INDIAN INSTITUTE OF TECHNOLOGY
MADRAS

ANNUAL REPORT

1967—68

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ANNUAL REPORT FOR THE YEAR 1967-68

FOREWORD

GENERAL:

During the year under review, the Institute made steady progress in all facets of its activities—courses of instruction, research programmes and liaison with industry.

Prof. B. Sengupto, the first Director of the Institute, completed his term of office on 11th December, 1967. His leadership and his contribution to the building up of the Institute in its first nine years will always be gratefully remembered.

Under the terms of the Second Indo-German Agreement, signed in June, 1966, six German Professors, one Assistant Professor and nine Senior Scientific Assistants, from Germany, took up positions at the Institute during the year. One German Professor left the Institute on completion of his assignment.

Five Senior Faculty-members of the Institute, including the Deputy Director, and the Librarian of the Institute paid short-term visits to Germany. Twenty-four Staff members, including three Foremen, were deputed to German Universities/Institutions for periods of study and training ranging from 18 to 24 months.

Visiting Professors :

The Institute benefited by short-term visits to the Institute of many distinguished German Professors : Prof. F. Bassler (Technical University, Darmstadt) in the field of Hydraulics Engineering ; Prof. K. Kordina (Technical University, Braunschweig) in the field of Structural Engineering ; Prof. H. Doring (Technical University, Aachen) in the field of High Frequency Technology ; Prof. K. Sattler (Technical University, Aachen) in the field of Electrical Machinery ; Prof. D. Kind (Technical University, Braunschweig) in the field of High Voltage Engineering); Prof. W. Leonhard (Technical University, Braunschweig) in the field of Control Engineering; Prof. R. Quack (Technical University, Stuttgart) and Prof. H. Brauer (Technical University, Berlin) in the area of Chemical Engineering; and Prof. H. Pick (Technical University, Stuttgart) in Physics. Dr. P. Kaegbein, Librarian of the Technical University, Berlin, visited the Institute in January, 1968.

All the visits provided the occasion for special lectures in several frontier-areas of research and development in science and technology and also the opportunity for useful discussions relating to the consolidation of work in the various laboratories and associated sections of the Institute.

A notable event of the year was the visit to the Institute, in March, 1968, of a team headed by Dr. G. Kerckhoff of the Ministry of Economic Co-operation, Government of the Federal Republic of Germany. The other members of the team were Dr. Hans A. Havemann, Director, Institute for International Technical Co-operation and Development, Technical University, Aachen and Mr. Kretzchmar of the office of the B. A. W., Frankfurt. The discussions held during the visit of this team will pave the way for a quicker realization of the objectives of the Second Agreement.

In January, 1968, the Institute was the venue of a three-day Seminar organized by the German Academic Exchange Service (D. A. A. D.). The Seminar was attended by 50 Indian Grantees of German Scholarships. The usefulness of the discussions was heightened by the presence of Dr. E. Lehnartz, President of the D. A. A. D., Miss. M Schmitz, Officer-in-charge, Scholarships Division, D. A. A. D., Bad Godesberg and Dr. H. Hessberger, Director, D. A. A. D, India Branch, New Delhi. The Seminar provided an opportunity to the delegates to review their experiences and make many useful suggestions for the operation of the exchange programme in future years.

ACADEMIC ACTIVITIES :

Convocation :

The Fourth Covocation of the Institute—the culmination of the academic activities for the year 1966-67, was held on 22nd July, 1967, with Sri C. Rajagopalachari as the Chief Guest. On this occasion, twelve research scholars of the Institute were awarded the Ph. D. Degree; 20 candidates received the M. Sc. Degree; 32 the M. Tech. Degree and 259 the B. Tech. Degree.

Research Journal :

The first number of the Institute's Research Journal, devoted to Mathematical and Physical Sciences, was released in November, 1967. Launched with an Editorial Board of eminent mathematicians and scientists both in India and abroad, the Journal hopes to gain recognition as a medium of publication of research papers of the highest quality.

Seminars and Symposia :

In February, 1968, the Department of Chemical Engineering organized a Seminar on "Developments in Chemical Engineering", with the objective of

reviewing current developments in many inter-disciplinary areas relevant to the needs of the Chemical Process Industries. A large number of delegates from different parts of the country and from academic and research institutions as well as industrial establishments, participated in the Seminar, which was inaugurated by Dr. S. K. Mukerjee, Director, Fertilizer Corporation of India. Papers were presented on fluid flow, heat transfer, mass transfer, particle technology, applied reaction kinetics and other allied topics. There was a useful exchange of ideas on the Chemical Engineering profession. The papers presented at the Seminar are to be published in the Journal 'Chemical Age of India'.

During the same month, the Physics Department of the Institute collaborated with the Bhabha Atomic Research Centre in conducting a four-day Symposium on 'Nuclear and Solid State Physics' under the chairmanship of Dr. Nag Choudary, Member, Planning Commission. Here again, the exchange of ideas on various topics discussed at the Symposium will make a deep impact on the research programmes of the Department.

Departmental Programmes:

The Department of Applied Mechanics and Aeronautical Engineering started in July, 1967 a post-graduate Course—the two-year M. Tech. Degree programme-in Engineering Mechanics with specialization in Structural Mechanics. The Laboratories in the Solid Mechanics Division were reorganized to provide special facilities in the following areas: elasticity and mechanics of materials; vibration; mechanisms; and photo-elasticity. As the first batch of students in Aeronautical Engineering came into the final year of the B. Tech. Degree programme during 1967–68, courses of instruction were established in the following areas: air-craft structures; aerodynamics; air-craft propulsion and design. Plans were on hand for the introduction of the M. Tech. Degree Course in Aeronautical Engineering in July, 1968, with specialization in one or the other of these three areas. Research work, both analytical and experimental, was initiated in several relevant areas: notably, thin shells, thermal stress analysis, non-linear structural mechanics, and, in the field of aerodynamics, infinite wing theory, interfacial instability of superposed fluids and turbulent boundary layer problems.

In the Department of Chemical Engineering, the two visiting Professors, Dr. R. Quack and Dr. H. Brauer, delivered lectures in the areas of 'Automation of Chemical Industries' and 'Fluid and Particle Dynamics' respectively. Plans were on hand for the starting of new post-graduate courses in High Polymers and in Chemical Engineering Plant Practice.

In the Department of Civil Engineering, the extension to the Hydraulics Engineering Laboratory made good progress and arrangements were worked out for the installation of the Towing Tank and the associated measurement facilities.

During his visit in January, 1968, Prof. Kordina performed the ground-breaking Ceremony for the new Structures Laboratory. The Department was active in research in the areas of Reinforced-Concrete Girders, Conoidal Shells, Hydraulic Jump Problems, Under-water Concrete etc.

The Department of Electrical Engineering reviewed and modernized the Course-content and laboratory-work for the post-graduate Courses in Control Systems, Power Systems and Measurements, and carried out the planning for the new courses, to be introduced, in Traction Technology and Radar Technology. Research work and development activity continued in the following areas: networks, systems theory, electrical and electronic measurements, control systems, semiconductor devices, power-system stability and protection, and high voltage engineering.

The Department of Mechanical Engineering intensified its research-work in the following areas: nucleate boiling, flame quenching, hot machining, and spark hardening. The foundation-stone for the Machine Elements and Mechanical Handling Laboratory was laid by Dr. G. Kerkhoff during his visit to the Institute in March, 1968. Planning was taken up for the starting of the M. Tech Degree programme in the area of Thermal Sciences, with the following electives: thermal power engineering; internal combustion engines and gas turbines; combustion and jet propulsion; and turbo machines. For the benefit of teachers in engineering institutions in the Western and Southern Zones of the country, the Department conducted the Sequential Summer School in Mechanical Engineering – the first and the second session, during the summer-months, May and June, of 1967 and 1968, with Dr. A. H. Church (New York University) and Dr. R. H. Eustis (Stanford University) as Consultants for these two sessions.

In the Department of Metallurgy, steps were taken for the starting of the M. Tech. Degree Course in Physical Metallurgy in July, 1968. During the year, development work was carried out in the design and testing aspects of metal-forming operations. New lines of work were initiated in Foundry Metallurgy.

The Department of Mathematics continued to be active in the following areas of researeh: fluid mechanics and hydrodynamics; elasticity, plasticity and piezo-electricity; stochastic processes; plasma dynamics; statistical mechanics; and probability. There was close liaison with the Institute of Mathematical Science, Madras, in arranging colloquia and seminars and in promoting research activities in areas of common interest. A monograph on 'Stochastic Theory and Cascade Processes', written by Prof. S. K. Srinivasan of the Department of Mathematics, is to be published by the American Elsevier Publising Co, New York, in the series 'Modern Analytic and Computation Methods in Science and Mathematics'.

In the Department of Physics, research work continued in the area of Solid State Physics. The C. S. I. R. has approved of a scheme for the study of 'Nuclear quadrupole resonance in ionic crystals containing chlorine'.

The Department of Chemistry was active in research in the fields of adsorption, heterogeneous and homogeneous catalysis, chemical kinetics, electrochemistry, photo-chemistry, polymer chemistry, solidstate inorganic chemistry, chemistry of co-ordination complexes, inorganic analytical chemistry and general organic chemistry. A research grant of $ 17,000, awarded by the American Chemical Society under its Petroleum Research Fund, came into effect this year and facilitated the import of a few valuable pieces of equipment. The acquisition of a few items of German equipment, notably a high-pressure, continuous flow catalytic reactor, helped to initiate work in the field of high-pressure organic reactions.

In the Department of Humanities and Social Sciences, active steps were taken toward a reorientation of the teaching of English and placing emphasis on its use for the presentation of technical information. The Post-graduate Diploma Course in Industrial Engineering continued to get strong support from Industry. This programme in Management Education opened up many fruitful channels of problem-oriented research of interest to industry.

LIAISON WITH INDUSTRY:

The Institute fully subscribes to the idea that a close inter-relationship should exist between its academic disciplines and the spheres of industrial activity to which they are relevant. The carefully planned in-plant training for students in Metallurgy in the big steel-making establishments in the country and the in-Plant study-periods by students in Mechanical Engineering specializing in Production Engineering in selected industrial concerns in the city of Madras continued as in previous years.

The Departments of the Institute continued to maintain contacts with industrial units and, wherever possible, opened up new areas of inter-action. Faculty-members were encouraged to devote their time and talent to the solution of problems in the design and development of apparatus, instrumentation and control of processes.

The Department of Mechanical Engineering undertook the following industrial projects: the design of a twelve-speed bench-type milling machine; the design and fabrication of a hydraulically-operated operation-table; the testing of a torsional vibration damper fitted to an Ashok Leyland engine; testing of a power-winch fitted to Leyland trucks; adaptation of a carburettor of Indian origin to the engine manufactured by Hindustan Motors; and the study of

thermal conductivity of certain insulating materials for Lloyds Insulation Ltd. The Department of Applied Mechanics collaborated with the Highways Research Station in an experimental analysis of the frequencies of bridge decks. The Civil Engineering Department carried out an investigation of the adequacy of the existing foundation of a Confectionery Factory near Madras. The Electrical Engineering Department developed an inexpensive but highly reliable protective gear for industrial motors. This Department continued, as in previous years, to assist a number of manufacturing organizations with tests on energy-meters, instrument transformers and protective relays. The Department of Chemical Engineering carried out several investigations of specific interest to various sectors of the Chemical Engineering industry. The Department of Metallurgy assisted many local industrial units with regard to their needs in heat treatment and fatigue-testing of newly designed components.

CONCLUSION :

The years immediately ahead are crucial from the point of view of the country's industrial growth and development. Keeping the needs of the hour at the forefront, this Institute will endeavour to make the best use of its established facilities and the available intellectual potential, and thereby play a worthy role in discharging its national responsibilities.

A. RAMACHANDRAN
Director

SECTION I

APPLIED MECHANICS AND AERONAUTICS DEPARTMENT

STAFF

APPLIED MECHANICS

D. V. Reddi, Ph. D. (Liverpool), Professor & Head
A. Klein, Dr.-Ing. (Braunschweig), Professor
Hans Wagner, Dr.-Ing. (Karlsruhe), Professor
N. V. Chandrasekhara Swamy, Ph. D. (IISc, Bangalore) Asst. Professor
B. V. A. Rao, Dr.-Ing. (Dresden), Assistant Professor
R. S. Alwar, Ph. D. (IISc, Bangalore), Assistant Professor
P. S. Srinivasan, B. E. (Madras), Lecturer
M. A. Veluswami, M. E. (Madras), Lecturer
S. Venkatesan, B. E. (Madras), Lecturer
C. R. Subramanian, M. Tech. (IIT, Madras), Lecturer
M. Balakrishnan, M. Tech. (IIT, Bombay), Lecrurer
P. Krishna Iyer, M. Sc. (Kerala), Lecturer
T. Narayanan, M. Tech (IIT, Bombay), Lecturer
V. Ramamurti, M. Tech. (IIT, Kharagpur), Lecturer
G. Bapiah, M. Tech. (IIT, Madras), Associate Lecturer
P. A. Aswatha Narayana, M. E. (IISc, Bangalore), Associate Lecturer
B. H. Lakshmana Gowda, M. E. (IISc, Bangalore), Associate Lecturer
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A. S. J. Swamidas, M. Sc. (Madras), Associate Lecturer

AERONAUTICS

K. A. V. Pandalai, D. Ae. E. (Brooklyn), Prof. & Head
K. Balaraman, M. S. (Purdue), Assistant Professor
N. R. Rajappa, Ph. D. (Stanford), Assistant Professor
G. Subramanian, M. E. (IISc, Bangalare), Lecturer
R. M. Siddaveere Gowda, M. E. (IISc, Bangalore), Lecturer
T. K. Varadan, M. E. (IISc, Bangalore), Lecturer
E. G. Tulapurkara, M. E. (IISc, Bangalore), Lecturer
H. S. Bathla, B. Tech. (Punjab), Associate Lecturer

RESEARCH WORK

I. SOLID MECHANICS

The research interests of the Solid Mechanics group have been in the fields of Structural Analysis, Elasticity, Vibration and Mechanisms. Several research and development projects investigated and in progress during 1967–68 are outlined below:

1. Vibrations of Cylindrical Shells with Different Types of Cores (D. V. Reddy and T. Narayanan):

   The project involves the study of natural frequencies of vibration of an infinitely long thin elastic cylindrical shell with an elastic core of a different material and subjected to initial stress.

2. Limit Analysis of Clamped Plates (D. V. Reddy and T. Narayanan):

   The load carrying capacity of rectangular plates with fixing moments at the edges and subjected to a parabolically varying load is studied by means of a lower bound approach. A solution which very closely agrees with the upper bound solution for a wide range of geometrical and load parameters was arrived at. A paper on the topic has been accepted for publication in the International Journal of Building Science.

3. Application of Closed-form Difference Equation Solution to Vibration Analysis of Plates and Plane Grids (D. V. Reddy and G. Subramanian):

   The purpose of the study is to develop closed-form solutions, based on difference equation, for plate and grid vibration problems and also study errors due to discretisation. The possibility of using finite element formulation for the determination of closed-form solutions is also being investigated.

4. Network Analysis of Plate Problems (D. V. Reddy and G. Venkata Rao):

   Problems of flexure of thin flat plates are analysed on an electrical resistance network analyser. The case of an isotropic, uniformly loaded and simply supported flat plate with different angles of skew has been investigated.

5. Analysis of Interface Stresses in Solid Propellant Grain (R. S. Alwar and P. Krishna Iyer):

   Stresses at the interface between the bonding agent and the fuel

element in a solid propellant grain have been analysed. This is a case where stress concentration occurs due to discontinuity in the material properties. This investigation has been carried out not only due to its practical utility but also to indicate how exact solutions can be developed for complicated multilayered interface problems. The solution obtained in this investigation is exact in the sense that it satisfies the equilibrium and the compatibility equations, and all the boundary and interface conditions. Numerical results have been given for a case of practical interest.

6. Some Experimental and Theoretical Investigations in Junction Stresses in Shell Structures (R. S. Alwar, D. V. Reddy and V. Ramamurti):

The stresses at the junction of cone and a cylinder subjected to unsymmetrical loading are determined by the difference method using the digital computer. A model is made of araldite and the results are verified experimentally.

7. Some Experimental and Theoretical Investigations in Sandwich Structures (R. S. Alwar and P. Krishna Iyer):

Elasticity solution for a 3 layered, long rectangular sandwich plate is given. The sandwich plate is assumed to be isotropic with identical face layers. Analysis is done for a central concentrated load. Computer results are presented for various core to face thickness, ratios and material properties. The results are compared with the approximate theories due to Reissner, Hoff and Eringen. The results are specialised for a homogeneous plate with a concentrated load which agree with the well-known Filon's solution.

8. Rigidity and Damping Characteristics of Built-up Structures with particular reference to the Effect of Welding (B. Ramakrishnayya, B. V. A. *Rao and Hans Wagner*):

It is modern practice to make use of built-up structures in all machinery and buildings in order to fabricate complicated structures and at the same time reduce the weight. This is achieved either by using temporary fastenings like bolts and nuts, keys etc. or through permanent fastenings like welding, rivetting, adhesives etc. It is therefore necessary to study the static and dynamic rigidities, and damping characteristics of such prototype model built-up structures in practice. As welding is the most common form of fastening employed, emphasis is given to this effect in the current investigations. Tests are conducted on built-up structures by varying the type of welding, the weld parameters etc. to arrive at optimum conditions.

9. Vibration Excitation and Isolation by use of Pneumatic Techniques (Compressed Air) for Shock and Vibration Isolation (P. R. Nagappan, B. V. A. Rao and V. Ramamurti):

To determine the resonant and damping characteristics of structures or elastic elements, mechanical and electrical shakers are usually used for introducing the excitation into the vibrating systems. The object of the present investigation is to obtain the same results through pneumatic excitation using compressed air. An exciter of this type has already been developed to produce a sinusoidal pulse, and attempts are now made to fabricate the equipment to produce other types of forced excitations. Fatigue studies are made for different types of vibration or shock pulse excitations. Pneumatic springs have been found to be good vibration and shock isolators for certain type of systems. It is therefore interesting to study the spring characteristics (essentially non-linear in nature) of these isolators for various types of excitations. An experimental rig is under progress.

10. Study of Automobile Vibrations through Analogue Techniques (C. R. Subramanian, B. V. A. Rao and D. V. Reddy):

The transient vibrations of the automobile chassis in the bouncing and pitching modes were analysed under the effect of external shock excitation caused by road irregularities. The technique adopted in this analysis was by simulation of the model on an Analogue Computer. Keeping all other parameters constant, only the external excitation was varied and the response of the system recorded through a loop oscilloscope. The work was submitted as a M. Tech. thesis by the first author.

11. Rotor Instabilities due to Oil and Gas Films in Journal Bearings (B. S. Prabhu, B. V. A. Rao and Hans Wagner):

Oil film contained between the journal and the slider bearing in all machinery gives rise to certain vibrations because of their quasi-elastic and damping properties. The critical speeds of shafts are very much affected by the oil film properties. Self-excited oscillations occur under certain conditions, exhibiting large amplitudes of motion of the journal and ultimate failure of bearings. A Universal Bearing Testing Machine has been fabricated in order to study the vibrations arising due to oil films. Theoretical investigations are also under study. Both the hydrodynamic and the aero (gas) dynamic bearings will be studied to get a clear picture of the lubrication effects of the incompressible and the compressible media.

12. Studies on Dynamically Loaded Bearings (G. Bapaiah, B. V. A. Rao and V. Ramamurti):

Study of slider bearing performances under dynamic loading has received a lot of attention in modern times. Failure of bearings for certain ratios of frequency of operation needs investigation. With this view in object, a bearing testing machine is under progress wherein the load variation is made periodic.

13. Studies on Fluids for their Viscous Damping Characteristics for Vibrations and Shock Absorption (N. Ganesan, B. V. A. Rao and V. Ramamurti):

It is interesting to study the viscous damping properties of oils and lubricants both under laminar and turbulent conditions. Viscous damping coefficient is not only a function of the viscosity of the fluid, but also is a function of various parameters such as frequencies and amplitudes of operation, dimensions of capillary or annular rings through which it flows. A test rig has been fabricated to determine the damping resistance of these fluids. This apparatus will also serve to test shock absorbers used in automobiles.

14. Random Vibration Studies on Elastic Structures (Mechanical and Acoustics) (Hans Wagner):

Experimental and analytical studies on plates are in progress under various boundary conditions exposed to random loadings. The test excitation will be generated by acoustic noise of considerably high sound pressure levels, to which end an open-air test stand (exponential horn) will be designed and fabricated.

15. Deterioration of Contact Surfaces (M. A. Veluswamy and V. C. Venkatesh):

The various types of wear namely pitting, scoring, galling etc. on metallic and nonmetallic surfaces that are in contact and subjected to rolling and sliding are studied with particular reference to gear profiles. Whether lubrication is the cause for pit formations on the surface, or not, is also being investigated.

16. Nonlinear Vibrations of Structures (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.

17. Thermal Stresses in Plates and Shells (R. M. Siddaveere 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 partieular interest.

18. Elastic and Perfectly Elastic Plastic Stress Analysis of Toroidal Shells of Elliptical Cross-section made of Isotropic and Orthotropic Material (K. Balaraman and K. A. V. Pandalai):

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.

I. FLUID MECHANICS

1. Compressible Flow Past Airfoils Between Plane Walls (N. R. Rajappa):

The effect of the presence of solid boundaries on the compressible flow past a thin body has been investigated.

2. Taylor Instability of Superposed Fluids (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. Three-dimensional Effects on the Interfacial Stability of Superposed Fluids (N. R. Rajappa):

The three-dimensional aspects of the growth or instability of superposed fluids are being investigated by taking the non-linear effects also into account.

4. A new Approach to the Study of Finite Amplitude Gravity Waves (N. R. Rajappa):

The non-linear theory of gravity waves is investigated by treating the problem as a singular perturbation problem. The frequency or period of oscillation is found to be different from that of the linear theory, and is in agreement with the experiments of G. I. Taylor.

5. A Rationalised Approach to Prandtl's Lifting Line Theory of a Finite High Aspect Ratio Wing (N. R. Rajappa):

The classical lifting-line theory of Prandtl has been modified by means of a modern technique known as singular perturbation technique. This is being applied to trapezoidal wings of high aspect ratio.

6. Non-Newtonian Lubrication of Slider Bearings (N. V. C. Swamy and G. Bapaiah):

The pressure distribution and load-bearing capacity of slider bearings have been analysed when the lubricant is a power-law or Ostwald-de Waele fluid, for various values of the exponent.

7. Pulsating Pressure Gradient Effects on Flow through Pipes (N. V. C. Swamy):

The effect of an impulsive pressure gradient, in the form of a surge, on the flow through a circular pipe is investigated and it is shown that back flow occurs over part of the pipe cross-section.

8. Friction Coefficients for Turbulent Flow through Circular Pipes (N. V. C. Swamy, B. H. Lakshmana Gowda and P. A. Aswatha Narayana):

Simple methods have been proposed for rapid calculation of friction factors for turbulent flow through circular pipes. The friction factors can be read directly from charts.

9. Structure of three-dimensional Turbulent Boundary Layers (N. V. C. Swamy and B. H. Lakshmana Gowda):

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

10. Structure of Axi-symmetric Turbulent Boundary Layers (N. V. C. Swamy and P. A. Aswathanarayana):

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.

11. Experimental Investigations on Rotating Bodies in Fluid Media (N. V. C. Swamy):

A set-up has been designed for investigations on the laminar boundary layer on a rotating sphere. The sphere can be rotated at 16, 32, and 42 r. p. m. Experimental work is in progress.

12. Experimental and Theoretical Investigation of Axismmetry Flow in a Diffuser with a Central Body (A. Klein and J. Mathew) :

    Potential flow analysis for flow through a diffuser with a central body has been made, using the concept of ring vortices. Fabrication of such a Diffuser is in progress.

13. Wing Flap Investigations (A. Klein and P. S. Srinivasan):

    Theoretical investigation is in progress. Experiments will be carried out when the Wind Tunnel is ready.

14. Interactions between rear-mounted Engines and Fuselage (A. Klein and M. Balakrishnan):

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

DEVELOPMENT WORK

I. SOLID MECHANICS

1. Photoelastic Polariscope
2. Test set-up for buckling
3. Shear centre apparatus
4. Membrane analogy equipment
5. Loading frames of capacities 20 Tons, 5 Tons and 2 Tons with auxiliary equipment
6. Development of structural models
7. Development of Gizmohr apparatus for kinematical determination of principal stresses
8. Design, development and studies on hydraulic vibration exciters
9. Development of seismic pick-ups incorporating dry friction damping
10. Design, fabrication and standardisation of electrical vibration transducers and exciters
11. Design and development of variable speed (stepless) friction drives
12. Fabrication of shock testing machines to study effects of shock on structures (for different types of pulse excitation)
13. Development of isolated foundations (free from vibration and shock) and also a universal type isolation bed with facilities to change the springs and dampers
14. Design and development of a dynamic balancing machine
15. Critical speed apparatus to study the whirling effect

16. Dynamic absorber model for illustration
17. Study of behaviour of mechanical vibration systems through electrical passive analogue networks
18. Design and fabrication of a mobile crane
19. Mechanism models

II. FLUID MECHANICS

1. A turn table mechanism for studies of rotating fluids
2. Strain-Gauge mechanism for force measurements
3. Electrical Analogues for fluid flow studies
4. Hele-Shaw apparatus for fluid flow studies
5. Apparatus for acoustic transition studies
6. Rotating sphere apparatus

LABORATORY FACILITIES

The Department has facilities for instruction and research in the following areas :

(I) Elasticity :

In addition to conventional facilities such as testing, loading frames, load cells and strain-gauge and deflection-gauge instrumentation, the following special items have been designed and fabricated by the Staff : network analyser, membrane analogy apparatus, photoelastic equipment, and a column testing apparatus.

(II) Fluid Mechanics :

The major items of equipment in this area are : an open jet, closed-circuit, low-speed Wind-Tunel of nozzle diameter 1.5m with an installed power of 180 kw, a maximum flow velocity of 60 m/sec. and a semi-automatic six component balance; a smaller low-speed Wind-Tunnel of the open-circuit type and of closed test section 0.6m.

A test-bench for special investigation on diffusers is nearing completion. The construction of various types of demonstration equipment, such as flow-visualization apparatus, orifice and venturi meters and devices to depict the fundamental laws of fluid motion, is in progress. The laboratory is equipped with measuring apparatus such as micromanometers and multi-manometers and electronic equipment for strain gauge measurement. A hotwire anemometer is to be installed.

A blow-down type supersonic Wind-Tunnel will become available in the near future.

(III) Vibrations, Mechanisms and Lubrication

The major items of equipment in this area comprise various types of mechanical and electrical shakers and transducers, static and dynamic strain-measuring equipment, frequency-counters and recording instruments, noise and random vibration measuring equipment and spectra-analysers.

The Mechanisms Laboratory has about 150 mechanism-models of link-motions, mechanical harmonic analysers and function-generators and integraph.

The Department commissioned the following major items of equipment during the year :

Universal Frequency-Time Counter; Precision Vibration Table; Universal Vibrograph—Geiger Type; Askania-Hand Vibrograph; Strobsoscopes with photo-elastic and inductive pickups; Robot Recording Camera; Six-channel Oscilloport; Three-Loop Oscillograph—Galvanometer type; Electrodynamic Exciter and Pick-ups; Universal Testing Machines—20 tons capacity; 10-channel Strain measuring Bridge; Displacement Pick-up Amplifier; 5-ton U. T. M.

SPECIAL COURSES OFFERED

The Department offered two special short-term Courses during the year : one, for students of the Technical Teachers Training Institute, Adyar, Madras, an intensive course in experimental work in Theory of Machines; and the other, for the students of the Sequential Summer School in Mechanical Engineering, in the subjects Elasticity, Plasticity and Experimental Stress Analysis, Vibrations, Dynamics of Machinery and Fluid Mechanics.

The Vibrations Laboratory provided training facilities for students of the Rsgional Engineering College, Warangal and the Birla Visvakarma Maha-Vidyalaya, Khaira, Gujarat State.

LIAISON WITH INDUSTRY

The following two projects were taken on hand during the year :

(i) Experimental Analysis of Frequencies of Bridge Decks: The objective is to determine the frequencies and mode shapes of inter-connected beam systems and stiffened slabs similar to those used for bridge decks. The test rig has been fabricated and experimental steps are being planned.

(ii) Design of a Forge-Hammer Foundation for the Heavy Vehicles Factory at Avadi, Madras: The objective is to help the Factory

in its efforts to reduce the amplitude of oscillations in the area around a double-acting Forge Hammer. This project has been undertaken wiih the collaboration of the Structural Engineering Research Centre, Roorkee.

The Department is maintaining close links with aero-space establishments in the country. Considerable stress is laid on applied research and development work.

PUBLICATIONS

I. Papers Published

1. "Response of a Spherical Shell to an Axisymmetric Pressure Wave"—D. V. Reddy and G. K. Narasimha Murthy, Nuclear Engineering and Design, Amsterdam, 5 (4), 426-432 (1967).
2. "Ultimate-Load Analysis of Edge Loaded Foundation Slabs",—D. V. Reddy and E. L. Murphree, The Structural Engineer, London, 46, 13-16 (1968)
3. "Torsional Vibrations of Internal Combustion Engines"—An experimental study of some locally made and foreign built engines,—B. V. Aswathanarayana Rao, "Viswakarma", Journal of Science and Technology (1967)
4. "Effect of Weld Length on the Stiffness and Structural Damping of Built-up Structures",—R. Rangarajan and B.V. Aswathanarayana Rao, "Viswakarma", Journal of Science and Technology (1968)
5. "Creep Behaviour of High Density Polythylene"—E. G. Tulapurkara and P. Narasimha Murthy, International Journal of Mechanical Science, January 1968

II. Papers Accepted for Publication

1. "Load-carrying Capacity of an Edge-Loaded Foundation Slab Clamped Along the Edges",—D. V. Reddy and T. Narayanan, International Journal of Building Science, Great Britain.
2. "Approximate Frequencies for Nonlinear Systems",—Hans Wagner, Journal of Applied Mathemasics and Physics.

III. Papers Presented in Conferences / Seminars

Twelfth Congress of Theoretical and Applied Mechanics held at IIT, Delhi.

1. "Frequency Analysis of Certain Curved Members using Newmark's Method",—D. V. Reddy and R. Balasubramaniam.

2. "One-dimensional Shock Wave Reflection in a Solid Medium",—D. V. Reddy.

3. "Hydrostatic Squeeze Films with Power-Law Non-Newtonian Lubricants"—N. V. Chandrasekhara Swamy and G. Bapaiah.

4. "Asymmetric Bending of a Cylinder-cone Junction"—R. S. Alwar and V. Ramamurti.

5. "A Non-Linear Theory of Taylor Instability of Superposed Fluid", N. R. Rajappa.

6. "Elastic-Plastic Analysis of Short Span Reinforced Concrete Cylindrical Shells"—T. Narayanan and R. S. Ayyer.

7 "The Flow in a Turbine Stage including Secondary Flows as analysed by Theory and Experiment"—A. Klein.

Annual Session of The Aeronatical Society of India and the Silver Jubilee Celebration of the Department of Aeronautical Engineering, Indian Institute of Science, Bangalore.

8. 'The Influence of Thermal Stresses on Natural Frequency of Vibration of Plates"—K. A. V. Pandalai.

9. "Closed-form Solutions of Difference Equations in Structural Mechanics"—G. Subramanian and D. V. Reddy.

IV. Papers Sent for Publication

1. "Friction Coefficient for Turbulent Flow through Smooth Pipes",—N. V. Chandrasekhara Swamy. P. A. Aswathanarayana and B. H. Lakshmana Gowda, Journal of the American Society of Civil Engineers, Hydraulic Division.

2. "Analysis and Design of Stiffener Rings around Rotary Kilns"—R. S. Alwar and V. Ramamurti, Journal of Institution of Engineers, India.

3. "Turbulent Boundary Layer"—J. Mathew, American Society of Civil Engineers.

4. "Natural Frequency of a Star-Shaped Membrane" Hans Wagner, Journal of the Royal Aeronautical Society.

5. "A New Approach to the Study of Finite Amplitude Gravity Waves"—N. R. Rajappa, ZAMP.

6. "Effect of Surface Tension on the Motion of a Bubble due to Taylor Instability" -N. R. Rajappa, Journal of Physical Society of Japan.

CHEMICAL ENGINEERING DEPARTMENT

STAFF

D. Venkateswarlu, Ph.D. (IIT Kharagpur), Prof. & Head
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G. S. Davies, Ph.D. (IIT, Kharagpur), Lecturer
B. C. Battacharya, M.Tech. (IIT, Kharagpur), Lecturer
A. Prabhakar Rao, M.Sc. (Tech) (Andhra), Lecturer
Ch. Durgaprasad Rao, Ph.D. (Andhra), Lecturer
R. Nagarajan, M.Tech. (IIT, Madras), Lecturer
C. Sivaprasada Rao, M.Sc. (Tech) (Osmania), Lecturer
A. Baradarajan, M.Tech. (IIT, Madras), Lecturer
R. Subramanian, M.Sc. (Tech.) (Bombay), Lecturer
V. Nagarajan, Ph.D. (IISc, Bangalore), Lecturer

Bernhard Haedke, Dip.-Ing. (Stuttgart), Senior Scientific Assistant

RESEARCH WORK

1. FLUID FLOW

1. Particle motions in Batch Fluid Beds (N. Subramanian and T. Gopichand) :

   The description of particle motions in batch fluid beds is attempted in a quantitative manner. This can be used to predict the transport rates taking place in the complex fluidised bed. Such predictions can be used in the control of various physical operations and chemical processes taking place in the fluidised bed to a better precision.

2. Studies in Non-Newtonian Fluids (R. Nagarajan and D. Venkateswarlu):

   The characteristics of turbulent flow of water can be altered by suitable materials. Some polymeric materials in water show a tendency

to decrease the drag causing the delayed transition to turbulence. The aim of this study is to propose a suitable mechanism for this reduction in drag based on the structure and properties of the polymers used.

II. HEAT TRANSFER

1. Heat Transfer Studies in Annular Liquid Fluidized Beds (K. Ramamurthi and K. Subbaraju.):

   Heat transfer studies in annular fluidized beds to investigate the influence of operating variables and physical properties of the systems involved on the wall heat transfer coefficient and to understand the mechanism of heat transfer are being carried out. Further studies related to pressure drop and bed characteristics with different types and sizes of particles in an annular liquid flluidized beds are also being carried out.

2. Study of Heat Ttansfer in Thin Film Evaporation (B. C. Bhattacharya and R. J. H. Bisanz):

   Film coefficients of Heat Transfer in thin film evaporation of water, glycerine solution and organic solvents are under investigation. The variables under study are feed rate, rotor speed, number of blades in rotor and their position and diameter to height ratio.

III. MECHANICAL OPERATIONS

1. Studies in Fluid Energy Grinding (M. Ramanujam and D. Venkateswarlu):

   An experimental jet mill was designed and constructed. The effect of different parameters such as solid feed size, feed rate and grinding nozzle air rate was stuied with calcite as test material. Correlations connecting grinding ratio with the above mentioned parameters and the specifiic surface area produced with the mean residence time of particles inside the mill are presented. The influence of air rate through injector nozzle, the size of grinding nozzle on the grinding characteristics are indicated. Factors affecting the efficiency of grinding and the optimum grinding conditions are also discussed.

2. Studies in Size Reduction by Vibration Mills (R. Vedaraman and D. Venkateswarlu):

   Investigations on the size reduction of materials of different hardness and grindability values and also of different particle sizes, mill and

ball charges are being carried out in an experimental vibration mill. The above results are compared with the results obtained using the conventional ball mill.

3. Granulation of Fertilisers (V. Narayana Rao and E. Hohmann) :

To understand the basic principles involved in the process of granulation and as a prelude to the granulation of concentrated mixed fertilisers, granulation studies are being conducted on superphosphate. The work includes study of conditions under which superphosphate can be converted into product of uniform size, shape and sufficient hardness to withstand handling, in a rotary granulator, without the use of any binder.

4. Flotation Studies of Salem Iron Ore (D. V. Ramana Rao and E. Hohmann) :

Salem iron ore is essentially magnetite and quartzite. Iron content varies from 32 to 40 per cent. Microscopic examination revealed that the particles of 0. 90 mm. size are completely liberated and can be satisfactorily recovered as iron concentrates. The process includes concentrating the iron content from 32 to 65 per cent by flotation using suitable collectors and frothers. The process is found to be effective for fines with minimum reagent eonsumption.

5. Studies in Flotation with reference to Settling Phenomenon (S. Raghunadha Rao and E. Hohmann) ;

Basic studies in flotation were made with special reference to the settling phenomenon. The effective variables are percentage and size of solids, speed of the stirrer and air rate. The critical variation of settled bed heights in flotation cell, for finer size particles at low temperature, is explained referring to the size, shape and moment of air bubbles in the pulp.

In order to reduce the imports of phosphate rock required for Fertiliser and allied Chemical Industries, work is being carried out to beneficiate the indigenous phosphate rock from Mussouri (U. P.). Preliminary microscopic studies have been carried out to determine percentage of liberation at different sizes and the types of locking between the constituents, the main impurities being calcite and silica in highly intergrown condition.

The bauxite from Kollihills (Salem), that contain high amounts of iron oxide (Fe_2O_3) and silica, is a problem of importance for the Aluminium Industry. Preliminary studies on magnetising roasting have

been carried out to convert Fe_2O_3 to Fe_3O_4 for magnetic separation. Microscopic studies have also been carried out to find out the economic size of liberation and the interlocking between the constituents.

IV. PARTICLE TECHNOLOGY

1. Compaction of Solids (C.M. Ramaswamy, Y.B.G. Varma and D. Venkateswarlu) :

   Compaction of solids is a problem of commercial importance in all industries such as the pharmaceutical and fuel industries and in the utilisation of waste fine particles of industries. Extensive data on compaction of materials is collected during the last five years. Correlations for predicting the behaviours of materials in compaction are developed.

V. APPLIED REACTION KINETICS

1. Solid-solid Reactions and Diffusion (A. Baradarajan and M. Satyanarayana) :

   The importance of solid state reaction in cement, glass and ceramic industries has been realised. An attempt is being made to study the reaction mechanisms and types of diffusion occuring in typical solid state reactions.

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

   The use of ion-exchange resins as catalyst for the esterification reactions is being studied. The effect of particle size, pole distribution ion-exchange capacity and initial water content in the catalyst and structure of fatty acids and alcohols on the rate of esterification are under investigation.

M. TECH. PROJECTS :

1. Studies on Grinding in Ball Mill on Pilot Plant Scale (M. Balasubramanian and E. H. Hohmann) :

   The influence of feed quantity, time of grinding, feed size and ball size on the grinding taking place in a Ball Mill of pilot plant scale, is presented in this work. Calcite from Salem District in Madras State has been used as the grinding material.

2. New Results in Continuous Vacuum Filtration on a Drum Filter (D. C. Dorayya and E. H. Hohmann):

   The object of the present work is to suggest optimum operating condi-

tions in the light of the experimental results obtained. The material is calcite powder, 40–50 micron size, from Andhra Pradesh. The filter aids used are starch, Bentonite and Tyllose.

3. Classification and Beneficiation Studies on a Hydrocyclone Pilot Plant : (S. Koteswara Rao and E. H. Hohmann) :

Classification studies on a Hydrocyclone are carried out on a pilot plant scale. The influence of the variables feed pulp density, feed pressure and diameters of the openings of the cyclone is studied. The diameter of separation is correlated with the recovery of the material in the underflow.

4. Extractive Distillation of Tar acids (K. Kurivilla Thomas and R. J. H. Bisanz) :

The mixture of tar acids extracted from a coal tar distillate from the Neyveli Lignite Corporation was analysed. The major components were identified and their relative proportions determined. A synthetic binary mixture consisting of phenol and U-cresol was prepared. The feasibility of extractive distillation of tar acids was examined. Promising available solvents were evaluated for their selectivity by determining the elective volatility of phenol with respect to o-cresol in the presence of various solvents. It was found that none of the available solvents exhibited selectivity for extractive distillation.

5. Separation of Tar Acids and Neutrals from Middle Oil by Liquid-Liquid Extraction in a Pulsed Column (V. Lakshmana Rao and R. J. H. Bisanz) :

A review of the literature concerning the recovery of tar acids from coal tars is presented. The feasibility of using a pulse extraction column for the recovery of tar acids from the middle oil supplied by Neyveli Lignite Corporation has been investigated. 70 per cent aqueous methanol and hexane, which are reported in the literature as the most effective solvent pair for this extraction are used. The effects of the amplitude of pulses and the ratio of flow rates of hexane to middle oil on the yields and purity of the tar acids and neutral oil are studied.

6. Diffusion and Mass Transfer Studies in Water-Phosphoric Acid-Butanol System (K. Raghavendra Rao and P. Bhimeswara Rao) :

Diffusion coefficients of phosphoric acid in water at 35 C, 40 C and in n—Butanol at 35 C are determined using sintered glass diaphragm

diffusion cell of pore size 20–30 microns Mass transfer coefficients of phosphoric acid from (a) Water to Butanol phase and (b) Butanol to water phase, at 35 C are studied using the stirred cell.

7. Vapour Phase Catalytic Re-Esterification of Ethyl Acetate with Methanol : (S. Ramachandran and M. Satyanarayana) :

The present work concerns with the kinetic study of the vapour phase re-esterification of ETOAC with MEOH in the presence of silica gel and catalyst.

8. Compaction of Solids with Shear : (K. Sitarama Sastry and Y. B. G. Varma) :

In the present work, the compaction with shear is studied for four materials viz. naphthalene, oxalic acid, copper sulphate and calcite. A model for finding the stress at any point inside the compact is developed and it is found to be in good agreement with experimentally determined stress planes in the compact.

9. Studies on Heat Transfer between an Axisymmetric Jet and a Plate held Normal to the Flow : (S. Seetharamiah and K. Subbaraju) :

Heat transfer between a submerged jet of water and a flat surface held normal to the flow was studied. The average heat transfer coefficients were found to be independent of nozzle to plate distance in the region studied.

10. On the Phenomena of Condensation Heat Transfer : (D. Subba Rao and K. Remananda Rao) :

An attempt is made to analyse the phenomena of condensation heat transfer. Conditions for getting large heat transfer co-efficients and heat fluxes are quantitatively analysed and a method is suggested to achieve that.

11. Studies on the Bubble Characteristics in Submerged Orifices : (K. Vaidhyanathan and Ch. Durgaprasada Rao) :

Effect of flow rates, liquid heads and orifice diameter on the bubble characteristics like bubble frequency, bubble diameter, volume, growth time and evolution patterns are studied. Resistance probe method is employed and oscilloscope signals are photographed.

