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International Conference
Computational Methods and Function Theory

March 21-25 1994 • USM

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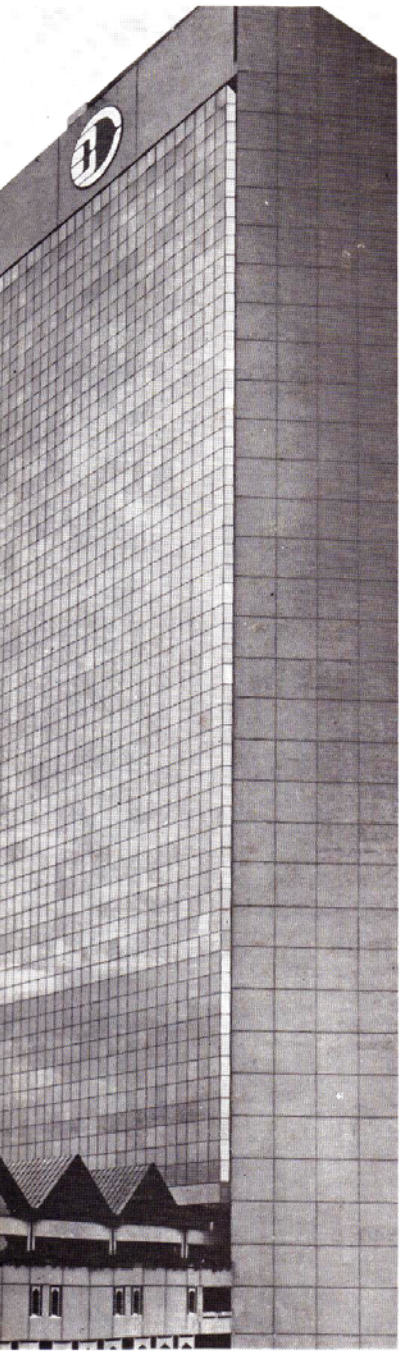
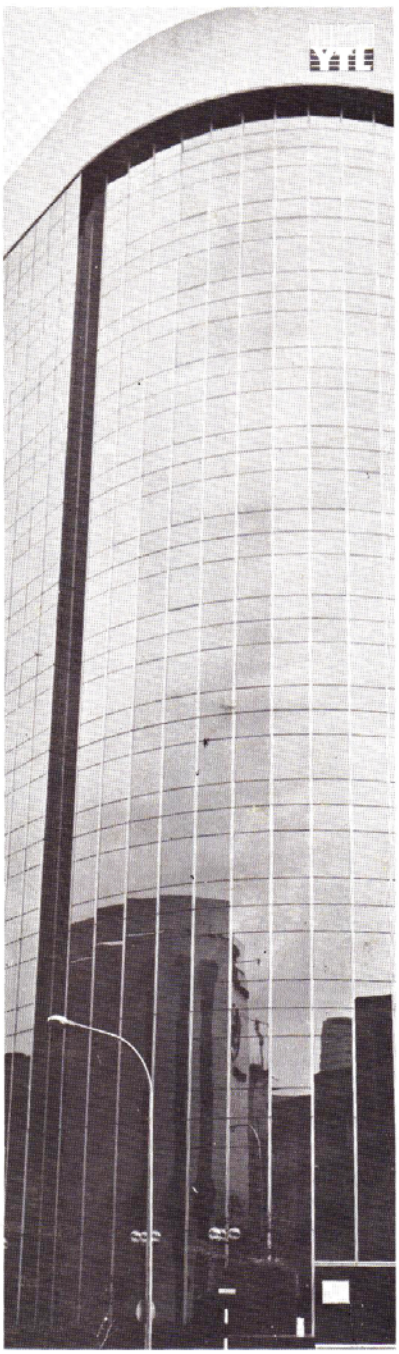
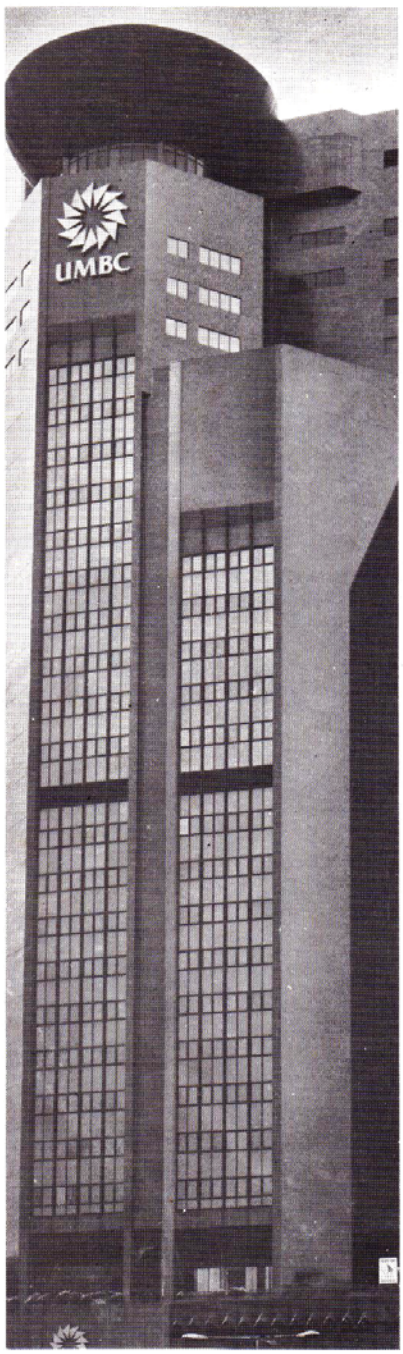
Storeys of success



