ethiraj College)
2. Hyma Ananthaswamy (Ethiraj College)
3. Mithrakumari (Stella Maris College)

German Recitation :

1. Chandrakumar (Loyola College)
2. V. Kumar (Max Mueller Bhavan)
3. S. Ramakrishnan (Max Mueller Bhavan)

Quiz :

1. P. Sudhir (Madras Christian College)
2. Benny Thomas (School of Architecture)
3. S. Parameshwaran (IIT)

Entertainment :

1. Best Dramatic Group : (SIET Women's College)
2. Best Musical Group : ACID (IIT)

Entertainment : (Individual Prizes)

1. Best Actor : Rathindra N. Roy (IIT)
2. Best Actress : Miss Usha Natarajan (SIET Women's College)
3. Best Vocalist : (Oriental). Venkatarama Seshu (Loyola College)
4. Best Vocalist : (Western). Solomon Rajkumar (College of Engineering, Guindy)
5. Best Instrumentalist : (Oriental). K. Ranganathan (Loyola College)
6. Best Instrumentalist : (Western). Suri (College of Engineering, Guindy)
7. Best Dance Presentation : Y.M.C.A. College of Physical Education (Bangra Dance)
8. Best Comedian : Miss Aneena Joseph (Madras Christian College)
9. Best Master of Ceremonies : Miss Usha Natarajan (SIET Women's College).

Photography :

Prof. Koch's Rolling Trophy : V. Jagdish (IIT).

Painting :

Sketches and Pastels :

First Prize : Miss Nalini Kanagaraj (SIET Women's College)

Second Prize : S. Maran (School of Architecture)

Oil Painting :

First Prize : M. Marcus (IIT)

Second Prize : Miss Nandini Raghavachari (SIET Women's College)

Water Colour :

First Prize: Miss Ranjini Reddy (Govt. Polytechnic for Women)

Second Prize : Gnan Chandra (IIT)

Judges' Special Prizes :

1. Ranjan Kelly (IIT)
2. (Miss) Srelekha Shah (Cultural Academy)
3. Gnan Chandra (IIT)

Children : First Prize : T. K. Prasad (Institute of Film Technology)

Action : Consolation Prize : G. S. Bajaj (College of Engineering, Guindy)

Silhouete and Contrast :

First Prize : Haridass (Madras Christian College)

Miscellaneous :

First Prize : T. K. Jayachandra Prasad (Institute of Film Technology)

Second Prize : T. K. Jayachandra Prasad (Institute of Film Technology)

Judges' Special Prize : G. S. Bajaj (College of Engineering, Guindy)

Science Fair :

1. Overall Best Project :
Multipurpose Rotary Mechanism
(S. P. Asthana and S. Sarin)
2. Best Electrical Project:
Electrosonic Resonance Gun.
(Amul Kaikini, Balakrishna Nambiar)
3. Best Mechanical Project :
Hobbyist's Lathe
(N. Chandrasekharan)
4. Judges Special Prize :
(K. Subramaniam)
5. Consolation Prize :
MONSTRAC II
(P. C. Venkatachalam & Team).

SCHOLARSHIPS

I. INSTITUTE SCHOLARSHIPS

Sl. No.	Category	No. of students awarded	Value per annum per student
B.Tech. and M.Sc. Degree Courses :			
Merit Scholarships			
	(a) Five-Year B. Tech. Degree Course	81	Rs. 900 (with free tuition)
	(b) Three-Year B. Tech. Degree Course	20	" "
	(c) M.Sc. Degree Course	6	" "
Merit-cum-Merits Scholarships			
	(a) Five-Year B. Tech. Degree Course	203	" "
	(b) Three-Year B. Tech. Degree Course	65	" "
	(c) M.Sc. Degree Course	13	" "
Free-Studentships			
	(a) Five-Year B. Tech. Degree Course	94	Free Tuition
	(b) Three-Year B. Tech. Degree Course	42	" "
	(c) M.Sc. Degree Course	7	" "
M.Tech. Degree Course :			
	(a) Applied Mechanics (Engineering Mechanics)	6	Rs. 3,000
	(b) Chemical Engineering	27	" "
	(c) Civil Engineering	25	" "
	(d) Electrical Engineering	25	" "
	(e) Mechanical Engineering	17	" "
D. I. T. Course :			
	Industrial Engineering	19	" "
Research Scholars			
	(a) Ph.D.		
	(i) Science	50	Rs. 3,000
	(ii) Engineering/Technology	25	P.S. 4,800
	(b) M.S. (Engineering)	24	Rs. 3,000
	(c) Post-Doctoral Fellowships		
	(i) Science	2	Rs. 4,800
	(ii) Technology	2	Rs. 6,000