12. Mass Transfer Studies from Falling Drops : (V. Muthukrishnan and N. M. Raghavendra) :

Mass transfer studies in the case of solute diffusing from a single drop falling in a solute free stagnant continuous phase is studied with

chlorobenzene-acetic acid-water system. Instantaneous mass transfer coefficients are plotted against time of fall.

13. Studies on Mixing of Solids in Double Cone Mixers: (K.J. Sethuraman and G. S. Davies):

In the present work, equal sized and different sized particles are mixed in a double cone mixer. The investigations are carried out in two parts. Effect of different types of deflectors on different proportions of sand and salt are studied.

LABORATORY FACILITIES

The Department has well-equipped laboratories for instruction and research in the following areas:

Technical Analysis; Chemical Technology; Fuels; Process Engineering; Mechanical Operations; Particle Size Analysis; Fluid Flow, Heat and Mass Transfer; Instrumentation.

SEMINAR

The Department organized a Seminar on 'Developments in Chemical Engineering' during February 1968. Dr. S. K. Mukherjee, Director, Fertilizer Corporation of India, inaugurated the Seminar. Two outstanding participants in the Seminar where Prof. Dr. R. H. Quack from the Technical University, Stuttgart and Prof. Dr. H. Brauer from the Technical University, Berlin.

Papers on Fluid Flow, Heat Transfer, Mass Transfer, Particle Technology, Applied Reaction Kinetics and a number of related subjects were presented during the Seminar. Special mention may be made of a discussion-meeting on 'The Chemical Engineering Profession'. Several of the delegates attending the Seminar were from Industry. The Proceedings of the Seminar are due to be published in the Journal 'Chemical Age of India'.

SPECIAL LECTURES

The two distinguished Visiting Professors from Germany, Dr. R. Quack and Dr. H. Brauer, delivered two series of lectures on 'Automation of Chemical Industries' and 'Fluid and Particle Dynamics' respectively.

LIAISON WITH INDUSTRY

The Department continued to maintain close links with Industry. The following projects were successfully completed during the year:

(i) Extractive Distillation of Tar Acids; Separation of Tar Acids and Neutrals from Middle Oil by Liquid-Liquid Extraction in a Pulsed Column (for the Neyveli Lignite Corporation);

(ii) Calibration of Orifice-Meter (for Messrs K. C. P. Ltd, Madras);

(iii) Particle Size Analysis of Ultra-fine Ground Samples of Mica (for Messrs Kasim & Co., Madras).

PUBLICATIONS

I Papers published

1. 'Compaction of Solids'—Y. B. G. Varma and D. Venkateswarlu, Chem. and Process Engg., 48, 77 (1967)

2. 'Trends in Chemical Engineering Education'—D. Venkateswarlu, Journal Chem. Engg. Soc., IIT, Madras, 1, 85 (1967)

3. 'Studies in Entrainment'—K. Jayasimhulu and D. Venkateswarlu, Chem. Age of India, 18, (1), 46 (1967)

4. 'Determination of Surface Energy of Solids'—Y. B. G. Varma, A. V. Ramani and D. Venkateswarlu, Jour. Chem. Engg. Soc., IIT, Madras, 1, 1 (1967)

5. 'Ejection Pressures and Strength of Compacts of Powders'—Y. B. G. Varma and D. Venkateswarlu, Ind. Jour. Tech. 5, 335 (1967)

6. 'Ternary Liquid Equilibria of Water-phosphoric acid-I Butanol, Butyl acetate, or Me-Et-Ketone Systems at 35°C'—S. Muralimohan and P. Bhimeswara Rao, Jour. Chem. and Engg. Data, 12, 494 (1967)

7. 'Ternary Liquid Equlibria of Water-phosphoric acid-Isoamyl Alcohol, Cyclohexanol or Methyl Isobutylketone systems at 35°C'—P. Ananthanarayanan and P. Bhimeswara Rao, Jour. Chem. and Enng. Data, 13, 194 (1968)

8. 'Vapour-Liquid Equilibria of Non-ideal Solutions at Atomospheric Pressure-cyclohexane-acetic acid System'—A. Baradarajan and M. Satyanarayana, Ind. Jour. of Tech. 5, No. 8, 264 (1967)

9. 'Vapour-Liquid Equilibria of Benzene-cyclohexane-acetic acid System at Atmospheric Pressure'—A. Baradarajan and M. Satyanarayana, Jour. Chem. Engg. Data, 13, (2), 148/150 (1968)

10. 'Effect of Dyes on Solar Evaporation of Salt Brines'—N. R. Neelakantan and K. Subbaraju, Chem. Age of India, August 1967.

II. Papers accepted for publication :

1. 'Removal of Traces of Nitric Acid from Nitrobenzene by Liquid Extraction' — K. Suryanarayanamurthy and M. Satyanarayana, Trans. Indian Inst. of Chemical Engineers.
2. 'Recovery of Labile Sulphur from Iron Pyrites'—K. Rajamani and M. Satyanarayanan, Indian Journal of Technology.
3. 'Diffusional Model for the Particle Motion in Batch Fluid Beds'— N. Subramaniam and T. Gopichand, Trans. Indian Inst. Of Chemical Engineers.
4. 'Studies on the Bubble Characteristics in Submerged Orifices'— K. Vaidyanathan and Ch. Durgaprasada Rao, Chemical Age of India.
5. 'Particle Size Distribution in Compacts of Solid Powders'— Y. B. G. Varma, T. Gopichand and D. Venkateswarlu, Journal of Chemical and Engineering Data.

III Papers Presented in Conferences / Seminars :

Papers presented at the Seminar on 'Developments in Chemical Engineering' held at I. I. T., Madras in February, 1968 and accepted for publication in 'Chemical Age of India'

1. 'Solid-State Reactions'— M. Satyanarayana.
2. 'Fluidisation and Pneumatic Transport'— N. Subramaniam.
3. 'Recent Developments in the Contacting Equipment (Gas-liquid)'— Ch. Durgaprasada Rao.
4. 'Chemical Reactor Design'—Y. B. G. Varma.
5. 'Transport Phenomena'—P. Bhimeswara Rao.
6. 'Multiphase Flow'—N. M. Raghavendra.
7. 'Recent Advances in Heat Exchangers'—K. Subbaraju.
8. 'Evaporators of the Day'—B. C. Bhattacharya.
9. 'Heat Regenerators'—H. H. R. Bock.
10. 'Recent Developments in Gas Absorption Process'—K. RemanandaRao.
11. 'Driers'—R. J. H. Bisanz.
12. 'Developments in Particulate Technology'—D. Venkateswarlu.

13. 'Particle Size Analysis'—M. Ramanujam and D. Venkateswarlu.

14. 'Mixing of Solids'— G. S. Davies.

15. 'Electrical and Magnetic Methods of Separation'— A. Prabhakara Rao.

16. 'Protein for Human Nutrition' (Torula food yeast)— R. J. H. Bisanz.

Papers presented at the 20th Annual Session of the Indian Institute of Chemical Engineers at Neyveli in December, 1967.

1. 'Particle Motions in Lean Batch Fluid Bed—Applicability of Brownian Motion type equations. Parts I to IV'—N. Subramaniam and T. Gopichand.

IV Papers sent for publication:

1. 'Vapour-Phase Catalytic Re-Esterification of Ethyl Acetate with Methanol'—S. Ramachandran and M. Satyanarayana, Journal of Chemical and Engineering Data.

2. 'Compaction of Solids with Shear'— K. S. R. Sastri and Y. B. G. Varma, Indian Journal of Technology.

3. 'Effect of Calcium Chloride on the Ternary Liquid Equilibria of Water-Phosphoric Acid-1-Butanol System at 35 C'—P. Anantha-narayanan and P. Bhimeswara Rao, Journal of Chemical and Engineering Data.

CHEMISTRY DEPARTMENT

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C. N. Pillai, Ph. D. (N. W. Uni., U. S. A.) Assistant Professor

C. Kalidas, Ph. D. (Jadavpur), Lecturer
V. Ramakrishnan, Ph. D. (Annamalai), Lecturer
C. S. Swami, Ph. D. (IISc, Bangalore), Lecturer (on deputation)
S. R. Ramadas, Ph. D. (IISc, Bangalore), Lecturer
V. Mahadevan, Ph. D. (Madras), Lecturer
K. Narayanan, Ph. D. (IIT, Madras) Lecturer
J. Rajaram, Ph. D. (IIT, Madras), Lecturer
M. Ramakrishna Udupa, Ph. D. (IIT, Madras), Lecturer

S. Narayanan, M. Sc. (Madras), Associate Lecturer

RESEARCH WORK

I. PHYSICAL CHEMISTRY

1. Physico-Chemical Study of Interface and Interfacial Processes (S. R. Rajagopalan and M. V. C. Sastri):

   The Capillary electrometer for electrocapillary measurements has been standardised with a view to study the adsorption processes occurring at Hg/solution interface. Various alcohols are being studied by electrocapillary measurements.

2. Physico-Chemical Studies on Oxide Catalysts (B. Viswanathan, V. Srinivasan and M. V. C. Sastri):

   The effect of the changes in the electronic and the structural characteristics of solid catalysts, like ZnO, on a typical decomposition reaction of isopropyl alcohol has been studied. This work involves measurements of electrical conductivity changes in the solid during reaction. Studies of structural changes have been carried out by X-ray and Differential Thermal analysis.

3. Kinetics of Electrode Reactions by Polarography (C. S. V. Venkatachalam and M. V. C. Sastri):

   The kinetics of the electrode reaction, $Zn^{++} + 2\,e \rightleftarrows Zn\,(Hg)$ was studied at the dropping mercury electrode in presence of an organic

inhibitor using current-time curves. The kinetic parameters were calculated and found to agree with the data obtained by polarography. The use of other inhibitors is under investigation.

4. Mechanistic Investigation of Heterogeneous Catalytic Reactions (R. Swaminathan and J. C. Kuriacose):

   The mechanism of ketonisation of acetic acid on chromia is being investigated. The activity of the catalyst is related to its electronic character and the nature of the acetic acid-catalyst surface interaction studied by comparing various adsorbates with predicatable ways of interaction with the surface.

5. A Study of the Dual Behaviour of a Chromia-Alumina Catalyst (C. Daniel and J. C. Kuriacose):

   The dual behaviour of chromia-alumina in relation to the dehydration and dehydrogenation of isopropanol is being studied with a view to identify the cause of the dual behaviour and relate it to the structure and electrical properties of the catalyst.

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

   The polarographic technique is being used to study the kinetics of dissociation and recombination of some weak acids in solution.

7. Studies of Adsorption in relation to Heterogeneous Catalysis (Late N. Chandrasekharan and V. Srinivasan):

   The isobaric temperature variation technique of Taylor–Liang has been applied to characterise the surface of pure iron catalyst. Instead of the usual desorption-re-adsorption phenomenon, an adsorption-desorption was observed which is utilised in characterising the heterogeneity of the surface. Simultaneous experiments on the kinetics of hydrogen chemisorption have also been utilised to interpret the results.

8. 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. The H_- acidity function has been calculated. Effect of addition of water, DMSO etc. on the H_- values were also carried out. Activity coefficient measurements for the molecular form of the Indicator acids have also been carried out.

9. Free Radical Initiated Polymerisation of Functional Monomers like, Vinyl Pyridine and NN'-Dimethylaminoethylmethacrylate by Azobis Isobutyronitrile and Benzoylperoxide (G. Balagangadharan and V. Mahadevan):

Kinetics of polymerisation of NN'Dimethylaminoethyl Methacrylate, initiated by azodinitrile at 60-70°C and Ceric ammonium nitrate (30–40°C), have been established. Initiation by peroxides was not possible due to interaction between monomer and catalyst by ionic mechahisms.

II. ORGANIC CHEMISTRY

1. Mechanistic Studies of Condensation and Hydride Transfer Reactions on Oxide Catalysts (D. V. Ramana and C. N. Pillai):

Reactions of alcohols and carbonyl compounds on modified alumina catalysts are being studied. Evidence for hydrogen transfer from one molecule to another has been obtained and the mechanism of this reaction is under investigation.

2. Reactions Catalysed by Oxide Catalysts (S. Santhanagopalan and C. N. Pillai):

Reactions of alcohols over alumina catalysts are being studied with particular emphasis on the effect of alkali metal content of the catalyst on the activity and selectivity of the catalyst.

3. Approaches towards the Synthesis of Oxa-Analogues of Oestrone and Equilenin (J. Radhakrishnan and S. R. Ramadas):

Syntheses of B-nor-6-oxa-estrone, 6-oxa-7 methylestrone and the corresponding equilenin analogues are in progress.

III. INORGANIC CHEMISTRY

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

Several transition metal complexes containing ligated morpholine and dimorpholin ethane were prepared and their structures elucidated from spectral, magnetic and X-ray methods. The insertion of CS_2 molecules into ligated morpholine molecules and into morpholinium ions in morpholinium metal acetate systems has been studied.

2. Chloramine-T Oxidations. (V. R. S. Rao and G. Aravamudan):

Spectrophotometric studies were made on Chloramine-T solutions in different media and the data were used to determine the type and

relative concentrations of various species present in the solutions. The oxidation of Fe (II) by Chloramine-T was found to be very complex. Formation of free radicals was envisaged to interpret the results obtained at pH 4.75 and this was confirmed by experimental verifications.

3. Solid State Studies on Uranium, Chromium and Vanadium Compounds (S Sampath and G. Aravamudan):

The nature of products obtained in the thermal decomposition of Uranyl chromate hexahydrate in the range ambient to 1200° was investigated. An interesting compound of composition $UCrO_4$ with uranium apparently in the fifth oxidation state was obtained at the higher temperatures. The kinetics and mechanism of the formation of initial, intermediate and final products were being worked out.

4. Chemistry of Selenium and Tellurium (P. R. Sethuraman and G. Aravamudan):

So far in aqueous solutions, Se and Te were known to occur only in $+4$ or $+6$ oxidation states. In the present study, many complexes have been prepared wherein the two elements are stabilised in the $+2$ oxidation state. The reactivity sequences of these complexes are being examined in the light of Ligand substitutions, oxidation-reduction reactions and solvent extraction systems.

IV. C. S. I. R. SCHEMES

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

Alkylation of phenols by alcohols catalysed by oxide catalysts is being studied from the mechanistic and developmental points of view. Conditions have been established for obtaining selective orthoalkylation.

2. Mechanisms of Photochemical Reactions involving Triplet States (M. Santhanam and V. Ramakrishnan):

The triplet state energy transfer processes occurring between benzophenone triplet and a variety of substances like hydrocarbons, amines etc. are being studied. Valuable data have been obtained from the rates of photochemical reactions sensitised by benzophenone.

LABORATORY FACILITIES

The Department has good undergraduate laboratories in Physical, Inorganic, Organic and Analytical Chemistry. For post-graduate instruction,

there are laboratory facilities in Physical, Inorganic, Organic and Nuclear Chemistry and considerable scope for gaining familiarity with electro-chemical instruments, gas chromato-graph, gas adsorption apparatus and analytical nuclear instruments. For research work, the Department is well-equipped in the following areas: Physical Chemistry—Electro-chemistry, Heterogeneous and Homogeneous Catalysis, Chemical Kinetics and Photo-chemistry; Inorganic Chemistry—Solid-State, Co-ordination and Analytical Chemistry and Organic Chemistry.

The following major items of equipment were procured during the year:

Cahn Balance; Micro-pump; Spinning Band Fractionating Column; High Sensitive Electrometers; High-pressure Continuous Flow Catalytic Reactor, Liquid-proportioning Pump and Gas-circulating Pump.

The last-mentioned items have helped to initiate active research in the field of high-pressure organic reactions.

PUBLICATIONS

I. Papers Published:

1. 'Dual Activity of Chromia – Alumina in the Decomposition of Isopropanol'—C. Daniel and J. C. Kuriacose, Curr. Sci., 36, 606 (1967).

2. 'Influence of Acetic Acid on the Dual Activity of Chromia'—R. Swaminathan and J. C. Kuriacose, Curr. Sci , 36, 516 (1967).

3. 'Enhancement of Dehydrogenation of Isopropylalcohol'—R. Swaminathan and J. C. Kuriacose, Curr. Sci ,

4. 'Molecular Complexes with Tetracyanoethylene as Acceptor'—K. Vasudevan and V. Ramakrishnan, Revs. of Pure & Applied Chemistry, 17, 95 (1967).

5. 'Catalytic Dehydration of Alchols over Alumina. Mechanism of Ether Formation'—J. R. Jain and C. N. Pillai, J. Catalysis, 9, 322 (1967).

6. 'Diagnostic Criteria for the Characterisation of Polarograms'—R. Ramaswamy, S. R. Rajagopalan and J. C. Kuriacose, Transaction of the Society for the Advancement of Electro-Chemical Science and Technology, 2 (4), 1967 (1).

7. 'A Polarographic Study of the Reduction of Benzophenone in Buffered Aqueous Ethanolic Medium'—R. Ramaswamy and J. C. Kuriacose, Proceedings of the 8th Seminar in Electrochemistry, CECRI, Karaikudi, Dec. 1967.

8. 'Evaluation of q from Electro Capillary Data by Numerical Analysis'—S. R. Rajagopalan and C. S. Venkatachalam, Proceedings of the 8th Seminar in Electro-Chemistry, CECRI, Karaikudi, Dec. 1967.

9. 'Kinetic Parameters for Inhibited Reactions at Constant Coverage'—C. S. Venkatachalam, Proceedings of the 8th Seminar in Electro-Chemistry, CECRI, Karaikudi, Dec. 1967.

10. 'Co-ordination Complexes of Morpholine and Dimorpholinoethane'—D. Venkapayya and G. Aravamudan, Curr. Sci., 37 (1) 12 (1968).

11. 'Catalytic Maxima in the Bromination of p-Bromophenol'—J. Rajaram and J. C. Kuriacose, Curr. Sci., 36, 293 (967).

12. 'Acceleration of Thermal Decomposition of Germane by Metal-Germanium Contacts'—J. C. Kuriacose, Ind. J. Chem., 5, 646 (1967).

II. Papers Sent for Publication :

1. 'Kinetics of Hydrogen Chemisorption'—Late N. Chandrasekharan, B. Viswanathan, V. Srinivasan and M. V. C. Sastri, Australian Journal of Chemistry

2. 'A Study of Dual Behaviour of Chromia-Alumina Cetalyst'—C. Daniel and J. C. Kuriacose, J. of Chem. CSIR.

3. 'The Mechanism of Dehydration and Dehydrogenation on Semi-Conductor Oxides'—J. C. Kuriacose, C. Daniel and N. Balakrishnan, J. of Chem. CSIR.

4. 'Influence of Substrate on the Activity of Chromia Catalyst'—R. Swaminathan and J. C. Kuriacose, Journal of Research Institute of Catalysis, Hakkaido Univ., Japan.

5. 'Modification of the Activity of Catalyst by Adsorbate'—J. C. Kuriacose, C. Daniel and R. Swaminathan, J. of Cat.

6. 'Estimation of Dimethylsulphoxide with Chloramine-T'—G. Aravamudan and D. Venkappayya, Talanta.

7. 'The System Megnesium Sulphate, Thiourea-Water at 30°C'—M. Ramakrishna Udupa and G. Aravamudan, Indian Journal of Chemistry.

8. 'The Bromination of p-Bromophenol I. Kinetics and Mechanism in Acetic Acid Solvent'—J. Rajaram and J. C. Kuriacose, Australian Journal of Chemistry.

Project Work for M Sc. Degree

1. 'Influence of Chemisorption on Subsequent Physical Adsorption'—P. Rukmani and V. Srinivasan.
2. 'Solvent Effects on Acid-Base Equilibria'—R. Rukmani and C. Kalidas.
3. 'Mechanism of Bromination of Anisole and p-Nitro Phenol'—G. Kothandaraman and J. C. Kuriacose.
4. 'Phase Equilibrium Study of the System Zinc Chloride - Zinc Isothiocynate - Water at 30°'—Ravivarma Raja P. C. and G. Aravamudan.
5. 'Kinetics of Polymerisation of NN'dimethylaminoethylmethacrylate initiated by Ceric Ions'—V. Ramamurthy and V. Mahadevan
6. 'A Quantum Mechanical Study on the Structure and Stability and some Organic Molecules'—G. V. Venkatesh and V. Ramakrishnan.
7. 'Studies on Knoevenagel Condensation of Bicyclic Ketones'—K. B. Sukumaran and S. R. Ramadas.
8. 'The Reduction of Carbonyl Compounds by Magnesium - Magnesium Iodide System and Related Reactions'—M. P. Krishnan Unni and C. N. Pillai.

CIVIL ENGINEERING DEPARTMENT

STAFF

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S. Selvaraj, M. Sc. (Madras), Associate Lecturer
H. Suresh Rao, M. Tech. (IIT, Madras), Associate Lecturer
R. Sivasankar, M. E. (IISc, Bangalore) Associate Lecturer
Y. M. Reddy, M. Tech. (IIT, Bombay), Associate Lecturer

RESEARCH WORK

1. Investigation of Welded Wire Fabric Reinforcement in R. C. Slabs (P. S. Rao):

   The behaviour in flexure, bond, anchorage and shear has been investigated.

Based on the test results, limits are recommended for the magnitude of the allowable stresses in tension and for the amount of overlap required in splices.

2. Investigations on the Weldability of High Strength Cold Worked Bars used as Concrete Reinforcement (P. S. Rao and N. Rajagopalan):

A large number of tests have been conducted to study the influence of welding on the properties of cold deformed bars. Different rates of welding and different types of electrodes were the chief variables in the investigation. Contrary to the widely prevalent belief, it has been observed that welding, when executed with the usual care, hardly affects the tensile strength of cold worked bars.

3. Effects of Settlements of Supports of R. C. Continuous Beams (P. S. Rao and P. Kalyanasundaram):

Changes in the moment and shear distribution caused by support settlements are being calculated using the correct moment-curvature relationships and also taking into account the long-term creep effects. The magnitude of the discrepancies arising from idealised assumptions are being worked out.

4. Behaviour of Reinforced Concrete Flanged Beams under Combined Bending Shear and Torsion (D. J. Victor):

The Complex interaction of moment, shear and torsion in R. C. beams with particular reference to flanged sections is being investigated. Design rules for loading conditions including torsion are being attempted, based on a study of behaviour of test specimens.

5. Simplified Loadings for Slab bridges (D. J. Victor and C. Ganapathy Chettiar):

An attempt to evolve simplified loadings for small span bridges is made. These loadings will give the same limiting bending moments and shears as those given by the more elaborate loadings prescribed by the Indian Roads Congress.

6. Corner Stresses in R. C. Frames (N. Sukesan Nair and P. C. Varghese):

The behaviour of R. C. corners under various loading conditions in the elastic and plastic stages has been studied. The investigation is complete.

7. Strength and Behaviour of R. C. Vierendel Girders (T. P. Ganesan and P. C. Varghese):

The investigation was continued to study the effect of haunch reinforcement at corners and that of axial forces. The prediction of ultimate strength using Baker's theory is attempted.

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

As a prelude to the study, the moment-curvature relationship of composite sections and the various parameters affecting the relation are being investigated.

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

Bending analysis of conoidal shells supported on ealstic edge beams is under investigation. The ultimate strength of conoidal shell is under study. The behaviour of short and long conoidal shells is also being investigated.

10. Behaviour of Folded Plates (C S. Krishnamoorthy and P.C. Varghese):

As a prelude to detailed experimental investigation on the behaviour of folded plates under loads, theoretical work on the analysis of folded plates is being carried. Computer programmes for the above work are being attempted.

11. Performance of R C. Structures in Adverse Environments (P. Kalyanasundaram and P. C. Varghese):

The purpose of the project is to evolve reliable guide lines and standard methods of accelerated testing for estimation of corrosion of embedded steel under the conditions in our country. The problem has been taken up for research study on a long term basis.

12. Ultimate Load Analysis of Flat Plates with Elastic Loading (N. Rajagopalan and P. C. Varghese):

With the aim to fix the yield pattern of flat plates and slab with elastic loading (such as soil reaction in a raft), theoretical work is being done, to be continued with experimental study at a later stage.

13. Behaviour of Fin Connectors in Cased Composite Beams (V. Paramasivam and P. C. Varghese):

The effect of various parameters on the strength of Fin connectors was determined by tests on push-out and beam specimens. Based on the tests, the design requirements of fin connectors have been formulated.

14. Investigation of Hyperbolic Paraboloid Roofs (P. C. Varghese):

Experimental investigation on hyperbolic paraboloids of different rise/span ratios has been conducted.

15. Thermal Characteristics of Water-proof Roof (V. Kannan and P. C. Varghese):

The temperature observations on plain concrete slabs topped with different water-proof materials are being continued.

16. Elastic Analysis of Deep Cantilever Walls (C. S. Krishnamoorthy, P. Kalyanasundaram and N. Rajagopalan).

Theoretical investigation on the elastic analysis of short cantilever walls of various height-width ratios subjected to different loading conditions is being carried out.

17. Analysis of Curvilinear Flows in a Two-dimensional Transition from a Conduit to Free-Surface Flows (M. H. Abdul Khader and G. Rouve):

Analytical studies based on potential theory have been made for a two-dimensional transition from a conduit to free surface-flow. Experimental studies have also been made and the results obtained in the analysis have been confirmed. The investigation has been completed.

18. Experimental Studies on Flow Around 90° Bend in a Lined Open Channel (B. T. Chenchaiah and V. Sethuraman):

Correction factors for kinetic energy and momentum for the flow in a 90° open channel bend are determined. Area factor and discharge factor are defined and evaluated to study the movement and concentration of flow.

19. Hydraulic Jump in Adverse Channel Slopes (S. Rajagopal and M. H. Abdul Khader):

Experimental investigations of hydraulic jump on adverse slopes have been made and stability, energy loss, length of roller etc. are studied.

20. Flow into Partially Penetrating Gravity Walls (M. Ragunathan and G. Rouve):

Experimental studies have been conducted in a sand model representing an unconfined aquifer and tests are made on partially penetrating wells. Discharge characteristics are studied for various penetration ratios.

21. Stability Analysis of Surge Tank Systems with the aid of Analog Computers (V. Sethuraman and S. Meenakshisundaram):

Investigation of throttled and differential surgetanks 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 surgetank systems.

22. Effect of Jet-Mixing on Sedimentation Removal Efficiency (V. Sethuraman and A.C. Radhakrishnan):

A study on the effect of a slot jet in a uniform flow on the sediment removal efficiency is planned. Analytical study is in progress. To verify theoretical results, experiments are planned. Finally it is proposed to extend the study for circular jets.

23. Studies on Roll Waves (H. R. Rama Rao):

Experimental investigation to verify the expression for the coefficient of amplification of an inertial wave and compare it with linearised theory. Further it is proposed to analyse the wave profile.

24. Studies on Sudden Impulse on Laminar Flow in a Pipe (F.G. Rohde):

Investigation on experimental setup to verify theoretical solutions is under progress.

25. Two-Dimensional Flow in a Channel Bay (F. G. Rohde):

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

26. Turbulent Flow Through Concentric Annuli (H. Suresh Rao and G. Rouve):

Experimental study of flow characteristics in a concentric pipe annulus is contemplated. Friction factors, velocity distribution, pressure drop with or without rotation of inner core will be determined.

27. Studies on the Performance of Hyperbolic Paraboloidical Shell Footings (P. K. Ninan and P. C. Varghese):

The behaviour of individual column footings on sand, made of hyper shell quadrants in the elastic and ultimate stages, has been analysed and the results are being verified by tests on models. The work is in progress.

28. Bearing Capacity of Circular Footings (B. Ramanathan and K. S. Sankaran):

An analytical method for calculating the bearing capacity of circular footings based on some simple model test is being attempted in this investigation.

29. Stability of Well Foundations (K. Muthukrishniah and K. S. Sankaran):

A hypothesis has been developed for the distribution of stress around well-foundation subjected to horizontal forces at the time of incipient failure. The investigation has been completed for two-dimensional cases and is being extended for three-dimensional problems.

30. Split Tensile Test for Soils (B. Ramanathan and V. Raman):

The applicability of split tensile test for soils has been investigated by testing several cylindrical soil specimens to estimate the shear strength parameters of soils. From the results obtained so far, it is observed

that, below the optimum moisture content, soils behave like brittle materials The study is in progress.

31. Clay Mineralogy of Indian Black Cotton Soils (V. Raman):

Black cotton soils from Akola, Nasik and Adilabad are subjected to qualitative and quantitative tests in order to know the dominant minerals present in them. The study is in progress.

32. The Effect of Stress Path on Soil Response in Triaxial Tests (K. Palaniappan, B. Ramanathan and K. S. Sankaran):

This investigation is carried out to study the influence of the total stress path on the results of consolidated undrained compressive tests of Saturated Clays.

The normalized behaviour of stress strain relationship and pore pressure response will enable one to predict stress-strain relationship and the pore pressure developed corresponding to any stress level in compression test with good accuracy.

33. Pore Pressure Response in Consolidated Tests (V. I. Pandurangan, M. S. Subramaniam and K. S. Sankaran):

This investigation aims at a study of the influence of load increment ratio and secondary compression and saturated cohesive soils in one dimensional consolidation tests.

It is found that the load increment ratio as well as the allowed secondary compression affect the pore pressure response.

34. A Study on Gap-graded Mixes for Asphalt Concrete (K. S. Sankaran and D. Raja Rao):

The project has been undertaken to deliberately introduce gaps in aggregate gradation, so as to utilize locally available aggregate to prepare dense mixes. The stability and durability of these mixes will be studied to find out the place of gap-graded dense mixes.

35. Stripping Resistance of Aggregates in Dense Graded Asphaltic Concrete Mixes (K. S. Sankaran and D. Raja Rao):

This project has been undertaken to determine the water susceptibility of different types of coarse aggregate and different type and amount of filler in dense graded asphaltic concrete mixes. Suitability of fly-ash as a filler in dense graded asphaltic concrete mixes will also be studied.

C. S. I. R. Scheme:

36. Study on Under-Water Concrete (P. C. Varghese and V. Kannan):

This project aims at studying the effect of various factors on the strength and density of concrete cast under water through a tremic.

For a specific cement content, the optimum flow required for the maximum strength and maximum density of concrete consistent with compaction without vibration or rolling under water is determined. The suitable relation between these factors will be worked out. The study is in progress.

LABORATORY FACILITIES

The Department has laboratory facilities for instruction and research in the following areas:

Structures; Hydraulics; Soil Mechanics; Concrete Materials; Geology; Highways; Public Health Engineering and Surveying.

Substantial progress has been made in the construction of the new laboratories for Structural Engineering. The extension to the Hydraulics Laboratory is nearing completion and steps have been taken for the installation of a Towing Tank.

The following are among the major items of equipment commissioned during the year:

AMIL: Bishop's pore-pressure apparatus; load frame; triaxial cell; volume change self-compensating mercury control; proving rings of 100-ton and 25-ton capacity; load measuring cell.

LIAISON WITH INDUSTRY

Active contact with industry was maintained throughout the year.

The following problems of interest to the construction industry were studied and tests were performed:

i. effect of cold-twisting reinforcing bars and effect of welding on cold-twisted bars;

ii. development of low-cost floor systems using bricks and R. C. joists;

iii. use of welded wire fabric reinforcement in R. C. slabs.

The following investigations were undertaken in the Soil Mechanics Section:

i. soil investigations, at the Manali Oil Refinery site;

ii. pile load test for the construction of multi-storey buildings, at Nandanam for M. E. S., Madras;

iii. investigations for the improvement of the existing foundation, at EID Parry & Co., Nellikuppam;

iv. preparation of a soil-survey map of Madras, in collaboration with the Highways Research Station at Madras.

PUBLICATIONS

I. Papers Published

1. 'Investigation of Prestressed Encased Steel Beams'—A. Rajaraman and P. C. Varghese, Cement and Concrete, October-December 1967.
2. 'Hyperbolic Paraboloid Footings'—P. C. Varghese and Kaimal, The Indian Concrete Journal, July 1967.
3. 'Geometry of Geodedic Domes'—C. Ganapathy Chettiar and V. Paramasivam, Journal of the Institution of Civil Engineers (India), November 1967 (Special).
4. 'Reinforced Concrete T-beams without Stirrups under Combined Moment and Torsion'—D. J. Victor and P. M. Ferguson, Journal of the American Concrete Institute - Proc. Vol. 65, No. 1, January 1968.
5. 'Beams under Distributed Load Creating Moment Shear and Torsion'—D. J. Victor and P. M. Ferguson, Journal of the American Concrete Institute, Proc. Vol. 65, No. 4, April 1968.
6. 'Effective Stress in Partially Saturated Soils'—B. Ramanathan, Indian Engineer, September 1967.
7. 'Stabilisation of Cohesive Soils with Phenolformal-dehyde Resin'—V. Raman, Journal of Indian National Society of S. M. F. E. October 1967.
8. 'Stability against Heave at the Bottom of Cuts in Cohesive Soils'—P. K. Ninan, Indian Engineer, November 1967.
9. 'Discussion on Bearing Capacity of Footing on Layered Clays'—B. Ramanathan, Journal of A.S.C.E. Soils Division, November 1967.
10. 'Shear Strength of Cohesive Soils by Laboratory Vane'—K. Muthukrishniah, Indian Engineer, February 1968.
11. 'Experimental Studies on Rotation of Deep Rigid Foundation Models subjected to Vertical and Horizontal Loads'—K. Muthukrishniah and P. K. Ninan, Journal of the Indian National Society of S. M. F. E., April 1968.
12. 'Swelling Characteristics of Black Cotton Soils of India'—V. Raman, Viswakarma, April 1968.
13. 'Clay Mineralogy of Creamy Shales from Sriperumbudur, Madras'—V. D. Muthayya, Journal of Engineering Geology, October 1967

14. 'Hydraulic Jump in Sloping Channels'—by G. Rouve, V. Sethuraman and N. Jothi Shankar, C. B. I. & P. Journal, Vol. 24, No. 3, July 1967, 285–293,

II. Papers Accepted for Publication

1. 'Analysis of Balcony Slabs'—C. S. Krishnamoorthy, The Indian Concrete Journal.

2. 'Effect of the Quality of Line Aggregate in Sheet Asphalt'—K. S. Sankaran and D. Rajarao, Journal of the Indian Roads Congress.

III. Papers presented in Conferences/Seminars

1. 'Potential Flows Analysis of Free Surface Flow' (a review article)—G. Rouve and M. H. Abdul Khader, Symposium on 'Hydraulics and its Applications' held at Jaipur, Dec. 1967.

2. 'Sediment movement in Branch Channels'—G. Rouve, and H. Suresh Rao, Symposium on 'Hydraulics and its Applications' held at Jaipur. Dec. 1967.

3. 'Spatial Hydraulic Jump'—G. Rouve, W. Rohrbach and S. Meenakshisundaram, Symposium on 'Hydraulics and its Applications' held at Jaipur, Dec. 1967.

ELECTRICAL ENGINEERING DEPARTMENT

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RESEARCH WORK

FUNDAMENTALS & MEASUREMENTS SECTION

I. Network and System Theory:

1. Analysis and Synthesis of N-port Networks (V. G. K. Murti, K. Thulasiraman and C. Easwaran):

   New methods of synthesis of resistive n-port networks and their extension to the synthesis of RLC n-port networks have been formulated. Criteria for proper interconnections of n-port networks have been established. Further work is in progress.

2. Studies on Equivalence in Networks (K. Thulasiraman and V. G. K. Murti):

   The problem of generation of equivalent multi-port networks for a given network is being studied, using the modified circuit and cut-set matrices as basic tools.

3. Enumeration and Allied Problems in Linear Graph Theory (V V. B. Rao, K. Sankara Rao, P. Sankaran and V. G. K. Murti):

   Efficient methods of determining all cut-sets and circuits of a given graph have been evolved. Explicit formulae for the number of cut-sets in special classes of graphs have been obtained.

4. Realisation of Circuit and Cutset Matrices (V. V. B. Rao, K. P. Rajappan and V. G. K. Murti):

   New methods of realisation of circuit and cut-set matrices are obtained. Use of these techniques in allied problems is under investigation.

5. Flow Problems in Communication Networks (V. V. B. Rao, K. Sankara Rao, P. Sankaran and V. G. K. Murti):

   Streamlined methods for evaluating maximum flow between two stations in a given network and determination of terminal capacity matrix are under investigation. A method suitable for use on computer is obtained.

6. State Space Techniques in Network Theory (K. Sankara Rao):

   Application of state variable formulation of network equations to the synthesis of networks is under investigation.

7. Active R. C. Network Synthesis (K Venkataramani, S. Natarajan and V. G. K. Murti):

Realisation of specified voltage transfer functions by grounded RC networks with one amplifier embedded in it is investigated. Some new realisation techniques are obtained.

II. Electrical and Electronic Measurements

1. Phase Angle Measurements (Anthony Reddy and S. Natarajan):

The problem of accurate phase-angle measurements using digital counters is investigated.

Phase angle measurement, using imperfectly squared sine waves and exclusive-OR gates, has been investigated. For a certain sub-class of gates it has been shown that the indication is still sufficiently accurate for simple purposes.

2. Development of Proton Magnetometer (K. P. Rajappan and P. C. Majhee):

A magnetometer based on proton-resonance has been designed for the measurement of the earth's magnetic field. The measuring range is upto 16 and the resolution is 18. The instrument is fully transistorised and designed for field use.

3. Transient Performance of Instrument Transformers (P. Sankaran and V. G. K. Murti):

The performance of Instrument Transformers under transient conditions is investigated. Compensation schemes so as to obtain a faithful reproduction of the primary transient on the secondary side are being worked out.

4. Development of Testing Apparatus for Energy Meters (H. W. Meyer and Vaithialingam):

Digital methods of determination of errors of energy meters are under study. The system is to indicate the percentage error directly after a short run of the energymeter.

5. Design and Measurement of Earthing Schemes (H. W. Meyer, K. Thulasiraman and K. B. Brahmadattan):

A study of methods of determination of the earthing resistance of a system of electrodes is undertaken. The study aims at developing more efficient earthing methods using network and field-theory concepts.

6. Design and Testing of Current Transformers (H. W. Meyer and S. Gnanapragasam):

Various design procedures of current transformers have been studied and compared to arrive at certain design criteria.

7. Design and Construction of Probability Density Analyser (K. P. Rajappan and S. Ramakrishnan):

The application of statistical methods to the study of communication systems has resulted in the improvement of the existing systems and the development of new ones. Some times a whole class of probability density functions is required to completely characterise a given random signal passing through the communication system. The project is concerned with the design and development of a probability density analyser for the above purposes.

8. Study of Digital Techniques in Measurement (G. Bruckmann, P. C. Majhee and G. G. Rao):

Construction of sophisticated digital equipment like digital voltmeters, counters etc. using indigeneous components is undertaken.

9. Measurement of Angular Acceleration (H. W. Meyer and B. V. Seshadri):

The measurement of angular acceleration using digital counting and differentiation is under experimentation. Photoelectric methods of measuring speed are adopted.

ELECTRONICS & TELE-COMMUNICATIONS SECTION

III. Electronic and Semi-Conductor Devices:

1. Studies on Thermal Effects on Transistors (M. K. Achuthan and T. J. Vitto):

Studies on the thermal stability of transmission circuit and its dependence on the electrical and thermal constants of transistor, as well as, on the ambient temperature are being carried out.

2. Wide-Band Amplification with Transistor Circuitry (G. N. Garud):

Investigation as regards linearisation of phase characteristic and matching of the input line of a transistorised distributed amplifier has been done. Frequency-dependent attenuation along the input line due to input conductance of the transistor warrants completely different procedures for optimization of the number of devices to be used compared to the techniques employed in case of vaccum tubes.

3. Transistor Operational-Amplifier Stability under Noise (B. S. Bhanumurthy):

Studies on the stability of transistor operational amplifiers with regard to drift and noise are being carried out.

IV. Electrical Communication Engineering

1. Design of Adaptive Filters (K. P. Rajappan and P. C. Majhee):

Investigations are currently in progress on filters, which will change their characteristics depending on the nature of the input signal, such that efficient detection of the signal in the presence of noise can be achieved.

2. Digital and Analog Communication Systems (P. W. Besslich):

Error probabilities of binary communication through fading and noisy channels have been calculated and measured. The performance of the compatible single-side band system has been investigated.

3. Transistorised Switching Circuits (G. N. Garud):

Investigation on transient response of transistorised flip-flop circuits have to take into account the switching time of the device as well as the modification due to positive feedback which exists during change over.

4. Design of Microwave Filters (D. K. Banerjee):

A four-cavity bandpass filter having inductive irises and coupled by quarter wavelength sections was designed to give a 3dB bandwidth of 90 Mcs having a centre frequency of 8 Gcs. The Butterworth response of the filter was calculated and measured. The insertion loss was analysed in terms of input reflection co-efficient and input standing wave ratio. The group delay-time characteristic was also calculated.

V. Electronic Computation Techniques

1. Design of Digitial Computers (P. W. Besslich):

Most economical methods for small computers have been investigated.

ELECTRICAL MACHINERY & CONTROLS SECTION

VI. Electrical Machines

1. Transient Studies on Autodyne Amplifier (S. S. Yegnanarayanan):

The frequency response and transient response of the Autodyne are under study for investigating the influence, on the dynamic perfor-

mance of the machine, of different methods of connection of internal feedback windings.

2. Leakage Reactance of Skewed-rotor Induction Motor; Axial Forces in Induction Motors (H W. Meyer and Vedam Subramaniam):

The influence of skewing on field distribution in induction motors has been investigated. The axial force due to the differences in flux density in axial direction is under investigation. A test-stand for the experimental study of the forces during the starting period of the machine is under construction.

3. Stray Load Loss Measurements (H. W. Meyer and Raja Reddy):

Different methods of determination of stray-load-losses are being compared. Data are being obtained for various machines.

4. Speed-changing Single-Phase Induction Motors-Pole-Amplitude Modulation Method (V. V. Sastri):

Economic and efficient two-speed and three-speed single-winding single-phase induction motors of any pole ratio using normal coils with independent starting and good running performances is shown possible using the pole-amplitude modulation method. Generalised methods have been developed to analyse the air-gap m. m. f. and performance characteristics of any irregular single-phase induction motor. Transient studies on such machines are being taken up.

VII. Automatic Control Systems

1. Bifrequency Phase-Equivalent Reduction and Applications (V. Seshadri, C. Easwaran and S. Eappen):

The technique of reducing high order linear systems to lower order for phase equivalence at two frequencies has been developed and its analysis and synthesis applications explored.