The 40-storey headquarters of Malaysia Airlines Berhad, one of the many corporate high-rises in YTL Corporation's track record.



YTL Corporation Berhad has commenced operations at its new corporate headquarters, Plaza Yeoh Tiong Lay.



YTL Corporation Berhad's financial institution clients include the United Malayan Banking Corporation.

In the process of developing from a sole proprietorship building company, to a major construction conglomerate, the story of YTL Corporation is a story of success.

Most prominent are the many multi-storey buildings that dot the Kuala Lumpur skyline. The Malaysia Airline Berhad Headquarters, UMBC Tower Annexe and Plaza Yeoh Tiong Lay are but three examples.

However, many of our proudest moments, and greatest achievements, though less visible, are no less rewarding and significant.

Our completion of the Klang Hospital 3 months ahead of schedule was not only good business, but beneficial to the welfare of our community.

Similarly, our now successful skid mounted transportable homes division grew out of a desire to improve the on-site living conditions and efficiency of YTL construction workers.

As both a developer and contractor of low-cost housing, we are conducting on-going research to improve the quality while reducing the price.

And our successful tender (the first by a Malaysian contractor) for a major turnkey project, the MR92.4 million Kuala Terengganu Hospital, reflects our on-going commitment to innovation and progress.

YTL Corporation Berhad, formerly Hongkong Tin Corporation (Malaysia) Berhad, offers new and exciting opportunities to business partners, property developers, potential employees and investors alike.

For more information, visit us at our new office (on the 11th floor of the middle building pictured above) or write to the Manager, Corporate Affairs at the address below.

YTL

YTL CORPORATION BERHAD

Stable & Able

YTL Corporation Berhad, Plaza Yeoh Tiong Lay, 55, Jalan Bukit Bintang, 55100 Kuala Lumpur. Tel: 03-2423666.

International Conference
on
Computational Methods and Function Theory

March 21 - 25, 1994

held under the auspices of

UNIVERSITI SAINS MALAYSIA
PENANG, MALAYSIA

co-sponsors:

PETRONAS • YTL Corporation • SHELL • British Council • International Centre for Theoretical Physics (ICTP) • Committee on Science and Technology in Developing Countries (COSTED) • Malaysia Tourism Promotion Board • Malaysia Airlines • Perwaja Steel • ESSO • Malaysian Mathematical Society • Southeast Asian Mathematical Society • UNESCO

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It is indeed my pleasure to welcome you to Universiti Sains Malaysia on the occasion of the international conference on Computational Methods and Function Theory.