II. EXTERNAL SCHOLARSHIPS AND LOANS

Sl. No.	Name of the Sanctioning Authority	Nature of Scholarships	No. of students awarded	Value per annum per student
Andhra Pradesh :				
1.	Director of Higher Education, Hyderabad	National Scholarships	17	Rs. 1,320
2.	do	Special Merit Scholarships	8	Rs. 1,500
3.	do	Government of India Merit Scholarship for children of Secondary/Primary School Teachers	1	Rs. 1,100
4.	do	National Loan Scholarships	6	Rs. 970
Delhi :				
5.	Director of Education, Delhi	National Scholarship	1	Rs. 1,320
Kerala :				
6.	Director of Collegiate Education, Trivandrum	National Scholarships	13	Rs. 1,320
7.	do	National Loan Scholarships	6	Rs. 970
8.	do	Government of India Merit Scholarships for children of Secondary/Primary School Teachers	2	Rs. 1,100
Madhya Pradesh :				
9.	Director of Technical Education, Bhopal	Engineering Scholarship	1	Rs. 1,000

Sl. No.	Name of the Sanctioning Authority	Nature of Scholarships	No. of students awarded	Value per annum per student
Madras :				
10.	Director of Higher Education, Madras	National Scholarships	94	Rs. 1,320
11.	do	National Loan Scholarships	35	Rs. 970
12.	do	Government of India Scholarships to children of Secondary Primary School Teachers	7	Rs. 1,100
13.	Director of Harijan Welfare, Madras	Government of India (decentralized) Scholarship for SC/ST/OBC	1	Rs. 977
14.	do	State Scholarship for Backward Classes	1	Rs. 802
Maharashtra :				
15.	Director of Education, Poona	National Scholarships	5	Rs. 1,320
Mysore :				
16.	Director of Collegiate Education, Bangalore	National Scholarships	23	Rs. 1,320
17.	do	National Loan Scholarships	5	Rs. 970
18.	do	Government of India Scholarship to children of Secondary/Primary School Teachers	1	Rs. 1,100
Orissa :				
19.	Education Department, Govt. of Orissa, Bhubaneswar	National Scholarships	1	Rs. 1,320
		Loan Stipend for Engineering studies	1	Rs. 1,375
Pondicherry :				
20.	Director of Public Instruction, Pondicherry	National Scholarships	2	Rs. 1,320
21.	do	State Merit Scholarships	2	Rs. 1,100

Sl. No.	Name of the Sanctioning Authority	Nature of Scholarships	No. of students awarded	Value per annum per student
Punjab :				
22.	Director of Public Instruction, Chandigarh	National Loan Scholarship	1	Rs. 960
Uttar Pradesh :				
23.	Director of Education, Allahabad	National Scholarship	1	Rs. 1,320
24.	do	National Loan Scholarship	6	Rs. 970
25.	do	GOI (decentralised) Scholarship SC/ST	1	Rs. 982
26.	Director of Technical Education, Kanpur	Loan Stipend	1	Rs. 1,000
West Bengal :				
27.	Director of Public Instruction, Calcutta	National Scholarship	4	Rs. 1,320
Others :				
28.	Ministry of Education, Govt. of India	T.C.S. (Colombo Plan) Scholarship for Nepal Scholars	11	Rs. 3,000
29.	do	General (Cultural) Scholarships for Ceylon Scholars	5	Rs. 3,000
30.	M/s. Tata Iron & Steel, Jamshedpur	Jubilee Scholarship	1	Rs. 1,500
31.	do	Scholarship to children of TISCO Workers	1	Rs. 960
32.	Prime Minister's Aid Fund	Financial Assistance	1	Rs. 900
33.	Lala Santaram Tirtharam Public Charitable Trust, Amritsar	Educational Stipend	1	Rs. 600
34.	National Institute of Education, New Delhi	National Science Talent Search Scholarships	8	Rs. 3,000
35.	Department of Atomic Energy, Bombay.	Atomic Energy Commission, PG Scholarship	3	Rs. 1,800