2. Generalised Analysis and Synthesis of Third-Order Systems (V. Seshadri, K. Ramar and S. Eappen):

Generalised chart and equations for transfer from open-loop to closed-loop real-frequency-domain parameters for third order type-1 systems have been developed and their synthesis applications explored. Such third-order-based conversion of parameters has been shown valid for higher order systems also within practical needs of approximation.

3. Empirical Correlations between Time-Domain and Frequency-Domain Specifications (V. Seshadri, C. Easwaran and S. Eappen):

Empirical equations have been eastablished for correlation of step-transient parameters and optimization indices of linear systems with real-frequency-domain parameters relating to the open-loop and closed loop frequency responses. Synthesis applications of the relationships have been found quite reliable.

4. Multirate, Multi-Sequential and Variable-Rate-Sampled-Data Systems (V. Seshadri and R, Saravanam):

The advantages relating to improvements in relative stability and optimization that can be brought about by introducing multirate, multi-sequential and variable-rate sampling in linear sampled-data systems have been investigated and compared.

5. Signal-Stabilization of Non-Linear Sampled-Data Systems (P. Venkata Rao and G. T. Manohar):

The feasibility of quenching of limit cycles in second and third-order sampled-data systems with saturation non-linearity by signal injection is established. The effect of the waveform and the amplitude of the stabilizing signal on the mode of quenching has been assessed.

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

Some investigations into the design of optimal linear regulators with incomplete state feedback have been carried out. A new method of transforming the state variable equations of a single-input single-output linear time-invariant system to the phase variable canonical form is found and the method is shown to be superior to all the existing methods.

7. Non-Interaction in Multi-Variable Systems (B. Ramaswami and N. Sundararajan):

Studies of the existing methods of designing non-interacting control systems have been carried out. The limitations of some of the best known methods are investigated and work on improving the existing methods is in progress.

8. Variable-Capacitance Torque Transducer (P. Venkata Rao, Y. Gopala Rao and G. Sridhar Rao):

The torque transmitted by the shaft is measured by means of the change in the capacitance between plates suitably placed and rotating with the shaft. The plates are connected through slip rings to a high-

frequency bridge whereby the capacitance is measured. This can be used for both steady state and transient dynamometry.

9. Vacuum-Tube and Transistor Switching Circuits for Transient Studies on Electrical Machines. (P. Venkata Rao, Y. Gopala Rao and G. Sridhar Rao):

This set-up consists of a relay which is switched on at any desired instant by thyratron whose firing angle is controlled by a phase shifter. A similar set up using transistors has also been built. They are useful for transient studies on electrical machines.

10. Optimization Studies with reference to Single-Time-Constant Ideals (V. Seshadri and T. Rajagopalan):

Studies have been made on the mean-square-error optimization of feedback control systems for stochastic inputs, with single-time constant ideals with and without transportation lag. It has been conclusively assessed that such optimization procedures lead to optimal systems that are better damped than what would be obtained under unity-ideal optimization.

11. Application of Phase-Equivalent Reduction to System Identification (V. Seshadri and D. V. R. L. Rao):

Equations for three-and-multiple-parameter identification of linear systems by sinusoidal signal injection have been developed under simplification using phase-equivalent reduction. The application of these equations for model-adaptive control with phase-equivalent models is under investigation.

12. Signal Stabilisation of Non-Sampled-Data Control Systems with Delay (P. Venkata Rao and M. V. Chalapathy Rao):

Analytical studies have been made concerning the effect of amplitude variations in square wave dither signals on the stabilisation of nonlinear sampled data systems having different types of nonlinearity for different amounts of delay. Changes in delay are found to affect the shape but not the period of limit cycle. Changing the type of nonlinearity is found to significantly change the nature of dependence of autonomous response on dither amplitude.

12. Generalized Studies on Cascade-Control Systems (V. Seshadri and K. Anbumani):

Possible approaches to evolving generalised synthesis procedures for cascade-control systems were investigated and synthesis equations have been developed for specifications in the complex-frequency domain.

POWER AND HIGH VOLTAGE ENGINEERING SECTION

VIII. Power Systems Analysis and Protection

1. Effect of Excitation Regulator Structure on Steady State Stability of Power Systems (A. Kuppurajulu and K. B. Subramaniam):

   Study of excitation regulator structure on the steady state stability and transmission capabilities of a power system has been made.

2. Development of Static Relays (K. S. Mehta, A. Chandrasekharan and M. Venugopal):

   Investigations leading to the development of various protective relays and time delay circuits using static components are in progress.

3. Development of Dynamic Test Bench for Protective Relays (M. Venugopal, M. Chinna Rao and J. Balakrishnan):

   A test bench with suitable input voltage and current device for testing protective relays both under steady and transient conditions using solid state devices is developed.

IX. High Voltage Engineering

1. Design and Construction of Recurrent Surge Generator (C. Narayana Reddi and R. Venkatadri):

   The Recurrent Surge Generator can give recurrent surge voltages upto 280 V. Surges of wave front and wave tail of respectively 0.5 to 5 MSec. and 4 to 200 MSec. are obtainable. Chopping instant can be varied from 1 to 30 MSec.

LABORATORY FACILITIES

The Department has good laboratory facilities for instruction and research in the following areas:

Fundamentals of Electrical Engineering and Electrical Measurements; Electrical Machines; Electrical Power and High Voltage Engineering; Electronics and Communication Engineering.

During the year under review, the equipping of the following laboratories for post-graduate work and research received special attention:

Control Engineering; Analog and Special-purpose Computation; Electronic Measurements and Digital Techniques; Transistor Circuits; Microwave Techniques; High Voltage and Relay Laboratories.

There are excellent facilities for calibration of electrical instruments and for precision measurements.

A special feature of the layout of the Department is a highly flexible power-distribution system that provides, for a wide-range of voltages and frequencies, interconnectors between the various laboratories and facility for remote control of any supply-machine from the experimental desk in any laboratory.

A D.C. Network Analyser was commissioned during the year. Several pieces of useful equipment, including an X-Y Recorder, were acquired for the Control Engineering Laboratory. The Measurements Section received a special-purpose electronic calculator equipped with some degree of memory.

LIAISON WITH INDUSTRY

The Department was very active in this area throughout the year. The following types of work were carried out :

i. testing and calibration of Ammeters, Voltmeters, Wattmeters, Energy-meters, Current-transformers and Tachometers;

ii. testing of Protective relays, HPMV lamp chokes, power and welding transformers, cables and thermostats ;

iii. magnetic measurements on Steel Specimens and

iv. testing and repairs on Electro-Miagraph equipment, amplifiers for photo-copying lathes etc.

The industrial and allied organizations which utilized the above forms of service included the Indian Standards Institution, the P & T Department, the General Hospital at Madras, the Madras Electricity Department, the Heavy Vehicles Factory at Avadi, Carborundum Universal, English Electric Company, W. S. Insulators, Best & Company, Omega Insulated Cable Company, Gem & Company, Seshasayee Industries, Easwaran & Sons Engineering, Kamala Industries, Simco Meters Ltd. at Tiruchy, Standard Electrical Applications at Tuticorin, Ennes Electrical Industries at Gudiyatham and the A. R. Electrical Engineering Corporation.

PUBLICATIONS

I. Papers Published

1. 'Parallel Connection of n-port Networks'—V.G.K. Murti and K. Thulasiraman, Proceedings of IEEE July 1967, Vol. 55, No. 7 pp. 1216-1217.

2. 'On the Number of Cutsets in a Class of Graphs'—V. V. B. Rao, P. Sankaran, K. Sankara Rao and V.G.K. Murti, International Journal of Electronics, September 67, Vol. 23, No. 3, pp. 233-243.

3. 'Comments on the Equivalence of Resistive n-Port Networks'--K. Thulasiraman and V.G.K. Murti, IEEE Transactions on Circuit Theory, September 67, Vol. CT-14, No. 3, pp. 357-359.

4. 'On the Equivalence of Resistance n-Port Networks'--K. Thulasiraman and V.G.K. Murti, IEEE Transactions on Circuit Theory, September 67, Vol. CT-14, No. 3, pp. 357-359.

5. 'Transfer Function Synthesis using Operational Amplifier'--K. Venkataraman and V.G.K. Murti, International Journal of Electronics, Oct. 1967, Vol. 23, No. 4, pp. 355-366.

6. 'Realization of Cutset Matrices into Graphs'--K.P. Rajappan, Electronics Letters, IEE, London, Oct. 67, Vol.3 No. 10.

7. 'Incompletely Partitioned Networks'--P. Sankaran, V. V. B. Rao, K. Sankara Rao and V.G.K. Murti, International Journal of Electronics, December 1967, Vol. 23, No. 6.

8. 'Unimodular Matrices of a Graph'--V.V.B. Rao, K. Sankara Rao, P. Sankaran, and V.G.K. Murti, Proceedings of the IEEE, Feb. 68, Vol. 56, No. 2, pp. 211-212.

9. 'Analog Computer Simulation of All-pass Functions'--V.G.K. Murti and K. Venkataramani, Proceedings of the IEEE, Feb. 68, Vol. 56, No. 2, pp. 206-207.

10. 'Maximum Flow in a Communication Network'--K. Sankara Rao, P. Sankaran, and V.G.K. Murti, Proceedings of the IEEE, January 1968, Vol. 56, No. 1, pp. 134-135.

11. 'Synthesis of a Class of n-Port Networks'--V. G. K. Murti and K. Thulasiraman, IEEE Transactions in Curcuit Theory, Vol. CT-15 No. 1, March 1968, pp. 54-63.

12 'Planar Graphs and Circuits'--V.V.B. Rao, K. Sankara Rao, P. Sankaran and V.G K. Murti, Matrix and Tensor Quarterly, London, March 68, Vol. 18, No. 3, pp. 88-91

13. 'Developments in Speed-Changing Single-Phase Induction Motors'--V.V. Sastry (and coauthor)--IEEE Transactions on Power Apparatus and Systems, April 68, pp. 1111-1125.

14. 'Speed-Changing Single-Phase Induction Motors with Single-layer Windings'--V.V. Sastry (and coauthor), IEEE Transactions on Power Apparatus and Systems, April 1968, pp. 1125-1129.

15. 'Determination of Parameters of a 2-phase Drag-Cup Accelerometer'—B. Ramaswami and P. Sasidhara Rao, Electronics Letters, Dec. 67, Vol. 3, No. 12.

16. 'The Transformer-Analog Polynomial Equation Solver (TAPES)'—P. Venkata Rao and B.Ramaswami, International Journal of Electronics, 1967, Vol. 23, No. 4, pp. 301-305.

17. 'The Transformer-Analog Bode Simulator (TABS)'—P. Venkata Rao and B. Ramaswami, International Journal of Control 1968, Vol. 7, No. 2, pp. 149-169.

18. 'Generalized Charts for Third Order Type-1 Systems'—V. Seshadri, Journal of the Institution of Engineers (India), Pt. Et. Vol. XLVIII No. 1, pp. 81-97.

19. 'Step-transient Input Describing Function for Saturation Type Nonlinearity'—V. Seshadri and P. Raghavan, Journal of the Institution of Engineers (India), January 68, Pt. Et. Vol. XLVIII, No. 5, pp. 159-168.

20. 'Frequency Domain Criteria for Optimization of Linear Feedback Control Systems'—V. Seshadri and P. Raghavan, Journal of the Institution of Telecommunication Engineers, 1968, Vol. 14, No. 4, pp. 151-156,

21. 'Linearization of Input Line Phase Characteristics of a Transistorized Distributed Amplifier'—G.N. Garud, Journal of the Institution of Telecommunication Engineers, Dec. 67.

22. 'Multichannel Pulse-counter Logic with Remote Control'—V.V. Khanna and G N Garud, Electronic Engineering, May 68.

23. 'Three-zone Distance Relay'—M. Venugopal, K. Jayaraman and N.M. Anil Kumar, Electrical Times, March 67, Vol. 151, No. 11, pp. 427-430.

II. Papers accepted for publication

1. 'Comment on the Construction of a Pair of M-Sub-Matrices of a Cut-Set Matrix'—V. V. B. Rao and V. G. K. Murti, IEEE Transactions on Circuit Theory.

2. 'Enumeration of all Cut-Sets of a Graph'—V. V. B. Rao, K. Sankara Rao, P. Sankaran and V. G. K. Murti, Proceedings of the IEEE, New York.

3. 'On the Network Theorems'—P. Sankaran, K. Sankara Rao, V. V. Bapeswara Rao and V. G. K. Murti, IEEE Transactions on Education.
4. 'The Modified Cut-Set Matrices of an n-Port Network'—K. Thulasiraman and V. G. K. Murti, Proceedings of the IEE, London.
5. 'Synthesis Application of the Modified Cutset Matrix'—K. Thulasiraman and V. G. K. Murti, Proceedings of the IEE, London.
6. 'The Modified Circuit Matrix of an n-Port Network and its Applications'—K. Thulasiraman and V. G. K. Murti, IEEE Transactions on Circuit Theory.
7. 'Psuedo-series Connection of n-Port Networks'—K. Thulasiraman and V. G. K. Murti, Proceedings of the IEEE, New York
8. 'Synthesis of a Class of Resistive 3-Port Networks'—C. Eswaran and K. Thulasiraman, International Journal of Electronics, London.
9. 'On the Phase-measuring Property of the Exclusively-OR Gate'—M. Anthony Reddy, International Journal of Electronics, London.
10. 'Two Speed Single-Winding Single-Phase Induction Motor using Non-Integral Cycle Modulation Techniques'--V. V. Sastry (and coauthor), IEEE Transactions on Power Apparatus and Systems.
11. 'A Note on Optimal Linear Regulators with Incomplete State-feedback'--K. Ramar and B. Ramaswami, IEEE Transactions on Automatic Control.
12. 'Transformation to the Phase-Variable Canonical Form'--B. Ramaswamy and K. Ramar, IEEE Transactions on Automatic Control.
13. 'On the Maxima of Transient Response and Frequency Response of Third Order Sampled-data Control Systems'--M. V. C. Rao, International Journal of Control, London.
14. 'Further Correlations between Time-domain and Frequency-domain Parameters'--V. Seshadri and C. Eswaran, Journal of Institution of Telecommunication Engineers, New Delhi.
15. 'Response Optimization of Feedback Control Systems with reference to Single-time Constant Ideal'--T. Rajagopalan and V. Seshadri, International Journal of Control, London.
16. '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.

17. 'Bifrequency Phase Equivalent Reduction and Applications'--G. Eswaran and V. Seshadri, Journal of the Institution of Engineers (India).

18. 'Application of Phase-Equivalent Reduction for Two-Parameter Identification by a Sinusoidal Test signals'--D. V. R. Rao and V. Seshadri, Journal of the Institution of Engineers (India).

19. 'Application of Bifrequency Phase-Equivalent Reduction to Systems Synthesis'--C. Eswaran and V. Seshadri, International Journal of Control, London.

20. 'New Static Comparators'--K. S. Metha, A. Chandrasekaran and M. Venugopal, International Journal of Electronics, London.

III. Papers Presented in Conferences/Seminars

1. 'Simulation of Chemical Plant'--by P. Venkata Rao, Seminar on 'Developments in Chemical Engineering, I. I. T. Madras, Feb. 1968.

2. 'Current Trends in Analog Computers'--by S. Sampath, Seminar on 'Developments in Chemical Engineering', I. I. T. Madras, Feb. 1968.

3. 'Applications of the Phase-Equivalent Reduction Technique'--V. Seshadri, Symposium on 'Control Theory', Department of Electrical Engineering, Indian Institute of Science, Bangalore, May 1968.

4. 'Signal Stabilization of Non-Linear Sampled-Data Control Systems'--P. Venkata Rao and G. T. Manohar (Co-author R. Manicka vasagam), Symposium on 'Control Theory', Department of Electrical Engineering, Indian Institute of Science, Bangalore, May 1968.

5. 'Some Thoughts on the Growth of Electronics in India'--S. Sampath, Symposium on 'Technology and Development in India since Independence' conducted by the A. C. College of Technology, University of Madras, March 1968.

IV. Papers sent for Publication

1. 'A Note on the Synthesis of Resistive n-Port Networks'--K. Thulasiraman and V. G. K. Murti, IEEE Transaction on Circuit Theory.

2. 'On Okada's Method for Realisation of Cut-Set Matrices'--K. P. Rajappan, Journal of Combinatorial Sciences, U. S. A.

3. 'Graphs from Matrices'--K. P. Rajappan, Journal of Mathematical Society of America.

4. '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.

5. 'State-Dependent Current Source Multiples Monostable Pulse-Width'--K. S. Mehta and M. Venugopal, Proceedings of the IEEE, New York.

6 'Variable-Width Low-Repetition-Rate Pulse using Schmitt Trigger'--K. S. Mehta, 'Idea for Design' in Electronic Design, New York.

7. 'Low Repetition-Rate Timers'-- K S. Mehta and M Venugopal, International Journal of Electronics, London.

8. 'Pulse-Circuit for Phase-Sequence Detection and Protection against Single Phasing'—K. S. Mehta and M. Venugopal, Electronic Engineering, London.

HUMANITIES AND SOCIAL SCIENCES DEPARTMENT

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RESEARCH WORK

I. ENGLISH

1. Post-Doctoral Research work in English Literature (A. V. Krishna Rao) :

   (i) THE INDO-ANGLIAN FICTION:- Systematic and continued special study of the Indian Writing in English has yielded enough material to bring out a major pioneering book in Indo-Anglian literary criticism, entitled "Studies in Indo-Anglian Novel". This is being published by M/s Rao & Raghavan, Publishers, Mysore.

   (ii) Thematic Studies in Contemporary American Fiction :-In response to a letter from USEFI, Fulbright House, New Delhi, the following two problems have just been taken up for a critical study :

   1. The Problem of War and Peace in Contemporary American Fiction (1945-1965)

   2. The Novels of J.D. Salinger and Saul Bellow

II MANAGEMENT AND PSYCHOLOGY

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

   A.H. Moslow, in his book "Personality and Motivation" has propounded a theory of motivation based on the heirarchy 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.

We 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.

The aims of the proposed study are: (a) to what extent does the original theory hold true in Indian conditions of work in industry ? (b) at what point do the needs in the heirarchy overlap amongst each other ? (c) are the needs in the heirarchy independent of each other or does the satisfaction or deprivation of one need may influence and modify accordingly behaviour of an individual in relation to other remaining needs in the heirarchy ?

It is proposed to construct a questionnaire in three different parts in relation to the three-fold aims of the study. The references and bibliography are being collected in relation to what was happening before the theory in question was put forward by Maslow and what kind of work has been done based upon this theory and other related aspects of motivation.

2. A Mathemetical Formula to predict Leadership (T.N. Govindarajan) :

A mathematical formula has been developed to predict leadership in small task-oriented groups. Though the workability of the formula has already been carried out, currently the validation of the mathematical formula is under investigation. Small groups are chosen from the 1st year I.I.T. student population for the present investigation. In addition to the existing criteria of leadership in small group research, an attempt is made to prove the utility of the mathematical formula in predicting leadership.

3. Workers Participation in Management in India (S. K. Jain) :

The Second Plan had recommended increased association of labour with management. It had observed that such a measure would help in (a) promoting increased productivity (b) giving employees a better understanding of their role in the working of the industry, and (c) satisfying workers' urge for self-expression. The research-work aims at surveying the working of the Joint Management Councils set up in selected Undertakings in the country in order to assess the impact

of increased labour-management association on its objectives spelled out in the Second Plan.

III. INDUSTRIAL ENGINEERING

1. Inventory Control in Multi-Stage Production (N. K. Datta):

   This is essentially an investigation for determining the behaviour-pattern of multi-stage lots in different setups and for evolving suitable models for different situations.

2. Technical and Economic Aspects of Process-Setting in Machine Tools (N.K. Datta):

   This is a study in the technical aspects of tool-setting and is expected to lead to suitable statistical techniques for economic tool-setting in machine-tools.

IV ECONOMICS

1. Migration Selectivity and Differentials of Metropolitan Cities in India (V. Hemsaleelavathi):

   Studies on Urbanisation in India reveal the tendency of slowing down of the process of urbanisation during 1951-61, compared to 1941-51 decade. During the decade 1951-61 the small towns of India grew very slowly while the metropolitan cities maintained the high growth rate. As migration is stimulated by the capacity of a particular area to support a differential population with one or more selective characteristics, a clear understanding of such selectivity and changes in selectivity with respect to space and time is very essential in order to project the future migration in India. The work is a detailed analysis of migration selectivity and differential, namely of Age, Sex, Marital Status, Education, Occupation and Industry of four metropolitan cities, Madras, Greater Hyderabad, Greater Bombay and Ahmedabad. In all these analyses, age, duration of residence and place of birth will be used as control variables. The data used in the study are mainly from 1961 census of India.

V. ECONOMIC HISTORY

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

   In the course of nearly seventy years (1784-1857), East India Company was gradually relieved of its long held trading privileges in the East; simultaneously it grew to be the paramount power in India,

responsible for the Government of a very large population spread over an immense area. Thus the Merchants of London trading to the East Indies came to be great territorial Lords - and came to establish revenue and judicial systems and to turn their ledger keepers and investment makers into tax collectors and judges. From that time the welfare of millions of Hindus and Mohamedans became dependent upon the wisdom and integrity of a small handful of European strangers.

This period is important not only in the history of India but also in the history of mankind because of the far-reaching changes taking place throughout the world especially in England and Europe. The beginning of this period gave birth to Industrialism and new ideas about capitalism, private property, and a number of new political concepts. How far these and other great developments taking place in other parts of the world affected the Government of India, how it influenced the policy of the East India Company which was entrusted with governance of millions especially in the field of economy is the scope and object of present research.

After completing the chapterisation, data are being collected from the Archives of the Madras Record Office for further use.

VI. OPERATIONS RESEARCH

1. Investigations regarding Application of Queueing and Renewal Theories for Solving Storage Problems (S. Ramani):

In the world of business, problems regarding inventory-control are seldom deterministic. Both the demand and the lead time are often random variables. Under these circumstances management is faced with the problem of setting optimum re-order quantities, under the (S, s) policy of inventory control.

The study so far has been confined to application of the concepts underlying renewal theory to the (S, s) policy of inventory control, treating the fluctuating inventory levels as a stochastic process. The applicability of the "master renewal concept" is being currently explored. It is proposed to simulate the (S, s) policy to confirm some of the findings in this study. A Fortran programme has already been designed for the proposed simulation. The programme is awaiting test on a Computer.

INDUSTRY-ORIENTED-PROJECTS

1. Development of a Cost Control System for an Automobile Ancilliary Unit (K. Ramanathan and R. K. Gupta):

   A study of the factory costs in a company manufacturing bearings and bushes was made. Standard costs of material and direct labour were determined; equations to determine overheads at different levels of activity in different sections of the plant were also developed. Based on these a budgetory procedure for the production department and a simple system of control of factory have been suggested.

2. Plan for the Re-layout of a Battery Manufacturing Unit (B. P. Ranga Rao and R. K. Gupta):

   A re-layout study was carried out in a battery cell manufacturing plant; the plant was to go in for expansion as a result of the shifting of some of the facilities from another plant of the same company. A new re-layout has been suggested. In addition improvements in the meterial handling and few improvements in the manufacturing processes, already incorporated in the company's another plant, were also included in the report. A net work programme for the implementation of the new layout was also suggested.

3. Reorganization of a Job Printing Press (H.R. Suresh and R.K. Gupta)

   The working of a job printing press in Mysore City, a branch of a bigger press and the head office of the company being located in Bangalore, was the subject matter of this study. A product preference analysis was made and the profitability of various types of printing orders was established. Besides a job evaluation study, an improved organization structure was also suggested. A simple system to control the affairs of the Mysore Press from Head Office was also suggested.

4. Stores Reorganisation in a Battery Manufacturing Plant (S. Ramakrishnan and R. K. Gupta):

   A study was carried out in the stores of a battery cell manufacturing plant. An analysis of the items of stores was undertaken to determine their characteristics in terms of their popularity, similarity, size, cost etc. Based on this, a new allocation of spaces for different items in the stores was suggested. Certain improvements in the methods of stacking and storing were also suggested.

5. Study of Overhead Conveyor Systems and the Application of Simulation to Optimise Crew Size for Trucks Unloading in a Manufacturing Organisation (Suresh J. Mahajan and S. Ramani):

The study of overhead conveyor system and a simulation study to optimise crew size for unloading trucks in a manufacturing organisation were conducted. The capacity and the utilisation of the conveyor system were found out. In the case of unloading of trucks, application of the Monte-Carlo technique revealed that addition of one more crew for unloading purposes would optimise the system and result in a net saving of Rs. 17,000 per annum and also a saving of 765 man hours per month.

6. A Simulation Study on EOT Cranes in a Railway Coach Assembly Shop (G. R. K. Murthy and S. Ramani):

The study on the utilisation of EOT cranes in a Railway Coach Assembly shop was made. The technique of Monte-Carlo asimulation was adopted to estimate the delay in assembly operations due to non-availability of cranes whenever required. The results of the simulation revealed that the average waiting time of the assembly workers due to non-availability of cranes was negligible. It was concluded that there is no necessity of providing one more crane.

7. A Quantitative Analysis for Optimum Product Mix and Production Batch Size Determination (N. Purushothaman Potty and S. Ramani):

Studies were conducted in a railway coach manufacturing organisation to determine (a) optimum batch size for production. The optimum product-mix was found by employing the technique of integer programming. The production batch size was found out by fitting a model and using an IBM – 1401 computer for calculation purposes. A table was prepared showing the optimum batch size for different ranges of production for the various types of railway coaches.

8. An Analysis of the Waiting Line of Ships by the Application of Queuing Theory (T. S. Ranganathan and S. Ramani):

A study was made in a port where there was considerable congestion due to loading and unloading of ships. Ships had to wait outside the harbour in a queue. Queuing theory was applied to determine the optimum number of products after computing the average waiting time of ships and average idle time of the berths. The analysis was also made by applying the Monte-Carlo simulation technique. The

Monte-Carlo technique yielded superior results since the various constraints could be built into the model.

9. Studies in Certain Aspects of Inventory Contorl in an Engine Manufacturing Organisation (Sanat K. Nandi and S. Ramani):

A study of inventory control was conducted in a leading internal combustion engines manufacturing organisation, manufacturing three models of engines. The sales forecasting was made for some of the raw materials. An ABC analysis was done and the economic batch order quantities were determined using a mathematical model. A statistical approach to fix re-order levels has been suggested. A number of recommendations in materials management have been suggested. A number of recommendations in materials management have been made as an offshoot of the above study.

10. A Quantitative Analysis for Materials Handling Management (Y. Chandrasekharan and B. Vasudeva):

A study of the materials handling process in an organisation was made with a view to streamline the existing system. A work sampling study to determine the utilization of the Fork Lift Trucks was made and methods for improving the utilisation were investigated with the help of Queuing models and Monte-Carlo simulation.

11. A Quantitative Analysis for Better Inventory Management in a Switchgear Manufacturing Plant (T.S. Krishnamurthy and B. Vasudeva):

Analysis of various phases of the inventory problem was made with a view to develop policies for effective inventory control. Economic lot sizes for the purchase and manufacture of various items were determined. Safety stocks for various items were found out, taking into account the lead time and demand variations. A sensitivity analysis to check the response characteristics of the system was also made.

12. Investigation of Inventory and Delivery Systems in a Container Industry (M. J. Kurian and N. K. Datta):

A study in the distribution pattern and demand pattern of highly seasonal products was carried out. A production planning system and an inventory control system were evolved and a suggestion to meet the dynamic condition was made.

13. Re-layout Analysis in a Container Manufacturing Plant (S. Rametra and N. K. Datta):

A study on the problem of layout arising out of expansion and change

in product mix was carried out and a suggested layout with the network of implementation programme was evolved.

14. Study of Optimum Machine Utilisation and a Sensitivity Analysis of an Expansion Programme in a Multiproduct Organisation (M. R. Gopalan and N. K. Datta):

A probe into the expansion programme and optimum product mix was carried out to facilitate top management in making decisions. The machine hour costs at different product mixes and at different stages of expansion revealed the scope of further expansion

15. Production Economy in Process Industry through Breakdown Analysis (C. G. Kotiswaran and N. K. Datta):

A study on process performance assurance in chemical industry through breakdown analysis and economy of standby equipment was carried-out. A suitable maintenance control policy and the level of standby economy were determined.

16. Statistical Quality Control in the Assembly Line of a Container Manufacturing Unit (T. Alexander and N. K. Datta):

A feasibility analysis on combined attribute control charts in assuring quality and rapidity of process was carried out. The result indicated the convenience of such a system. A procedure has been suggested for improvement in sensitivity.

17. Productivity Analysis in a Phosphating Plant (V. Surendran and N. K. Datta):

A study on productive process utilisation and optimum process condition was carried out in a process industry. The study reveals a considerable improvement in production through a suggested system of activity pattern and nominal increase in productive facilities.

18. Investigation of Multistage Process Capacity Machine Loading and Inprocess Inventory (V. Krishnakumar and N. K. Datta):

A study on the relationship of product demand and utilisation of production facilities in a line layout was carried out. Through the analysis of work element and the pattern of the product demand a suitable sequencing system was suggested for optimum machine utilisation.

19. Productive Performance Analysis in an Abrasive Industry (R. Shanker and N. K. Datta):

A study on the activity pattern, handling system and packaging techniques in abrasive industry was carried out. An improved production system and packaging techniques were suggested. A relationship between output and performance was also determined.

20. Study of Cupola Charging Operations in the General Foundry of a Steel Plant (Nokheylal and N. K. Datta):

A study on the arrival rate, storage and feeding of raw material in a general foundry was carried out. The investigation revealed that a considerable scope for improvement in the handling system exists. An improved inventory control system was suggested and methods of bringing in and feeding the raw material were evolved.

LABORATORY FACILITIES

Industrial Engineering Laboratory

The Industrial Engineering Laboratory is in the process of being set up. The laboratory development is directed towards motion analysis and optimal motion time study.

Computation Laboratory

The Computation laboratory is being set-up. At present, the following facilities are available :

IBM Card Punching Machine
IBM Card Verifier
IBM Sorter
FACIT Hand Calculators (Mechanical Type)

One more punching machine with printing device is under order. Acquisition and building up of special computer programmes are under way.

Psychology Laboratory

The Department of Humanities is planning to build up a Psychology Laboratory along three lines :

1. Purchase of necessary materials to demonstrate to the undergraduate students in connection with the teaching of the basic concepts in Psychology.
2. To procure necessary psychological tests for the purpose of selection and training.

3. To acquire those materials which are necessary for conducting research by the staff members teaching Psychology, Management and Industrial Engineering.

PUBLICATIONS

I. Papers Published

1. 'Batch Quantity for Multistage Production' — N. K. Datta, Work Study and Management Services, United Kingdom, Feb. 1968.
2. 'Some Thoughts on Scientific Management' — S. Ramani, Stream, I. I. M., Calcutta, May-June 1967.
3. 'Leadership and Literature' — A. V. Krishna Rao, Triveni, Madras, Jan. 1968.
4. 'Significant National Symbols in the Novels of R. K. Narayan' — A. V. Krishna Rao, Literary Half-yearly, Mysore, July '67.
5. 'Business Leadership' — S. K. Jain, Business Horizon, November 1967.
6. 'Impact of Migration on Industrial Development' — V. Hamsaleelavathi, Indsearch, Madras, July 1967.
7. 'Population Growth of Four Metropolitan Centres' — V. Hamsaleelavathi, Indsearch, Madras, August 1967.
8. 'The Relationship between Migration and Industrialization of the Urban Centres' — V. Hamsaleelavathi, Indsearch, Madras, November 1967.

II Papers Presented in Conferences/Seminars

1. 'Leadership and Management' — R. K. Gupta, Proceedings of the Seminar conducted by the Industrial Engineering Society, Madras. September 1967.
2. 'Leadership and Creativity' — S. Ramani, Proceedings of the Seminar conducted by the Industrial Engineering Society, Madras, September 1967.
3. 'Leadership in History' — M. S. Vairanapillai, Proceedings of the Seminar conducted by the Industrial Engineering Society, Madras, September 1967.
4. 'Leadership and Group Dynamics' — T. N. Govindarajan, Proceedings of the Seminar conducted by the Industrial Engineering Society, Madras, September 1967.

5. 'Who is a Leader?' — S. G. Asthana, Proceedings of the Seminar conducted by the Industrial Engineering Society, Madras, September 1967.

6. 'Leadership in a Democracy' — C. Ramachandran, Proceedings of the Seminar conducted by the Industrial Engineering Society, Madras, September 1967.

7. 'Statistical and Technical Aspects of Tool-Setting in Machine Tools' — N. K. Datta, Proceedings of the All India Conference on Quality Control, Madras, December 1967.

MATHEMATICS DEPARTMENT

STAFF

S. D. Nigam, Ph. D. (Agra), Professor and Head
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P. Achuthan, Ph. D. (IIT, Madras), Associate Lecturer
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RESEARCH WORK

I. General

S. K. Srinivasan has completed a monograph under the title "Stochastic Theory And Cascade Processes" which provides an account of some of the recent developments in stochastic processes with special reference to their applications in classical physics, cosmic rays and population growth. The general results of stochastic theory that are presented in the monograph will also be useful in other contexts like queuing theory, operations research and control systems. American Elsevier Company will bring out this monograph by the end of 1968, under the series 'Analytic and Computational Methods in Science and Mathematics'.

II. Stochastic Processes and Their Applications

1. Statistical Physics (S. K. Srinivasan and R. Vasudevan):

A novel method of arriving at the energy spectra of the particles obeying different kinds of statistics has been proposed.

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

A new method of formulating queuing problems by imbedding the given process in an appropriate renewal has been proposed. This is expected to be a powerful method of arriving at many of the quantities of physical significance.

3. Storage Theory (S. K. Srinivasan and N. V. Koteswara Rao):

A stochastic differential equation governing the storage theory has been proposed. The statistical properties of the system are studied on the basis of some simple models.

III. Theory of Elementary Particle Interactions

(S. K. Srinivasan and R. N. Sarkar):

The estimates of the vector meson contribution to the nucleon anamolous magnetic moments have been made. By using the S-matrix theory, they have been able to obtain the best possible fit to the magnetic moments of the nucleons.

IV. Photoproduction of Pseudoscalar Mesons (η, X°)

(S. K. Srinivasan and P. Achuthan):

The problem has been investigated using dispersion theoretic techniques. Theoretical predictions obtained compare fairly well with the recent experimental results.

V. Continuum Mechanics

(a) Elasticity

1. Invariant Elastic Constants for Crystals (T. P. Srinivasan and S. D. Nigam):

The elastic constants for various crystal classes have been exprsesed in invariant forms. This leads to a form of stress-strain relations which give the elastic theory of anisotropic solids a status comparable to that of isotropic elastic solids. This formulation is being used for the study of wave-propagation in crystals.

2. Mixed Boundary Value Problems (H. S. Paul):

Dual integral equations technique has been employed for obtaining solutions to mixed boundary value problems in elasticity and micropolar elasticity.

3. Vibration Problems in Piezoelectricity (H. S. Paul and B. Srinivasa Rao):

Several vibration problems have been solved. The solutions will be useful in the study of transducers and resonators.

(b) Fluid Mechanics

1. Two-Body Problems in Hydrodynamics (P. V. Arunachalam):

The total drag on two spheres performing longitudinal oscillations in

phase has been found in terms of the corresponding steady drag. Similar results must hold for axisymmetric pairs of bodies. This problem is being investigated.

2. Existence and Uniqueness Theorems in Boundary Layer Theory (U. N. Srivastava and G. B Narasimha Rao):

The existence and uniqueness of a certain boundary layer equation which occurs in a number of physical situations have been investigated. Further work in this direction is in progress.

3. Slow Viscous Jets (S. Vijayalakshmi and S. D. Nigam):

A general solution for jet type of flow through an orifice of any shape in a plane wall has been obtained and various special cases have been discussed.

4. Variational Approach to Hydrodynamic Stability (S. N. Venkatarangan and A. Avudainayagam):

The concept of local potential introduced by Prigogine has been applied to stability problems in hydrodynamics. Using variational approach, the stability criteria can be found in a simpler way as compared to other methods. Several configurations, Couette flow between rotating cylinders, Bernard problem with a transverse magnetic field, have been analysed. Work on the non-linear stability is in progress. The effect of temperature on Stokes' drag has been found using variational techniques.

5. Waves in Rotating Liquids (A. Ramachandra Rao):

The motion induced by a point source of oscillatory strength in a rotating inviscid liquid has been obtained in a closed form. A theory of multipoles in rotating liquids has been developed.

6. Effect of Boundary Proximity on Torque and Drag at Small Reynolds Numbers (S. N. Majhi):

Brenner's work on steady flows has been extended to unsteady periodic flows and the effect of wall-proximity on the drag has been found in terms of unsteady drag in unbounded fluids and the geometrical parameters.

The upper and lower bounds for Oseen's drag for an arbitrary body have been found.

7. Relativistic Hydrodynamics (A. V. Gopalakrishna):

An analogy between the equations of steady motion of a relativistic incompressible fluid and the equations governing the steady motion of

a classical compressible fluid has been found Exact solutions of the relativistic equations are given.

8. Magnetohydrodynamies (R Seetharamaswamy and L.V.K.V. Sarma) : Cross-field effects in Magnetohydrodynamics and certain theoretical problems having a direct bearing on Magneto-hydrodynamic power generation have beed studied.

9. Stratified Flows (D. V. Krishna and L. V. K. V. Sarma) : The areas of intrest include flows with density stratification which have applications in Meteorology and Oceanography.

10. Rotating Fluids (C. V. Raghava Rao and L. V. K. V. Sarma) : Motion of a sphere in rotating viscous liquid has been investigated using thc inner and outer expansions.

VI. Graph Theory

(M. R. Sridharan and K. R. Parthasarathy) :

The generating functions for enumerating self-complementary graphs and digraphs have been obtained. The second author has obtained explict expressions for the cycle indices of line groups of k-partite graphs and developed an algorithm for enumerating k-coloured graphs. The relation between group representation theory and graph enumeration theory is being examined with a view to obtaining formulae for the coefficients in thə generating functiens for various graph enumeration problems.

VII. Periodic Solutions of Differential Equations

(D. S. Subramanyam) :

The existence of periodic and almost periodic solutions of ordinary differential equations and their stability properties are being investigated. Attempts are being made to relax some of [the conditions which have been imposed for the derivation of the results in these areas.

JOURNAL OF MATHEMETICAL AND PHYSICAL SCIENCES

During the year under review, the Department took a significant step in launching a Journal of the Institute featuring Mathematical and Physical Sciences. The Editorial Board is international in character, consisting of eminent scientists drawn from different countries. The Journal is fully supported by the Institute and has the co-operation of the Institute of Mathematical Sciences, Madras and the University of Madras. The first number of the Journal was

released by the Madras Minister for Education, Sri V. R. Nedunchezian, on 24th November 1967, at a function presided over by Dr. A. L. Mudaliar, Chairman, Board of Governors of the Institute.

PUBLICATIONS

Papers Published

1. 'Response of Linear Vibratory Systems to Non-stationary Stochastic Impulses'—S. K. Srinivasan, R. Subramanian and S. Kumaraswamy, J. Sound Vib., **6**, 169-179 (1967).
2. 'Theory of Turbulence',—S. K. Srinivasan, Zeit Phys., **205**, 221 (1967).
3. 'On A Class of Non-Markovian Processes and its Application to the Theory of Shot Noise and Barkhausen Noise'—S. K. Srinivasan, Symp. Theo. Phys., N. Y., **3**, 107-119 (1967).
4. 'Sequent Correlations in Evolutionary Stochastic Point Processes'—S. K. Srinivasan, Symp. Theo. Phys., N. Y., **4**, 145-156 (1967).
5. 'Fluctuating Density-fields and Fokker-Planck Equation'—S. K. Srinivasan, Symp. Theo. Phys., N. Y. **5** (1967).
6. 'Angular Correlations in Brightness of Milky Way'—S. K. Srinivasan, A. Ramakrishnan and R. Vasudevan, J. Math. Phy. Sci., **1**, 75-84 (1967).
7. 'Stochastic Point Processes'—S. K. Srinivasan, J. Math. Phys. Sci., **1**, 1-37 (1967).
8. 'Fluctuating Density Fields'—S.K. Srinivasan and R. Vasudevan, Ann. Inst. Henri Poincare, **7**, 303-318 (1967).
9. 'Invariant Imbedding Technique and Age Dependent Birth and Death Processes'—S. K. Srinivasan and N. V. Koteswara Rao, J. Math. Analy. Applications, **21**, 43 (1968).
10. 'Vibration of A Rigid Circular Disc on an Infinite Isotropic Elastic Plate'—H. S. Paul, J. of the Acoustical Society of America, 42, 412-416 (1967).
11. 'Transient Analysis of the Propagation of an Electric Pulse in a Piezo-electric Plate'—H. S. Paul, J. of the Acoustical Society of America, **43**, 697-700 (1968).
12. 'Transient Temperature in Thick Dielectric of Spherical Shape'—R. Subramanian, Ind. J. of Theo. Phys., **15**, 5, (1967).

13. 'Stress Concentration Around a Small Anisotropic Spheroidal Inclusion on the Axis of a Circular Cylinder under Torsion'—R. Subramanian, Ind. Jl. of Theo. Phys., **20**, 1, (1967).

14. 'Enumeration of Graphs with Given Partitions'—K. R. Parthasarthy, The Can. Jl. of Maths., 20, 40-47, (1968).

15. 'A Variational Principle for Hydromagnetic Flows'—S. N. Venkatarangan, Bulletin of Belgium Academie of Sciences, **53**, 851-860 (1967).

16. 'Asymmetric Creeping Flow From an Orifice in a Plane Wall-I,'—S. Vijayalakshmi, App. Sci. Res., **17**, 355-358 (1967).

17. 'Secondary Flows in Rotating Liquids'—D. Y. Kasture and V. Subba Rao, J. M. P. S., Vol. 1, 1, & 2, p. 65 (1967).

18. 'Secondary Flow in a Rotating Channel'—V. Vidyanidhi and S. D. Nigam, J. M. P. S., Vol. 1, 1 & 2, P. 85 (1967).

19. 'Some Exact Solutions of the Flow of an Incompressible Fluid in Special relativity'—A. V. Gopalakrishna, J. Math. Analy. & Appl., Vol. 23 (1968).

20. 'Boundary Layer Flow Past a Circular Cylinder Embedded to a Wedge'—U. N. Srivastava, J. M. P. S., Vol. 1, 3. p. 194 (1967).