We appreciate and recognize the role that function theory, as one of the fundamental disciplines of mathematics, plays in many areas of science and technology. The advancement of modern computers has made problems in function theory become more manageable. On the other hand, computer algorithms for the solution of these important problems frequently rely on the function theoretic methods and theorems. It is therefore timely and appropriate for this conference to be held as a means for exchanging ideas and information.

I am pleased to see that many specialists are able to congregate at this conference. It has always been our hope to draw greater participation of scientists from the third world countries, and in this regard, I am particularly impressed to see the large gathering of participants from so many different countries.

Best wishes and may this conference achieve its ultimate objectives.

Thank you

DATUK AMAR DR. SULAIMAN BIN HAJI DAUD
Education Minister of Malaysia

The University pays particular attention to matters that enhance its role as an institution of higher learning, in line with its mission of pursuing and maintaining excellence while being committed to the aspirations of the people and country. This mission is embedded in USM's manifesto, which includes exploring and disseminating knowledge and truth, and encouraging the production of quality research.

In this regard, I am pleased that the School of Mathematical and Computer Sciences has taken yet another initiative in organizing this International Conference on Computational Methods and Function Theory. This Conference serves as a perfect forum for algorithmic mathematicians to meet with scholastic mathematicians to discuss new findings in this research field.

This year we celebrate our 25th anniversary and this Conference is one of the more significant events held in conjunction with it. As Vice Chancellor, I am pleased that this Conference is being succesfully organised. I welcome all participants and wish you every success.

DATO' HAJI MUSA MOHAMAD
Vice-Chancellor

I would like to extend my heartiest "Selamat Datang" or a warm welcome to participants of the international conference on Computational Methods and Function Theory.

Mathematics is a growing, expanding and dynamic body of knowledge. Each year thousands of research-related mathematical papers are published. Without doubt, mathematics has made a profound impact on scientific and technical discovery and advancement. These advances are not only dependent on results of mathematical research but are also due to results of mathematical methods.

With this thought, the initiative to hold this conference is most welcomed as it provides opportunities for mathematicians from all over the world to gather and exchange ideas, and to discuss recent advances in function theory and scientific computations. It is especially appropriate to hold this conference in view of the fact that the division between pure and applied mathematics is no longer clearly defined. It is also hoped that this conference will increase public awareness and appreciation of mathematics.

Finally I would like to extend my sincere gratitude to all individuals, particularly to the Organizing Committee, for making this event possible in conjunction with Universiti Sains Malaysia's 25th anniversary celebrations. My best wishes for the success of this conference.

ASSOC. PROF. DR. HASSAN SAID
Dean
School of Mathematical & Computer Sciences

The organizers of the international conference "Computational Methods and Function Theory 1994" welcome all participants and hope and wish that this meeting will have a positive and fruitful impact on them. We are most grateful to the host UNIVERSITI SAINS MALAYSIA for all the efforts that have been taken to provide the "hardware" for running the conference smoothly and in a very pleasant atmosphere. It is our duty, as scientists, to add the adequate intellectual "software" and turn this event into an overall success. We consider it an honour to participate in this forum as part of the celebrations of the 25th anniversary of this still young and developing university.

The scientific goal of CMFT '94 is the continued interaction of the areas of classical Function Theory with Scientific Computations, two subjects which can gain very much from each other. This does not exclude the possibility that certain lectures deal exclusively with one or the other of the two fields: in this case, the experts of both groups in the audience are invited to comment from their points of view.

CMFT '94 is the second in a projected series of conferences on the same subject to be held in various places in the world, where mathematics (and our special subject) is developing. The first one, CMFT '89, took place in Valparaiso, Chile. It is felt that conferences like this can contribute to the better integration of mathematicians from developing countries and regions into the international mathematical community. Also a better inter-cultural understanding seems possible, taking into account that for many foreign participants, this is their first visit to the Southeast Asian region and, in particular, to Malaysia.

We would like to thank all those who have helped us with the preparation of this meeting. It is due to them that we can exchange our mathematical problems and ideas during the coming few days in such friendly surroundings.

Stephan.

PROF. DR. STEPHAN RUSCHEWEYH
(for the organizers)

OPENING CEREMONY

9:25 am - *Arrival of guests*

9:30 am - *Address by the International Advisory Committee Chairman*
Prof. Dr. Stephan Ruscheweyh

- *Address by the Dean, School of Mathematical & Computer Sciences*
Assoc. Prof. Dr. Hassan Said

- *Address by the Vice-Chancellor USM*
The Hon. Dato' Hj. Musa Mohamad

9:50 am - *Official Opening of the Conference by*
The Hon. Education Minister of Malaysia

10:00 am - *Tea Reception*

Growing minds need constant stimuli and challenge.

At Esso, we have emphasised mental development in many ways. Under our Computer Appreciation Programme, which began in 1985, we have donated about 200 computer units to secondary schools throughout the country. We have sponsored computer camps and computer club teachers' training programmes. Our objective? To promote computer proficiency among students, especially those who live in the rural areas. And to equip them with the proper skills for a high-tech future.

Investing in Malaysia's active growing minds.

Investing in Malaysia's active growing minds is not something new on the Esso agenda. We have been doing it for years. With an annual contribution of over RM1.5 million to programmes such as our Student-Of-The-Year awards, scholarships, grants and support for the study of the sciences, welfare and the arts.

Our aim is to help Malaysia achieve its vision to be a developed nation by the year 2020.

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MASTER SCHEDULE

Monday *March 21*	**Tuesday** *March 22*	**Wednesday** *March 23*	**Thursday** *March 24*	**Friday** *March 25*
8:30am - 9:30am Registration				
9:30am - 10:00am Opening Ceremony	*9:00am - 10:00am* Invited Speaker ***Frederick W. Gehring***	*9:00am - 10:00am* Invited Speaker ***Alan F. Beardon***	*9:00am - 10:00am* Invited Speaker ***Herbert Stahl***	*9:00am - 10:00am* Invited Speaker ***Peter B. Borwein***
10:00am - 11:00am Reception	*10:00am - 10:30am* Coffee Break	*10:00am - 10:30am* Coffee Break	*10:00am - 10:30am* Coffee Break	*10:00am - 10:30am* Coffee Break
11:30am - 12:30pm Invited Speaker ***Walter K. Hayman***	*10:30am - 12:30pm* Parallel Session (8 x 25)	*10:30am - 12:30pm* Parallel Session (12 x 25)	*10:30am - 12:30pm* Parallel Session (8 x 25)	*10:30am - 12:30pm* Parallel Session (8 x 25)
1:00pm - 2:00pm Lunch	*1:00pm - 2:00pm* Lunch sponsored by **Penang State Govt.**	*1:00pm - 2:00pm* Lunch sponsored by **Perwaja Steel**	*1:00pm - 2:00pm* Lunch	*1:00pm - 2:00pm* Lunch
2:30pm - 3:30pm Invited Speaker ***Dieter Gaier***	*2:30pm - 3:30pm* Invited Speaker ***Nicholas Papamichael***	**Excursion** *2:45pm - 3:30pm* Sleeping Buddha	*2:30pm - 3:30pm* Parallel Session (4 x 25)	
3:30pm - 4:00pm Coffee Break	*3:30pm - 4:00pm* Coffee Break	*4:00pm - 5:00pm* Butterfly Farm	*3:30pm - 4:00pm* Coffee Break	*3:00pm - 5:00pm* Parallel Session (11 x 25)
4:00pm - 6:00pm Parallel Session (8 x 25)	*4:00pm - 6:00pm* Parallel Session (8 x 25)	*5:30pm - 7:00pm* Beach	*4:00pm - 6:00pm* Problem Session	*5:00pm - 5:30pm* Coffee Break
		7:30pm Buffet Dinner Bayview Beach Resort		
8:00pm Welcoming Dinner The Merlin Hotel hosted by **Vice-Chancellor, USM**				*8:00pm* Farewell Dinner City Bayview Hotel

GUIDELINES FOR ATTENDEES, SPEAKERS, AND SESSION CHAIRS

Two or three rooms will be used for parallel sessions. Each session will last 120 minutes, except on Thursday afternoon. To facilitate session-hopping, all chairpersons should adhere to the listed start times (schedule of equal time per presentation, within each session). For example, presentations in a four paper session would be alloted 30 minutes. The papers should be presented in the order listed in the Program Book.