MECHANICAL ENGINEERING DEPARTMENT

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P. K. Philip, M. Tech. (IIT, Kharagpur), Lecturer
V. Seshagiri Rao, M. E. (IISc., Bangalore), Lecturer
V. N. Rajan, P. G. Dip. (Saskatchewan, Canada), Lecturer
K. N. Gopalan, M. Sc., (Madras), Lecturer
M. Adithan, M. Sc. (Engg.) (Madras), Lecturer
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S. S. Mani, B. E (Mysore), Workshop Superintendent

H. J. Ebert, German Technical Staff
H. Sohre, German Technical Staff
W. Goetz, German Technical Staff

RESEARCH WORK

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

I. INSTRUMENTATION

1. Optimization of Feedback Control-Systems with Reference to Single-time-constant Ideals (T. Rajagopalan and V. Seshadri):

   Investigations have been carried out on optimization of feedback control-systems, for deterministic and stochastic inputs, with reference to single-time-constant ideals. It has been shown that optimization based on mean-square-error minimization in this case leads to better damped optimal systems than obtained under the conventional unity ideal optimisation.

2. Parameter Identification in Adaptive Control-Systems (D. V. Ramalingeswara Rao and V. Seshadri):

   Parameter identification by means of sinusoidal test-signals has been investigated. Equations of identification of n parameters have been established. The application of these equations for arriving at phase-equivalent models is being examined.

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

   The friction characteristics of parallel surface sintered thrust-bearings are not known. People have worked on parallel surface solid-thrust bearings, where the load carried is explained by the "Thermal Wedge" phenomenon. An attempt is being made to find how the load is carried and determine the frictional characteristics of the paralled

surface sintered thrust-bearings. The design of the experimental set-up is in progress.

INTERNAL COMBUSTION ENGINEERING

1. Investigations of the Effect of Turbulence Frequencies on the Mixing Process in Combustion Chambers (K. V. Gopalakrishnan, G. Stahl, B. S. Murthy and R. G. Narayanamurthi):

   A test setup has been fabricated and erected for turbulence measurements using a hot-wire anemometer. This is a part of Doctoral work of K. V. Gopalakrishnan. This investigation is kept in abeyance as he is now in Germany on deputation.

   The same test setup is being used for three dimensional turbulent boundary-layer studies by Lakshmana Gowda and Aswathanarayana of the Applied Mechanics Department.

2. Precombustion Reactions in Dual Fuel Engines (K. R. Govindamallan, G. Stahl, B. S. Murthy and R. G. Narayanamurthi):

   A thermodynamic analysis of the energy-effect of early combustion reactions has been made. An engine test setup is arranged to verify the findings of the energy-effects of early combustion reactions on the combustion parameters of the engine. It is believed that early combustion reactions under certain conditions will contribute to an increase of the thermal efficiency and better fuel-selectivity and clean exhaust of I. C. Engines.

3. Influence of Heat Release pattern on the Performance of I. C. Engines (K. N. Gopalan, G. Stahl and B. S. Murthy):

   The course of heat release determines the output, noise, efficiency and thermal stress level on the different components of an I. C. Engine. 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 Internal Combustion Engines (P. Srinivasa Rao and B. S. Murthy):

   The stratified combustion process is a fuel injected, unthrottled spark ignition cycle that requires selective stratification of the fuel around the spark plug.

This involves the study of droplet mechanics and evaporation in swirling air. The impact of charge stratification on cycle efficiency and fuel economy at part load, where the automobile is generally operated, is being evaluated experimentally.

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

The resonance curve of the Ashok Leyland crankshaft system is being determined using the electrical strain-gauging technique. The damping effects of the various elements of the rubber hysteresis damper are being evaluated, both theoretically and experimentally.

Recommendations have been made to the manufacturers on the improvements.

6. Study of the Influence of Temperatures on Gas Composition in Oxidation and Reduction Zones of a Producer Gas Plant (G. John Sunder Rao, G. Stahl and B. S. Murthy):

An experimenal gasifier with adjustable grate and facilities to measure the temperature and gas sampling at different levels of the fuel-bed has been made. The optimum rate of gasification is 80 (m^3/m^2hr) and the fuel bed-depth can be varied between 350 (mm) and 530 (mm). The water-cooled air nozzle has provision to generate steam with heat in the oxidation zone. The effect of fuel particle size, fuel bed-depth and addition of steam to gasification air can be studied.

7. Evaluation of Small Two-Stroke Engines and Turbine-type Sprayers (V. Balabhaskaran, R. Ramamoorthy, H. Conen and B. S. Murthy):

The present day insecticide sprayers are being powered by imported engines and it is envisaged to replace them by indigenous makes (in particular "Villiers"). The first step for evaluating the engines is the fabrication of small transmission-dynamometers to enable testing under service conditions.

Cold starting problems, effects of altitude and effect of carburettor tilt on the performance are being evaluated for the imported as well as the indigenous engines. An energy balance of the engine, compressor and turbine units is also being made with both the types.

III. PRODUCTION ENGINEERING & MACHINE TOOLS

1. Secondary Shear During Machining (P.K. Philip and V.C. Venkatesh):

In metal-cutting it has been observed that shear flow is not confined to the primary shear zone. Plastic flow in the chip at low and high

speeds constitute a secondary shear phenomenon. With the aid of quick-stop devices, chips "frozen" on to the workpiece were studied under the microscope.

2. Tool Wear-Propagation in Cutting-Tools (V. Radhakrishnan, J. Chandramouli and V. C. Venkatesh):

A study of crater wear contour areas revealed, by extrapolation, a tendency for the crater walls to become vertical with passage of time. An inflexion in the flank wear propagation curve was observed and this coincided with the commencement of groove formation (boundary wear).

3. Spark-Hardening of Tools (S. Vaidyanathan and F. W. Lohr):

An electrical device to harden surfaces by means of carbide deposition on H. S. S. tools using a carbide electrode was developed. Tool life improved in some cases and in others there was a deterioration. Surface-changes were investigated.

4. Rotary Tools in Turning and Milling (S. Sampath and V.C. Venkatesh):

Instead of using a fixed straight-edged tool, a circular tool capable of revolving about its axis was used for turning. Tool-life improved but surface-finish was poor in turning. A milling cutter head with 8 rotary tools was developed and successfully used for milling. Work is continuing with carbide cutters.

5. Hot Machining (M. S. Francis and V. C. Venkatesh):

A setup for electrical resistance heating of the work-piece was developed, with the object of machining materials that are normally difficult to machine in the cold state.

6. Surface Deterioration of Gear Surfaces (M. A. Veluswamy and V. C. Venkatesh):

A study is being made of pitting, scouring and galling that occur on spur gears during prolonged use. The effect of lubrication on these types of deterioration is being investigated.

7. Bench-Type Milling Machine (H. Balasubramaniam, K. Ramamurthy, J. Chandramouli, V. C. Venkatesh and F. W. Lohr):

This milling machine has a speed range of 12 speeds, from 50 to 1250 rpm., with an output of 1 hp. and was designed for a local industry.

8. Ruppert Drives (H. Balasubramanian, K. Ramamurthy, V. C. Venkatesh and F. W. Lohr):

A 3 HP 4-speed simple Ruppert Drive Gear Box consisting of 3 pairs of gear wheels was designed and manufactured. Speeds 630—800—1000—1250 rpm. A 3 HP 8-speed extended Ruppert Drive Gear Box consisting of 4 pairs of gears but on 3 shafts in two axes was also designed and manufactured. Speed 180—2000 rpm.

A 16-speed doubly extended Ruppert drive Gear Box has been designed and is to be constructed. 5 pairs of gears are used on 3 shafts but on 2 axes.

9. Utilisation of Preferred Numbers in Machine Tool Design (P. Krishnan Nair and F. W. Lohr):

In an interesting study of preferred numbers, its utility has been exploited in the preparation of nomograms for calculating speed, torque, power, cutting time, etc. in a simple manner.

10. Design and Manufacture of Gear-Pump (P. Krishnan Nair and F. W. Lohr):

A low pressure (10 atmospheres) gear-pump of two spur gears and capacity of 16 litres/min. at 1500 rpm. was designed and manufactured. Use of charts mentioned under no. 9 above was used to advantage in this design.

11. Operation Table for Veterinary Hospital (H. Balasubramaniam and F. W. Lohr.)

This table is hydraulically operated for up and down-movement and mechanically for inclined positions, and is meant for operations on horses.

IV. MACHINE ELEMENTS & MECHANICAL HANDLING

1. Elasticity of Wire Ropes under Tensile and Compressive Stresses (G. Bechtloff)

Tests have been conducted to find out the various strains and displacements in a wire rope under tension and lateral compression such as strains in the individual wire and reduction in rope diameter. Such measuremants are important to develop rational criteria for wire rope design and selection.

2. Design of a Book-lift. (G. Bechtloff.)

A 1-ton capacity book-lift for the new 3-storeyed building was designed. The fabrication has been taken up by the Central Workshops.

3. Design of an Electric Overhead Travelling Crane (G. Bechtloff)

The design of a 10-ton electric over-head travelling crane for the laboratory has been taken up. The work is in progress.

4. Study of Friction and Lubrication of Gears (G. V. K. Rayudu and G. Bechtloff.)

A test-stand for studying the frictional losses in a set of gears is designed and is under fabrication. The problem is to investigate the effect of variation of pertinent parameters, like the correction-factor to improve the efficiency of spur-gear drives.

5. Study of Properties of Metal Sprayed Surfaces (P. Szelagowski and G. Bechtloff.)

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.

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

An apparatus to incorporate both the alternating and mean stresses has been designed and fabricated for this purpose.

7. Synthesis of Two-degree of Freedom Linkages (K. Lakshminarayana, G. Bechtloff and R. G. Narayanamurthi):

Third-order synthesis of bivariate function generator linkages has been achieved. Equations for fourth-order synthesis have been set up and are being programmed for solution on the Digital Computer.

8. Optimum Design of Wheels (A. Ramamohana Rao and G. Bechtloff):

Apparatus for testing welded and cast wheels, under different loading conditions, with a view to arriving at suitable recommendations for good design practice is under construction.

9. Study of Properties of Plastics for Application in Machine Elements (Abdul Wahab and G. Bechtloff):

Investigation was carried out on two component plastics for their wear and frictional properties. Metal and non-metal fillers were used.

10. Calculation of Stresses in Single Wires of a Wire Rope (K.V. Thyagarajan and G. Bechtloff):

A test-stand towards this end has been designed and is taken up for fabrication. Study of elongation of individual wires is in progress.

11. Study of Disc and Shoe Brake Performance (S. Sukumar and G. Bechtloff):

A test stand for studying the disc and shoe brake performance, with different lining materials and thicknesses, is being designed.

12. Design and Development of an Aircraft Towing Pole (N. Venkiteswaran and G. Bechtloff):

An apparatus for determining the load-deflection characteristics of foam rubber and other springs has been designed and constructed. Tests are being conducted on foam rubber to determine its suitability as a shock-absorbing medium for an aircraft towing pole.

13. Study of Properties of Arresting Ropes (T. Nagarajan and G. Bechtloff):

Tests on various wire ropes are being conducted to determine their suitability for use as arresting ropes for aircraft etc. A working model of the arresting arrangement will be constructed.

V. Heat Transfer and Thermal Power

1. Mechanism of Nucleate Boiling (V. N. Rajan and Ludwig Narjes):

Investigation to explain the mechanism of nucleate boiling is being made both experimentally and analytically. Experimental setup is made to investigate the effect of vibrations on the boiling heat transfer coefficient on the outside surface of a vertical tube under constant wall-temperature conditions. Temperature distribution is being measured by means of thermocouple traverse.

2. Performance Characteristics of Labyrinth Seals (K. V. Chalapathi Rao and Ludwig Narjes):

An experimental setup is made to determine experimentally and analytically the optimum conditions for sealing steam flow in high pressure turbines. Different types of labyrinth glands with adjustable spacings are being tried out to keep the leakage area and pressure drop a minimum. The project work has been completed.

3. Investigation on the Effect of Longitudinal Flow Pulsations on Heat Transfer to Water Flowing Inside Horizontal Pipe (G. Sama Rao and Ludwig Narjes):

The experiment is carried out in a double-shell heat exchanger, with the steam condensing on the pipe carrying water. The pulsations are created by a solenoid valve. The Nusselt Number in pulsated flow at

various Reynold's Numbers and at different frequencies of pulsations is compared with that of a steady flow. The project work has been completed.

4. The Performance Characteristics of the Existing Cooling Tower (M. N. Viswanathan and Ludwig Narjes) :

Investigations are being conducted to determine the performance characteristics of the existing cooling tower. Keeping the air-flow rate constant the water-flow rate is varied. The work is in progress.

VI. Thermodynamics and Combustion Engineering

1. Ignition Delay by Shock Tube Technique (K. A. Bhaskaran, H. Heitland and 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 occuring in the shock tube. Some preliminary data have been obtained and the work is continuing.

2. Studies on Flame Quenching (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, H. Heitland and M. C. Gupta):

The effect of acoustic oscillations introduced in the supply-stream of Burshane-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 Eneroy (A. Venkatesh, D. Suresh, H. Heitland and 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 Methods of Flame Temperature Measurement. (Basu John Vetteth and 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, with the aid of a Computer.

6. Thermal Conductivity of Insulating Materials (V. Sriramulu, U. S. Premanand Shet, N. S. Nagaratnam and 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.

VII. Turbomachines

1. Investigation of the Flow Conditions in the Vane Channels of Radial Flow Pumping Machines with particular Reference to Dead Zones (H. C. Radhakrishna and Wolfgang Scheer):

'Dead zones' in vane channels, due to boundary layer growth or separation, have been responsible for the decrease in efficiency of centrifugal pump impellers. This project was undertaken to study the flow conditions in vane channels with different vane designs. Two gift impellers, given by Dr.-Ing. Petermann, of Pfleiderer Institut fur Stromungsmaschinen are to be used. These impellers enable different vane angles to be set, as well as the number of vanes.

The erection of the test bed is in progress.

2. Influence of Boundary Layer on the Performance of Centrifugal Blower Impellers (G. Gopalakrishnan and Wolfgang Scheer):

Boundary layer separation has a pronounced effect on centrifugal blower impeller performance. This problem was therefore conceived with an idea to study the influence of vane geometry on boundary layer growth, and thereby predict blower performance.

This is a parallel investigation to that on pumps, using water media. The same two impellers that were gifted by Dr.-Ing. Petermann are also to be used in these investigations. The investigation is in its initial phase.

3. Influence of the Shape of the Stationary Head of Hubs on the Flow Pattern as well as on the Velocity Distribution; Three Different Shapes, (i. e. in Circular, Parabolic and Spear) (M. Ravindran and Wolfgang Scheer):

   Flow-over hub heads have been found to influence the flow-pattern in the vane-channel. The development of the skewed boundary layer has a definite influence on the flow downstream of the hub. This project therefore has, as its objective, the study of the flow situation occuring downstream of impeller hubs, and the effect of hub shapes. Measurements are intended to be taken. The project is in its initial stages. Preliminary arrangements are in progress.

4. Influence of Free Rotating and Braked Guide Blades at the Suction Side of Pumping Impellers on the Characteristic of the Pumping Turbomachines (N. Venkatrayulu and Wolfgang Scheer.):

   The project involves the design of a rotating guide blade hub. Two designs, one for internal and the other for external braking, have been taken up. The first design incorporates straight untwisted blades, and the second has facilities to investigate different guide blade shapes. The blades are nearing fabrication in the Turbomachines Laboratory and the entire test rig is expected to be completed soon.

LABORATORY FACILITIES

The following major items of equipment were commissioned during the year in the various Laboratories of the Department:

Hanomag Engine Test Setup, consisting of a single cylinder two-stroke water-coold Diesel Engine coupled to an electrical swinging-field Dynamometer;

Siemens Electrical Swing-field Dynamometers of 15 kw and 22 kw capacity; Pelton Turbine; Kaplan Turbine; Francis Turbine; Radial Blower Test-Bed; Calibrating Wind-Tunnel; Test-Bed for Small Radial Pumps; A. C.-D. C. Converter Sets, two of 100 kw. and two of 25 kw.

Progress was made in the erection work relating to the I. C. Engines Test Cubicles in the Thermodynamics Laboratory Building.

The following machines were added to the Central Workshop:

Broaching Machine; Ultrasonic Drilling Machine; and Centreless Grinder.

SEQUENTIAL SUMMER SCHOOL

The Department conducted the second session of the Sequential Summer School in Mechanical Engineering during May-June 1968. Dr. Robert H. Eustis, Professor of Mechanical Engineering, Stanford University, was the U. S. Consultant for the Course.

LIAISON WITH INDUSTRY

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

(i) design of a twelve-speed bench-type milling machine;

(ii) design and fabrication of a hydraulically operated operation-table;

(iii) testing of the torsional vibration-damper fitted to the Ashok Leyland Engine;

(iv) testing of the paver-winch fitted to Leyland Trucks;

(v) adaptation of an Indian-made Carburettor to the Engine manufactured by Messrs Hindustan Motors;

(vi) determination of thermal conductivity of insulating materials, for Messrs Lloyds Insulation Ltd.

PUBLICATIONS

I. Papers Published

1. 'High Speed Machining of Cast Iron and Steel'—V. C. Venkatesh, Annals of the C.I.R.P. Vol. XV. pp 387-391, London 1967.

2. 'Frictional Pressure Drop in Laminar and Turbulent Flow in Isoceles Triangular Ducts'—M. A. Tirunarayan and A. Ramachandran, American Society of Mechanical Engineers, Paper No 67-FE-18.

3. 'Frequency Response of Counterflow Heat Exchangers with Flow Rate Inputs'—S. S. Tripathi and A. Ramachandran, A.S.M E., paper 67-WA/AUT-5.

4. 'Influence of Solid Gradients on Casting Soundness of Aluminium-4·5% Copper Alloy'—N.S. Mahadevan, K. S. Srinivasamurthy, M. R. Seshadri and A. Ramachandran, Trans. American Foundrymen Society, V 68, p 77-84, 1968.

5. 'Influence of Mould Materials on Solidification of Simple Shaped Non-ferrous Castings'—S. Seshan, M. R. Seshadri and A. Ramachandran, The British Foundryman, V 60, Dec. 67, p 483-493

6. 'Dynamic Viscosity of Gas Mixtures'—G J Gururaja, M. A. Tirunarayan and A Ramachandran, Journal of Chemical Engineering Data, V 12, 4, p 562-567, 1967.

7. 'Heat Transfer and Pressure Drop Characteristics of Crossed Tube Heat Exchangers'—B. G. Nair and A. Ramachandran, Indian Journal of Technology, V 6 n 2, p 33-38, 1968.

II. Papers Accepted For Publication

1. 'Further Contribution to a Study of the White Layer on H.S.S. Tools'—V. C. Venkatesh, paper submitted for presentation at the 17th C. I. R. P. Conference, Ann Arbor, U.S.A. September, 1967. (to be published shortly in Annals of the C.I.R.P. Vol. XVII, London 1968)

III. Papers Presented in Conferences/Seminars

1. 'Influence of Chills on Soundness of Alluminium-4·5% Copper Alloy Plate Shaped Castings'—K. S. Srinivasamurthy, M. R. Seshadri and A. Ramachandran, 34th International Foundary Congress, Paris, October 1967.

2. Analysis of Film Boiling on Horizontal Cylinders'—M. V. Krishnamurthy and A. Ramachandran, 3rd All Union Heat and Mass Transfer conference, Minsk, U.S.S.R., May, 1968.

3. 'Heat Transfer during Condensation of Steam on a Rotating Disk'—J. Gururaja and A. Ramachandran, 2nd Western Canadian Heat Transfer Conference, Vancouver, May 22nd–24th, 1968.

4. 'Dust Sampler Equipment for Quasi-isokinetic Sampling in Steam-Power Plants by Means of New Zero-pressure Probes and Determination of Flow-densities, Particle Segregations and Time-conditioned Flow-fluct-nations during the Pneumatic Conveyance of Bituminous Coal-dust'—Ludwig Narjes, Seminar on 'Recent Developments in Chemical Engineering' held at I.I.T., Madras, February 1968.

5. 'Method of Investigating Materials Flow'—G. Bechtloff, Seminar on 'Recent Developments in Chemical Engineering' held at IIT., Madras, Feb. 1968.

6. 'Flame Quenching'—M. C. Gupta, Seminar on 'Recent Developments in Chemical Engineering' held at IIT., Madras, Feb. 1968.

7. 'New Energy Transformation Technology'—B. S. Murthy, Seminar on 'Recent Developments in Chemical Engineering' held at IIT., Madras, Feb. 1968.

8. 'Mechanism and Correlations of Nucleate Boiling Heat Transfer'—V. N. Rajan, 48th Annual Convention of the Institution of Engineers (India), held at Ahmedabad., February 1968.

9. 'Evaluation of Energy Release during Perflame Reactions in Dual-fuel Engines'—K. R. Govindamallan, Meeting of the Institution of Engineers (India) held on 9th April, 1968 at V J.T.I , Bombay.

10. ' Parameters Affecting the Design and Operation of Turbogenerators Meant for Two-Shift Operation'—M. N. Viswanathan, Semiuar Organised by the Research and Development Organisation for Electrical Industry, Bhopal, August, 1968.

IV. Papers Sent For Publication

1. 'Effect of the Lean Mixture Operation on the Thermal Performance and Heat Transfer Rates in I.C. Engines', B. S. Murthy, Institution of Engineers (India).

METALLURGY DEPARTMENT

STAFF

E. G. Ramachandran, Ph. D. (Met) (Sheffield), Prof. & Head
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RESEARCH WORK

I. Physical and Mechanical Metallurgy

1. Studies on Stabilisation of Austenite (E. G. Ramachandran):

   Effects of, (i) mechanical working, (ii) nature, amount and pressure of occluded gases and (iii) nature and proportion of prior constituent on the reactivity of austenite are being studied. Theoretical studies and construction of some of the apparatus required for the above investigations are being carried out.

2. Investigations on Stacking Faults and Work-Hardening of Metallic Materials (R. Vasudevan):

   Recovery effects of 18–8 quenched austenitic stainless steels cold-worked to various degrees have been studied in detail. These results are compared with results from similar studies on other f. c. c. metals and alloys e. g., copper and brasses of differing stacking-fault energies. Analysis of X-ray diffraction profiles of some types of stainless steels to reveal faulting frequency and correlation of this frequency with work-hardening studies on polycrystalline materials at room and elevated temperatures are in progress.

3. (a) Studies on Fatigue at High Temperature (K. Srinivasa Raghavan):

   Preliminary theoretical studies and study of the interaction of fatigue

and creep have been carried out. A special apparatus for fatigue-testing with provision for high temperature work is being constructed.

(b) Studies on Fatigue-Softening (R. Vasudevan and S. Sridharan):

Fatigue-softening of various austenitic alloys cold-worked to different extents at room and elevated temperatures and then fatigued at various stress values are being studied.

(c) Effect of Diffusion Coatings on Fatigue (R. Vasudevan, S. Ramakrishna Iyer and S. Swaminathan):

Experiments are being conducted to determine the possible effects of diffusion coatings of metals like aluminium on the fatigue behaviour of various types of steels.

4. Deposition and Structural Aspects of Metallic Thin Films (E. G. Ramachandran and K. J. Lakshminarayana Iyer):

A vacuum coating unit for the deposition of thin metal and alloy films has been designed and is being constructed. Thin film deposition is also being tried in vacuum furnace. It is proposed to study the mechanical properties and structural aspects of the thin films thus produced.

II. Extraction Metallurgy

1. Improvement in Properties of Vacuum-Treated Steels (R. K. Srikanta Kumaraswamy):

It has been found that vacuum-treated steels show a significant improvement in the transverse ductility and about a two-fold improvement in notch impact strength and fatigue properties over their air-melted counterparts. Investigations are underway to find out the improvement in different kinds of alloy steels and fixing lower minimum for the alloying elements. The steels are air-melted in the Tamann furnace and vacuum-treated in the Degussa high-frequency induction-furnace and tested. An analytical section for the rapid analysis of steels has been set up.

2. Investigations on Low-Carbon Ferrochrome (R. K. Srikanta Kumaraswamy and S. K. Seshadri):

Attempts are being made to produce low-carbon ferrochrome by soaking a mixture of high-carbon ferrochrome and chrome ore at about 1100°C under vacuum of about 10^{-1} m.m. Hg, employing the Degussa vacuum furnace.

III. Metallurgical Analysis, Electrometallurgy and Corrosion

1. Structure and Properties of Electrodeposited Alloys (E. G. Ramachandran):

   Preliminary studies on occlusion of hydrogen at a hollow mild steel electrode have been carried out in connection with studies on the inter-relationship between cast and electrodeposited alloys and the effect on their properties by occluded hydrogen.

2. Electrowinning of Nickel and Copper using Sulphide Anodes (S. Ramakrishna Iyer, S. Kumaran and V. Vasantasree):

   It is proposed to recover traces of nickel from the matte of Ghatsila ore. In this connection, behaviour of pure cuprous sulphide in a sulphate bath and the relation-ship between physical structure and chemical behaviour of the anodes are undertaken. Preliminary studies on deposition from the above solution have been carried out. Attempts are being made to cast pure copper, iron and nickel sulphides and study of their anodic behaviour is proposed.

3. Properties of Electrodeposited Nickel, Cobalt and Thin Alloys (V. Vasantasree and M. Viswanathan):

   Effect of addition agents, including colloids, in acid and alkaline electrolytes, on the physical and mechanical properties of nickel, cobalt and their alloys are proposed for study. The construction of apparatus and experimental set-up in this connection is in progress.

4. Fused Salt Electrolysis (V. Vasantasree):

   Feasibility of employing urea and/or acctamide as the basic electrolyte for metal electrodeposition is to be tested. Preparation of metal-urea complexes that can be employed as electrolytes is being tried out. The apparatus for conducting the electrolysis is being constructed.

IV. Foundry

1. Thermal Properties of Mould Materials and their Application to Solidification Problems (H. Md. Roshan):

   Work has been taken up to study solidification of metals in shell moulds. Preliminary experiments have been carried out to find out the optimum composition of the moulding sand to obtain a good shell. The temperature of the muffle surface, the dwell-time and cure-time are standardised to get consistent good shells. It is proposed to investigate (i) Chvorinov's rule validity in case of shell moulds (ii) influence of

ultrasonic agitation, (iii) influence of shell moulds on hot-tearing tendency of aluminium alloys and (iv) applicability of cast test-bars in shell moulds in place of conventional test-bars.

LABORATORY FACILITIES

The Department is equipped with apparatus for conducting tests and instruction in the following fields:

Physical Metallurgy

Metallography; X-ray Diffraction; Radiography; Ultrasonic Testing; Dye-penetrant Testing; Magnetic Sorting and Dilatometric Studies.

Mechanical Testing

Hardness; Impact; Tensile and Compressive tests—three Universal Testing Machines, with capacity upto 60 tons, are available for these purposes; fatigue—one Vertical Pulsator of capacity 2 tons, a Vertical Pulsator with programming unit of capacity 20 tons, and a few smaller machines are available.

Heat Treatment and Melting

Facilities are available for annealing in argon atmosphere, isothermal transformation studies, and melting ferrous, non-ferrous and refractory materials. Two furnaces, the Tamann furnace and the Degussa high-frequency induction furnace capable of attaining temperatures 1800 to 2000°C are under commission. Any kind of heat-treatment can be carried out with the available muffle-furnaces and air-tempering furnace of range 800–1200°C.

Metallurgical Analysis, Electrometallurgy and Corrosion

Analyses of various metallurgical materials by electro-chemical, spectrophotometric, polarographic and chemical methods are undertaken.

Development work is in progress for the setting up of the cold working laboratory. A CSIR grant has been solicited for carrying out a research scheme in the Foundry Section.

LIAISON WITH INDUSTRY

Small projects involving work useful to industry have been taken up. For example, the influence of vacuum-melting on the properties of alloy steels is be ng studied. The problem of remelting and casting of alloy steel scrap is also being investigated.

Some problems relating to development of correct heat treatment procedures for specific machinery components are also being studied.

As routine aid to industry, the following facilities are offered by the Department.

i. Metallography and hardness testing of metals and non metals.

ii. High-temperature mechanical testing.

iii. Fatigue-testing of normal samples and of springs.

iv. Chemical analysis of ferrous and non-ferrous materials.

v. Flaw-detection using radiographic, ultrasonic and magnetic methods.

Among the industries which have approached the Department for technical assistance are the Integral Coach Factory, Bharat Heavy Electricals, Surgical Instruments Factory, Wheels India Ltd. to name only a few.

PUBLICATIONS

I. Papers Published

1. 'Standardisation of Special Steels for Automobile Industry and Their Manufacture and Testing in India'—R. K. Srikanta Kumaraswamy, Indsearch, **2**, No. 4, July 1967; Sokul Ind **1**, No. 8, March 15, 1967; Souvenir released at Seminar on 'Automobile Research' held on 25th and 26th Feb, 1967.

2. 'Gas Tight Thermobalance Load-seal'—V. Vasantasree, D. A. Pantony and M. G. Hocking, J. Sci. Inst., **44**, 791, 1967.

3. 'Tensile Behaviour of Single Crystal Gold Films—a Phenomenological Theory'—K. Srinivasa Ragavan, Trans. I.I.M., **21**, 45, 1967.

4. 'Satin Chrome Plating'—M. Viswanathan and N. V. Parthasarathy, Electroplating and Metal Finishing, **21**, 81, 1968.

II. Paper Accepted for Publication

1. 'Construction of a Square Sided F. C. C. Lattice from Close-Packed Planes'—R. Vasudevan, Metals and Materials.

2. 'Blast Furnace Raw Materials'—R. K. Srikanta Kumarasamy, I. I. M. Monograph on Iron making.

III. Papers Sent for Publication

1. 'Some Studies on the Work Hardening of a Chromium-Nickel Austenitic Stainless Steel'—R. Vasudevan.

PHYSICS DEPARTMENT

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R. Ramji Rao, M. Sc. (Banaras), Lecturer
S. B S. Sastry, Ph. D. (IIT, Madras), Lecturer
V. Ramabhadran, M. Sc. (Madras), Lecturer
Y. V. G. S. Murthy, Ph. D. (IIT, Madras), Lecturer
G. Santaram, Ph. D. (Andhra), Lecturer

H. D. Henkel, Dipl. (Physics) (Aachen), Senior Scientific Assistant

B. S. V. Gopalam, M. Sc. (Andhra), Associate Lecturer
B. S. V. S. Ramachandracharyulu, M. Sc. (Andhra), Associate Lecturer
S. Srinivasan, M. Sc. (IIT, Madras), Associate Lecturer
K. Viswanatha Reddy, M. Sc. (Andhra), Associate Lecturer
A. V. Narasimhan, M. Sc. (Andhra), Associate Lecturer

RESEARCH WORK

I. SOLID STATE PHYSICS:

The Department of Physics has built up a good school of research in Solid State Physics. Besides studying the structure and the nature of the atomic arrangements in crystals, various properties of the crystals are also being investigated. Some work in theoretical Solid-State Physics is also being pursued. The different areas of investigation in Solid State Physics are listed below with a brief report of the progress achieved in 1967–1968 in each of these areas.

1. X-ray Crystal Structure Analysis (B. V. Ramanamurthy and S. Swaminathan):

   As part of a programme for the study of crystal structures of molecules with interesting features to the Chemist and Physicist alike, the structures of several organic and inorganic substances are currently being investigated. In the period under review, the structures of phenyl hydrazine and 1·4 dihydroxy anthraquinone have been solved. These studies have shed some light on the nature of the ionicity of the carbon-oxygen bond in the latter compound. The structures of mono-thio-urea-cadmium-sulphate dihydrate and bi-thiourea-cadmium nitrate

crystals were also determined successfully. These studies have provided interesting information on the coordinations of the cadmium atoms in these crystals.

2. Studies on Ionic Conductivity and Radiation Damage (C. Ramasastry, S. B. S. Sastry, Y. V. G. S. Murthy and J. Sobhanadri):

The electrical conductivity of sodium nitrate crystals has been measured as a function of temperature. The nature of the point-defects responsible for the electrical conductivity in this crystal has been identified. The possible anisotropic jump mechanisms for the migration of the defects in this crystal have been investigated. A calculation of the cohesive energy of the crystal and the energies of activation and migration of point-defects in sodium nitrate has been made.

When X-rays irradiate any crystal, they give rise to defects which have absorption in specific regions of the spectrum. The colour centres produced in sodium chlorate crystals by X-irradiation have been the subject of an exhaustive investigation. The destruction of these centres by annealing the crystal at different temperatures-the so called thermal bleaching-has been followed up using a spectrophotometer for making optical absorption measurements. It is found that the fundamental absorption edge of sodium chlorate is modified by the presence of the defects.

Electron spin resonance is a very convenient tool for the study of defects in crystals. Though the Physics Department does not possess the requisite facilities, electron spin resonance spectra of X-irradiated crystals of alkali sulphates were obtained through the kind courtesy of I.I.T. Kanpur. The electron spin resonance studies have helped in the identification of defects produced in these relatively complicated crystals by X-rays.

3. Semiconductor Physics (C. Ramasastry):

The transport of electrons in a semiconductor like Germanium is hindered by the presence of surface states which act as traps with different relaxation times. Measurements of the surface conductance of Germanium crystals at different frequencies reveal the presence of two types of surface states with very different relaxation times. Further studies are being made to identify the nature of the states.

4. Non-linear Elasticity Theory and Thermal Expansion of Crystals (R. Srinivasan and R. Ramji Rao):

Recently the third-order elastic constants of a number of crystals have been measured by studying the elastic behaviour of these crystals

under hydrostatic and uniaxial stresses. These third-order elastic constants must be related to the anharmonicity of the interatomic forces in the crystal. The theoretical expressions for these elastic constants in terms of the third-order coupling paramerers of the lattice were worked out for general ionic and non-ionic lattices. In the case of the semiconductors, germanium and silicon, it was shown that the measured third-order elastic constants imply that the interatomic forces extend beyond the first neighbours. In the alkaline earth fluorides, the third-order elastic constants were predicted from a knowledge of the interatomic forces. Later measurements on Barium fluoride have confirmed the theoretically predicted values. These third-order elastic constants can be related to the other anharmonic properties of the crystal. In the alkaline earth fluorides it has been shown that the low temperature thermal expansion calculated from the third-order elastic constants is in complete agreement with the recent experimental measurements. A method has been worked out to calculate the thermal expansion at low temperatures of uniaxial crystals from third-order elastic constant data. The method has been applied to alpha-quartz and the results are shown to be consistent with the experimental measurements of thermal expansion down to 6° K of this crystal performed in Australia. With a view to working out the theory of expansion in hexagonal metals, zinc, magnesium and beryllium, the lattice dynamics of these crystals has been worked out using a new approach due to Keating. The extensive numerical computation needed for this work is at present being carried out on the CDC 3600 computer at the T. I. F. R., Bombay.

5. Spectroscopic and Optical Properties (C. K. Narayanaswami, R. Srinivasan and V. Sivaramakrishnan):

The Raman and Infra red spectra of crystals provide useful information on the nature of lattice vibrations, the symmetry of the crystal and the type of bonding. Here again, the extent of the work that could be done has been severely restricted due to the non-availability of an infra-red spectrograph and an ultra-violet Raman Recording spectrograph. Still, the spectra of benzophenone and a number of citrates in the solid state have been obtained with the help of equipment available in other places and the spectra are being analysed. The effect of temperature and stress on the refractive index of the alkaline earth fluorides is being studied at different wavelengths right down to the ultraviolet. The effect of a magnetic field in rotating the plane of polarisation of light passing through a crystal is also under investigation.

Even with severe limitations as to the nature of the available equipment, the achievements of the Physics Department in the area of Solid State Research are commendable. This is reflected in the fact that in the year 1967-68 more than 20 papers were published in such well known journals like Acta Crystallographica, Proceedings of the Royal Society (London), Physical Review and Journal of Physics and Chemistry of Solids, and presented at Symposia held in India.

II. NUCLEAR PHYSICS

Research work in this year is at present confined to an application of radioactive methods to the geological dating of rocks and minerals in the Deccan trap. The necessary equipment for this research work has been built locally from items purchased mainly from the Bhabha Atomic Research Centre. In the period under review, a scintillation counter arrangement was designed and fabricated for the measurement of low-level alpha activity in these rocks. (V. Sivaramakrishnan):

III. General

The Department also encourages the development of original ideas in other fields of research activity in Physics. A new theory of the volume viscosity of liquids has been worked out by A. V. Narasimham. A method for the simultaneous determination of the refractive index and thickness of thin films by ellipsometry has been proposed by a group of workers of whom R. Srinivasan is a member.

LABORATORY FACILITIES

The Department has established the following major laboratory-facilities for research work:

X-ray set with different types of cameras for crystal structure studies;

Zeiss spectrophotometer for optical absorption studies;

Electronic equipment for work on semi-conductors and dielectric crystals.

Work is in progress on the construction of a nuclear quadrupole resonance spectrometer, the C. S. I. R. having agreed to support this project for a period of three years under the supervision of J. Sobhanadri.

A Spectroscopic laboratory with a few low dispersion spectrographs and power sources is in the process of being set up.

The place of the Physics Department as an active centre of research in Solid State Physics was recognized by the Bhabha Atomic Energy Research Centre which held its Annual Nuclear Physics and Solid State Physics Symposium in the Department during February 1968. Over 250 delegates from various parts of India participated in this Symposium. Staff-members of the Physics Department presented papers at the Symposium. The exchange of ideas on various topics has provided a fillip to the research activities of the Department.

PUBLICATIONS

I. Papers Published

1. 'X-ray Study of Mono-Thiourea-Cadmium Sulphate Dihydrate Crystal' —S. Natarajan, Acta Crystallographica, **23**, 1096 (1967).
2. 'Crystal Structure of Bi-Thiourea Cadmium Nitrate'—S. Swaminathan and S. Natarajan, Current Science, **36**, 513, (1976).
3. 'Crystal Structure of 1, 4 Dihydroxy-Anthraquinone'—S. Swaminathan and G. D. Nigam, Current Science, **36**, 541 (1967).
4. 'The Crystal and Molecular Structure of Phenyl Hydrazine'—S. Swaminathan and S. Srinivasan, Current Science, **36**, 372, (1967).
5. 'Colour Centres in Potassium Chlorate'—C. Ramasastri and S. B. S. Sastry, Journal of Physics and Chemistry of Solids, **29**, 399, (1968).
6. 'Electron Spin Resonance of Coloured Sodium Chlorate'—C. Ramasastri and S. B. S. Sastri, Solid State Communications, **5**, 799, (1967).
7. 'Electron Spin Resonance in Irradiated Sodium Sulphate' - J. Sobhanadri and N. Hariharan, Current Science, **36**, 534, (1967).
8. 'Colour Centre Studies in Alkali Sulphate Crystals Part I, Optical Absorption in Sodium Sulphate'—J. Sobhanadri and N. Hariharan, Indian Journal of Pure and Applied Physics, **6**, 273, (1968).
9. 'Lattice, Theory of Third-Order Elastic Constants of Germanium and Silicon'—R. Srinivasan, Journal of Physics and Chemistry of Solids, **28**, 2385, (1967).
10. 'Lattice Theory of the Elastic Dielectric'—R. Srinivasan, Physical Review, **165**, 1041, (1968).
11. 'Lattice Theory of the Elastic Dielectric : Application tothe Fluorite Lattice'—R. Srinivasan, Physical Review, **165**, 1054, (1968).
12. 'A Theory of the Volume Viscosity'—A. V. Narasimham, Canadian Journal of Physics, **45**, 3923, (1967).

13. 'A Goniometer for X-Ray Diffraction Analysis'—A. V. Narasimham, Indian Journal of Pure and Applied Physics, 5, 311, (1967).

14. 'Simultaneous and Independent Determination of the Refractive Index and Thickness of Thin Films by Ellipsometry'—R. Srinivasan (with K. Vedam, R. Rai and F. Lukes), Journal of the Optical Society of America, 58, 526, (1968).

II. Papers Accepted for Publication

1. 'The Crystal Structure of Phenyl Hydrazine'—S. Swaminathan and S. Srinivasan, Zeitschrift fur Kristallographie.

2. 'Effect of a Large Number of Heavy Atoms on the Intensity Distribution of X-Ray Reflections for Centric and Acentric Crystals'—G. D. Nigam, Indian Journal of Pure and Applied Physics.

3. 'Electrical Conduction in Sodium Nitrate Crystals'—C. Ramasastri and Y. V. G. S. Murthy, Proceedings of the Royal Society (London).

4. 'Colour Centre Studies in Alkali Sulphate Crystals: Part II: Paramagnetic Centres in Sodium Sulphate at 77° K'—J. Sobhanadri and N. Hariharan, Indian Journal of Pure and Applied Physics.

5. 'Surface States Relaxation Times in n-Type Germanium'—C. Ramasastri and J. Majhi, Indian Journal of Pure and Applied Physics.

6. 'The Low Temperature Limit of the Effective Gruneisen Parameter in the Fluorides of Calcium, Strontium and Bariun on Axe's Shell Model'—R Srinivasan, Journal of Physics (London): Solid State.

7. 'Calculation of Generalised Gruneisen Parameters for Uniaxial Crystals from Third-Order Elastic Constant Data'—R. Ramji Rao and R. Srinivasan, Physical Status Solidii.

8. 'Ultrasonic Absorption in Mixtures of Non-Associated Liquids'—A. V. Narasimham, Indian Journal of Pure and Applied Physics.

9. '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 the Solid State Physics and Nuclear Physics Symposium, February 1968, at the I. I. T. Madras

1. 'Association of Point-Defects in Sodium Nitrate'—C. Ramasastri and Y. V. G. S. Murthy.

2. 'Fundamental Absorption Band Edge of Sodium Chlorate Crystal'—C. Ramasastri and S. B. S. Sastry.

3. 'Irradiated Lithium Sulphate; ESR Spectra'—J. Sobhanadri and N. Hariharan.
4. 'Temperature Dependence of Fast Surface-States of Germanium'—C. Ramasastri and J. Majhi.
5. 'Exchange Charge Model, for the Third-Order Elastic Constants of Germanium and Silicon'—R. Srinivasan.

IV. Papers Sent for Publication

1. 'E. S. R. in X-Irradiated Sodium Sulphate'—J. Sobhanadri and N. Hariharan.
2. 'Paramagnetic Centres in Irradiated Lithium Sulphate'—J. Sobhandri and N. Hariharan.
3. 'A Simple Design for an Alpha Scintillation Counter'—V. Sivaramakrishnan and C. S. Sastry.
4. 'Computing Elastic Constants of Polycrystals by Modern Methods'—B. Subramanyam.

AWARD OF DOCTORATE DEGREES

During the year under review, the following candidates completed their work leading to the award of the Ph D Degree of the Institute. The titles of the Theses are also given below :

Chemical Engineering

M. Ramanujam—"Studies in Fluid Energy Grinding".
(Supervisor :-Dr. D. Venkateswarlu)

Civil Engineering

M. K. Abdul Khader—"Analysis of Curvilinear Flows in a Two-Dimensional Transition from a Conduit to Free Surface".
(Supervisor :-Dr. G. Rouve)

Electrial Engineering

K. Thulasiraman—"The Modified Cut-set and Circut Matrices and Synthesis of n-Port Networks".
(Supervisor :-Dr. V. G. K. Murti)

Chemistry

J. Rajaram—"The Kinetics and Mechanism of the Bromination of Bromophenol"
(Supervisor :-Dr. J. C. Kuriacose)

K. Narayanan—"Study of the Dehydration of Alcohols on Oxide Catalysts"
(Supervisor :-Dr. C. N Pillai)

Mathematics

U. N. Srivastava—"Studies in Boundary Layers"
(Supervisor :-Dr. S. D. Nigam)

V. P. Muthuswamy—"Problems on Fracture and on Non-homogeneity in Elastic Plastic Solids"
(Supervisor :-Dr. S. C. Das)

TECHNICAL TEACHERS TRAINING PROGRAMME

During the year under review, five Departments of the Institute participated in this programme. As many as 42 candidates were undergoing training. 12 are expected to leave at the end of the academic session on satisfactory completion of their programme.

Sl. No.	Name	Date of joining	Name of Supervisor	Remarks
	I. Applied Mechanics and Aeronautics			
1.	Sri M. N. Siddhanty	8-11-1965	Dr. B. V. A. Rao	Due to complete the M. Tech. Degree Course in Dec., 1968
	II. Chemical Engineering			
1.	Sri K. Ethirajulu	10-7-1967	Dr. E. Hohmann	Enrolled for the M. Tech. Degree Course
2.	Sri C. Chandraprasad	10-7-1967	Dr. R. J. H. Bisanz	,,
3.	Sri V. S. Ramachandra Rao	18-12-1967	Dr. H. H. R. Bock	,,
	III. Civil Engineering			
1.	Sri M. Inbasakaran	16-8-1965	Dr. P. C. Varghese	Completed M. Tech. Degree Course in July 1968
2.	,, B. T. Chenchiah	28-8-1965	Dr. V. Sethuraman	,,
3.	,, S. Rangarajan	17-9-1965	Dr. P. C. Varghese	,,
4.	,, M. Raghunathan	16-9-1965	Dr. G. Rouve	,,
5.	,, C. Vijayan	1-9-1966	Sri K. S. Sankaran	Enrolled for M. Tech.

Sl. No.	Name	Date of joining	Name of Supervisor	Remarks
6.	Sri K. V. Natarajan	15-7-1967	Sri K. S. Sankaran	M. Sc. (Engg.) Degree holder.
7.	,, S. Chockalingam	10-7-1967	Dr. G. Rouve	Enrolled for M. Tech.
		IV. Electrical Engineering		
1.	Smt. Sarasu Eappan	3-9-1965	Dr. V. Seshadri	Completed the M. Tech. Degree Course in July 1968
2.	Sri K. Ramar	6-9-1965	Dr. H. W. Meyer	,,
3.	,, C. Easwaran	6-9-1965	Dr. V. G. K. Murti	,,
4.	,, G. T. Manohar	20-9-1965	Dr. P. Venkata Rao	,,
5.	,, M. Someswara Rao	20-9-1965	Dr. M. Venugopal	Due to complete M. Tech. Degree Course in December 1968.
6.	,, K. Narayana Bhat	8-8-1966	Dr. G. N. Garud	Enrolled for M. Tech. Degree Course
7.	,, M. C. Vaidyalingam	8-8-1966	Dr. H. W. Meyer	,,
8.	,, P. Karivaratharajan	9-8-1966	Dr. V. Seshadri	,,
9.	,, S. Yuvarajan	5-10-1966	Dr. B. Ramaswami	,,
10.	,, R. Parimelalagan	10-10-1966	Dr. K. P. Rajappan	,,
11.	,, S. Kannan	10-7-1967	Dr. M. Venugopal	,,
12.	,, T. S. Balasubramanian	10-7-1967	Dr. P. Venkata Rao	,,
13.	,, Normal Ratna Kumar	10-7-1967	Dr. M. K. Achuthan	,,
14.	,, R. Saravanam	11-7-1967	Dr. V. Seshadri	,,
15.	,, B. Ram Mohana Rao	26-7-1967	Dr. B. Ramaswamy	,,
16.	,, Y. Gopala Rao	10-7-1967	Dr. M. K. Achuthan	,,
17.	,, K. Raja Reddy	26-7-1967	Dr. H. W. Meyer	,,

Sl. No.	Name	Date of joining	Name of Supervisor	Remarks
		V. Mechanical Engineering		
1.	Sri G. John Sundar Rao	16-8-1965	Dr. G. Stahl	Completed the M. Tech. Degree Course
2.	,, K. V. Chalapathi Rao	17-8-1965	Dr. L. Narjes	,,
3.	,, M. Ravindran	9-8-1966	Dr. W. Scheer	Enrolled for the M. Tech. Degree Course
4.	,, K. Ramamurthy	9-8-1966	Prof. F. W. Lohr/ Dr. V. C. Venkatesh	,,
5.	,, V. Nagarajan	10-8-1966	Dr. L. Narjes	,,
6.	,, N. Venkatarayulu	18-8-1966	Dr. W. Scheer	,,
7.	,, T. Nagarajan	9-9-1966	Dr. Bechtloff/ Sri G. V. N. Rayudu	,,
8.	,, P. Radhakrishnan Nair	10-7-1967	Prof. F. W. Lohr/ Dr. V. C. Venkatesh	,,
9.	,, V. S. Premanand Shet	17-7-1967	Dr. M. C. Gupta	,,
10.	,, N. S. Nagaratnam	20-7-1967	Dr. M. C. Gupta	,,
11.	,, V. Balabaskaran	19-7-1967	Dr. B. S. Murthy	,,
12.	,, V. Ganesan	7-8-1967	Dr. B. S. Murthy	,,
13.	,, S. Sampath	4-9-1967	Dr. L. Narjes	,,
14.	,, H. V. Lakshmi-narayana	27-3-1968	Dr. Bechtloff/ Sri. G. V. N. Rayudu	Resigned on 2-7-1968

SEQUENTIAL SUMMER SCHOOL IN MECHANICAL ENGINEERING

The Department of Mechanical Engineering organised the Sequential Summer School in Mechanical Engineering for teachers in Engineering Institutions, on behalf of the Association of Principals of Technical Institutions (India) in collaboration with the United States Agency for International Development. These Summer Schools are sponsored by the National Council for Science Education and supported by the National Science Foundation of the U. S. A.

The Summer School was inaugurated by the Madras State Minister for Education, Sri V. R. Nedunchezian on 3rd May, 1967. Forty Staff-members from Engineering Institutions in the western and southern regions of the country were registered as participants. The participants were given the option to choose an elective in one of the following areas: Machine Design; Machine Tools; Power with options - Turbomachines/Internal Combustion Engines/Steam Power/ Combustion.

The instruction is offered at an advanced level in the field of Mechanical Engineering with the objective of achieving a standard appropriate to a Master's Degree. The Course is sequential and will continue through the next summer. Successful completion of the entire sequential course will be recognised by the award of a certificate or diploma.

Prof. A. H. Church, Professor of Mechanical Engineering, University of New York, was the U. S. Consultant for the course during the Summer of 1967. The first session concluded by the 1st of July, 1967. The Department of Mechanical Engineering was assisted by several allied Departments of the Institute in organising and running the Course.

The Second Sequence of the Summer School has been conducted through May-June, 1968. Prof. Robert H. Eustis, Professor of Mechanical Engineering, Stanford University, was the U. S. Consultant for the Course. The second session concluded by 29th June, 1968.

LECTURES/SEMINARS BY DISTINGUISHED VISITING SCIENTISTS AT THE INSTITUTE

Name of Visiting Scientist	Dates	Topic of Seminar/Lecture
Applied Mechanics and Aeronautics		
Dr. G. Gurfinkel, University of Illinois, U. S. A.	18-7-1967	Elastically Restrained Columns in Pre-fabricated Structures.
Dr. R. Sankaranarayanan, Senior Design Engineer, Hindustan Aeronautics Ltd, Bangalore.	12-3-1968 to 15-3-1968	Limit Analysis of Shells Revolution.
Chemical Engineering		
Prof. Dr. Ing. R. Quack, Technical University, Stuttgart, West Germany.	4-2-1968	Automation in Chemical Industries
Prof. Dr. Ing. H. Brauer, Technical University, Berlin, West Germany.	5-2-1968 to 9-2-1968	Fluid and Particle Dynamics
Civil Engineering		
Sri N. Neelakanta Sarma, Dy. Chief Engineer (Gen.) Southern Railway, Madras.	23-11-1967	Pre-Stressed Concrete in Railway Works
Mr. H. C. Marvel, Project Supervisor, American Consulate-General, Madras.	30-11-1967	Extremes of Construction
Prof. Dr.-Ing. K. Kordina, Technical University, Braunschweig, West Germany.	7-1-1968 to 17-1-1968	Modern Reinforced Concrete Construction; Design of Slender Reinforced Concrete Columns; Safety-Factor in Concrete Design; Design of Circular Cylindrical Shells under Thermal Load.

Name of Visiting Scientist	Dates	Topic of Seminar/Lecture
Prof. Dr.-Ing. F. Bassler, Technical University, Darmstadt, West Germany	21-9-1967 to 27-10-1968	Pump Storage Schemes
Prof. Nielson, Unesco Visiting Professor, Suratkal Engg. College.	27-2-1968 to 1-3-1968	Coastal Engineering
	Electrical Engineering	
Prof. Dr.-Ing. Doring, Technical University, Aachen, West Germany	19-1-1968 to 27-1-1968	Circuit Theory of Microwaves ; Modulation of Laser Beams
Prof. Dr.-Ing. Sattler, Technical University, Aachen, West Germany.	20-1-1968 to 27-1-1968	Matrix Analysis of Electrical Machines ; Design of Large-Capacity Machines.
Prof. Dr.-Ing. D. Kind, Technical University, Braunschweig, West Germany.	26-2-1968 to 8-3-1968	High Voltage Testing Techniques ; Dielectric Measurements
Prof. Dr.-Ing. W. Leonhard, Technical University, Braunschweig, West Germany.	26-2-1968 to 8-3-1968	Sampled Data Control Systems ; Process Identification for Control
	Mathematics	
Prof. P. L. Bhatnagar, Indian Institute of Science, Bangalore.	16-5-1968 to 19-5-1968	Statistical Mechanics
	Mechanical Engineering	
Prof. V. P. Alexeev, Visiting Professor, I. I. T., Bombay.	5-2-1968 to 8-2-1968	The Development of Supercharged High-Speed Diesel Engine i) Four-stroke engine ii) Two-stroke engine iii) Automotive Marine and Stationary Engines.

DEPUTATION OF INSTITUTE FACULTY MEMBERS/RESEARCH SCHOLARS TO CONFERENCES, SYMPOSIA, SUMMER SCHOOLS ETC.

Programme	Venue	Date	Name of Staff-Member/ Research Scholar
I. Applied Mechanics and Aeronautics Department			
Intensive Course in Computation	I. I. T., Kanpur.	October 16-26, 1967.	Sri G. Subramanian
Twelfth Congress on Theoretical and Applied Mechanics	I. I. T., Delhi	December 18-21, 1967.	Dr. D. V. Reddy Dr. A. Klein
Jubilee Celebration of the Department of Aeronautical Engg. I. I. Sc., Bangalore & Annual Session of the Aeronautical Society of India	I. I. Sc., Bangalore.	May 3-5, 1968	Dr. D. V. Reddy Dr. K. A. V. Pandalai Dr. A. Klein Dr. H. Wagner Sri G. Subramanian
Advanced Summer School in Structural Engineering	P. S. G. College of Technology, Coimbatore.	May 15-June 12, 1968	Sri S. Radhakrishnan
Advanced Summer School in Vibration Control and Isolation	I. I. T., Kharagpur.	June 6-29, 1968.	Sri G. Bapaiah
II. Chemical Engineering Department			
Winter School in Chemical Reaction Engineering	I. I. T., Kanpur.	December 1967	Dr. Y. B. G. Varma

Programme	Venue	Date	Name of Staff-Member/ Research Scholar
	Chemical Engineering Department (Contd.)		
Summer School in Advanced Numerical Analysis and Computation	College of Engineering, Guindy, Madras.	May 13 – June 8, 1968.	Sri R. Nagarajan
	III. Civil Engineering Department		
Symposium on "Construction Costs"	National Buildings Organization, New Delhi.	Aug. 3–5 1967.	Sri T. P. Ganesan
Refresher Course on "Corrosion and its Prevention"	Central Electro-Chemical Research Institute, Karaikudi.	Aug. 2 – Sep. 5, 1967	Sri P. Kalyanasundaram
Symposium on "Hydraulics and its Application"	Jaipur	December 1967	Dr. G. Rouve
Training in "Instrumentation"	I. I. Sc., Bangalore and N. A. L., Bangalore.	Dec. 20 – Jan. 10 1967–68.	Sri S. Meenakshisundaram
	IV. Electrical Engineering Department		
Seminar on Defence Electronics	Defence Electronics Research Laboratory, Hyderabad.	Aug. 7–9, 1967.	Prof S. Sampath and Dr. D. K. Banerjee
Summer School on Advanced Numerical Analysis and Computation	College of Engineering, Guindy, Madras.	May 13 – June 8, 1968.	Sri Vedam Subrahmanyam.
Symposium on Control Theory	I. I. Sc., Bangalore.	May 16–18 1968.	Dr. P. Venkata Rao, Dr. B. Ramaswami, Dr. V. Seshadri Sri G. T. Manohar

Programme	Venue	Date	Name of Staff-Member / Research Scholar
	Electrical Engineering Department (Contd.)		
Visit to Industry (Semi-conduction Devices)	Bharat Electronics Ltd., Bangalore.	May 14–18, 1968.	Dr. G. N. Garud
	V. Mechanical Engineering Department		
Summer School in Advanced Numerical Analysis and Computation	College of Engineering, Guindy, Madras.	May 13 – June 8, 1968.	Sri K. N. Gopalan Sri S. Doraiswamy Sri P. Srinivasa Rao
48th Annual Convention of the Institution of Engineers (India)	Institution of Engineers (India), Ahmedabad.	Feb. 9–14, 1968.	Sri V. N. Rajan
C. I. R. P. Sub-group Conference on Optimization Metal Cutting Grinding	Paris	Jan. 31–Feb.2, 1968.	Dr. V. C. Venkatesh
Summer School in Mechanical Engineering	P. S. G. College of Technology.	May 5– June 12, 1968.	Sri A. Ramamohana Rao
	VI. Metallurgy Department		
Seminar on "Corrosion and its Prevention"	Corrosion Advisory Bureau of Metals Committee, CSIR, Madras.	Feb. 1968	Dr. (Miss) V. Vasantasree
	VII. Chemistry Department		
Eighth Seminar in Electro-Chemistry	Central Electro-Chemical Research Institute, Karaikudi.	Dec. 26–29, 1967.	Sri R. Ramaswamy and Sri C. S. Venkatachalam

Programme	Venue	Date	Name of Staff-Member/ Research Scholar
	VIII. Mathematics Department		
Sixth Anniversary Symposium	The Institute of Mathematical Sciences, Madras-20.	Jan. 17–Feb. 2, 1968	Dr. S. K. Srinivasan Dr. R. Subramanian, Dr. P. Achuthan Sri R. N. Sarkar
Summer School in "Functional Analysis"	Tata Institute of Fundamental Research, Bombay.	May 13–June 11, 1968.	Smt. R. Kalyani
	IX. Physics Department		
Winter School in "Molecular Biology"	Tata Institute of Fundamental Research, Bombay.	Nov. 13–Dec. 9, 1967	Sri S. Natarajan and Sri G. D. Nigam
Advanced International School on "Theory and Technology of Semi-Conduction"	I. I. T., Delhi.	April 8–May 3, 1968.	Dr. Y.V.G.S. Murthi and Sri J. Majhi
	X. Humanities & Social Sciences Department		
Summer School in "Advanced Numerical Analysis and Computation"	College of Engineering, Guindy, Madras.	May 13–June 8, 1968.	Sri S. Ramani
Symposium on "Educational Technology"	National Institute of Education, Delhi.	March 2-3 1968.	Sri T. N. Govindarajan
All India Conference on "Psychology Applied to Education"	Indian Academy of Applied Psychology, Waltair.	Dec. 28–30, 1967.	Sri T. N. Govindarajan
Course on "Organization Behaviour"	Thiagarajar School of Management, Madras (in collaboration with Graduate School of Business, University of Pittsburgh, USA.)	Nov. 11–17, 1967.	Sri T. N. Govindarajan

SPECIAL LECTURES DELIVERED BY FACULTY MEMBERS ON INVITATIONS FROM OUTSIDE BODIES

Organization	Date	Subject	Name of Speaker
Indian Institute of Science, Bangalore	4-11-1967	A Non-linear Theory of Taylor Instability of a Gas-Liquid Inter-face	Dr. N. R Rajappa, Assistant Professor, Department of Applied Mechanics & Aeronautical Engg.
The Aeronautical Society of India (Madras Branch)	18-3-1968	A New Approach to Prandtl's Wing Theory	,,
Space Science &	20-5-1968	Variational Methods	Dr. K. A. V. Pandalai,
Technology Centre, Trivandrum	22-5-1968		Professor, Department of Applied Mechanics & Aeronautical Engg.
	24-5-1968	Finite Difference Methods	,,
	27-5-1968 & 29-5-1968	Composite Structures	,,
	31-5-1968	Thermal Stresses	,,
	1-6-1968	Aero-elasticity	,,
I. I. T., Kharagpur (Advanced Summer School in Vibration Control and Isolation)	14-6-1968	Rotor Vibration with Special reference to Oil Whirl	Dr. B. V. A. Rao, Assistant Professor, Department of Applied Mechanics & Aeronautical Engg.
	17-6-1968	Random Vibrations	Dr. Hans Wagner, Professor, Department of Applied Mechanics & Aeronautical Engg.

Organization	Date	Subject	Name of Speaker
Central Electronics Engg. Research Institute, Pilani (Summer School on Control Systems)	May-June, 1967	Lectures in Control Theory	Dr. V. Seshadri, Assistant Professor, Department of Electrical Engineering.
Osmania University, Hyderabad (Summer School on Computation and Control)	June, 1968	Lectures in Control Theory.	,,
Small Scale Industries Association, Madras	10-2-1968	Materials Management.	Sri S. Ramani, Assistant Professor, Department of Humanities & Social Sciences.
Indian Institute of Metals, Madras Chapter, Madras	11-4-1968	Hindustan Steels Ltd.	Sri S. K. Jain, Lecturer, Department Humanities & Social Sciences
Seventh International Conference on "The Properties of Steam", Tokyo	9-9-1968 to 13-9-1968	Representation of Thermodynamic Behaviour of Super-heated Steam by means of Quasi-Ideal Vapour.	Dr. Ing. L. Narjes, Professor, Department of Mechanical Engg.
Banares Hindu University	26-1-1968 to 29-1-1968	Extension Lectures	Dr.-Ing. G. Stahl, Professor, Department of Mechanical Engg. and Mr. H. Conen, Senior Scientific Assistant, Department of Mechanical Engineering.

Organization	Date	Subject	Name of Speaker
Annamalai University	13-3-1968	Extension Lectures	Dr.-Ing. G. Stahl, Professor, Department of Mechanical Engg.
,,	14-3-1968	,,	Dr. B. S. Murthy, Professor, Department of Mechanical Engg.
,,	,,	,,	Mr. H. Conen, Senior Scientific Assistant, Department of Mechanical Engg.
Andhra University	24-2-1968	,,	Dr. B. S. Murthy, Professor, Department of Mechanical Engg.
Institution of Engineers, V. J. T. I., Bombay	9-4-1968	Duel Fuel Engines	Sri K. R. Govinda Mallan, Lecturer, Department of Mechanical Engg.
Institution of Engineers, Mysore Chapter, Bangalore	16-5-1967 & 18-5-1967	Cathodic Protection in Soil and Marine Corrosion.	Dr. (Miss.) V. Vasanthasree, Lecturer, Department of Metallurgy,

SECTION II

THE BOARD OF GOVERNORS

The Board of Governors met four times during the year. The following were members of the Board during the year :

Dr. A. L. Mudaliar, University of Madras. (Chairman)

Prof. B. Sengupto Director, I. I. T. Madras till 10-12-67

Dr. A. Ramachandran, Director, I. I. T., Madras. (Ex-officio) from 11-12-1967.

Prof. K. T. Chacko, Director of Technical Education, Government of Kerala.

Dr. B. L. Santhamallappa, Director of Technical Education, Government of Mysore.

Shri T. Muthian, Director of Technical Education, Government of Madras.

Shri T. R. Das, Director of Technical Education, Government of Andhra Pradesh.

Shri P. M. Reddy, formerly General Manager, Hindustan Aeronautics Ltd., Bangalore.

Prof. Samuel Mathai, Vice-Chancellor, University of Kerala, Trivandrum.

Dr. D. S. Reddy, Vice-Chancellor, Osmania University, Hyderabad.

Dr. K. S. G. Doss, formerly Director, Central Electro Chemical Research Institute, Karaikudi.

Dr. P. C. Varghese, Professor & 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.

Shri C. V. Sethunathan, Registrar, I. I. T., Madras. (Secretary)

Buildings and Works Committee :

The Buildings and Works Committee met two times during the year. The following served on the Committee during the year :

Dr. A. L. Mudaliar, Chairman, Board of Governors, I. I. T., Madras.

Prof. B. Sengupto, Director, I. I. T. Madras till 10-12-1967

Dr. A. Ramachandran, Director, I. I. T., Madras, from 11-12-1967.

Shri M. E. Hussain, Chief Engineer (General), P. W. D., Chepauk, Madras.

Shri G. S. Bhasin, Under Secretary, (Works Division), Ministry of Finance, Department of Expenditure, Government of India, Nirman Bhavan, New Delhi.

Shri V. Narayanan, Superintending Engineer, CPWD, Madras.

Shri S. Nagarajan, Institute Engineer, I. I. T. Madras.

Dr. P. C. Varghese, Head of the Department of Civil Engineering, I. I. T., Madras.

Shri C. V. Sethunathan, Registrar, I.I.T., Madras (Secretary).

Finance Committee :

The Finance Committee met once during the year to consider the Budget of the Institute. The following served on the Committee during the year :

Dr. A. L. Mudaliar, Chairman (Ex-officio).

Shri G. K. Chandiramani, Additional Secretary to Ministry of Education.

Dr. (Miss) Kaumudi, Deputy Financial Adviser (Education).

Shri P. M. Reddy, formerly General Manager, Hindustan Aeronautics Ltd., Bangalore.

Shri T. Muthian, Director of Technical Education, Government of Madras.

Dr. A. Ramachandran, Director, I. I. T., Madras.

Shri C. V. Sethunathan, Registrar, I. I. T., Madras (Secretary).

THE SENATE

The Senate met six times during the year. The following served on the Senate during the year under review :

Chairman

Prof. B. Sengupto (Director) till 10-12-1967

Dr. A. Ramachandran (Director) from 11-12-1967

External Members

Dr. P. L. Bhatnagar, Head of the Department of Applied Mathematics, Indian Institute of Science, Bangalore-12.

Dr. G. S. Laddha, Director, A. C. College of Technology, Madras-25.

Prof. T. Balakrishnan Nayar, " Chitra ", Kilpauk Garden Road, Madras-10.

Internal Members

Dr. M. K. Achuthan (from 4-3-1968)

Dr. G. R. Bechtloff (from 5-8-1967)

Dr. R. J. H. Bisanz

Dr. H. H. R. Bock (from 3-10-1967)

Prof. N. K. Datta

Dr. M. C Gupta (from 10-8-1967)

Prof. R. K. Gupta

Dr. H. Heitland (till 31-10-1967)

Dr. E. Hohmann

Dr. A. Klein

Dr. N. Klein

Dr. W. Koch

Prof. A. L. Krishnan

Prof. F. W. Lohr

Shri S. S. Mani, Workshop Superintendent

Dr. H. W. Meyer

Dr. B. S. Murthy

Dr. V. G. K. Murthi (from 4-3-1968)
Prof. R. G. Narayanamurthi
Dr. L. Narjes (from 4-9-1967)
Shri V. S. Nazir Ahmed (Librarian)
Dr. S. D. Nigam
Dr. K. A. V. Pandalai (from16-11-1967)
Dr. Phillip Besslich (from 1-4-1968)
Dr. J. Plahn (from 16-1-1968)
Dr. E. G. Ramachandran
Dr. C. Ramasastry
Dr. D. V. Reddy
Dr. G. Rouve
Prof. S. Sampath (Dy. Director)
Dr. M. V. C. Sastri
Dr. W. Scheer
Dr. V. Sethuraman (from 5-10-1967)
Dr. S. K. Srinivasan (from 10-8-1967)
Dr. G. Stahl
Dr. P. C. Varghese
Dr. P. Venkata Rao
Dr. M. Venugopal (from 4-3-1968)
Dr. D. Venkateswarlu
Dr. Hans Wagner (from 18-10-1967)
Dr. H. W. Wagener (from 4-3-1968)
Dr. H. E. D. Zuern
Dr. B. V. A. Rao (Senior Warden) (till 7-4-1968)
Dr. V. Anantaraman (Senior Warden) (from 8-4-1968)

Secretary

Shri C. V. Sethunathan (Registrar)

STAFF

Dr. A Ramachandran assumed charge as Director of the Institute on 11th December, 1967, on the retirement of Prof. B. Sengupto, First Director of the Institute.

Prof. S. Sampath and Sri C. V. Sethunathan continued in the posts of Deputy Director and Registrar respectively.

During the year, Dr. M. V. C. Sastri, Professor and Head of the Department of Chemistry, Dr. P. Venkata Rao, Professor and Head of the Department of Electrical Engineering and Dr. P. C. Varghese, Professor and Head of the Department of Civil Engineering were appointed Professors in the Senior Scale.

Dr. K. A. V. Pandalai joined the Institute as Professor in the Department of Applied Mechanics and Aeronautical Engineering. Dr. S. K. Srinivasan, Assistant Professor of Mathematics, Dr. M. C. Gupta, Assistant Professor of Mechanical Engineering, Dr. C. Ramasastry, Assistant Professor of Physics and Dr. V. Sethuraman, Assistant Professor of Civil Engineering were appointed Professors in the respective Departments. Other changes that took place in the staff-position are listed in *Annexure III* to this Section.

During the year under review, Dr. H. Heitland, Professor and Head of the Thermodynamics and Combustion Laboratory, completed his assignment at the Institute and left for Germany on 1-11-1967. The Institute is under a debt of gratitude to this distinguished German Professor for his contribution to the building up of the Thermodynamics and Combustion Laboratory and for the technical and research activities that he has triggered off at the Institute.

The death, while in service, of Mr. Kurt W. H. Schroeter, Foreman, Instruments, Workshop, Department of Metallurgy, on 5-4-1968, is recorded with deep regret. Mr. Schroeter joined the Institute on November 1st, 1961 and has left behind a record of distinguished and devoted service to the Institute.

During the year, the Institute had the privilege of welcoming 6 Professors, 1 Assistant Professor and 9 Senior Scientific Assistants. Their affiliations and date of joining are given in *Annexure I* to this Section.

Under the provisions of the Second Indo-German Agreement, the Institute deputed 24 Indian members of the staff for training in German Technical Universities. Four Senior Faculty-members, in the areas of Machine Tools, Combustion Engineering, Hydraulics and Chemical Engineering completed short-term visits to German institutions. The Librarian of the Institute and the Deputy Director also paid short-term visits to Germany. Details of the deputation of Indian staff-members to Germany are given in *Annexure II* to this Section.

ANNEXURE I

1967 - 1968

German Staff-members

(a) Incoming Staff-members

Sl. No.	Name	Department / Laboratory	Date of joining
	Professors		
1.	Dr. G. R. Bechtloff	Mechanical Engineering-Machine Elements and Mechanical Handling.	5- 8-1967
2.	Dr. Ludwig Narjes	Mechanical Engineering-Heat Transfer and Thermal Power	4- 9-1967
3.	Dr. H. H. R. Bock	Chemical Engineering-Process Control	3-10-1967
4.	Dr. Hans Wagner	Applied Mechanics-Vibrations Laboratory	18-10-1967
5.	Dr. J. Plahn	Civil Engineering-Structures Laboratory	16- 1-1968
6.	Dr. H. W. Wagener	Metallurgy-Hot & Cold Working	4- 3-1968
	Asst. Professors		
1.	Dr. Hermann Heitmann	Mechanical Engineering-Metrology and Machine Tools	27-11-1967
	Senior Scientific Assistants		
1.	Mr. Helmut Conen	Mechanical Engineering-I. C. Engines	25- 7-1967

Sl. No.	Name	Department/Laboratory	Date of joining
2.	Mr Peter Szelagowski	Mechanical Engineering-Machine Elemēnts and Mechanical Handling	5- 8-1967
3.	Mr. D. Robertz	Mechanical Engineering-Thermodynamics & Combustion Engineering.	10- 8-1967
4.	Mr. R. Kirmse	Mechanical Engineering-Turbomachines	4- 9-1967
5.	Mr. G. Bruckmann	Electrical Engineering-Measurement Laboratory	15-11-1967
6.	Mr. D. Lukoschus	Electrical Engineering-Electronics Laboratory	15-11-1967
7.	Mr. Gunter V. D. Kammer	Mechanical Engineering-Heat Transfer and Thermal Power	4-12-1967
8.	Mr. B. Haedke	Chemical Engineering-Process Control	13- 1-1967
9.	Mr. Edward Fischer	Metallurgy-Metal Joints	12- 3-1968

(b) Outgoing Staff-members

1.	Dr. H. Heitland, Professor	Thermodynamics and Combustion Engg.	1-11-1967

ANNEXURE II

Deputation of Indian Staff-members to Germany

Name	Duration	Institutions in Germany
	Short-term Visits	
1. Sri V. S. Nazir Ahmed, Librarian.	September–November 1967	Second Annual Seminar on International Library Methods and Techniques at Delft. Netherlands and West Germany
2. Dr. V. C. Venkatesh, Assistant Professor, Department of Mechanical Engineering.	September, 1967–March, 1968	Technical Institutes & Industrial Establishments in the area of Machine Tools.
3. Dr. M. C. Gupta, Professor, Department of Mechanical Engineering.	April–August, 1968	Technical Institutes in the area of combustion.
4. Dr. V. Sethuraman, Professor, Department of Civil Engineering.	May–July, 1968	Technical Institutes & Laboratories in the area of Hydraulic Engineering.
5. Prof. S. Sampath, Deputy Director.	May, 1968	Technical Universities Stuttgart, Berlin, Braunschweig and Aachen and Industrial Establishments.
6. Dr. D. Venkateswarlu, Head of the Department of Chemical Engineering.	June, 1968–September, 1968	Technical Universities in Stuttgart

Name	Duration	Institutions in Germany
	Long-term Visits	
1. Sri T. K. Ramanujam, Senior Technical Asst., Department of Chemical Engg.	September 1967–December 1968	Technical University, Karlsruhe
2. Sri R. Radhakrishnan, Lecturer, Department of Civil Engineering.	September 1967–December 1968	Technical University, Braunschweig
3. Sri H. Rama Ayyar, Lecturer, Department of Civil Engineering.	September 1967–June 1969	Technical University, Hanover.
4. Sri K. S. Padiyar, Lecturer, Department of Mechanical Engineering.	September 1967–June 1969	Technical University, Koln-Pory.
5. Sri K. A. Bhaskaran, Lecturer, Department of Mechanical Engineering.	September, 1967-June 1969	Technical University, Koln-Pory
6. Sri K.V. Gopalakrishnan, Lecturer, Department of Mechanical Engineering.	September, 1967–December, 1968	Technical University, Braunschweig
7. Sri K. Satyanarayana, Lecturer, Department of Mechanical Engineering.	September, 1967–December, 1968	Technical University, Braunschweig
8. Sri V. Radhakrishnan, Lecturer, Department of Mechanical Engineering.	September, 1967–June 1969	Technical University, Braunschweig
9. Dr. V. Subba Rao, Lecturer, Department of Mathematics.	September, 1967–December 1968	Institut fur Angewandte Mathematik, Hamburg.

	Name	Duration	Institutions in Germany
10.	Sri P. Sankaran, Lecturer, Department of Electrical Engineering	October, 1967–March, 1969	Technical University, Stuttgart
11.	Sri K. S. Venugopal, Foreman, Department of Mechanical Engg.	October, 1967–March, 1968	Firma Index Werke and Pfauter at Ludwigsburg
12.	Sri Umapada Das, Foreman, Department of Mechanical Engg.	October, 1967–March, 1968	M/s. Siemens AG Karlsruhe
13.	Sri R. Rangachary, Foreman, Department of Electrical Engineering	October, 1967–November, 1968	M/s. Rohde & Schwazz, Munchen
14.	Sri R. Ramakrishnan, Senior Technical Assistant, Department of Chemical Engineering.	November, 1967–December, 1968	Technical University, Berlin
15.	Dr. N. V. C. Swamy, Assistant Professor, Department of Applied Mechanics.	June, 1968–September, 1969	Technical University, Braunschweig
16.	Dr. R. S. Alwar, Assistant Professor, Department of Applied Mechanics.	June, 1968–September, 1969	Technical University, Munchen
17.	Dr. C. Kalidas, Lecturer, Department of Chemistry.	June, 1968–September, 1969	Max-Planck-Institute Gottingen
18.	Dr. S. R. Ramadas, Lecturer, Department of Chemistry.	June, 1968–September, 1969	Karlsruhe University

	Name	Duration	Institutions in Germany
19.	Dr. M.H. Abdul Khader, Lecturer, Department of Civil Engineering.	June, 1968– September, 1969	Technical University, Stuttgart
20.	Sri T.A. Ramalinga Bhat, Lecturer, Department of Electrical Engineering.	June, 1968– September, 1969	Technical University, Aachen
21.	Sri V. Subrahmanyan, Lecturer, Department of Electrical Engineering.	June, 1968- September, 1969	Technical University, Aachen.
22.	Dr. H.C. Radhakrishna, Assistant Professor, Department of Mechanical Engineering.	June, 1968– September, 1969	Technical University, Braunschweig.
23.	Sri V.M. Radhakrishnan, Lecturer, Department of Mechanical Engineering.	June, 1968– September, 1969	Technical University, Braunschweig
24.	Sri S. Sundaresan, Lecturer, Department of Metallurgy.	June, 1968- September, 1969	Technical University, Braunschweig

ANNEXURE III

Appointments

Professor in the Senior Scale :

1. Dr. K. A. V. Pandalai
2. ,, P. Venkata Rao
3. ,, M. V. C. Sastri
4. ,, P. C. Varghese

Professor :

1. Dr. S. K. Srinivasan
2. ,, M. C. Gupta
3. ,, C. Ramasastry
4. ,, V. Sethuraman

Associate Professor :

1. Dr. V. G. K. Murthi
2. ,, M. K. Achuthan

Assistant Professor :

1. Dr. N. R. Rajappa
2. ,, V. Seshadri
3. ,, Y. B. G. Varma
4. Shri R. K. Srikantakumaraswamy

Lecturer :

1. Dr. A. Kuppurajulu
2. ,, H. R. Rama Rao
3. ,, V. Nagarajan
4. Shri H. Md. Roshan
5. Dr. Y. V. G. S. Murti
6. Shri P. Subbarami Reddy
7. ,, M. Krishnamurthi
8. ,, G. Gopalakrishnan
9. Dr. C. Santaram
10. ,, R. Narayan

ANNEXURE IV

Distinguished Visitors to I. I. T.

24-7-67	Dr. I von Ruckteschell, First Secretary (Commercial), Embassy of the Federal Republic of Germany, New Delhi.
24-7-67	Dr. A. Maclenan, Director, Ruddersfield College of Education, United Kingdom
3-8-67	Dr. Prof. Klaus Kuhn, Specialist (Collagen), Max Planck Institute, West Germany.
25-10-67	Mr. Beynon, Asst. Regional Representative of the United Nations, New Delhi.
31-10-67	Mr. S. K. Banerji, Ambassador-Designate to Japan
9-11-67	Prof. R. Farsky, UNESCO Expert, Karnataka Regional Engineering College, Surathkal.
14-11-67	Mr. Inche Mansor bin Othman, Director, M. R. A. A, Malayasia.
14-11-67	Lt. Col. Kipfer, Major Hartman and Major Lamb, American Scientists, U. S. Air Force.
24-11-67	Dr. A. Seifriz, Minister for Federal Affairs, Baden Wuerttenburg, West Germany.
	Dr. A. Reichl, Secretary-General, Indo-German Society.
30-11-67	Prof. Ing. Dr. Vladimir Kolousk, Visiting Professor, Civil Engineering Department, I. I. T., Bombay.
15-12-67	Col. S. W. Burrett, Deputy Commandant, College of Military Engineering, Poona.
19-1-68	Prof. Dr. Lehnartz, President, D. A. A. D. (German Academic Exchange Service); Mrs. Lehnartz.
	Dr. Miss M. E. Schmitz, Office of the D. A. A. D., Bad Godesberg,
	Dr. Hessberger, Director, Office of the D. A. A. D., New Delhi.

22-1-68	Mr. Schwarz, Hon'ble Minister for Economic Affairs of Baden Wuerttenburg, Baron Von Mirbach, Ambassador of the Federal Republic of Germany in India, New Delhi.
29-1-68	His Excellency C. J. Von Heydebreck, President of the Conference of Ministers of Education & Cultural Affairs, Federal Republic of Germany.
8-2-68	Mr. Davis, Technical Director, I. C. I. Ltd., Calcutta.
23-2-68	Dr. Hein, Secretary of State, Ministry of Economic Co-operation, Bonn.
24-2-68	Dr. J. S. Hunck, Chief Editor, Handelsblatt, West Germany.
26-2-68	Professor Matzke and Prof. Hampe, German Democratic Republic.
11-3-68	Dr. G. Kerckhoff (Ministry of Economic Co-operation, Federal Republic of Germany); Prof. Dr. H. A. Havemann (Institute for International Technical Co-operation, Technical University, Aachen) Mr. Kretzschmar (B. A. W., Frankfurt) and Mr. F. Diederich (Technical University, Aachen)
25-4-68	Mr. Wilton W. Quist, Chief Adviser, USAID. Mr. Harold C. Magelssen, Adviser for Curriculum Development Laboratory, C. T. I., Bombay.
10-6-68	Dr. V. G. Podoinitsin, Project Manager, United Nations Educational, Scientific and Cultural Organization, Warangal.
25-6-68	Mr. Ong Hean Tat, Organizer of Technical Education, Ministry of Education, Malaysia. Mr. Shaari bin Modh, Isa, Organiser of Commercial Subjects, Ministry of Education, Malaysia.

SECTION III

ADMISSIONS TO THE COURSES OF STUDY FOR THE 1967-68 SESSION

The number of students admitted to the various under-graduate and post-graduate courses, for the 1967-68 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. For the admissions made in July 1967, I I. T., Madras served as the Organizing Institute.

Data pertaining to the Joint Entrance Examination (1967) are included in *Annexure I* to this Section.

The Institute conducted a special entrance examination, on an All-India basis, for admissions into the three-year B. Tech. Degree Course and the M. Sc. Degree Courses.

Admission for the M. Tech. Degree Courses and the post-graduate Diploma Course in Industrial Engineering and for research work leading to the award of the Ph. D. Degree in Science/Engineering were made on the basis of the candidates' previous academic records and their performance at the interviews. Students were admitted for the first time into the M. Tech. Degree Course in 'Engineering Mechanics' offered by the Department of Applied Mechanics.

Admission into the Various Courses of Study for the 1967-68 Session

Course	Area of Study	No. of candidates offered admission	
Five-Year B. Tech.	Aeronautical Engineering		15
	Chemical Engineering		28
	Civil Engineering		78
	Electrical Engineering (H. C.)	25	53
	Electrical Engineering (L. C.)	28	
	Mechanical Engineering		57
	Metallurgy		30
			261

Course	Area of Study	No. of candidates offered admission
Three-Year B. Tech.	Chemical Engineering	20
	Civil Engineering	27
	Electrical Engineering (H. C.) 20 Electrical Engineering (L. C.) 25	45
	Mechanical Engineering	24
		116
M. Sc.,	Chemistry	14
	Mathematics	16
	Physics	17
		47
M. Tech.	Applied Mechanics (Engineering Mechanics)	7
	Chemical Engineering	16
	Civil Engineering	19
	Electrical Engineering	13
	Mechanical Engineering	11
		66
D. I I. T.	Industrial Engineering	19

Course	Department	No. of Scholars admitted
Research	Chemistry	2
	Mathematics	3
	Aeronautics and Applied Mechanics	1
	Chemical Engineering	3
	Electrical Engineering	3
	Mechanical Engineering	1
	Total	13

17 Technical Teacher Trainees were enrolled in M. Tech. Degree Courses in the various Departments, on a part-time basis. One Staff-member was enrolled for the M. Sc. Degree Course in Engineering Mechanics. The following numbers pertain to staff-members registered for the Ph. D. Degree in the various Engineering Departments on a part-time basis.

Department	Number registered
Aeronautics and Applied Mechanics	9
Civil Engineering	9
Electrical Engineering	5
Mechanical Engineering	8
Metallurgy	1
Total	32

STUDENT POPULATION OF THE INSTITUTE (1967-68 SESSION)

During the year under review, the Institute had on its rolls 1446 students in the B. Tech. Degree Courses, 64 Students in the M. Sc. Degree Courses, 85 Students in the M. Tech. Degree Courses, 19 in the D. I. I. T. Course in Industrial Engineering besides 51 full-time research scholars working for the Ph. D. Degree, 90 staff members are currently enrolled in the Ph. D. programme and are working, on a part-time basis towards the degree.

A statement giving particulars of the research scholars working at the Institute is included as *Annexure II* to this Section.