In the event that the session chair is absent, then of those speakers present, the last speaker scheduled should assume the chair's duties.

Requests for papers presented at the meeting should be made directly to the speaker, not to the session chair or members of the conference committee.

INFORMATION FOR SPEAKERS

Please restrict your presentation to the key issues with a summary of your findings. Individuals interested in a complete exposition may request a copy of your paper. Each speaker is urged to leave some time for a few questions from the floor.

Speakers are reminded that the meeting rooms will contain only overhead projectors, screens, whyteboards, and that they are responsible for preparing and bringing their own transparencies. It is advisable to bring along blank transparencies and markers for last minute revisions and responses to questions. Limited blank transparencies and markers, may also be obtained from the Secretariat at the Conference Hall.

GUIDE FOR SESSION CHAIRPERSONS

Each technical session will last 120 minutes. Speakers should present their papers in the order listed in the Program Book. Out of equity, and to facilitate session-hopping, please ensure all speakers adhere to the alloted starting times for each paper. Session chairs are responsible for starting and ending each session on time and for alerting speakers when five minutes remain for their presentation.

PARALLEL SESSIONS

Monday 4:00pm - 6:00pm

Room 1	Room 2
Dr. Richard Fournier *On a convolution conjecture*	**Dr. Stamatis Koumandos** *On the positivity of some basic orthogonal sums*
Dr. R. Parvatham *On a study of integral operator*	**Dr. Beat Aebischer** *Stable convergence of Möbius sequences*
Prof. V. Singh *On coefficients of parabolic starlike functions of order ρ*	**Prof. Gerhard Opfer** *Faber versus Chebyshev versus minimal polynomials on annular sectors*
Prof. David Minda *Distortion theorems for Bloch functions*	**Prof. I. N. Baker** *Convergence of some iteration processes*

Tuesday 10:30am -12:30pm

Room 1	Room 2
Prof. Ram Singh *Some recent results on the partial sums of convex and starlike functions*	**Prof. Nikolaos Danikas** *Nevanlinna functions with small values on prescribed sequences in the unit disk*
Dr. O. P. Ahuja *Extreme points and convolution properties of a class of analytic functions related to Ruscheweyh derivatives*	**Prof. Chung-Chun Yang** *G.C.D. and L.C.M. of two entire functions*
Dr. Frode Rønning *Integrated univalent functions and a multiplier conjecture*	**Prof. W. J. Thron** *Singularities of analytic functions given in terms of continued fractions*
Prof. Ming-Po Chen *On certain class of multivalent functions defined by Ruscheweyh derivative*	**Prof. Gerhard Schmeisser** *Integral inequalities for entire functions of exponential type*

Tuesday 4:00pm - 6:00pm

Room 1	Room 2
Dr. T. S. Taha *Integral means of harmonic univalent functions*	**Prof. T. K. DeLillo** *Numerical conformal mapping methods based on Faber series*
Dr. Peter C. Fenton *Two variable Wiman-Valiron theory*	**Dr. Andreas Karageorghis** *A numerical conformal mapping technique for harmonic mixed boundary value problems*
Dr. Mehrdad Simkani *On a local limiting behavior of zeros of approximating polynomials*	**Prof. Laurent L. Baratchart** *Rational interpolation of the exponential function*
Prof. Paul M. Gauthier *Approximation on unbounded sets*	**Prof. Edward B. Saff** *Minimal discrete energy on the sphere*