The number of students enrolled for the various courses of study is set out below :—

Course & Year		No. of students enrolled
Five Year B. Tech. Degree Course :		
I Year		233
II Year		221
III Year :		
Aeronautical Engg.	21	
Chemical Engg. . .	29	
Civil Engg.	43	
Electrical Engg. .	52	
Machanical Engg. .	62	
Metallurgy. . . .	30	
		237
IV Year :		
Aeronautical Engg.	15	
Chemical Engg. . .	40	
Civil Engg. . . .	26	
Electrical Engg. .	45	
Mechanical Engg. .	70	
Metallurgy. . . .	18	
		214

Course & Year			No. of students enrolled	
Five Year B Tech Degree Course Contd				
V Year :				
Aeronautical Engg.	12			
Chemical Engg. . .	40			
Civil Engg. . . .	26			
Electrical Engg. .	33			
Mechanical Engg. .	63			
Metallurgy. . . .	28			
			202	
Three Year B. Tech. Degree Course :				
			I Term	II Term
I Year			112	113
II Year :				
	I Term	II Term		
Chemical Engg.	28	28		
Civil Engg.	9	9		
Electrical Engg.	58	58		
Mechanical Engg.	30	30		
			125	125
III Year :				
Chemical Engg.	25	25		
Civil Engg.	20	19		
Electrical Engg.	28	27		
Mechanical Engg	30	30		
			103	101
Total			340	339
M. Sc. Degree Course :				
CHEMISTRY :				
I Year			13	11
II Year			8	8
MATHEMATICS :				
I Year			16	14
II Year			7	7
PHYSICS :				
I Year			17	15
II Year			9	9
Total			70	64

Courses & Year	No. of students enrolled	
M. Tech. Degree Course :	I Term	II Term
Applied Mechanics (Engineering Mechanics)		
I Year	7	9
II Year	–	–
CHEMICAL ENGINEERING		
I Year	16	14
II Year	12	12
CIVIL ENGINEERING :		
I Year	19	19
II Year	8	8
M Tech Degree Course:		
ELECTRICAL ENGINEERING		
I Year	13	11
II Year	12	12
MECHANICAL ENGINEERING :		
I Year	11	8
II Year	7	7
Total	105	100
D.I.I.T.		
Industrial Engineering	19	
Research Scholars:	Full-time	Part-time
(Registered for Ph. D.)		
Chemistry	12	4
Mathematics	15	7
Physics	10	13
Applied Mechanics & Aeronautics	2	10
Chemical Engineering	6	9
Civil Engineering	1	19
Electrical Engineering	4	11
Mechanical Engineering	1	15
Metallurgy	–	1
Humanities & Social Sciences	–	1
	51	90

PROMOTION PATTERN

Results of the Examinations held during the 1967-68 Session

Serial No.	Course and Year	No who appeared	No. who passed
1.	**Five-Year B. Tech. Degree Course :**		
	I Year	232	223
	II Year	221	213
	III Year		
	Aeronautical Engineering	21	19
	Chemical Engineering	29	29
	Civil Engineering	44	43
	Electrical Engineering	51	50
	Mechanical Engineering	62	61
	Metallurgy	30	29
		237	231
	IV Year		
	Aeronautical Engineering	15	14
	Chemical Engineering	40	38
	Civil Engineering	26	21
	Electrical Engineering	43	42
	Mechanical Engineering	69	69
	Metallurgy	18	18
		211	202
	V Year		
	Aeronautical Engineering	12	12
	Chemical Engineering	40	40
	Civil Engineering	26	26
	Electrical Engineering	33	32
	Mechanical Engineering	63	63
	Metallurgy	28	27
		202	200

Serial No.	Course and Year	I Term		II Term	
		No. who appeared	No. who passed	No. who appeared	No. who passed
2.	**Three-Year B. Tech. Degree Course**				
	I Year	112	112	113	102
	II Year				
	Chemical Engineering	28	28	29	26
	Civil Engineering	9	8	9	8
	Electrical Engineering	58	57	57	45
	Mechanical Engineering	30	29	28	24
		125	122	123	103
	III Year				
	Chemical Engineering	25	25	24	23
	Civil Engineering	20	19	19	15
	Electrical Engineering	28	27	27	24
	Mechanical Engineering	30	30	31	30
		103	101	101	92
3.	**M. Sc. Degree Course**				
	I Year				
	Chemistry	11	10	10	9
	Mathematics	14	10	10	7
	Physics	15	15	14	11
		40	35	34	27
	II Year				
	Chemistry	8	8	8	8
	Mathematics	7	7	7	3
	Physics	9	9	9	7
		24	24	24	18

Serial No.	Course and Year	I Term		II Term	
		No. who appeared	No. who passed	No. who appeared	No who passed
4.	**M. Tech. Degree Course**				
	I Year				
	(a) Applied Mechanics (Engineering Mechanics)	6	6	6	6
	(b) Chemical Engineering	15	15	14	14
	(c) Civil Engineering	19	18	18	10
	(i) Structural Engineering	9	8	8	7
	(ii) Hydraulics	5	5	5	2
	(iii) Soil Mechanics and Foundation Engineering	5	5	5	1
	(d) Electrical Engineering	11	10	9	7
	(i) Control System	2	2	2	2
	(ii) Measurements	3	2	2	1
	(iii) Power Systems	3	3	3	2
	(iv) Electronics	3	3	2	2
	(e) Mechanical Engineering	9	9	8	8
	(i) Machine Design	5	5	5	5
	(ii) Machine Tools	4	4	3	3
	II Year				
	(a) Chemical Engineering	12	12	12	12
	(b) Civil Engineering	8	8	8	8
	(i) Structural Engineering	5	5	5	5
	(ii) Hydraulics	1	1	1	1
	(iii) Soil Mechanics and Foundation Engineering	2	2	2	2

Serial No.	Course and Year	I Term		II Term	
		No. who appeared	No. who passed	No who appeared	No. who passed
	II Year (*Contd*)				
	(c) Electrical Engineering :	12	12	12	12
	(i) Control Systems	1	1	1	1
	(ii) Measurements	3	3	3	3
	(iii) Power Systems	4	4	4	4
	(iv) Electronics	4	4	4	4
	(d) Mechanical Engineering :	6	6	6	6
	(i) Machine Design	3	3	3	3
	(ii) Machine Tools	3	3	3	3

5.	D. I. I. T. Course	No. who appeared	No. who passed
	Industrial Engineering	19	19

The following numbers qualified themselves for the awards of various Degrees at the Fifth Convocation of the Institute :

STUDENTS ELIGIBLE FOR AWARDS OF DEGREES AT THE FIFTH CONVOCATION OF THE INSTITUTE

Degree	No. of students			
	I Class with Distinction	I Class	II Class	Total
B. Tech. (Five-Year Course)	1	144	55	200
B. Tech. (Three-Year Course)	1	50	41	92
M. Sc.	1	15	2	18
M. Tech.	5	43	4	52*

Degree	No. of students			
	I Class with Distinetion	I Class	II Class	Total
D. I. I. T.	1	14	4	19
Ph. D.				
Chemistry	2			
Mathematics	2			
Chemical Engineering	1			
Civil Engineering	1			
Electrical Engineering	1			7
			Total	388

* Includes 10 Teacher Trainees and 4 Staff-members.

PATTERN OF GRADUATION (1964–68)

The Institute has held Five Convocations so far, the fifth, representing the culmination of the academic activities for the year 1967–68, being held on 1st August, 1968, with Dr. Vikram A. Sarabhai, Chairman, Atomic Energy Commission, as the Chief Guest.

Over the period 1964–68, since the inception of the Institute, 961 students have been awarded the B. Tech. Degree, 91 students the M.Sc. Degree, 148 students the M.Tech. Degree and 19 students the Diploma of the Institute of Industrial Engineering.

It is noteworthy that as many as 25 research scholars have been awarded the Ph.D. Degree of the Institute.

The following table presents the members of the various graduating classes and groups.

Sl. No.	Course	Branch	1964	1965	1966			1967			1968			Total
					5 Year	3 Year	Total	5 Year	3 Year	Total	5 Year	3 Year	Total	
		a) Chemical Engineering	11	18	19	9	28	37	8	45	40	23	63	165
		b) Civil Engineering	16	15	17	7	24	32	7	39	26	15	41	135
1	M. Tech.	c) Electrical Engineering	24	30	36	22	58	33	28	61	32	24	56	229
	Degree	d) Mechanical Engineering	28	35	37	25	62	53	33	86	63	30	93	304
		e) Metallurgy	13	17	24	7	31	18	10	28	27	—	27	116
		f) Aeronautical Engineering	—	—	—	—	—	—	—	—	12	—	12	12
		Total :	92	115	133	70	203	173	86	259	200	92	292	961

Sl. No.	Course	Branch	1964	1965	1966	1967	1968	Total
		a) Chemistry	—	3	12	5	8	28
2	M. Sc.	b) Mathematics	5	1	6	8	3	23
	Degree	c) Physics	10	7	9	7	7	40
		Total :	15	11	27	20	18	91

Sl. No.	Course	Branch	1964	1965	1966	1967	1968	Total
		a) Chemical Engineering	—	6	9	10	13	38
3	M. Tech.	b) Civil Engineering	—	10	9	11	13	43
	Degree	c) Electrical Engineering	—	12	8	7	17	44
		d) Meehanical Engineering	—	4	6	4	9	23
		Total :	—	32	32	32	52	148

Sl. No.	Course	Branch	1964	1965	1966	1967	1968	Total
4	D.I.İ.T.	Industrial Engineering	—	—	—	—	19	19

Sl. No.	Course	Branch	1964	1965	1966	1967	1968	Total
5	Ph.D. Degree	a) Chemistry	—	—	—	2	2	4
		b) Mathematics	—	2	1	3	2	8
		c) Physics	—	1	1	2	—	4
		d) Chemical Engineering	—	—	1	1	1	3
		e) Civil Engineering	—	—	—	—	1	1
		f) Electrical Engineering	—	—	—	2	1	3
		g) Mechanical Engineering	—	—	—	2	—	2
		Total:	—	3	3	12	7	25
		TOTAL	107	161	265	323	388	1,244

ANNEXURE I

Joint Entrance Examination 1967

STATEMENT No. 1 : **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.**

Sl. No.	State	First choice of Institute					Total
		BOMBAY	DELHI	KANPUR	KHARAGPUR	MADRAS	
1.	ANDHRA PRADESH ...	86	23	27	186	697	1019
2.	ASSAM ...	1	—	—	—	—	1
3.	BIHAR ...	—	—	—	3	1	4
4.	DELHI ...	—	6	1	2	4	13
5.	GUJARAT ...	1	—	—	1	6	8
6.	GOA ...	—	—	—	—	1	1
7.	KERALA ...	58	14	9	59	651	791
8.	MADHYA PRADESH ...	1	—	—	1	2	4
9.	MADRAS ...	24	19	13	92	2036	2184
10.	MAHARASHTRA ...	8	—	2	2	6	18
11.	MYSORE ...	220	14	8	72	459	773
12.	ORISSA ...	—	—	—	2	1	3
13.	PONDICHERRY ...	—	1	—	1	23	25
14.	PUNJAB ...	—	3	2	1	4	10
15.	RAJASTHAN ...	2	—	—	—	7	9
16.	UTTAR PRADESH ...	1	1	1	3	4	10
17.	WEST BENGAL ...	2	1	—	3	3	9
18.	FOREIGN COUNTRIES ...	1	—	2	2	20	25
	TOTAL ...	405	82	65	430	3925	4907

STATEMENT No. 2: **The number of candidates who actually appeared for the Joint Entrance Examination in the various centres in the Southern Zone.**

Sl. No.	Centre	Maths	English	Physics	Chemistry	Phy. & Chem.	Drawing
1.	ANANTAPUR ...	35	34	30	30	3	3
2.	HYDERABAD ...	246	239	213	206	15	15
3.	KAKINADA ...	94	93	88	88	4	4
4.	SECUNDERABAD ...	77	75	69	68	5	4
5.	TIRUPATI ...	56	52	48	46	2	2
6.	VIJAYAWADA ...	159	154	145	143	7	7
7.	WALTAIR ...	97	97	87	85	10	10
8.	GUNTUR ...	113	111	103	97	7	7
9.	CALICUT ...	84	84	83	83	1	1
10.	TRICHUR ...	102	100	97	94	2	2
11.	TRIVANDRUM ...	225	223	209	201	9	9
12.	ERNAKULAM ...	174	171	163	157	6	5
13.	CHIDAMBARAM ...	89	88	85	84	3	3
14.	COIMBATORE ...	169	164	158	154	3	3
15.	MADRAS (A. M. Jain College) ...	236	236	227	225	6	6
16.	MADRAS (Pachaiappa's College)	370	368	329	323	37	37
17.	MADRAS (Sir Theagaraya College)	72	70	58	57	9	9
18.	MADRAS (Vivekananda College)	476	472	434	426	33	33
19.	MADURAI ...	266	264	244	243	15	15
20.	SALEM ...	114	113	104	100	4	4
21.	TIRUCHIRAPPALLI ...	271	268	260	257	5	5
22.	BANGALORE (National College)	171	170	165	160	4	4
23.	BANGALORE (St. Joseph's College)	179	177	166	166	9	9
24.	DHARWAR ...	162	157	153	144	1	1
25.	MANGALORE ...	138	136	129	129	4	4
26.	MYSORE ...	56	56	49	48	7	7
	TOTAL ...	4231	4172	3896	3814	211	209

STATEMENT No. 3: **The number of candidates who qualified in the written examination and were called for interview at I.I.T. Madras (Distribution shown State-wise)**

Sl. No.	State	First choice of Institute					Total
		BOMBAY	DELHI	KANPUR	KHARAGPUR	MADRAS	
1.	ANDHRA PRADESH ...	6	—	3	6	12	27
2.	DELHI ...	—	2	1	—	1	4
3.	KERALA ...	8	2	1	9	52	72
4.	MADRAS ...	3	—	—	8	142	153
5.	MAHARASHTRA ...	1	—	—	—	—	1
6.	MYSORE ...	15	—	1	9	36	61
7.	PUNJAB ...	—	1	—	—	1	2
8.	RAJASTHAN ...	—	—	—	—	2	2
9.	UTTAR PRADESH ...	—	—	—	1	—	1
10.	WEST BENGAL ...	—	—	—	2	—	2
11.	FOREIGN COUNTRIES ...	—	—	—	—	1	1
	TOTAL	33	5	6	35	247	326
						From other I.I.Ts.	5
						TOTAL	331

STATEMENT No. 4 : **The number of candidates offered admission to I Year of the 5 Year B. Tech. Degree Course (Session 1967–68)**

Sl. No.	State	No. of appln. received	No. qualified for interview in S. Zone	No. admitted as on 1-7-67 from IIT.					Total Offered	Branch						
				Madras	Bombay	Delhi	Kanpur	Kharagpur		Mech.	Aero	EE (LC)	EE (HC)	Chem.	Met.	Civil
1.	Andhra Pradesh	1019	27	7	—	2	—	—	9	3	—	—	1	1	3	1
2.	Assam	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3.	Bihar	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4.	Delhi	13	4	2	—	8	1	—	11	—	1	—	2	—	—	8
5.	Goa	1	—	—	—	1	—	—	1	—	—	—	1	—	—	—
6.	Gujarat	8	—	—	1	—	1	—	2	—	—	—	1	—	—	1
7.	Kerala	791	72	47	1	1	—	2	51	8	1	8	3	9	5	17
8.	Madhya Pradesh	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9.	Madras	2184	153	115	2	9	—	7	133	39	11	16	12	11	17	27
10.	Maharashtra	18	1	—	4	—	1	—	5	—	—	—	—	1	—	4
11.	Mysore	773	61	29	1	1	—	—	31	6	2	4	4	5	4	6
12.	Orissa	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13.	Pondicherry	25	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14.	Punjab	10	2	1	—	1	—	—	2	—	—	—	—	—	—	2
15.	Rajasthan	9	2	2	—	—	—	—	2	1	—	—	—	1	—	—
16.	Uttar Pradesh	10	1	—	—	—	9	—	9	—	—	—	—	—	—	9
17.	West Bengal	9	2	1	—	—	1	2	4	—	—	—	1	—	—	3
18.	Foreign Countries	25	1	1	—	—	—	—	1	—	—	—	—	—	1	—
	Total :	4907	326+5* =331	205	9	23	13	11	261	57	15	28	25	28	30	78

* from other I.I.Ts.

STATEMENT No. 5 : **The number of candidates (shown Branch-wise) admitted to the Indian Institute of Technology, Madras after interview at all the I.I.Ts.**

I I T at	Mechanical Engineering	Aeronautical Engineering	Electrical Engg. (L. C.)	Electrical Engg. (H. C.)	Chemical Engineering	Metallurgy	Civil Engg.	Total
BOMBAY	—	—	1	2	1	—	5	9
DELHI	6	—	2	4	1	1	9	23
KANPUR	—	—	—	—	—	—	13	13
KHARAGPUR	2	—	4	1	—	—	4	11
MADRAS	49	15	21	18	26	29	47	205
	57	15	28	25	28	30	78	261

ANNEXURE II

List of Research Scholars

The following is a list of Research Scholars who are currently working, full-time or on a part-time basis, in the various Departments of the Institute, towards the Ph. D. Degree.

Sl. No.	Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
	I. Applied Mechanics and Aeronautics			
	(a) Full-time Scholars			
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
	(b) Part-time Scholars			
1.	Sri M. A. Veluswami, Lecturer	1- 1- 1966	Dr. V. C. Venkatesh	Wear in Metallic Surfaces
2.	Sri P. S. Srinivasan, Lecturer.	12- 2-1966	Dr. A. Klein	Wing Theory
3.	Sri K. Ramamurthi, Lecturer	12- 4-1967	Dr. D. V. Reddy	Theory of Elasticity - Junction Stress in Shells
4.	Sri B. H. Lakshmana Gowda, Associate Lecturer	16- 8-1967	Dr. N. V. C. Swamy	Three-dimensional Turbulent Boundary Layer Theory
5.	Sri P. A. Aswathanarayana, Associate Lecturer	16- 8-1967	Dr. N. V. C. Swamy	Axially Symmetric Boundary Layer Theory

Sl. No.	Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
	I. Applied Mechanics and Aeronautics-Contd.			
6.	Sri T. Narayanan, Lecturer	28- 9-1967	Dr. D. V. Reddy	Dynamics of Shells
7.	Sri M. Balakrishnan, Lecturer	21-11-1967	Dr. A. Klein	Aerodynamics of rear-mounted engines
8.	Sri R. M. Siddaveera Gowda, Lecturer	16-2-1968	Dr. K. A. V. Pandalai	Aeronautics-Structural Mechanics
9.	Sri T. K. Varadan, Lecturer	16-2-1968	Dr. K. A. V. Pandalai	Structural Mechanics
10.	Sri K. Balaraman, Asst. Professor	26-4-1968	Dr. K. A. V. Pandalai	Shell Theory
	II. Chemical Engineering			
(a)	**Full-time Scholars**			
1.	Sri C. M. Ramaswamy	1-9-1965	Dr. D. Venkateswarlu and Dr. Y. B. G. Varma	Compaction of Solids
2.	Sri V. Narayana Rao	7-9-1965	Dr. E. Hohmann	Granulation of Fertlizers
3.	Sri D. V. Ramana Rao	6- 10-1965	Dr. E. Hohmann	Flotation of Inorganic Materials
4.	Sri S. Raghunatha Rao	13- 9-1967	Dr. E. Hohmann	Metallic & non-metallic processing by different techniques
5.	Sri S. G. V. Rajappa Raju	2-4-1968	Prof. H. Bock	Masotransfer and Process Dynamics
6.	Sri Dibeyenda Maitra	19- 4-1968	Prof. R. J. H. Bisanz	Long Tube Evaporation of Liquids

Sl. No.	Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
	II. Chemical Engineering-Contd.			
(b)	**Part-time Scholars**			
1.	Sri M. Ramanujam, Lecturer	8- 2-1963	Dr. D. Venkateswarlu	Fluid Energy Grinding
2.	Sri R. Vedaraman, Associate Lecturer	11-11-1963	Dr. D. Venkateswarlu	Vibration Milling
3.	Sri K. Ramamurthy, Associate Lecturer	11-11-1963	Dr. K. Subbaraju	Heat Transfer in Fluidized Beds
4.	Sri B. C. Battacharya, Lecturer	16- 3-1966	Dr. R. J. H. Bisanz	Thin Film Evaporation
5.	Sri R. Ramakrishnan, Senior Technical Assistant	25- 8-1966	Dr. R. J. H. Bisanz	Thin Film Evaporation
6.	Sri R. Subramanian, Lecturer	11-11-1963	Dr. P. B. Rao	Kinetics of Esterification of Alcohols
7.	Sri T. K. Ramanujam, Senior Technical Assistant	25- 8-1966	Dr. D. Venkateswarlu and Dr. G. S. Davies	Mixing of Solids
8.	Sri R. Nagarajan, Lecturer	25- 8-1966	Dr. S. D. Nigam and Dr. D. Venkateswarlu	Non-Newtonian Fluids
9.	Sri A. Baradarajan, Lecturer	25- 8-1966	Dr. M. Satynarayana	Reaction and Diffusion in Solid Systems
	III. Civil Engineering			
(a)	**Full-time Scholar**			
	Sri K. Sukesan Nair	4- 1-1964	Dr. P. C. Varghese	Structural Engineering
(b)	**Part-time Scholars**			
1.	Sri K. S. Sankaran, Assistant Professor	21-11-1964	Dr. P. C. Varghese	Soil Mechanice
2.	Sri R. Radhakrishnan, Lecturer	3- 6-1965	Dr. P. C. Varghese	Structural Engineering

Sl. No.	Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
		III. Civil Engineering-Contd.		
3.	Sri T. P. Ganesan, Lecturer	11- 2-1966	Dr. P. C. Varghese	Structures
4.	Sri P. K. Ninan, Lecturer	11- 2-1966	Dr. P. C. Varghese	Soil Mechanics and Foundation Engineering
5.	Sri M. H. Abdul Khader, Lecturer	12- 2-1966	Dr. G. Rouve	Fluid Mechanics
6.	Sri H. Rama Ayyar, Lecturer	19- 5-1967	Dr. G. Rouve	Fluid Mechanics, (Coastal Engineering)
7.	Sri H Suresh Rao, Associate Lecturer	21- 3-1968	Dr. V. Sethuraman	Hydraulics
8.	Mr F. G. Rohde, Senior Scientific Assistant	25- 3-1968	Dr. G. Rouve	Hydraulics
9.	Sri C. Ganapathi Chettiar, Lecturer	9- 10-1967	Dr. P. C. Varghese	Behaviour of R. C. Conoidal shells
10.	Sri N. Rajagopalan, Lecturer	9- 10-1967	Dr. P. C. Varghese	Ultimate Load behaviour of R. C. Plate and Slab with elastic loading
11.	Sri V. Parameswarn, Lecturer	9-10-1967	Dr. P. C. Varghese	Limit design of cased composite beams.
12.	Sri C S. Kishnamurthyr, Lecturer	9-10-1967	Dr. P. C. Varghese	Strength and behaviour of reinforced concrete folded plates
13.	Sri P. Kalyanasundaram, Lecturer	9-10-1967	Dr. P. C. Varghese	Influence of environmental factors on performance of R. C. Structures

Sl. No.	Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
		III. Civil Engineering–Contd.		
14.	Sri B. Ramamohan, Lecturer	22- 6-1968	Dr. P. C. Varghese	Engineering Properties of Marine clays
15.	Sri K. Muthu-krishniah, Associate Lecturer	22- 6-1968	Dr. P. C. Varghese	Effect of impact loads on the foundations of structures
16.	Sri M. G. Srinivasan, Associate Lecturer	22- 6-1968	Dr. P. C. Varghese	Shear strength of flat plates
17.	Sri K. R. Rajagopalan, Associate Lecturer	22- 6-1968	Dr. J. Plahn	Prestressed Concrete
18.	Sri S. Selvaraj, Associate Lecturer	22- 6-1968	Dr. P. C. Varghese	Circular Cylindrical Shell
19.	Sri M. Achyutha, Associate Lecturer	22- 6-1968	Dr. P. C. Varghese	Composite action of brick work and reinforced concrete structures
		IV. Electrical Engineering		
(a)	**Full-time Scholars**			
1.	Sri S. Kantilal Mehta,	26-10-1966	Dr. M. Venugopal	Static Relays
2.	Sri C. Venkataseshia,	3- 9-1967	Dr. M. Venugopal	Transient Stability of Power Systems
3.	Sri M. V. Chalapathi Rao	16- 1-1968	Dr. P. Venkata Rao	Non-linear Sampled Data Systems
4.	Sri K. Anbumani	10- 1-1968	Dr. V. Seshadri	Generalized Synthesis of Cascade Control Systems
(b)	**Part time Scholars**			
1.	Sri S. S. Yegnanarayanan, Lecturer	26-11-1963	Dr. M. Venugopal	Transient Analysis of Electrical Machines working as Amplifiers

Sl. No.	Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
		IV. Electrical Engineering–Contd.		
2.	Sri K. Thulasiraman, Lecturer	4–11–1965	Dr. V. G. K. Murti	n-port Network Theory
3.	Sri P. Sankaran, Lecturer	27– 8–1966	Dr. V. G. K. Murti	Compensating Network for Instrument Transformers
4.	Sri A. Chandra-sekharan, Lecturer	18– 2–1967	Dr. M. Venugopal	Computer Methods in Power System Studies
5.	Sri B. S. Bhanu-moorthy, Lecturer	18– 2–1967	Prof. S. Sampath	Transistor Operational Amplifier Stability with regard to noise and drift
6.	Sri Vedam Subrah-manyan, Lecturer	19– 5–1967	Dr. H. W. Meyer	Axial Forces in Induction Machines
7.	Sri T. A. R. Bhat, Lecturer	23– 8–1967	Dr. G. N. Garud	Pulse Techniques
8.	Sri V. V. Bapeswara 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 Synthesis and Linear Graph Theory
10.	Sri P. C. Majhee, Associate Lecturer	23–11–1967	Dr. K. P. Rajappa	Studies in Instrumentation
11.	Sri V. Subrahmanyam, Lecturer	29– 5–1968	Dr. K. Sivaprasad	Microwave Techniques
		V. Mechanical Engineering		
(a)	**Full-time Scholar**			
	Sri Basu John Vetteth	24– 8–1967	Prof. H. Heitland/ Prof. R. G. Nara-yanamurthy	Combustion

Sl. No.	Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
	V. Mechanical Engineering–Contd.			
(b)	**Part-time Scholars**			
1.	Sri K. V. Gopala-krishnan, Lecturer	1- 7-1966	Dr. G. Stahl	Combustion Problems in I. C. Engines
2.	Sri K. N. Gopalan, Lecturer	25- 8-1967	Dr. B. S. Murthy	Combustion Problems in I. C. Engines
3.	Sri K. S. Padiyar, Lecturer	2- 7-1966	Prof. H. Heitland	Effect of sound on flames
4.	Sri K. A. Bhaskaran, Lecturer	2- 7-1966	Prof. H. Heitland	Ignition delay of Hydro-carbon fuels by shock-tube technique
5.	Sri V Sriramulu, Lecturer	18-10-1967	Dr. M. C. Gupta	Combustion
6.	Sri M. Satynarayana, Lecturer	24- 8-1967	Prof. W. Scheer/ Prof. R. G. Narayanamurthy	Turbomachines
7.	Sri V. Radha-krishnan, Lecturer	1- 1-1966	Dr. V. C. Venkatesh	Surface Finish
8.	Sri M S. Francis, Lecturer	23- 9-1966	Prof. Lohr/ Dr. V. C. Venkatesh	Hot Machining
9.	Sri S. Vaidyanathan, Lecturer	7- 3-1967	Prof. Lohr/ Dr. V. C. Venkatesh	Spark Hardening of Tools
10.	Sri P. K. Philip, Lecturer	7- 3-1967	Dr. V. C. Venkatesh	Secondary Shear during Machining
11.	Sri G. V. N. Rayudu, Asst. Professor	4-10-1967	Prof. G. R. Bechtloff	Study of Friction and Lubrication of gears

Sl. No.	Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
		V. Mechanical Engineering-Contd.		
12.	Sri V.M.Radhakrishnan, Lecturer	14-11-1966	Dr. K. Srinivasa raghavan/ Prof. R. G. Narayanamurthi	Inter-action of creep and fatigue in metals
13.	Sri K. Lakshminarayana, Lecturer	4-10-1967	Prof. G. R. Bechtlof/ Prof. R. G. Narayanamurthi	Synthesis of two-degree of freedom linkages
14.	Sri A. Rammohana Rao, Lecturer	4-10-1967	Prof. G.R. Bechtloff	Optimum design of wheels
15	Sri D. Roberts, Senior Scientific Assistant	18-10-1967	Dr. M. C. Gupta	Combustion
		VI. Metallurgy		
Part-time Scholar				
	Sri S. Sundaresan, Lecturer	3- 7-1967	Dr. H. D. Zuern	Metal Fatigue
		VII. Chemistry		
	(a) **Full-time Scholars:**			
1.	Sri B. Viswanathan,	1- 8-1964	Dr. M. V. C. Sastri/Dr. V. Srinivasan	Physico-chemical Studies on Oxide Catalysts
2.	Sri R. Swaminathan	1- 8-1964	Dr. J. C. Kuriacose	Machanistic investigation of Heterogeneous Catalytic Reactions
3.	Sri D. Venkapayya	1- 9-1965	Dr. G. Aravamudan	Complexes containing Morpholine or Morpholinium ion

Sl. No.	Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
		VII. Chemistry–Contd.		
4.	Sri C. Daniel	8- 9-1965	Dr. J. C. Kuriacose	A study- of the dual Behaviour of chromia alumina catalysts
5.	Sri N. Chattanathan	11- 5-1966	Dr. C. Kalidas	Acid-Bas ereactions in non-aqueous media
6.	Sri S. Santhanagopalan	23- 8-1966	Dr. C. N. Paillai	Reactions catalysed by oxide catalysts
7.	Sri J. Radhakrishnan	29- 8-1966	Dr. S. R. Ramadas	Approaches towards the synthesis of Oxa-analogues of Oestrone and equilenin
8.	Sri S. Sampath	5- 9-1966	Dr. G. Aravamudan	Solid State studies on Uranium, Chormium, and Vanadium Coumpound
9.	Sri P. R. Sethuraman	22- 8-1967	Dr. G. Aravamudan	Chemistry of Selenium and Tellurium
10.	Sri G. Balagangadharan	7-11-1967	Dr. V. Mahadevan	Free radical initiated polymerisation of functional monomers like vinyl pyridine and MN' Dimethylaminoethylmethaerylate by Azobis isobutyronitrile and Benzoyl-peroxide

Sl. No	Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
		C. S. I. R. Scheme		
11.	Sri S. V. Kannan	27-7-1964	Dr. C. N. Pillai	Esterification and Etherification Reactions on Oxide Catalysts
12.	Sri M. Santhanam	1-9 -1965	Dr. V. Ramakrishnan	Mechanism of Photosensitised Oxidations
(b)	**Part-time Scholars**			
1.	Sri V. R. Satyanarayana Rao, Senior Technical Assistant	13-8 -1966	Dr. G. Aravamudan	Chloramine-T Oxidations
2.	Sri D. V. Ramana, Senior Technical Assistant	22-8 -1966	Dr. C. N. Pallai	Mechanistic studies of condensation reachtions over oxide catalysts
3.	Sri R. Ramaswamy, Senior Technical Assistant	2- 9-1966	Dr. J. C. Kuriacose	Mechanistic study of reactions by electro chemical techniques
4.	Sri C. S. Venkatachalam, Junior Technical Assistant	19- 9-1966	Dr. M. V. C. Sastri	Kinetics of eletrode reactions by polarography
		VIII Mathematics		
(a)	**Full time Scholars**			
1.	Sri R. Seetharamaswamy	27- 4-1965	Dr. L. V. K. V. Sarma	A Study of Cross-field Effects in Magneto-hydrodynamics
2.	Sri R. N. Sarkar	25- 8-1965	Dr. S. K. Srinivasan	Some aspects of Elementary Particle Physics

Sl. No.	Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
		VIII. Mathematics-Contd.		
3.	Sri D. V. Krishna	2- 9-1965	Dr. L. V. K. V. Sarma	Flow Problems in Stratified Fluids
4.	Sri S. N. Majhi	23- 9-1965	Dr. S. D. Nigam	Slow Viscous Drag
5.	Sri G. V. Prabhakara Rao	7- 9-1966	Dr. V. Subba Rao/ Dr. S. D. Nigam	Wave Propagation in Graph Theory
6.	Sri M. R. Sridharan	14- 9-1966	Dr. K. R. Parthasarathy	Enumeration Problems in Graph Theory
7.	Sri G. B. Narasimha Rao	20- 9-1966	Dr. S. D. Nigam	Studies in Boundary Layer Theory
8.	Sri A. Rangan	22- 9-1966	Dr. S. K. Srinivasan	Stochastic Processes
9.	Sri A. Avudainayagam	24- 9-1966	Dr. S. D. Nigam	Application of Variational Methods to Compressible Flows
10.	Sri K. S. Ramesh	24-10-1966	Dr. R. Subramanian	Operations Research
11.	Sri B. Srinivasa Rao	29-10-1966	Dr. H. S. Paul	Piezo-Electricity
12.	Sri V. Arunachalam	24-11-1966	Dr. S. D. Nigam	Two-Body Problems in Fluid Mechanics
13.	Kumari S. Kalpakam	22- 8-1967	Dr. S. K Srinivasan	Statistical Mechanics
14.	Sri N. Muthiyalu	6-12-1967	Dr. H. S. Paul	Elasticity
15.	Smt. R. Kalyani	16- 1-1968	Dr. S. D. Nigam	Fluid Dynamics

Sl. No.	Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
(b)	**Part-time Scholars**			
1.	Sri S. N. Venkata-rangan, Senior Tech-nical Assistant	21- 8-1964	Dr. S. D. Nigam	Variational Approach for Stability Pro-blems
2.	Sri C. V. Raghava Rao, Senior Technical Assistant	4- 8-1964	Dr. L. V. K. V. Sarma	Viscous Rotating Flow Past Bodies
3.	Sri A. Ramachandra Rao, Senior Technical Assistant	6- 8-1964	Dr. S. D. Nigam	Wave Propaga-tion in Rotating Liquids
4.	Sri A. V. Gopala-krishna, Senior Tech-nical Assistant	11- 8-1964	Dr. S. D. Nigam	Relativistic Fluid Mechanics
5.	Sri G. Rajamannar, Junior Technical Assi-stant	25- 8-1965	Dr. S. K. Srini-vasan	Stochastic, Processes
6.	Sri S. Kumaraswamy, Associate Lecturer	1- 1-1966	Dr. S. K. Srini-vasan	Stochastic Differ-ential Equations
7.	Sri U N. Srivastava, Associate Lecturer	4- 8-1964	Dr.S. D. Nigam	Boundary Layer Theory
		IX. Physics		
(a)	**Full-time Scholars :**			
1.	Sri N. Hariharan	13- 8-1964	Dr. J. Sobhanadri	Investigations on some of the opti cal and magnetic properties of alkali halides
2.	Kumari S. Vijaya-lakshmi	10- 8-1964	Dr. S. D. Nigam	Flow at small Reynolds number
3.	Sri K. Mallikarjuna-Rao	14-8-1964	Dr. C. K. Nara-yanaswamy	Spectroscopy
4.	Sri G. D. Nigam	8-10-1964	Dr. B. V. Ramana-murthy	X-ray study of crystal of 3 nitro toludine

Sl. No.	Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
		IX. Physics–Contd.		
5.	Sri C. S. Sastry	10- 9-1964	Dr. V. Sivarama-krishnan	Measurement of radio-activity and its applications to problems in Solid State Physics
6	Sri T. P. Srinivasan	9- 9-1965	Dr. S. D. Nigam	Plasma Waves
7.	Sri S. Natarajan	13-9-1965	Dr. B. V. Ramana-murthy	Crystal structure of Monothiourea cadmium sulphate dihydrate solved in projection
8.	Smt. Kamala Balaraman	5-10-1966	Prof. W. Koch	Optical effects of Mechanical stress
9.	Kumari Janaki Lakshmi	30-11-1966	Dr. C. Ramasastry	Colour centres
10.	Sri M. Veerabhadra Rao	23- 1-1967	Dr. B. V. Ramana-Murthy	Crystal/Structure analysis
(b)	**Part-time Scholars :**			
1.	Sri R Ramji Rao, Lecturer	30-10-1962	Dr. R. Srinivasan	Some problems related to Lattice Dynamics
2.	Sri V. Ramabhadran, Lecturer	30-10-1962	Dr. S. K. Srinivasan	Elementary Particle Interactions
3.	Sri S. Srinivasan, Senior Technical Assistant	30-10-1962	Dr. V. Sivarama-krishnan	Optical and Magneto Optical Rotations
4.	Sri B. S. V. S. Ramachandracharyulu, Associate Lecturer	30-10-1962	Prof. W. Koch/ Dr. C. Ramasastry	Luminiscence Effects in Solids
5.	Sri B. S. V. Gopalam, Associate Lecturer	30-10-1962	Prof. W. Koch/ Dr. C. Ramasastry.	Barrier Layers

Sl. No.	Name of the Scholar	Date of Registration	Name of the Research Guide	Field of Research
		IX. Physics–Contd.		
6.	Sri G. Sreenivasa-murthy, 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
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	Electrical and Optical Properties of Crystals
10.	Sri K. Sarangapani, Senior Technical Assistant	1– 8–1964	Dr. S. Swaminathan	An X-ray study of Texture and Structure of Crystal
11.	Sri V. Subramanya-Murthy, Senior Technical Assistant	27-9-1965	Dr. C. Ramasastry	Electron Spin Resonance
12.	Srs J. Majhi, Senior Technical Assistant	29–9–1965	Dr. C. Ramasastry	Surface States in Semi-conductors
13.	Sri K. Viswanatha Reddy, Associate Lecturer	1–11–1965	Prof. W. Koch	Semi-conductcrs
		X Humanities & Social Sciences		
Part time Scholar				
	Sri S. Ramani, Assistant Professor of Industrial Engg.	4-10-1968	Dr. S. K. Srinivasan	Operations Research

SECTION IV

Indian Institute of Technology, Madras-36

RECEIPTS AND PAYMENTS ACCOUNT FOR THE YEAR 1967–68

RECEIPTS	Rs.	PAYMENTS	Rs.	Rs.
OPENING BALANCE:	14,61,649	**ON CAPITAL ACCOUNTS:**		
Grant from Govt. of India:		i. Works and Buildings		47,95,347
i. Capital Account	75,00,000	ii. **Equipment, Furniture and Fittings:**		
Refund of Customs Duty	4,35,077	(Departments)		
		Civil Engineering	19,378	
		Mechanical Engineering	4,71,291	
		Workshops	81,458	
		Electrical Engineering	1,93,796	
		Chemical Engineering	73,571	
		Metallurgy	58,317	
		Applied Machanics and Aeronautical Engineering	1,26,834	
		Chemistry	89,671	
		Physics	1,04,592	
		Humanities	606	
		Mathematics	18,155	
		Industrial Engineering	7,215	
				12,44,884
		iii. **Customs Duty on West German Equipment:**		
		Customs duty paid	10,90,656	
		Clearance charges etc.	8,532	
				10,99,188
		iv. Furniture and Fittings (Office, Library and Institute)		4,39,857
C/o	93,96,726	C/o		75,79,276

RECEIPTS			PAYMENTS		
	Rs.	Rs.		Rs.	Rs.
B/F		93,96,726	B/F		75,79,276
			v. Hostels:		
			Utensils	4,384	
			Furniture and Fittings	3,775	
					8,159
			vi. Others:		
			Motor vehicles	—	
			Cycles	515	
			Typwriters and Duplicators	5,786	
			N.C.C. Aeromodelling Equipment	751	
			Hospital equipment	8,815	
			Fire fighting equipment	—	
			Telephones	58,931	
			Projector-Erection charges (Gymkhana)	6,795	
					81,594
			vii. Books and Journals:		
			i. Books	1,48,618	
			ii. Journals and Back volumes	67,971	
					2,16,588
			ON REVENUE ACCCUNT:		
			i. Academic Section—Pay and Allowances of Teaching staff:		
ii. Revenue Account		76,64,000	Civil Engineering	2,80,518	
			Mechanical Engineering	3,54,527	
C/o		1,70,60,726	C/o		78,85,617

RECEIPTS	Rs.	Rs.	PAYMENTS	Rs.	Rs.
B/F		1,70,60,726	B/F		78,85,617
Receipts from Academic Sections :			Electrical Engineering	3,38,218	
Tution fees	2,46,150		Chemical Engineering	2,17,472	
Hostel seat rent	1,72,929		Metallurgy	1,22,376	
Gymkhana and Medical fees	47,838		Applied Mechanics and Aeronautical Engineering	2,60,307	
Fines	3,803		Chemistry	1,49,364	
Examination fees	15,300		Physics	1,84,034	
Degree in absentia	1,755		Mathematics	1,17,125	
		4,87,775	Humanities	1,53,766	
OTHER RECEIPTS :					21,77,707
Application fees from students	1,07,135		**ii. Pay and Allowances for Non-Teaching staff :**		
Application fees for advertised Posts	16,159		Civil Engineering	1,50,010	
Admission fees	5,915		Mechanical Engineering	2,18,821	
Grade Card	3,591		Electrical Engineering	1,98,847	
Gymkhana receipts	8,511		Chemical Engineering	1,74,165	
Institute bus collections	79,255		Metallurgy	89,481	
Hire charges on Institute vehicles	7,145		Applied Mechanics and Aeronautical Engg.	97,738	
Library overdue collections	5,683		Chemistry	99,449	
Interest on fund deposits —			Physics	1,55,705	
Governor's prize 87·50			Mathematics	41,732	
Interest on conveyance advance 3,924·37			Humanities	35,514	
Interest from M.E.S. on security deposits 2,161·25					12,61,462
	6,173				
Sale of Tender forms, Iron scrap etc.	14,485				
C/o		1,75,48,501	C/o		1,13,24,786

RECEIPTS	Rs.	Rs	PAYMENTS	Rs.	Rs.
B/F		1,75,48,501	B/F		1,13,24,786
Miscellaneous recoveries	49,280		iii. a. **Depatmental Expenses:**		
Re-checking of answer books	205		Civil Engineering	34,042	
Migration certificate	45		Mechanical Engineering	1,09,306	
Breakages from students	1,258		Electrical Engineering	56,050	
Hire charges for gowns	757		Chemical Engineering	64,930	
Taramani House—Boarding charges	53,375		Metallurgy	35,822	
Subscription to journal of Mathematical & Physical Sciences	1 994		Applied Machanics	34,394	
Seminar in Chemcial Engg.	1,750		Chemistry	55,870	
Forfeiture of E. M. D.	2,500		Physics	44,812	
		3,65,216	Mathematics	574	
Receipts from buildings:			Humanities	765	
Rent	2,12,266		Industrial Engineering	3,686	
Electricity, Water & Service charges	1,01,482				4,40,251
		3,13,748	b. **Institute Scholarships:**		
Lands & Gardens:			Under graduates scholarships	3,22,758	
Auction sale of trees and usufructs	5,812		Post graduates Scholarships	4,52,286	
Sewage farm receipts	649				7,75,044
		6,461	c. N. C. C. (including Pay and Allowances)	62,234	
			Athaletic and Gymkhana (including Pay and Allowances)	77,197	
			T. A. for excursions and surveys	2,314	
			Prizes for Academic distinction	1,600	
			Part-time lecturers and visiting Professors	17,481	
			Inplant training and special inplant course	13,960	
			Convocation.	22,661	
					1,97.447
C/o		1,82,33,926	C/o		1.27.37.528