Wednesday 10:30am - 12:30pm

Room 1	Room 2	Room 3
Dr. G. L. Reddy *On various integral operators*	**Wolfgang Lauf** *Local compactness in the automorphism space $\sum(G)$*	**Ms. L. Nalinakshi** *On Salagean-Pascu type of generalized Sakaguchi class of functions*
Dr. T. N. Shanmugam *Certain properties of the class of uniformly convex functions*	**Prof. Carl Fitzgerald** *The Marden constant in several complex variables*	**Prof. K. S. Padmanabhan** *On uniformly convex functions with negative coefficients*
Prof. M. K. Aouf *A new criterion for meromorphic p-valent starlike functions*	**Prof. Lisa Lorentzen** *Asymptotic behavior of solutions of three term Poincaré difference equations*	**Prof. P. R. Subramanian** *Zeros of simple Laguerre polynomials & Hermite polynomials are irrational*
Dr. S. Ponnusamy *On the theory of first order differential subordination*	**Prof. Vladimir Gutlyanskii** *On geometrical properties of certain quasiconformal curves*	**Dr. U. Balakrishnan** *Transformation of series and some applications*

Thursday 10:30am -12:30pm

Room 1	Room 2
Prof. Arcadii Grinshpan *On coefficients of polynomial compositions*	**Prof. Mohd. Rashidi Md. Razali** *A numerical method for conformal mapping*
Prof. Gavin Brown *Positivity of some classical trigonometric sums*	**Dr. Le Ba Khanh Trinh** *Inverse theorems for Padé approximants and their generalizations*
Dr. Xin Li *Orthogonal rational functions*	**Prof. Ngo Van Luoc** *Projection iterative methods for solving boundary value problems in theory of complex functions*
Prof. Ted Suffridge *Approximation of Schwarz-Christoffel mappings by polynomials*	**Prof. Kathy Driver** *Simultaneous rational approximants to a Nikishin system of two functions*

Thursday 2:30pm - 3:30pm

Room 1	Room 2
Dr. Yik-Man Chiang *A note on an oscillation problem of $y'' + (e^z - k)y = 0$ and a result of Bank, Laine and Langley*	**Dr. Tamas Erdelyi** *The resolution of some conjectures via a Remez-type inequality for Muntz spaces*
Prof. Heinrich Renelt *On the Laurent coefficients of generalized powers*	**Dr. J. Caldwell** *Solution of potential problems using integral equations*

Friday 10:30am -12:30pm

Room 1	Room 2
Prof. Yong Chan Kim *Univalent integral operators and their applications*	**Dr. Michael Eiermann** *Zeros of Faber polynomials*
Mr. Marjono *On α-convex functions in a sector*	**Dr. Aslam Chaudhry** *Generalized incomplete gamma functions with applications*
Dr. Rosihan M. Ali *On the fourth and fifth coefficients of strongly starlike functions*	**Dr. J. A. Adepoju** *On the convergence of a class of generalized Goncarov polynomials*
Dr. D. K. Thomas *On the Fekete-Szegö problem for close-to-convex functions*	**Prof. Olav Njåstad** *Convergence of orthogonal rational functions*

Friday 3:00pm - 5:00pm

Room 1	Room 2	Room 3
Dr. Antonio Córdova *On sequences of compositions of analytic functions*	**Dr. Nguyen Huu Duc** *Singularities of generalized Airy-Weber functions*	**Dr. M. S. Ganesan** *Interpolation - A functional analytic approach*
Dr. Faiz Ahmad *Padé approximation for e^x and tan x*	**Prof. Hans-Peter Blatt** *The distribution of sign changes in best L^p-approximation*	**Prof. Mamoru Nunokawa** *On gamma-starlike functions*
Prof. Dinh Dung *Sampling series and approximation of functions*	**Dr. G. B. Thapa** *Min-constant for polynomials*	**Prof. Wang Kun-Yang** *On the convergence of Fourier-Laplace series*
Prof. J. M. Anderson *Quasi-conformal self-mappings with smooth boundary values*	**Dr. Ali Abdul Rahman** *Numerical conditioning properties of generalized polynomials*	**Dr. Yuefei Wang** *Some problems on meromorphic functions*

ABSTRACTS

Monday 11:30am - 12:30pm
Invited Speaker

Integrals of functions along two curves
Prof. Walter K. Hayman, FRS, University of York, England

Suppose that C_0 is a circle and that C is a rectifiable curve, whose interior D contains the interior of C_0, so that $C_0 \subset \overline{D}$. Let L_0, L be the lengths of C_0, C respectively. Then it follows from the isoperimetric inequality that

$$L_0 = \int_{C_0} |dz| \leq \int_C |dz| = L.$$

Suppose now that $\mathcal{F}$ is a class of nonnegative weight functions u(z) defined in $\overline{D}$. We ask under what conditions on $\mathcal{F}$ it remains true that

$$\int_{C_0} u(z)\,|dz| \leq K \int_C u(z)\,|dz|,$$

and what is the best constant $K = K(\mathcal{F}, C)$. If no such constant exists, we set $K(\mathcal{F}, C) = \infty$.

Harold Shapiro conjectured and Garnett, Gehring and Jones [1983] proved, that if $\mathcal{P}$ is the class of moduli of polynomials, then $K(\mathcal{P},C)$ is less than an absolute constant. It can be shown that $K(\mathcal{P},C) < 12$. On the other hand if S^+ is the class of positive subharmonic functions, then $K(S^+,C)$ can be infinite. A survey of the above and related results will be given.

Monday 2:30pm - 3:30pm
Invited Speaker

Conformal modules and their computation
Prof. Dieter Gaier, Justus-Liebig-Universität, Giessen, Germany

There are two types of conformal modules:
modules M(G) for ring domains G
modules m(Q) for quadrilaterals Q.
Both functionals are important not only theoretically, but also in applications, for example in electrostatics, aerodynamics, and torsion problems. Our problem is: How do we compute M(G) and m(Q)?

For M(G) there are available:
Variational methods (Dirichlet and Gauβ-Thomson principle)
Alternating method of Komatu
Application of Bergman's kernel function
For m(Q) there are available:
Variational methods (Dirichlet principle) give upper and lower bounds
Analog method
"Long quadrilaterals" are discussed too.
The lecture will be a survey of these known methods, with some numerical results.

Monday 4:00pm - 6:00pm
Room 1

On a convolution conjecture
Dr. Richard Fournier, Dawson College, Montreal, Canada

We wish to discuss some aspects of a recent convolution conjecture due to St. Ruscheweyh. The conjecture asserts that

$$\mathrm{Re}\left(\frac{f*g*h(z)}{z}\right) > 0,\ z \in E$$

where $f \in \mathcal{D} = \left\{f \in S \mid |f''(z)| \leq \mathrm{Re}(f'(z)),\ z \in E\right\}$, g, h ∈ S.

Here S means the usual class of univalent functions, E the unit disc of the complex plane and * the Hadamard product of functions analytic on E.

On a study of integral operator
Dr. R. Parvatham, Ramanujan Institute, University of Madras, India

We consider the class CS^* of close-to-star functions introduced by M.O. Reade. These functions need not be univalent. But if $f(z) = z + a_2z^2 + \cdots + a_nz^n + \cdots \in CS^*$, then $|a_n| \leq n$; i.e. Bieberbach's conjecture holds positively for this class CS^*. We proved the long unattended problem for this class, namely, CS^* is closed under the Ruscheweyh integral operator for $\alpha \geq 1$; that is whenever $f \in CS^*$ and $\alpha \geq 1$,

$$F(z) = \left\{\frac{c + \frac{1}{\alpha}}{z^c} \int_0^z t^{c-1} f^{1/\alpha}(t)\,dt\right\}^{\alpha}$$

is also in the class CS^*.

On coefficients of parabolic starlike functions of order ρ
Prof. Vikramaditya Singh, Universiti Sains Malaysia, Penang, Malaysia