RECEIPTS	Rs.	Rs.	PAYMENTS	Rs.	Rs.
B/F		1,82,33,926	B/F		1,27,37,528
			iv. Other Sections :		
			a. Central Administration		
			Pay and Allowances of Officers	1,48,246	
			Pay & Allowances of other staff	6,21,668	
					7,69,914
			b. Library :		
			Pay and Allowances of Librarian	11,551	
			Pay and Allowances of establishment	97,019	
			Contingencies-Operating cost	3,253	
			Binding charges	313	
					1,12,136
			c. Contingencies :		
			Postage	29,982	
			Entertainment	6,744	
			Telephones	41,896	
			Liveries	2,814	
			Stationery	59,813	
			Printing	6,778	
			Advertisements	18,524	
			Electricity	11,247	
			Sundries (Miscellaneous Expenses)	36,315	
					2,14,113
C/o		1,82,33,926	C/o		1,38,33,691

RECEIPTS			PAYMENTS		
	Rs.	Rs.		Rs.	Rs.
B/F		1,82,33,926	B/F		1,38,33,691
			d. Other items:		
			General Stores	12,447	
			Expenditure from Director's Discretionary fund	—	
			Technical Bulletins & Journals	2,321	
			Power	3,25,268	
			Oil and Petrol	35,316	
			Security	83,322	
			Repairs and Maintenance		
			Furniture	12,773	
			,, Motor vehicles	38,489	
			,, Cycles	185	
			,, Typewriters & Duplicators	4,495	
			Audit charges	6,635	
			Fire fighting-operating cost	776	
			Remuneration to External Examiners	58,474	
			Duty, Insurance and Road taxes	14,827	
			Models and Exhibits	—	
			Hire charges of Furniture to W. G. Experts	206	
			Scientific Congress and Seminars	5,422	
			Joint entrance examination	88,932	
			Customs duty on personal effects of W. G. Experts.	5,70,856	
			Legal expenses	400	
C/o		1,82,33,926	C/o		1,38,33,691

RECEIPTS			PAYMENTS		
	Rs.	Rs.		Rs.	Rs.
B/F		1,82,33,926	B/F		1,38,33,691
			Honorarium to legal adviser	2,000	
			Grant to Central School	4,200	
			Travelling allowances :		
			Board of Governors	3,581	
			Staff Committees, Selection Committees, Senate etc.	13,735	
			Candidates called for interview for appointment etc.	11,863	
			External examiners	19,394	
			Congress Conferences and Seminars	2,826	
			Joint entrance examination	12,504	
			Training of teachers	2,025	
					13,33,272
			Stores :		
			Pay and Allowances of Stores Officer	14,980	
			Pay and Allowances of Establishment	65,742	
			Contingencies etc.	6,317	
					87,039
			Workshops :		
			Pay and Allowances	5,48,291	
			Contingencies (Instruments, tools and working expenses)	1,38,711	
			Stipend for apprentices	3,084	
					6,90,086
C/o		1,82,33,926	C/o		1,59,44,088

RECEIPTS			PAYMENTS		
	Rs.	Rs.		Rs.	Rs.
B/F		1,82,33,926	B/F		1,59,44,088
			Hostels :		
			Allowance to Wardens	15,201	
			Electricity charges.	65,215	
			Taramani House.	47,693	
			Other charges.		
					1,28,109
Recovery of advances :			**Lands & Gardens :**		
1 Motor car and other conveyance	91,185		Pay and Allowances of Horticultural Supervisor	2,830	
2. Customs Duty on W. G. Equipment	10,91,151		Wages to Labourers, Purchase of seeds etc.	49,565	
3. Customs duty on personal effects of West German Experts	5,69,813				52,395
4. Festival advance	50,132		**Medical-Dispensary :**		
5. Letter of Credit	187		Honorarium and conveyance allowances, to part-time Medical Officer	8,100	
6. Miscellaneous advances	1,05,089		Purchase of medicines	31,809	
7. Unesco coupons-Library	10,353				39,909
8. Colombo plan	319		L.S. & P.C. on account of personnel on Foreign Service		3,561
		19,18,229	Contribution to C. P. Fund		3,14,763
Deposits :			Works & Maintenance (including Pay & Allowances of Maintenance staff)		8,34,286
External Scholarships	4,17,707		Membership fees to outside bodies		5,307
Contractors Deposit (Instt.)	10,000				
Contractors Deposit (Works)	2,90,599				
Students Caution Deposits	14,717				
C. S. I. R.	10,173				
Miscellaneous	2,77,568				
C/o		2,01,52,155	C/o		1,73,22,418

RECEIPTS	Rs.	Rs.	PAYMENTS	Rs.	Rs.
B/F		2,01,52,155	B/F		1,73,22,418
Technical Teachers Training Scheme	1,90,000		Cost of stores lost damaged or rendered unservicable - written off–Engg. unit		7,085
Specialised Training course on multistoreyed buildings	—		**Advances paid:**		
		12,10,764	Motor car and other conveyances	1,02,050	
Grant received from American Chemical Society A/c with First National City Bank, Newyork ($ 15,000)		1,12,500	Customs duty on German equipment	9,95,460	
			Customs duty on personal effects of W.G. Experts	4,85,934	
			Other Advances:		
			Festival advances	44,281	
			Other Miscellaneous advances	1,05,434	
			Library–Unesco–coupons	15,100	
			Chemistry –do–	4,228	
					17,52,487
			Refund of Deposits:		
			External scholarships	4,07,232	
			Contractors deposits (Instt.)	6,500	
			Contractors deposits (Works)	3,15,784	
			Students caution deposits	9,974	
			C. S. I. R.	13,147	
			Miscellaneous Deposits	2,06,132	
			Technical Teachers Training Course	1,71,255	
					11,30,024
C/o		2,14,75,419	C/o		2,02,12,014

RECEIPTS			PAYMENTS		
	Rs.	Rs.		Rs.	Rs.
B/F		2,14,75,419	B/F		2,02,12,014
			Advance paid for purchase out of grant received from American Chemical Society ($ 6577·84)		49,334
			Closing Balance:		
			Cash on hand	6,969	
			With State Bank of India	11,43,936	
			With First National City Bank, Newyork ($ 8422·16)	63,166	
					12,14,071
	Total	2,14,75,419	Total		2,14,75,419

(Sd.) C. R. RAMASWAMY
Accountant

(Sd.) A. V. K. NAMBIAR
Accounts Officer

(Sd.) A. RAMACHANDRAN
Director, Indian Institute of Technology, Madras

Indian Institute of Technology, Madras-36

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31-3-1968

EXPENDITURE	Rs.	Rs.	INCOME	Rs.	Rs.
EDUCATION EXPENSES :			**GRANT FROM GOVERNMENT OF INDIA(On Revenue Account)**		76,64,000
Pay of Teaching Staff			**General Income :**		
Department of Civil Engineering	2,83,168		Tuition fees	2,47,550	
Mechanical ,,	3,53,160		Hostel Seat Rent	1,72,667	
Electrical ,,	3,39,296		Admission Fees	5,915	
Chemical ,,	2,17,894		Gymkhana and Medical Fees	47,757	
Metallurgy	1,24,316		Fines	3,803	
Applied Mechanics & Aeronautical Engg.	2,65,289		Application fees from students	1,07,135	
Chemistry	1,49,830		Examination fees	15,300	
Physics	1,85,619		Fees for degree in absentia	1,755	
Mathematics	1,18,700		Application fees for appointments	16,159	
Humanities	1,57,508				6,18,041
		21,94,780	**Miscellaneous Receipts :**		
Pay of Non-Teaching Staff :			On Gymkhana Account	8,511	
Department of Civil Engineering	1,51,823		Institute Bus Collections	79,505	
Mechanical ,,	2,20,890		Hire charges of Institute vehicles	5,586	
Electrical ,,	2,00,450		Rent on Buildings	2,16,739	
Chemical ,,	1,76,458		Electricity, Water and Service charges	1,20,758	
Metallurgy	91,113		Lands and gardens (Auction sale of trees etc.)	6,461	
Applied Mechanics	1,01,071		Taramani House boarding charges	45,280	
Chemistry	1,01,375		Other receipts	87,734	
Physics	1,57,661				5,70,574
Mathematics	43,526				
Humanities	36,371				
		12,80,738			
C/o		34,75,518	C/o		88,52,615

EXPENDITURE			INCOME		
	Rs.	Rs.		Rs.	Rs.
B/F		34,75,518	B/F		88,52,615
Departmental Expenses :			Excess of Expenditure		
Civil Engineering	61,967		over Income		6,79,319
Mechanical ,,	81,788				
Electrical ,,	54,673				
Chemical ,,	85,672				
Metallurgy	58,410				
Applied Mechanics and Aeronautical Engineering	31,533				
Chemistry	65,915				
Physics	38,511				
Mathematics	627				
Humanitics	767				
Industrial Engineering	3,495				
		4,83,358			
General Expenses :					
Institute Scholarship:					
Under graduates	3,18,550				
Post Graduates	4,60,460				
N.C.C. (including pay and allowances)	60,540				
Athletic and Gymkhana (including pay and allowances)	77,855				
T. A. for Excursion and Surveys	2,314				
Prizes for Academic distinctions	1,600				
Part-time Lecturer and visiting Professors	17,481				
	9,38,800				
C/o		39,58,876	C/o		95,31,934

EXPENDITURE			INCOME		
	Rs.	Rs.		Rs.	Rs.
B/F	9,38,800	39,58,876	B/F		95,31,934
Convocation	22,661				
Inplant Training and Special inplant Course	13,960				
		9,75,421			
Other Sections :					
Central Administration (Pay and allowances)					
Officers	1,51,545				
Establishment	6,29,887				
		7,81,432			
Library :					
Pay and Allowances :					
Librarian	11,605				
Establishment	99,500				
Contingencies – Operating cost	3,292				
–do– Binding charges	4,145				
		1,18,542			
Contingencies :					
Postage	28,873				
Entertainment	6,744				
Telephone	36,201				
Liveries	2,814				
Stationery	49,998				
Printing	6,777				
Advertisements	41,174				
	1,72,581				
C/o		58,34,271	C/o		95,31,934

EXPENDITURE			INCOME		
	Rs.	Rs.		Rs.	Rs.
B/F	1,72,581	58,34,271	B/F		95,31,934
Electricity	16,886				
Sundries (Miscellaneous expenses)	36,475				
		2,25,942			
Other Items :					
General Stores	691				
Technical Bulletin and Journals	2,320				
Power	3,05,367				
Oil and Petrol	36,038				
Security–wages to N.M.R. watchmen	85,132				
Repairs and maintenance – Furniture	12,773				
Repairs and maintenance – Motor vehicles & Cycles	16,913				
Repairs and maintenance – Typewriters & Duplicators	4,445				
Audit charges	9,125				
Fire Fighting – Operating cost	930				
Fees to External Examinars	58,474				
Duty, Insurance and Road Taxes	9,573				
Models and Exhibits	—				
Hire charges of Furniture (West German Experts)	201				
Scientific Congress and Seminars	5,422				
Joint Entrance Examination	88,932				
Customs Duty on Personal Effects of West German Experts	5,70,856				
	12,07,192				
C/o		60,60,213	C/o		95,31,934

EXPENDITURE			INCOME		
	Rs.	Rs.		Rs.	Rs.
B/F	12,07,192	60,60,213	B/F		95,31,934
Legal Expenses	400				
Honorarium to Legal Adviser	2,000				
Grant to Central School	4,200				
Travelling Allowances :					
Board of Governors	3,581				
Staff Selection Committee, Senate, Etc.	13,735				
Candidetes called for interview	11,863				
External Examiners	19,394				
Scientitic Conferences and Seminars	2,826				
Joint Entrance Examination	12,505				
Training of Teachers	2,025				
		12,79,721			
Stores :					
Pay and Allowances-Officers	15,023				
–do- Establishments	66,604				
Contingencies	6,182				
		87,809			
Workshops :					
Pay and Allowances	5,53,872				
Contingencies	1,57,153				
Stipend to Apprentices	6,147				
		7,17,172			
C/o		81,44,915	C/o		95,31,934

EXPENDITURE	Rs.	Rs.	INCOME	Rs.	Rs.
B/F		81,44,915	B/F		95,31,934
Hostels :					
Allowance to Wardens	15,194				
Electricity Charges	63,339				
Taramani House Expenses	50,449				
		1,28,982			
Lands and Gardens :					
Pay and Allowances to Horti-cultural Supervisor	2,856				
Daily wages to Labourer, purchase of seeds, etc.	49,843				
		52,699			
Medical :					
Honorarium and Convayance allowance to P. T. Medical Officer	8,100				
Medical Dispensary	26,260				
Leave salary and pension contribution	4,098				
C. P. F. Contribution	3,22,868				
Works and maintenance	8,31,067				
Membership fees to outside bodies	5,307				
		11,97,700			
Cost of stores lost, damaged or rendered unserviceable writtenoff		7,638			
Total		95,31,934	Total		95,31,934

(Sd.) A. V. K. NAMBIAR
Accounts Officer

(Sd.) A. RAMACHANDRAN
Director, Indian Institute of Technology, Madras

Indian Institue of Technology, Madras-36

Balance Sheet as at 31st March, 1968

CAPITAL FUND AND LIABILITIES				PROPERTY AND ASSETS			
		Rs.	Rs.		Rs.	Rs.	Rs.
CAPITAL FUND				**Buildings:**			
Block value of German Aid per contra:				Cost of completed buildings as on 31—3—'67	3,57,67,367		
Equipment		2,10,35,830		*Add* Buildings completed during the year	65,44,993	4,23,12,360	
Less German aid equiqment		40					
		2,10,35,790		Buildings under construction as on 31—3—'67	1,00,18,418		
Technical Books and Journals		2,26,734	2,12,62,524	*Add* Expenditure for the year	55,27,737		
					1,55,46,155		
Block value of Gift from U.S.A				*Less* Transferred to completed buildings account	65,44,993	90,01,162	5,13,13,522
Analogue computer per contra			2,28,100				
Capital Grants and Balance of Income and Expenditure account as on 31—3—'67		6,42,72,390		**Equipments, Furniture & Fittings**			
Add: Capital Grant during' 67-68		75,00,000		At cost as per Balance sheet as at 31—3—'67	82,01,939		
		7,17,72,390		*Add* Additions during the year	19,63,529	1,01,65,468	
Add: adjustments		26,005					
		7,17,98,395		*Less* Loss of Utensils/Stores written off		553	
Less adjustments 1961—62	52,792						1,01,64,915
Excess of Expenditure over income for 1967—68	6,79,319	7,32,111	7,10,66,284	Value of Analogue Computer received as gift from U.S.A. (tools for freedom) per contra		2,28,100	
				Add Customs Duty, Insurance etc.		11,044	2,39,144
C/o			9,25,56,908	C/o			6,17,17,581

CAPITAL FUND AND LIABILITIES	Rs.	Rs.
B/F		9,25,56 908
Gymkhana fund		42,606
Endowment fund (Governors) Prize etc. to the end of 31—3—'67	2 000	
Add: Additions during the year	7,000	9,000
Deposits:		
Earnest Money, Caution and other Deposits		6,62,724
Sundry Creditors:		
On works account – purchases		1,22,783
For Supplies made or services rendered to Departments Sections.		3,57,633
Outstanding Expenses payable:		
a. Pay and allowances		4,47,772
b. Scholarships		77,428
c. Other allowances-medical		6,443
d. Wages to N. M. R Labourers Departments etc.		11,047
e. Audit fees		8,000
Fees Refundable		3,914
Addltional C. P. F. contribution payable		3,439
Leave salary & Pension Contribution		537
Grant received from American Chemical Society ($ 15,000)		1,12,500
C/o		9,44,22,734

PROPERTY AND ASSETS		Rs.	Rs.
B/F			6,17,17,581
Block value of Equipment from West Germany as per Balance sheet as on 31—3—'67	1,88,47,115		
Add additions during the year	21,88,715		
	2,10,35,830		
Less Cost of equipment written off (1967—68)	40		
		2,10,35,790	
Customs duty & clearance charges on equipment from West Germany as per balance sheet as on 31—3—'67	30,55,037		
Add additions during the year	6,65,783		
	37,20,820		
Less adjustment 1961—62	52,577		
		36,68,243	
			2,47,04,033
Motor vehicles at cost as per balance sheet as at 31—3—'67		3,23,392	
Less adjustment (1960—61)		215	
			3,23,177
Library books and Scientific Journals at cost as on 31—3—'67		13,13,989	
Additions during the year		2,33,728	
			15,47,717
Block value of Technical books & Journals from West Germany as per balance sheet as at 31—3—'67		1,92,207	
Add Additions during the year		34,527	
			2,26,734
C/o			8,85,19,242

CAPITAL FUND AND LIABILITIES		PROPERTY AND ASSETS		
	Rs.		Rs.	Rs.
B/F	9,44,22,734	B/F		8,85,19,242
Unpaid items as on 31—3—'68 as per undisbursed pay register	15,670	Typewriters & Duplicators at cost as per balance sheet as at 31—3—'67	1,10,056	
		Add Additions during the year	5,787	1,15,842
		Tools and Plants (Works) as per balance sheet as on 31—3—'67	2,00,911	
		Add Additions during the year	11,173	2,12,084
		Cycles at cost as per balance sheet as on 31—3—'67	7,817	
		Add Additions during the year	1,235	9,052
		Endowment fund - Investment account Governors prize etc.	2,000	
		Additions during the year	7,000	9,000
		Stock of Provisions with Taramani House as on 31—3—'68		979
		Stock of Consumable stores with Departments as on 31—3—'68		8,49,948
		Stock of Engineering unit as on 31—3—'68 (Works a/c)		22,22,466
		Stock of Stationery articles as on 31—3—'68		21,428
		Stock of tyres and tubes as on 31—3—'68		23,082
		Gymkhana Assets (Projector & Taperecorder) at cost as per Balance sheet as at 31—3—'67	43,016	
		Add Additions during the year	6,795	49,811
C/o	9,44,38,404	C/o		9,20,32,934

CAPITAL FUND AND LIABILITIES	Rs.	PROPERTY AND ASSETS	Rs.	Rs.
B/F	9,44,38,404	B/F		9,20,32,934
		Stock of Consumable stores with Central stores as on 31—3—'68		9,683
		UNESCO - COUPONS - LIBRARY		19,807
		do Chemistry		4,228
		Fees Receivable		9,765
		Rent etc. recoverable		74,387
		Taramani House Boarding charges recoverable		8,287
		Hire charges of Institute vehicle etc. recoverable		3,529
		Stamp on hand		2,903
		Advance paid out of grant received from the American Chemical Society ($ 6577·84)		49,334
		Advances and Deposits		
		Works Advances		1,10,975
		Others (General)		3,27,774
		Deposits with Collector of Customs A/c No. I	4,62,062	
		A/c No. II	92,495	
				5,54,557
		Closing Balances:		
		Cash on hand	6,969	
		Office Imprest Cash	500	
		With State Bank of India (includes refundable deposits of Rs. 6,62,723·83)	11,43,936	
		Balance with First National City Bank, New York ($ 8422·16)	63,166	
		Unpaid Cash Balance	15,670	
				12,30,241
Total	9,44,38,404	Total		9,44,38,404

Note : 1. 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.

2. Demand towards property tax amounting to Rs. 8,31,786·00 for the period from 1/61—62 to 2/67—68 has been received from Corporation of Madras and will have to be incorporated in the Balance sheet after ascertaining the correct position.

(Sd.) A. V. K. NAMBIAR
Accounts Officer

(Sd.) A. RAMACHANDRAN
Director, Indian Institute of Technology, Madras

SECTION V

SECTION V

REPORTS

LIBRARY

STAFF

V. S. Nazir Ahmed, B. A., LL. B., D. L. Sc., Librarian
V. K. Vedapuri, M. A., D. L. Sc., Assistant Librarian
C. Deenadayalu, M. A., B. Lib. Sc., Assistant Librarian
N. Satyamurthi, B. Sc., D. L. Sc., Assistant Librarian
K. Sankaran, B. Lib. Sc., D. S. S., Technical Assistant
P. Venkatesan, B. Lib. Sc., Technical Assistant
Mrs. J. Durairaj, B. Lib. Sc., Technical Assistant
N. K. Gopalakrishnan Empranthiry, B. Lib. Sc., Technical Assistant

PART I

The Library moved into the new building in July, 1967 and was declared open by the Chairman of the Board of Governors on 21st July, 1967. The Director explained the salient features of the building and announced that its services could be extended to the neighbouring industrial organisations and other outsiders without affecting the services to its own academic staff. The Librarian in his report appealed for more funds and staff to carry out the functions of a Technical University Library more effectively as envisaged in the various recommendations of the two Education Commissions and the University Grants Commission.

Readers' Service: The Library continued to work on all the days of the year under review (except for 7 closed holidays for the Library) between 7-30 a.m. to 9-00 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 1,08,000 and the number of books and periodicals issued was 1,26,000.

Book Stacks: The total stock of books and pamphlets rose from 61,439 at the beginning of the academic year to 69,799 as on 30-6-1968 consisting of 58,860 books and 10,939 pamphlets. The periodicals numbering 1,050 titles were continued to be received though some of them subscribed through subscription agents did not arrive in time due to failure on the part of the agents.

Text Book Collection: A separate section of Text Books Collection consisting of multiple copies of recommended books was opened specially for the undergraduates.

Gifts and Exchange: The Library is grateful to the various organizations and other Governmental Agencies for their gifts of publications. Mention may be made specifically of 2,859 German publications (including 2,833 DINS) and 110 periodicals received during the year under the Indo German agreement. Arrangements were also finalized for a regular exchange of publications with the Libraries of the five German Technical Universities co-operating with the Indian Institute of Technology, Madras in planning and developing its academic activities. Of these, the Library of Technical University, Berlin has agreed in addition to supply free Xerox copies of any article of periodicals available in its holding. Thus, the orders for all such photocopies which could not be executed by INSDOC, New Delhi, for want of foreign exchange, were diverted to the Library of Berlin with success.

Reclassification of Books: In pursuance of the recommendation of the Library Committee, the reclassification of the book stock according to Universal Decimal Classification was taken up and pursued progressively particularly during the last two vacations of the Institute by appropriate diversion of the staff. A collection of about 10,000 volumes on General Science, Mathematics, Physics, Chemistry and a few branches of Engineering Sciences has so far been completed.

Library Publications: The Library continued to bring out the Library Information Bulletin, a fortnightly of new accessions to the library stock. It has also published the following two publications and arranged for their distribution among the members and other users of the Library:

(a) Catalogue of Periodical holdings (1-7-68)
(b) Know Your Library - a guide to the Library resources (15-7-68)

While the catalogue was acclaimed as a first and important tool in effective co-operation among the Libraries of IITs and others for inter-Library loans, the guide to the Library was felt useful for better utilization of its resources.

Translation work: Translation service from Russian and German into English was rendered from within the resources available. It has also procured, processed and supplied 278 translation and photocopies of scientific articles from INSDOC, New Delhi, Technical University, Berlin and other outside agencies for the use of the research workers at the Institute.

Bindery: A bindery equipped with modern machinery was commissioned and the binding work was gradually diverted to it from the outside contractors who were doing this job so far. 800 folders of special type for incomplete sets of periodicals were made within the bindery and put the volumes to immediate use by the library members.

Visits & Conferences: The Librarian participated in the following Seminars and Conferences:

(i) Second Annual Seminar on International Library Technique sponsored by IATUL at Delft (Sept 4-9, 1967);
(ii) Second International Congress on Reprography at Cologne (Oct 25-31, 1967); and
(iii) Nineteenth Congress of German Association of Documentalists at Kiel (Oct 10-13, 1967)

He also visited 18 Libraries of technical universities and other organizations in West Germany, Netherlands and Rome and observed their working in detail. Most important of them particularly from the point of exchange facilities are:

(i) Technical University Library, Berlin
(ii) University Library, Stuttgart
(iii) Technical University Library, Braunsweig
(iv) Technical University & Information Centre, Hannover
(v) Technical University, Aachen
(vi) Technical University Library, Delft
(vii) Institute of Pathology of Books, Rome

The above visits and also participation in the Conferences were made possible by the offer of fellowships of D. A. A. D (West Germany) and the Dutch Government.

The Librarian also visited the factories of Agfa-Gaveart (Leverkusen) and Siemens & Rotaprint (Berlin) before recommending their certain makes or models of equipment for Reprography and other sections of the Library which GAWI has now finally agreed to supply to the Institute. The year was also significant in that Dr. P. Kaegbein, the Director of the Technical University Library, Berlin visited our Library in January-February 1968, for exploring and enlarging the scope of co-operation between the Libraries of the Institute and those of the German collaborating Institutes. His suggestions are under active consideration.

PART II

Books:

(i)	Total Number of Volumes acquired till the end of June, 1968	... 69,799
(ii)	Number of books added during the period between 1st July, 1967 and 30th June, 1968	... 8,360

Journals:

(iii)	Total number of Journals ordered during the year under report	... 771

(vi) No. of Journals arranged Department-wise as detailed below :

Department	Subscription & membership	Exchange/German Gift, etc
1. Aeronautics & Applied Mechanics	32	—
2. Chemical Engg	38	29
3. Civil Engg	93	40
4. Electrical Engg	84	73
5. Mechanical Engg	43	49
6. Metallurgy	32	29
7. Chemistry	64	30
8. Humanities	139	1
9. Mathematics	73	22
10. Physics	93	4
11. Journals of common interest to all Depts, Library Science & Gymkhana	80	2
	771	279

(v) **Binding** : No. of Periodicals bound during the year under review and repairing/damages to books, if any : 1,344

(vi) **Gifts** : Names of organizations from where books, pamphlets, circulars and other reading materials have been received as free gift :

1. Association of Commonwealth Universities, London
2. British Petroleum Co., London
3. Director of University Computing Centre, Cincinnati
4. GAWI, Frankfurt
5. Indian Institute of Science, Bangalore
6. Institute of Mathematical Sciences, Madras
7. New Book Co., Bombay
8. Premier Publishers, New Delhi
9. Rotary Club, Poona
10. Swiss Eastern Institute, Berne
11. Tata Institute of Fundamental Research, Bombay-5
12. USIS, Madras-2

(vii) **Library Co-operation** : Names of Libraries from where books and journals were obtained on Inter-Library loan system :

1. Indian Institute of Technology, Kanpur
2. Tata Institute of Fundamental Research, Bombay-5
3. Insdoc, Regional Centre, Bangalore
4. Heavy Electricals (India) Ltd., Bhopal
5. Madras University Library, Madras
6. American Library, USIS, Madras-2

(viii) **Back volumes** : Over 10,000 bound volumes of periodicals on all subjects have been acquired so far.

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 (Electrical)

The Engineering Unit maintained a high tempo of activity during the year and a number of buildings and schemes were completed and handed over for occupation. The following major works may be mentioned:

(i) Women's Hostel
(ii) Students Hostel No. 10
(iii) Bank (with quarters for the Agent)
(iv) Post office (with quarters for the Post-Master)
(v) IV phase Residential quarters, consisting nine Blocks of 'C' type quarters and five Blocks of 'B' type quarters
(vi) Sub-stations for Electric Transformers
(vii) Providing Asphaltic concrete wearing course to the reach of Bonn Avenue.

The construction of the Administration Block is nearing completion.

Under the Second Indo-German agreement the Institute is getting aid in the form of machinery and equipment from West Germany. To house these, the following major construction jobs were taken up during this year:

(i) Extension to the Hydraulics Laboratory
(ii) Structures Laboratory
(iii) Machine Elements and Mechanical Handling Laboratory
(iv) Aeronautics Laboratory

In addition to these major buildings, a number of equipment and instruments were installed in various Departments with such modifications and changes as were needed to suit the requirements of the German Planners and Suppliers in the interests of efficient operation of the instruments etc.

Various minor works pertaining to the Institute buildings, Hostels, etc. were also executed and the maintenance of buildings, water-supply, sewage, and electrification services were attended to regularly. The total amount spent on the construction-works, during 1967-68, was about Rs. 60 lakhs.

THE FACULTY ASSOCIATION

The Faculty Association comprises the academic staff of the Institute. The following were the members of the Executive Committee for the year 1967–68 :

The Director	President
Dr. H. E. D. Zurn	Vice-President
Prof. S. Sampath	,,
Dr. D. Johnson Victor	Secretary
Shri S. K. Jain	Joint Secretary
Shri V. D Muthayya	Treasurer
Dr. V. Anantharaman	Auditor
Dr. N R. Rajappa	,,
Dr. G Aravamudhan	Member
Shri G. V. N. Rayudu	,,
Dr. S. B. S. Sastry	,,
Dr. M. Venugopal	,,

Distinguished speakers, who addressed the Association during the year, included the following :

Date	Speaker	Topic
20–10–67	Dr. Alladi Ramakrishnan, Director, MATSCIENCE, Madras.	Communication among Academicians.
27– 1–68	Prof. M. S. Thacker Former Member, Planning Commission.	Technical Education in India.
28– 2–68	Dr. Paul Kaegbin, Director of Library, Technical University, Berlin.	German Technological University Libraries.

Date	Speaker	Topic
29- 2-68	Dr. Martin Greiffenhagen, Head of the Dept. of Political Sciences, Stuttgart University, Stuttgart.	Democracy and Technocracy.
14- 3-68	Dr. H. A. Havemann, Dr. Kerckhoff and Mr Kretzscmar, Advisers to the Federal Ministry of Economic Cooperation of German Government	Indo-German Co-operation in Technical Education.

A two-day Seminar on "Postgraduate Programmes at I. I. T., Madras", held on 28th and 29th November, 1967, provided the occasion for a free and frank exchange of ideas amongst the members of the Association on the progress of the Institute in the years immediately ahead.

THE ALUMNI ASSOCIATION AND THE STUDENT-PLACEMENT CENTRE

The Alumni Association functioned during the year with the following Office-bearers:

Prof. R. G. Narayanamurthi,	President
Sri V. Gopal	Vice-President
Sri N. Hariharan	Secretary
Sri J. Pattabhiraman	Joint Secretary
Dr. P. Srinivasa Rao	Treasurer
Sri V. D. Muthayya	Auditor
Sri M. Balakrishnan	Member
Sri M. G. Srinivasan	Member

The membership of the Association rose from 791 (July, 1967) to 1,050. The Association is constantly engaged in nourishing the link between the alumni and the *alma mater*.

One issue of the 'Newsletter' was published in January, 1968 and the second third issues were merged with the annual number 'Pradeep'. The General information provided by the Association, especially relating to Foreign Universities, has been valuable to the outgoing students.

Prof R. G. Narayanamurthi was Professor-in-charge of the Placement Section. This section contacted as many as 163 Organisations both in private and public sectors and arranged interviews for students by 21 companies.

The Alumni Association keeps a complete record of the alumni with an indexing system.

NATIONAL CADET CORPS

A. THE AIR WING

During 1967-68, this Unit went into its third year of service at the Institute. Sqn. Ldr. C. P. A. Nair took over command of the Unit on 18th March, 1968 from Flt. Lt. R. N. Ananda Gupta. On 29th March 1968, a Technical Engineering Officer joined the regular Staff. Two N. C. C. Officers, Flg. Offr. P. Sankaran and Lieut. V. Subrahmanyam were placed on the supernumerary list, as they proceeded on deputation to Germany for advanced studies.

The objective of the Air Wing is to train engineering students to become potential technical officers for the Air Force.

At the commencement of the year, the Unit had one N. C. C. Officer, 61 cadets of the Second year and 3 cadets who opted for a third year of training. 59 new cadets were enrolled from fresh entrants to the Institute; and subsequently 127 cadets were transferred from the other Units at the Institute that were disbanded in the wake of the re-organization of the N. C. C. set up.

Training was imparted to the cadets of the first and second years, in accordance with the prescribed syllabus, which comprises Citizenship, General Service Training and Technical Training.

A combined Camp for both the Air-Force and Army Units of the N. C. C. was held at the Air Force Station, Tambaram from 17th to 26th December, 1967. During the camp, instruction was imparted in Physical Training, Ceremonial Parade Field Craft and Range Firing

Two Special Parades were held, jointly with the No. 2 Madras Mixed Coy., N. C. C., on Independence Day and Republic Day. On both the occasions, the Director of the Institute took the salute and addressed the cadets. On Independence Day, the National Solidarity Pledge was administered to the cadets. The cadets presented a special guard of honour to Prof. Sengupto, the outgoing Director of the Institute, on 5th December, 1967.

At the conclusion of the annual training period, 18 cadets, who had completed two years, appeared for the 'B' Certificate Examination. Of these, 3 passed out with a grading of "B" and 8 with a grading of "C".

With the acquisition of additional training aids like aero-engines, the Unit hopes to set up a more interesting and more effective programme of training for its cadets.

B. THE MIXED UNIT

The No. 2 Madras Mixed Engineers/Signals/EME Company N. C. C. is the result of the re-organization of three former Units known as 6 Madras Engineers, 3 Madras Signals and 6 Madras EME. The new, Composite Unit has three platoons, namely Engineers, Signals and EME. It has a capacity for training 200 cadets every year.

The Offices, Stores, Arms-Kit, Ammunition Magazine and Demonstration Rooms are located in the new N. C. C. Building at the Institute. There is a quadrangular well levelled and tarred for parades. A miniature firing range has been constructed in an adjacent open area. A small lake and undulating ground with a few natural features, in the vicinity of the location of the Unit, offer some scope for training in military tactics at the Section Level.

Parades are held every Monday and Thursday from 1630 to 1830 hours. Military training is common to the cadets of all the three platoons and comprises drill without arms, cane-drill and drill with arms. The cadets are given practice in rifle-firing and annual range classification. Exercises are arranged which enable cadets to acquire practice in map-reading, field-craft and section-leading. There is also provision for training in First Aid, Civil Defence and Military History and Geography. Cadets are, from time to time, taken on long-route marches and patrolling.

The Technical Training Programme is directed toward the use, handl ng and operation by the cadets of the technical equipment relevant to the Platoon in which they are enrolled.

The cadets attended the Annual Training Camp for 10 days during December, 1967. The emphasis during the training was on cultivation of endurance, toughness, team-spirit, leadership and allied qualities ; and the acquisition of practice in long-range patrolling, elements of jungle warfare and small-scale mountaineering, together with knowledge of the technical and tactical use of equipment and men in the areas of Signals, Engineers and EME.

Of the cadets who appeared for the 'B' and 'C' Certificate Examinations, 25 qualified for the 'B' Certificate and 20 for the 'C' Certificate. 4 cadets were deputed for the Advanced Leadership Course at Purandhar and 3 for the Course at Noyyar Dam. These cadets acquitted themselves very creditably.

The Unit presented the guard of honour at all ceremonial occasions at the Institute.

The cadets took part voluntarily, in the construction work at the Institute's Swimming Pool.

THE INSTITUTE GYMKHANA

For the Gymkhana the year was marked by vigorous and fruitful activity, thanks to the co-ordinated efforts of the following Committees :

President : Dr. N. Klein

General Secretary : Sri S. Subramaniam

Sub-Committees :

(i)	Sports and Games	:	Sri M. Chandrasekhar, Secretary Prof. E. G. Ramachandran, Staff-Adviser Sri A. N. Lamech, Senior P. T. I. Sri V. Srinivasan, Physical Training Instructor Sri M. Sarvotham, -do- Sri S. Joga Rao, -do-
(ii)	Literary Activities	:	Sri K. S. Lokanathan, Secretary Dr. N. V. Chandrasekharaswamy, Staff-Adviser
(iii)	Music, Entertainment and Films	:	Sri B. Amir Ahmed, Secretary Smt Shanti Sengupto, Adviser
(iv)	Fine Arts and Photography		Sri Ram Kumar Nayar, Secretary Mr. H. J. Ebert, Staff-Adviser.
(v)	Publications	:	Sri M. G. Venkatesh Mannar, Secretary Dr. H. E. D. Zurn, Staff-Adviser Prof. S. Sampath Publisher

The highlights of the year are presented below in summary-form :

22nd July 1967	Dr. N. Klein took over as President from Dr. P. C. Varghese
17th August	Annual Quiz Competition
23rd August	Talent Search Contest
28th August	Inter-Collegiate Student Seminar on "Regionalism and Lack of Communication"
30th August	Participation in the All-India Debate at I. I. T. Bombay.
1st September	Reception to Directors of the I. I. T' s.
6th September	Annual Debate
10th September	Sitar Recital by Sri Janardhanan
13th September	Annual Essay Competition
15th September	Participation in the Servants of India Society, Oratorical Contest
20th September	Inauguration of Gymkhana Activities by Shri M. Sondhi, General Manager, Heavy Vehicles Factory, Avadi
27th September	Inter-Hostel Group Discussion
24th November	Participation in the Dramatics Competition at the College of Engineering, Guindy ("The Bet")

26th November	Participation in the Debate Contest at St. Stephen's College, Delhi
30th November	Puppet show by Mr. Albert Roser
1st December	Inter Hostel Debate
4th December	Address on "Psycho-Therapy" by Dr. D. Dhairyam
5th December	Participation in the Junior Chamber of Commerce Debating Contest
6th December 7th December 12th December 13th December	Inter-Hostel Entertainment Competition for the Engineering Unit Trophy
13th December	Inter-Hostel Quiz Competition (Quiz Master: Sri R. Natarajan)
20th December	Participation in the Debating Contest at Ramjas College, Delhi
26th December 31st December	Inter-I. I. T. Meet at Delhi
29th Jan. 1968 1st February 2nd February 5th February	Film-shows, in aid of the Koyna Earth-quake Victims.
3rd February	Concert by the Philadelphia String Quartet
24th February 25th February 26th February	Inter-Collegiate Basket-Ball Tournament (Organized by the Institute)
24th February 25th February 26th February	Inter-Collegiate Basket-Ball Tournament (Organized by the Institute)
2nd March	Annual Sports
2nd March	Participation in the Debating Contest at I. I. T. Kharagpur
4th March	Inauguration of the Cultural Week-All India Debate
5th March	German Recitation Competition
6th March	Group Discussion
7th March	Quiz Contest
7th March	Variety Entertainment
8th March	Variety Entertainment
8th March	Valedictory Function (Chief Guest : Dr. Alladi Ramakrishnan, Director, Matscience Institute.)
23rd March	Institute Day Chief Guest : Dr. Kaul Pfauter, Consul-General, Federal Republic of Germany, Madras.

The year's activities were rounded off by the Institute Day Ceremony held on 23rd March in the colourful setting of the Open Air Theatre. Dr. Kaul Pfauter, the German Consul-General, who was the Chief Guest addressed the gathering on this occasion and released the Annual Number of the Institute Magazine – a Special Issue that is dedicated to Prof. B. Sengupto, the First Director of the Institute to mark his selfless and devoted services to the Institute in its formative years.

HOSTELS

KAVERI

Dr. B. V. Aswathanarayana Rao, Warden and Chairman, Council of Wardens (till April 1968)

Dr. P. C. Varghese, Warden and Chairman, Council of Wardens (from April 1968)

Sri B. C. Battacharyya, Assistant Warden

Sri R. Ravindran, Assistant Warden

Sri K. Ramamurthy, General Secretary

The Hostel celebrated Independence Day on 15-8-1967 with Sri R. Natarajan, I. A. S., former Registrar of the Institute, as Chief Guest. The Reading Room of the Hostel was inaugurated on 25-9-1967 by Prof. M. Ruthnaswamy, former Vice-Chancellor of Annamalai University. On 21-2-1968, Dr. V. Seshadri, Assistant Professor of Electrical Engineering, addressed the residents of the Hostel on "Trends in Indian Philosophers". On 11-3-1968, Sri K. V. Subba Rao, a leading industrialist of Madras, spoke on 'The importance of Science in relation to the spiritual fulfilment of man.'

The combined Hostel-Day of Kaveri Hostel and Ladies' Hostel was celebrated on 18th March, 1968. Sri C. A. Ramakrishnan, I. C. S., Chief Secretary to the Government of Madras was the Chief Guest. Smt. Ramakrishnan gave away prizes to the winners in the various Hostel-competitions.

The last formal function for the year was on 4th May when the Hostel bade farewell to Dr. B. V. Aswathanarayana Rao and welcomed Dr. P. C. Varghese.

KRISHNA

Dr. N. V. Chandrasekhara Swamy, Warden (till June 1968)

Dr. M. V. C. Sastri, Warden (from June 1968)

Sri S. K. Jain, Assistant Warden

Sri P. Krishna Iyer, Assistant Warden

Sri A. Lahiri, General Secretary

The Literary Secretary, Sri Ashok Kacker, was active throughout the year. The Hostel won the first place in the following Inter-Hostel Games : Basket-Ball, Ball-Badminton, Cricket, Bridge and Chess. The Hostel performed well in Athletics, thanks to its brilliant Relay Team and won the Schroeter Cup. The success in athletics was due to the energetic efforts of Sri George Varghese, Sri Batra, Sri Rajagopalan and Sri Chandrasekhar.

Two special dinner-meetings held during the year were addressed by Mr. Freeman of the U. S I. S. on "The American Policy on Viet-Nam" and by Dr. Alladi Ramakrishnan, Director of the Mathematical Science Institute, Madras on "Some Impressions of my Recent Tour".

The Hostel Carnival was held on 16th March, followed by the Hostel Day on the 17th. Sri G. Lakshminarayanan, Chairman, Indian Bank Ltd., was the Chief Guest. Smt. Lakshminarayanan distributed the Prizes. On this day, 'Krishna Hostel-Brouchure', which has now become a regular annual feature, was released by the Chief Guest.

NARMADA

Dr. D. K. Banerjee, Warden

Sri M. Krishnamurthi, Assistant Warden

Sri E. G. Tulapurkara, Assistant Warden

Sri R. C. Jacob, General Secretary

The Hostel was very active in the area of literary activities and sports. In the Inter-Hostel Competition, the Hostel won the second place in group discussion and the third place in Quiz. The Fine Arts Representative of the Hostel was the Fine Arts Secretary of the Gymkhana. The English Play staged by the Hostel in the Inter-Hostel Entertainment Competition was awarded the First Prize, Sri Sudarsan being adjudged to be the best actor.

In the field of Games and Sports, the Hostel was ranked second for overall performance. It won trophies for Foot-Ball, Athletics and Carroms.

The Hostel-Day was celebrated on 17th Februrary, 1968, with Sri M. V. Arunachalam, Managing Director, Tube Investments Ltd, as the Chief Guest.

TAPTI

Dr. B. V. Ramanamurthy, Warden (till January, 1968)

Dr. J. C. Kuriacose, Warden (from January, 1968)

Sri. G. Subramanian, Assistant Warden

Sri. H. S. Bathla, Assistant Warden

Sri. B. B. Kamdar, General Secretary

With Sri S. Subramanian as the General Secretary of the Gymkhana, Sri K. S. Lokanathan as the Secretary of the Literary Committee and Sri B. Amir Ahmed as the Secretary of the Entertainments Committee, the Hostel was virtually the focus of the cultural activities of the Institute Gymkhana.

The Hostel excelled in the Inter-Hostel Literary and Entertainment Competitions, securing the first place in Debate, Group-Discussion and Entertainment and the second place in Quiz. In the individual competition, Sri R. Shankar stood first and Sri B. Amir Ahmed third in Debate and Sri G. Govindarajan first in General Knowledge and second in Essay-writing. Sri R. Shankar was adjudged to be the best speaker in the All-India Debate conducted by the Institute.

The residents took an active interest in sports, but the Hostel's success in the Inter-Hostel tournaments was limited to Tennikoit (first place) and Table-Tennis (second place). Sri K P. Mohanty organized the indoor-Gymnastics in the Hostel Cellar He won the Mr Strong Man Contest and gained the second place in the Mr. I I T. Contest.

The Hostel-Day was celebrated on 24th February, 1968, with Dr D. N Rao Regional Director of the U. S Educational Foundation in India, Madras as the Chief Guest Smt Susila Ramachandran gave away the Prizes to the winners in the various Competitions.

GODAVARI

Dr. V. Sethuraman, Warden
Sri. S. G. Asthana, Assistant Warden
Sri G Govardhanagiri Rao, Assistant Warden
Sri J. P. Ramappa, General Secretary

Good work was put in by the Secretaries of the various Committees–Sports, Social, Publications and Fine Arts, resulting in a year of many-sided activities.

The Hostel won the top place in the Inter-Hostel Tournaments in Hockey and Tennis In the Inter-Hostel Entertainment Competition, Sri George was adjudged to be the best instrumentalist.

The Library of the Hostel was inaugurated in February, 1968 by Prof. R. K. Gupta.

The Hostel-Day was celebrated on 22nd February, with Sri M. K. Raju, Managing Director, India Pistons Ltd, as the Chief Guest. Mrs. Raju gave away the Prizes to the winners in the various Competitions.

SARASWATHI

Dr. M. Venugopal, Warden
Sri M. Durgaprasad Rao, Assistant Warden
Sri S. Selvaraj, Assistant Warden
Sri T. T. Jagannathan, General Secretary

There was sustained activity throughout the year due to the participation by a large number of students of this Hostel in various sports and cultural events at the Inter-Hostel and Gymkhana levels.

The Hostel started a Library during this year with a good collection of books.

The Hostel-Day was celebrated on 30th March, 1967 with Sri Badrinath, I. A. S as the Chief Guest.

The Hostel organized a Library with about 300 books on English literature and fiction.

The Hostel Table-Tennis Team won the Inter-Hostel Championship. The Hockey-Team won second place and the Cricket Team narrowly missed the first place.

The Hostel-Day was celebrated on 20th March, 1968 with Prof. K. S Hegde Principal, College of Engineering, Guindy, as the Chief Guest.

JAMUNA

Dr. V. Anantaraman, Warden
Sri P. A. K. Murthy, Assistant Warden
Sri J. Chandramouli, Assistant Warden
Sri V. Ramakrishnan, General Secretary

The Hostel was very active in both literary and sporting activities.

The literary activities for the year began on 5th October, 1967 with a debate on the theme : 'One who does not know the art of learning takes up teaching'. A Quiz programme was conducted on 25th November, 1967, with Sri H. S Bathla as Quiz-Master. An Essay-writing competition and an oratorical competition were held in January, 1968. The finale came with a "Tall-Story -telling Competition". It was felt that with a refinement, a competition of this type could be held on an All-India basis.

The Hostel started its own Library with a collection of about 400 books.

The Hostel Kabbadi Team won the Inter-Hostel Championship. The Foot-Ball Team were runners-up. In the Open Boxing Competition, the Bantam and the Feather weight Titles were won boy the Hostel.

The Hostel-Day was celebrated on 10th March, 1968, with Prof. B. Ramamurthy, eminent Neuro-Surgeon, as the Chief Guest. Smt. Dr. Indira Ramamurthi gave away the Prizes to the winners in the various competitions.

ALAKANANDA

Sri S. S. Mani, Warden
Sri N. Venkateswaran, Assistant Warden
Sri M. R. Vijayaraghavan, Assistant Warden
Sri S. Vaidyanathan, General Secretary

A welcome ceremony to the new incoming residents of the Hostel was held on 12th July, 1967, with Prof. B. Sengupto in the Chair.

During the winter-recess (December, 1967), 120 delegates to the Indian Conference of Social work were accommodated in the Hostel. On the final day of the Conference, Sardarini Ujjal Singh was the Guest of Honour at a lunch served in the Hostel. During January, 1968, a group of 40 Napalese students visiting the city were accommodated in the Hostel. On 31st January, this group reciprocated the hospitality by staging an enjoyable entertainment programme of Nepalese music and folksongs.

Sri K. F. Kapadia won the second prize in the Debate conducted by the Servants of India Society.

Sri Edwin Srinivasan and Sri S. Vaidyanathan represented the Madras State in the National Shuttle Badminton Tournament held in Madras during December, 1967.

Sri Gautam Gopalarathnam, with Sri R. Ramakrishnan of Jamuna Hostel, went on a successful Cycle-tour of South India during the summer vacation.

The Hostel won the coveted Engineering Unit Trophy in the Inter-Hostel Entertainment Competition. It also won the Director's Trophy for the Best Garden in the Inter-Hostel Garden Competition.

The Hostel Day was celebrated on 19-2-1968 with Dr. T. Janardhanan, Director of Medical Services, Government of Madras, as the Chief Guest.

LADIES' HOSTEL

Kumari V. Hamsaleelavathy, Assistant Warden
Kumari M. S Janaki, General Secretary
Kumari Y. Pramila, Gymkhana Representative

The Hostel had a strength of 15 students throughout the year. The residents moved into the newly constructed premises on 11th February, 1968.

The Hostel conducted its annual Sports on 10th February, 1968. The sporting events were inaugurated by Smt. Susila Ramachandran.

The Hostel combined with Kaveri in celebrating the Hostel-Day on 13th March, 1968. Sri C. A. Ramakrishnan, I. C S. was the Chief Guest and Smt. Ramakrishnan gave away the Prizes to the winners in various competitions.

MEDICAL CENTRE

STAFF

Dr. P. M. Palani, M. D., Part-time Medical Officer
Dr. (Mrs.) Shanta K., M. B. B. S., D. G O., Medical Officer
Dr. Subhir Ghosh, M. B. B. S., Medical Officer, (From January, 1968)
Sri G. Prabhudas, Dip in Compounding, Pharmacist
Sri K. R. Venkataramani, Dip. in Pharmacy, Pharmacist
Smt. Chandra Joshi, Dip. in General Sickness and Midwifery, Staff-Nurse
Smt. G. Thirupuram, Dip. in Auxiliary Nursing and Midwifery, Ayah
Sri G. Gopalakrishnan, Dresser
Sri M. Adaikalaswamy, Store-Keeper

EQUIPMENT

The Dispensary is equipped to open a Clinical Laboratory with the Chemicals, instruments and accessories acquired during the year. Minor surgical instruments and operation-equipment, worth Rs. 8,815, were added during the year; the minor-operation theatre was commissioned in July, 1967, and as many as 153 minor operations were carried out.

Drugs worth Rs. 31,809 were dispensed to entitled patients.

IMMUNISATION PROGRAMMES

The following immunisation programmes were undertaken and completed during the year;

Cholera Inoculation – 1568 cases;

Small-pox Vaccination- 1568 cases;

Triple Antigen Immunological Schedule (with 3 injections of Antigen at monthly intervals) - 46 children;

Oral Polio Vaccine of Sabin Immunological Schedule against Poliomyelites (with three oral doses of the vaccine at intervals of 6 to 8 weeks) – 40 children;

T. A. B. Vaccination against Typhoid and Para-Typhoid – 550 cases;

INFECTIOUS DISEASES

A Chicken-Pox epidemic of moderate intensity occurred during February, 1968. Twelve cases were isolated and treated at the Dispensary; twentyfive other cases were isolated and treated at the residences of the patients.

There were sporadic cases of infective hepatitis and measles during February-April, 68. These were treated at the residences or referred to the nearby hospital.

ANTE-NATAL AND FAMILY PLANNING CLINICS

An Ante-Natal Clinic for the examination of pregnant women and a Family Planning Clinic for Women began functioning from January, 1967. 137 persons attended the Ante-Natal Clinic. At the Family Plnning Clinic, family-planning methods were explained. Oral contraceptive tablets were issued free of cost. Lippes loop-insertion was carried out in a few voluntary cases and a periodical check up is being done in these cases.

A premature delivery case was handled at the Dispensary on an emergency basis.

The services of a male Social Worker from the Andhra Mahila Sabha Nursing Home has been available from February, 1968 for imparting advice to males in the use of contraceptives. 300 male residents received contraceptives free of cost.

GENERAL

During the year, 355 emergency cases were dealt with at the Dispensary. 256 cases were referred to specialists for consultation and treatment. 33, 175 outpatients were treated at the Dispensary, putting the daily average at 88 cases.

The Dispensary looks forward to a future in which, with increased amenities, it can render more useful service to all the residents of the Campus; It is hoped that steps will be taken to convert it into an inpatient hospital with at least 10 beds, and to provide it with an ambulance van. The establishment of a few out-patient Departments with part-time specialists in areas like Tye, ENT, Dental, Skin etc., is a keenly felt need that awaits fulfilment.

THE CENTRAL SCHOOL

STAFF

Sri M. K. Natarajan, M. A. L. T., Dip. Geo., Cert Lib., Principal

Sri R. Satyanarayana, M. Sc., M. Ed., Post-Grad. Teacher in Mathematics

Smt C. Ravichandran, M. Sc., Post-Graduate Teacher in Biology

Sri E. V. Joseph, M.A., B. Ed., Post-Graduate Teacher in Economics

Sri R. Rama, M A., M. Ed., Cert. A. V. Ed., Cert. A. V. Eqpmt. Post-Graduate Teacher in History

Sri V. S. Sundararajan, M. A., Siromani in Sanskrit, Vidwan in Tamil, Pracharak of Dakshin Bharat Hindi Prachar Sabha, Post-Graduate Teacher in Sanskrit

Sri K. Gururaja Rao, M. A., B. T., Post-Graduate Teacher in English

Smt N. Rajeswari, M. Sc., Post-Graduate Teacher in Chemistry

Kumari S. Rukmini, B. A., B. Sc , M. A , B, Ed., Post-Graduate Teacher in Hindi

Sri K. Swaminathan, M. Sc., Post-Graduate Teacher in Physics

Smt N. Y. Visalakshi, B Sc., B. T., Trained Graduate Teacher in Science

Smt Lucina George, B Sc.,B T, Trained Graduate Teacher in Mathematics.

Sri R. Krishnamurthi, M. A., M. Ed., P. G. Diploma in Geography, P. G Diploma in Social Service, Trained Graduate Teacher in Humanities

Kumari C. S Uma, B A., B T., Trained Graduate Teacher in Humanities

Sri S. P. Tripathi, B. A., B. T., Trained Graduate Teacher in Humanities

Sri K. E. Chandy, B A., D Ph. Ed , Physical Training Instructor

Smt G. Maduram, Rashtra Basha Visharad, Rashtra Basha Praveen, Tech Exam. (Higher Grade) in Needle working and Dress-making ; and Embroidery, Craft Instructress

Sri P Venkateswara Rao, L. E. E., Craft Instructor

Sri L R. Kelkar, Sangeet Praveen, Music Teacher.

CENTRAL SCHOOL

The Kendriya Vidyalaya (Central School) I. I. T., Madras-36 is one of the 120 Higher Secondary Schools established in various parts of the country by the Ministry of Education, Government of India. The School is affiliated to the Central Board of Secondary Education, New Delhi and prepares students for the All-India Higher Secondary Examination.

The School started functioning on July 20, 1964, with Classes VI to IX. Classes X and XI were added in subsequent years. The School 's new premises were declared open on January 20, 1965 by Dr. A.Lakshmanaswami Mudaliar, Chairman, Board of Governors, Indian Institute of Technology, Madras. The School has Class-rooms for intake of 360 pupils, Laboratories for Physics, Chemistry and Biology and a spacious Library-hall. There is a large play-ground with facilities for a variety of outdoor games.

During the year the following members served on the School-Management Committee:

Dr. A. Ramachandran, Director, Indian Institute of Technology, Madras . . (Chairman)

Rev. Fr. L. D. Murphy S. J., Loyola College, Madras

The Accountant-General, Madras

The Collector of Madras

The Divisional Inspector of Schools, Madras Division, Madras-14

Prof. R. G. Narayanamurthi,
Professor of Mechanical Engineering
Indian Institute of Techonlogy
Madras

Prof. R. K. Gupta, Professor of Humanties,
Indian Institute of Technology, Madras

Sri R. Rama, Post-Graduate Teacher in History,
Kendriya Vidyalaya, Madras-36

Sri N. Vaideeswaran, Principal, Kendriya Vidyalaya,
Madras-36 . . (Secretary)

During 1967-68, the strength in the various classes were as follows :

Class VI	...	69
Class VII	...	54
Class VIII	...	64
Class IX	...	44
Class X	...	31
Class XI	...	15
		277

In March, 1968, the second set of 15 students from the School appeared for the All-India Higher Secondary Examination, New Delhi. 14 were successful, 6 being placed in First Class, 7 in Second Class and 1 in Third Class. 3 students of the School were successful in the Joint Entrance Examination conducted by the Indian Institutes of Technology and secured admission into Indian Institute of Technology, Madras.

Prof. R. J. Dennien of the Nuffield Foundation visited the School and conducted an experimental lesson in Physics for the pupils of Class XI. Dr. A. J. Howsoni Assistant Director Curriculum Research and Educational Development Centre, London gave a model lesson in Mathematics for the pupils of Class XI. Both the visitors were favourably impressed by the quality of the students.

The School played the host for an All-India Summer Institute in Biology during May—June, 1968. Forty teachers from all over India attended this Institute sponsored by the British Council, the University Grants Commission and the University of Madras.

The School Day was celebrated on February 29, 1968, with Dr. A. Ramachandran as the Chief Guest. Mrs. Ramachandran gave away the Prizes to the pupils who had won them in literary competitions.

THE PRIMARY SCHOOL

STAFF

Smt. Jebamalai Peter, B. A., B. T., Head Mistress
Smt. M. Tara Bai, Praveen Pracharak
Kumari Sarojini Shanker, B. SC., B. T.,
Smt. L. Vijaya Krishna, B. A., B. T.,
Kumari K. Vimala, B. SC., B. T.
Smt. H. Venkatarangam, Secondary Grade Teacher
Kumari J. Valli, Secondary Grade Teacher
Smt. R. Dhanalakshmi, Secondary Grade Teacher
Smt. Barbara John, B. A.,
Smt. Narayani, Montessori
Smt. Sarah, B. A.,
Smt. H. Fernandez
Smt. Rajamanikam
Kumari S. Pushpa
Smt. Prema, Hindi Visharad (On leave)
Kumari M. Madhavi, Diploma in Bharata Natyam
Smt. Surya Krishna Rao.

Working under the paternal care of Father Murphy, Vana Vani Primary School reached another year of useful service to the residents of the Campus. The Advisory Committee, consisting of the following members, met several times during the year to consider and make suggestions for the smooth and efficient running of the school :

Rev. Fr. L. D. Murphy, Loyola College, Madras, Manager of the School.
Sri M. K. Natarajan, Principal, Kendriya Vidyalaya, Madras-36.
Prof. S. Sampath, Deputy Director, Indian Institute of Technology, Madras-36.
Dr. D. Venkateswarlu, Professor of Chemical Engineering, Indian Institute of Technology, Madras-36.
Smt. Jebamalai Peter, Headmistress, Vana Vani Primary School.

The number of pupils rose to the maximum of 400. The staff strength was 16 teachers, including the Head-mistress, two of the teachers being specially trained for teaching Hindi.

The School held the Annual Sports Day in February, 1968, with Sri C. V. Sethunathan, Registrar, Indian Institute of Technology, Madras as the Chief Guest. Parents' Day was celebrated on April 6, 1968, with Dr. A. Ramachandran in the Chair. This day customarily provides the setting for the Schools' little 'Convocation'. Mrs Ramachandran gave away the Pass-Certificates and Prizes to the outgoing children.

47 children, who successfully completed class V, bade farewell to the School. They will seek admission for further study into the Kendriya Vidyalaya at the Institute or other Schools.

THE STAFF CLUB

The year under review was one of sustained and fruitful activity for the Staff Club. The following were members of the Executive Committee:

Dr. E. G. Ramachandran	President
Sri K. S. Sankaran	Vice-President
Dr. S. B. S. Sastry	General Secretary
Dr. N. M. Raghavendra	Treasurer
Sri A. Venkatesh	Secretary for Sports and Games
Sri. M. R. Vijayaraghavan	Secretary for Fine Arts and Literary Activities

The Club activities for the year were inaugurated on September 19, 1967 by the Hon'ble Justice K. S. Venkataraman, Judge, High Court of Madras.

A Puppet show was held on September 29, 1967. Six language films were screened during the year.

Taking note of the enthusiasm for Badminton among the members, the Staff Club put up a Second Badminton Court which was inaugurated by Dr. A. Ramachandran, Director of the Institute and Patron of the Club, on February 16, 1968. The Staff Club Bridge Team participated in the City League tournaments and put up a creditable performance. A colourful event was occasioned by the visit to the club of the renowned Chess Champion, Sri Manuel Aaron,who engaged simultaneously 20 opponents seated at various tables. That the Club potential for Chess is satisfactory was shown by the fact that three of its players got the better of the champion in this exercise.

The Staff Club combined with the Ladies Club and the Faculty Association to organise a Farewell Dinner to Prof. B. Sengupto and Srimathi Shanti Sengupto in December, 1967.

On the Annual Day on April 30, 1968, which climaxed the activities for the year, the Club had the honour of receiving Srimathi Rukmani Devi Arundale as its Chief Guest.

THE LADIES CLUB

The Club was active, as usual, throughout the year.

In December, 1967, the Club bade good bye to its Founder President, Srimathi Shanti Sengupto. At a General Body Meeting of the Club, the members decided to request the incoming First Lady of the Campus to be the Patron of the Ladies Club and to elect a President from amongst the members.

The following were elected the new office-bearers :

Mrs. P. C. Varghese	President
Mrs. W. Koch	Vice-President
Mrs. M S. Vairanapillai	Vice-President
Mrs. H. C. Radhakrishna	Secretary
Mrs. J. C. Kuriacose	Secretary
Mrs. R G Narayanamurthy	Treasurer

In all the activities of the club, the keynote was on the making of better and happier homes.

Demonstration in cooking were held, highlighting dishes that are popular in different parts of the country represented by the members of the Club. Lessons were arranged in tailoring and doll making, the emphasis being on things that will be lovely and attractive to children. A competition in painting was arranged for the children of the Campus, leading to the award of Prizes on the Club Day. Lessons in First Aid were arranged and Certificates issued to those who attended the Course Other programmes arranged included a book review on 'George Washington's Career' by Mrs. Vairanapillai, and a demonstration of the use of cosmetics by Srimathi Vimala Swaminathan.

The Club has organied a Circulating Library from which members can borrow magazines for a monthly fee of 50 paise.

Dr. (Mrs) Pavanabai was the Chief Guest at the Annual Day of the Club. Many members and children took part in the variety entertainment arranged on this occasion. A notable item was a parade on the stage representing the colourful costumes of India.

Under the leadership of its Patron, the Club plans to enlarge its activities and serve the cause of making the Campus a happy abode for all.

THE STAFF CO-OPERATIVE CANTEEN
(1-7-1967 to 30-6-1968)

The I. I. T, Staff Co-operative Canteen completed four years of service in December, 1967. The following constituted the Board of Management for the year under review.

Dr. V. Srinivasan, Asst. Professor of Chemistry	President
Sri J. C. S. Venkatarangam, U. D. C., Academic Section	Vice-President
Sri K. V. Santhanam, U. D. C., Audit Section.	Secretary
Dr. C. K. Narayanaswamy, Lecturer in Physics	Treasurer
Sri T. Varadarajan, P. A. to the Director	Member
Sri P. Natarajan, U. D C., Physics Department	Member
Sri J. Rajasekharan, U. D. C., Admission Committee	Member
Sri V. Srinivasan, Physical Training Instructor	Member
Sri C. S. Paramaguru, Cashier	Member
Kum. M. S. Vasantha Bai, U. D C., Accounts Section	Member

Sri P. S. Sivaguru, Internal Auditor of the Institute, is *ex-officio* Auditor of the Canteen.

The year proved to be difficult period for the Canteen on account of the sharp increase in the price of all food-stuffs. The sale prices of the edibles served at the Canteen had to be increased. A dividend of 20% was declared for the year 1967 and one month's salary was paid as bonus to the Staff of the Canteen

With prospect of stabilisation of the price-line in respect of provision, oils, pulses etc., the Canteen looks forward to an improved situation in which it can render with efficiency, the much needed service for the Staff of the Institute.

THE INSTITUTE CO-OPERATIVE STORES

The Indian Institute of Technology Co-operative Stores was registered on 12-4-1962 under the Madras Co-operative Societies Act, on the basis of limited liability, and commenced its work on 23-4-1962. Its area of operation is confined to the Campus of the Institute. The membership is restricted to students of the Institute, Staff-members of the Institute and the Hostels of the Institute.

During the year under review the following constituted the Board of Directors of the Stores:

Shri K. Balaraman	President
Shri R. Balasubramanian	Secretary
Shri A. Ramamohana Rao	Treasurer
Shri T. N. Govindarajan	Member
Shri J. Rajamannar	Member

The authorised Capital of the Stores is Rs. 50,000 made up of 5,000 shares of Rs. 10/- each. The membership stood at 849 and the paid-up Share Capital at Rs. 15, 180/- at the end of the year.

Out of Rs. 10,000 borrowed by the Stores from the Institute, in shape of an interest free loan, a sum of Rs. 2,845/- is pending re-payment.

The Stores had an opening stock of Rs. 34,953. 98 P. at the commencement of the year. Goods worth Rs. 3,78,662. 12 P. were purchased and sales effected to the extent of Rs. 3,74,183. 20 P. The stock held at the end of the year was of the value of Rs. 40,626. 38 P. Besides catering to the needs of the students by way of books, stationery, cosmetics etc, the stores supplied provision to the Hostels. The sales, on account of this together with other articles supplied to the Institute, amounted to Rs. 74,719. 44 P.

The Stores continued to run the provision and rations section for the benefit of the residents of the Campus. The Stores took up also the agency for the Indian Express inside the Campus.

With the co-operation of its members, assistance from the Hostels and the patronage of the Institute authorities, the stores hopes to play an increasingly useful role in the community-life of the Institute.

THE EMPLOYEES CO-OPERATIVE BUILDING SOCIETY LTD., MADRAS-36.

The Society, which was established in 1959 and commenced its activities in right earnest during the year 1966-67, continued to be quite active during the year under report. The following were on the Board of Directors as on 30-6-1968:

1. Shri C.V. Sethunathan (Registrar) ... President
2. ,, T.S. Rajagopalan [Asst. Registrar (Admn.)] ... Secretary
3. ,, V. Ramachandran (Asst. Accountant) ... Treasurer
4. Dr. V. Sethuraman, Professor, Department of Civil Engineering
5. Shri B. Ramanathan, Lecturer, Department of Civil Engineering
6. Dr. B. V. Ramanamurthi, Assistant Professor, Department of Physics
7. Shri C.R. Subramaniam, Lecturer, Department of Applied Mechanics
8. Shri R.M. Dubay, Stenographer, Administration

The Society acquired an additional area of 4.59 acres adjoining its site at a cost of Rs. 60,863/-. Thus the total land with the Society is 15·65 acres, purchased at a cost of Rs. 1,94,767/-. A compact layout was prepared and the approval of the Director of Town Planning had been obtained therefor and steps are being taken to allot the sites to the members. The Society has on its anvil a plan to acquire additional area with a view to have its own independent access to Velacheri-Tambaram Road. With this, the Society will have completed its land purchase scheme and may have to embark on its more useful role to offer its services for the development of the area and the house building activities. The total number of members, as on 30-6-1968, stood at 175.

APPENDICES

APPENDIX I

FOURTH CONVOCATION OF THE INSTITUTE
22nd July 1967

The Fourth Convocation of the Institute was held at 5 p. m. on Saturday, 22nd July, 1967 at the Open-Air Theatre of the Institute. Dr. A. L. Mudaliar, Chairman, Board of Governors, presided over the Convocation. Bharat Ratna Sri C. Rajagopalachari 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. The Director conferred the degrees on the candidatas who attended the Convocation to receive their degrees in person and also in absentia on the candidates who could not be present. The numbers of the graduands in the various categories are given below :

	In person	In absentia	Total
Ph. D. Degree :			
Chemistry	1	1	2
Mathematics	2	1	3
Physics	2	—	2
Chemical Engg.	1	—	1
Electrical Engg.	2	—	2
Mechanical Engg.	2	—	2
	10	2	12
M. Sc., Degree :			
Chemistry	5	—	5
Mathematics	6	2	8
Physics	5	2	7
	16	4	20

	In person	In absentia	Total
M. Tech. Degree :			
Chemical Engineering	9	1	10
Civil Engineering	7	4	11
Electrical Engineering	4	3	7
Mechanical Engineering	1	3	4
	21	11	32

B. Tech. Degree: (5-Year and 3-Year Courses):

	In person		In absentia		Total	
	5-year	3-year	5-year	3 year	5-year	3-year
Chemical Engineering	12	1	25	7	37	8
Civil Engineering	10	3	22	4	32	7
Electrical Engineering	9	9	24	19	33	28
Mechanical Engineering	25	1	28	22	53	33
Metallurgy	8	7	10	3	18	10
	64	31	109	55	173	86
	95		164		259	

After the conferment of the Degrees was completed, the Chief Guest distributed the Prizes to all the Prize-winners.

The graduates of the year took the customary pledge, led by Sri Gursharan S. Sidhu, winner of the President's Prize.

The Chairman, in a brief speech, paid a tribute to the outstanding stature of the Chief Guest and requested him to address the graduates.

Sri Rajagopalachari then delivered the Convocation Address. The text of the Address is reproduced in *Annexure* to this Section.

The Chairman signed the Record of Degrees and the Ceremony concluded with the singing of the National Anthem.

ANNEXURE

FOURTH CONVOCATION
22nd July, 1967
Address by Shri C. Rajagopalachari

It is a great honour conferred on me by the Director to make me Chief Guest at this Fourth Convocation of the Indian Institute of Technology.

My first natural duty is to express most grateful feelings towards the Federal Republic of Germany. I do this on behalf of all those who desire the peaceful progress of our country. Three other great Governments have helped to establish technological Institutes in various parts of India. We might discover or invent motives of self-interest in respect of those various governments but in respect of the Federal Republic of Germany nothing but the natural instinct of of helping others, and of dividing what you have with those who do not have it, has induced Germany to help building up this Institute. 12 Professors, 4 Senior Scientific Assistants and 4 Foremen serve in the Institute—all paid by the German Government and only free living accommodation furnished by our Government. During 1967–68, the German Professors will be 24, Senior Scientific Assistants 16 and Foremen 9. Scholarships for 60 Indians for training in Germany will be provided. Two Presidents of the Federal Republic have come here personally and blessed the Institute. Two crores worth of equipment has been supplied.

This scheme of developing big Institutes for higher training in technology was started before the British transferred power to India and while they were still governing this country through their Secretary of State and the Viceroy and his Council. The scheme has advanced very considerably since then and this Fourth Convocation of the Institute in Madras is evidence of India's realization of the technological requirements for progress in the present age.

A great deal of high class research work is being done in the Institute. This is an age of engineering and technology and provided we are lucky in other respects, there is no limit to progress in India as our boys and girls are in no way inferior to boys and girls in other countries in brain matter.

I am very glad to notice that practical workshop training is sandwiched into theoretical teaching and as a result the graduates going out of this Institute will not feel lost when they face reality but plunge into work more easily. This is not the first time I say it! Boys and girls of our country should be trained from the start in using their hands and not brought up in an atmosphere of pure

brain work. They must be taught to think with their hands as all craftsmen do as somebody put it. Advanced theorizing is good and may make a great show, but for helping the country to go forward, training from the earliest period in the use of one's hands must go alongside of theoretical learning. I have seen engineers unable to do anything without maistries and experienced workmen. I have also seen rare engineers who can handle tools and materials and work like the maistry or foreman, when necessary.

Our progress rests on the skill, efficiency and availability of technological engineers. Unfortunately, the world has planted engineers with their potentiality on the brink of a terrible precipice—the nuclear weapons. Any day the world may burst into annihilating flame and then there will be an end to all science and all technology. We have to eliminate nuclear weapons. It is the first condition for maintaining civilization. Or, we must see that war itself disappear. It is difficult to say which is easier and therefore calls for prior effort. The United Nations has failed to tackle the problem of war by reason of opening its doors too wide.

Our internal affairs in India too are not in good order. Without a sound agricultural and economic base we can do nothing with technological improvement or exploit our potentiality in that respect. The continuous production of specially trained technologists or for that matter any other specially trained people involving much private and public expenditure without scope for suitable absorption in technological activities will create an undesirable and unhealthy imbalance. In Soviet Russia and other Communist countries specialised education is limited and adjusted to requirements and so there is not this imbalance in those countries as there will be in countries like ours. Bertrand Russel writing in the Conquest of Happiness says : " It must be admitted that the most intelligent young people in Western countries tend to have that kind of unhappiness that comes of finding no adequate employment for their best talents. This, however, is not the case in Eastern countries. The intelligent young at the present day are, probably, happier in Russia than anywhere else in the world." There is much in the daily papers coming everyday to make us downhearted. We appear to be caught in a bad recession. Many industrial concerns have closed down departments and laid off workers. This is not, however, the place for discussing such matters. But I must say that it is very unfortunate for our graduates that our industrial climate is not favourable for absorption of trained hands. Let us hope that things will improve.

I congratulate all the graduates who have secured diplomas and wish them all success in life and opportunities to help our nation to advance.

APPENDIX II

PRIZE-WINNERS

A. Prizes Awarded at the Fourth Convocation of the Institute Held on 22 July, 1968

President's Prize

(for the student of the B. Tech. Degree Courses with the best academic record)

Shri Gursharan S. Sidhu (5-Year B. Tech., Mechanical Engineering)

Governor's Prize

(for all-round proficiency in the B. Tech. Degree Course)

Shri Thomas Victor (5-Year B. Tech., Mechanical Engineering)

Institute Special Merit Prize

(for the student of the 3-year B. Tech. Degree Course with the best academic record).

Shri Naresh Puri (3-year B. Tech., Electrical Engineering)

Institute Merit Prizes

(for the students with the best academic record in each discipline of each course)

M Tech. Degree Course

Shri N. R. Neelakantan	Chemical Engineering
,, L. S. Jayagopal	Civil Engineering
,, P. Raghavan	Electrical Engineering
,, R. Raman	Mechanical Engineering (*in absentia*)

M. Sc , Degree Course

Shri B. R. Ramachandran	Chemistry
,, R. Parthasarathy	Mathematics
,, M. V. Krishnan	Physics

5-Year B. Tech. Degree Course

Shri R. Neelamegam	Chemical Engineering
,, P. S. Govindarajan	Civil Engineering
,, R. Kalyanakrishnan	Electrical Engineering
,, Gursharan S Sidhu	Mechanical Engineering
,, Gajanan Rajaram Kamat	Metallurgy (*in absentia*)

3-Year B. Tech. Degree Course

Shri Gopal Krishna Chantran	Chemical Engineering (*in absentia*)
,, K. Janakiraman	Civil Engineering
,, Naresh Puri	Electrical Engineering
,, P. Suryaprakasa Rao	Mechanical Engineering
,, P. S. A. Narayanan	Metallurgy

Siemens Prizes

(Presented by Messrs. Siemens Engineering and Manufacturing Company of India Ltd., Madras to the students with the best academic record in Electrical Engineering M. Tech. and 5-year B. Tech. Degree Courses)

M. Tech. Degree Course (Electrical Engineering)

Shri P. Raghavan

5-Year B. Tech. Degree Course (Electrical Engg.)

Shri N. S. Sridharan
(with Heavy Current Engineering option)

B. Prizes Awarded at the Institute Day Held on 23rd March, 1968

(For excellence in academic work during the 1966-67 Session)

Five-Year B. Tech. Degree Course

I Year

1. Shri S. Ramdhyani
2. ,, N. Subbiah
3. ,, S. Narayanamurthi
4. ,, N. Jagadeesh

II Year

1. Shri T. T. Jagannathan
2. , S. Ramakrishnan

Subject	III Year	IV Year
Aeronautical Engg.	Sri D. L. N. Sastry	Sri D. D. Bansal
Chemical Engg.	Sri R. Mutharasan	Sri S. Sivaramakrishnan
Civil Engg.	Sri M. Hariharan	Sri Pawan Kumar Jain
Electrical Engg.	Sri Vikram Prabhu	Sri D. Santhanam
Mechanical Engg.	Sri J. Srinivasan	Sri K. Chandrasekharan
Metallurgy	Sri V. Nagarajan	Sri Dilip Bhandarkar

Three-Year B. Tech. Degree Course

I Year

Sri P. Raghavendran

Subject	II Year
Chemical Engineering	Sri T. N. Kannan
Civil Engineering	Sri R. P. S. Malik
Electrical Engineering	Kum. M. A. Vedavalli
Mechanical Engineering	Sri G. Raghavan

M. Sc., Degree Course

Subject	I Year
Chemistry	Sri G. Kothandaraman
Mathematics	Sri R. Radhakrisbnan
Physics	Sri B. K. Satyan

M. Tech Degree Course

Subject	I Year
Chemical Engineering	Sri M. Balasubramanian
Civil Engineering	Sri B. V. Subrahmanyam
Electrical Engineering	Sri T. T. Vitto
Mechanical Engineering	Sri S. Sampath

Rajalakshmi Krishnamurthi (English) Prize

Sri Paul Prabhakar Swamy

(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–1965–67).

Garden Competition:

Trophy for the best Hostel-Garden	:	Alakananda Hostel
Second Prize	:	Krishna Hostel
Trophy for the best Flower-Garden	:	Jamuna Hostel
Trophy for the best Vegetable Garden	:	Sri R. Vedaraman
Judges' Special Prize	:	Lord Jalakanteswara Temple Garden

INSTITUTE GYMKHANA PRIZE WINNERS 1967-1968

I. Literary Competitions :

Annual Debate	:	Sri R. Shankar ,, V. S. Krishnan ,, B. Amir Ahmed
Annual Quiz	:	Sri Ramani N. Swamy ,, S. Parameswaran ,, T. M. Mukundan
Annual Essay Writing	:	Sri M. G. Jayaraman ,, G. Govindarajan ,, S. Parameswaran
Annual General Knowledge Test	:	Sri G. Govindarajan ,, P. Sundarsan ,, T. L. Palanikumar

II. Inter Hostel Group Discussion :

Winners : Tapti Hostel	:	Sri B. B. Kamdar ,, B. Amir Ahmedi ,, K. S. Lokanathan ,, S. Belani ,, Mohan Chalam.
Runners-up : Narmada Hostel	:	Sri Rathindra N. Roy ,, P. Sundarsan ,, S. Venkatapathy ,, A. D. Chatterjee ,, Umesh Dutta

III. Inter-Hostel Quiz :

Winners : Krishna Hostel	:	Sri Ramani N. Swamy ,, Rajaram Nityananda ,, A. Thiagarajan
Runners up : Tapti Hostel	:	Sri K. S. Lokanathan ,, B. B. Kamdar ,, G. Govindarajan

IV. Inter-Hostel Debate :

Winners : Tapti Hostel	:	Sri R. Shankar
		,, B. Amir Ahmed
Runners-up : Krishna Hostel	:	Sri Ashok Kacker
		,, Rajaram Nityananda

V. Entertainment :

Engineering Unit Troghy (Rolling Cup) : Alakananda Hostel

Best Actor	:	Sri P. Sudarsan
Best Vocalist	:	Sri Baseen
Best Instrumentalist	:	Sri George Varghese
Special Prizes	:	Sri Vijayan
		Sri Mohan Rangala
Best Musical Group	:	Sri Jayaram
		Sri M. S. Venkateswaran
Best Dramatic Group	:	Sri Roy
		Sri Ramajayam
		Sri Shankar N. Swamy
		Sri Ram Kumar Nayar

VI. Publications :

Best Essay	:	Sri Ashok Kacker
Best Technical Article	:	Sri Umesh Datta
Best Poem	:	Sri Sagit
Best Short Story	:	Sri P. C. Venkatachalam
Best Wrapper Design	:	Sri P. Venugopalachari

VII. Lettrics Competition :

First Prize	:	Dr. Hans Wagner
Second Prize	:	Sri Thomas Tharu

VIII Science Fair :

First Prize	:	Sri Vijayanarayana Reddy
		,, Umesh Datta
		,, Kumar Subramaniam
Second Prize	:	Sri Vasanth Kumar
Third Prize	:	Sri Muthanna
		,, Raju
		,, Mohana Krishnan
		,, Amol Kaikini
		,, Kalyanaraman

APPENDIX 3

SCHOLARSHIPS

I. INSTITUTE SCHOLORSHIPS

Sl. No.	Category	No. of awards	Value per annum per student
	Under-graduate Courses :		
1.	Merit Scholorships		
	a) Five-Year B. Tech. Degree Course	81	Rs. 900 (with free tution)
	b) Three-Year B. Tech. Degree Course	20	,, ,,
	c) M.Sc. Degree Course	6	,, ,,
2.	Merit-cum-Means Scholorships		
	a) Five-Year B. Tech. Degree Course	203	,, ,,
	b) Three-Year B. Tech. Degree Course	65	,, ,,
	c) M.Sc. Degree Course	13	,, ,,
3.	Free-Studentships		
	a) Five-Year B. Tech. Degree Course	94	Free Tution
	b) Three-Year B. Tech. Degree	42	,,
	c) M.Sc. Degree Course	7	,,
	Post-graduate Course :		
4.	M.Tech. Degree Course :		
	a) Applied Mechanics (Engineering Mechanics	6	Rs. 3,000
	b) Chemical Engineerlng	27	,,
	c) Civil Engineering	25	,,
	d) Electrical Engineering	25	,,
	e) Mechanical Engineering	17	,,
	D. I. I. T. Course :		
5.	Industrial Engineering	19	,,
	Research Scholors (Registered for Ph.D.):		
6.	a) Science	37	Rs. 3,000
	b) Engineering/Technology	14	Rs. 4,800

II. EXTERNAL SCHOLORSHIPS 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	1,320/-
2.	do	Special Merit Schalorshlp	5	1,500/-
3.	do	Government of India Merit Scholarship for children of Secondary/Primary School Teachers	1	1,100/-
4.	do	State Merit Scholarships	3	900/-
5.	do	National Loan Scholarships	2	970/-
	Assam :			
6.	Director of Technical Education, Shillong	Engineering Scholarship	1	900/-
	Delhi :			
7.	Director of Education, Delhi	National Loan Scholarship	1	1,320/-
8.	do	National Loan Scholarship	1	970/-
	Himachal Pradesh :			
9.	Director of Education, Himachal Pradesh Administration, Simla	Merit Scholarship	1	750/-
	Kerala :			
10.	Director of Collegiate Education, Trivandrum	National Scholarships	13	1,320/-
11.	do	National Loan Scholarships	9	970/-

Sl. No.	Name of the Sanctioning Authority	Nature of Scholarships	No. of students awarded	Value per annum per student
	Madhya Pradesh :			
12.	Director of Technical Education, Bhopal	Engineering Scholarship	1	1,000/-
	Madras :			
13.	Director of Higher Education, Madras	National Scholarships	80	1,320/-
14.	do	National Loan Scholarships	36	970/-
15.	do	Government of India Scholarships to Children of Secondary / Primary School Teachers	7	1,100/-
16.	Director of Harijan Welfare, Madras	Government of India (decentralized) Scholorships for SC/ST/OBC	1	977/-
17.	do	State Scholarships for Backward Class	1	802/-
	Maharashtra :			
18.	Director of Education, Poona	National Scholarships	3	1,320/-
	Mysore :			
19.	Director of Collegiate Education, Bangalore	National Scholarships	23	1,320/-
20.	do	National Loan Scholarships	5	970/-
21.	do	Govt. of India Scholarships to children of Secondary/Primary School Teachers	2	1,100/-
	Orissa :			
22.	Education Department, Govt. of Orissa, Bhubaneswar	National Scholarship	1	1,320/-
		Loan Stipend for Engineering studies	1	1,375/-
	Pondicerry :			
23.	Director of Public Instruction, Pondicherry	National Scholarships	3	1,320/-
24.	do	State Merit Scholarships	2	1,100/-

Sl. No.	Name of the Sanctioning Authority	Nature of Scholorships	No. of students awarded	Value per annum per student
	Punjab :			
25.	Director of Public Instruction, Chandigarh	Govt. of India (decentralised) Scholarships for SC/ST/OBC		1,127/-
26.	do	National Loan Scholarship	1	960/-
27.	Director of Technical Education, Chandigarh	Loan Stipend for Engineering studies	1	600/-
28.	do	do	2	450/-
	Uttar Pradesh :			
29.	Director of Education, Allahabad	National Scholorships	2	1,320/-
30.	do	National Loan Scholarship	1	970/-
31.	Director of Technical Education, Kanpur	Loan Stipend	2	1,000/-
	West Bengal :			
32.	Director of Public Instruction, Calcutta	National Scholarship	6	1,320/-
33.	Ministry of Education, Govt. of India	T. C. S. (Colombo Plan) Scholarships for Nepal scholar	12	3,000/-
34.	do	General (Cultural) Scholarships for Ceylon Scholars	4	3,000/-
35.	M/s. Tata Iron & Steel, Jamshedpur	Jubilee Scholarship	1	1,500/-
36.	do	Scholarship to children of TISCO Workers	1	960/-
37.	Prime Minister's Aid Fund	Financial Assistance	1	900/-
38.	Lala Santaram Tiratharam Public Charitable Trust, Amritsar	Educational Stipend	1	600/-
39.	National Institute of Education, New Delhi	National Science Talent Search Scholarships	3	3,000/-