Let Ω_ρ be the region $\Omega_\rho = \left\{w = u + iv : v^2 \leq 4(1 - \rho)(u - \rho),\ 0 \leq \rho < 1\right\}$ $= \left\{w: |w - 1| < 1 - 2\rho + \mathrm{Re}\,w\right\}$. The class of normalized analytic functions f in the unit disc U for which $f(z) = z + \sum_{n=2}^{\infty} a_n z^n$ and $\frac{zf'(z)}{f(z)} \subset \Omega_\rho$, $z \in U$ is denoted by $S_p(\rho)$ and is called the class of parabolic starlike functions of order ρ. For $\rho = \frac{1}{2}$ this class of functions arises in the study of uniformly convex functions introduced by Goodman and studied in detail by W. Ma and D. Minda, and F. Rønning. In the present paper we obtain sharp upper

bounds on the coefficients $|a_n|$, n = 2, 3 and 4 and first three coefficients of functions inverse to $f \in S_p(\rho)$. Unlike the case of $\rho = \frac{1}{2}$, in the present situation there are at least two extremal functions. However, for the third coefficient of the inverse functions three different cases arise. If $\frac{zf'(z)}{f(z)} = 1 + \sum_{k=1}^{\infty} b_k z^k$, $f \in S_p(\rho)$ we also show that $\sum_{k=1}^{\infty} |b_k|^2 \le 8(1 - \rho)^2$ which is sharp. This yields a general Littlewood type of bound on $|a_n|$ given by $|a_n|\ (n - 1) \le (1 - \rho)\ 2\sqrt{2}\, e^{4(1-\rho)^2}$.

[This is joint work with Rosihan M. Ali]

Distortion theorems for Bloch functions
Prof. David Minda, University of Cincinatti, USA

A holomorphic function f defined on the unit disk D is called a Bloch function provided

$$\|f\|_B = \sup \left\{ \left(1 - |z|^2\right) |f'(z)| : z \in \mathbb{D} \right\} < \infty.$$

Let $B(\alpha)$ denote the class of normalized $\left(\|f\|_B = 1,\ f(0) = 0 \text{ and } f'(0) = \alpha\right)$ Bloch functions; the normalization forces $0 \le \alpha \le 1$. For $\alpha \in (0, 1]$ let $B_\infty(\alpha)$ be the subfamily of locally univalent Bloch functions. A type of subordination theorem is established for both $B(\alpha)$ and $B_\infty(\alpha)$. This subordination theorem can used to derive sharp growth, distortion, curvature and covering theorems for the two classes of functions. The results for locally univalent Bloch functions have applications to hyperbolic geometry on Bloch regions in the plane.

(This is joint work with Mario Bonk and Hiroshi Yanagihara.)

Monday 4:00pm - 6:00pm
Room 2

On the positivity of some basic orthogonal sums
Dr. Stamatis Koumandos, The University of Adelaide, Australia

In their very well-known paper [1] Askey and Steinig state the following problem: Expand the function $f(x) = (1-x)^{-c}(1+x)^{-d}$ in an orthogonal series of Jacobi polynomials P(n, a, b, x). For which values of a, b, c, d are all the partial sums of the above series nonnegative? In [1] all the known cases of the above problem are stated. In [2] Askey gives the connection of this problem with quadrature problems and the positivity of generalized Cotes numbers. We prove some new cases of the above problem as an application of some refined inequalities concerning basic sums of Jacobi, Gegenbauer and Legendre polynomials. Our proof requires some very detailed numerical estimates of special functions. For this purpose we have used "Maple V". We are also going to discuss about Maple V software as a powerful tool in numerical and symbolic computation.

Stable convergence of Möbius sequences
Dr. Beat Aebischer, Universitaet Bern, Switzerland

The search for conditions which guarantee convergence of a parameter depending continued fraction in a neighborhood of a parameter value leads to a natural notion of stable convergence. Assume the sequence of linear fractional transformations $S_n = s_1 \circ \cdots \circ s_n$, $s_n(x) = \frac{a_n x + b_n}{c_n x + d_n}$, converges at some point $x_0 \in \hat{\mathbf{C}}$. (For continued fractions $x_0 = 0$, $s_n(x) = \frac{a_n}{b_n + x}$.) Roughly, the convergence is called stable if, for any choice of linear fractional transformations $\tilde{s}_n$ sufficiently close to s_n, the sequence $\tilde{S}_n(x_0)$ converges, where $\tilde{S}_n = \tilde{s}_1 \circ \cdots \circ \tilde{s}_n$. For instance, a C-fraction $\mathbf{K}\left(\frac{a_n z^{\alpha_n}}{1}\right)$ $(a_n \neq 0)$ which converges stably at $z_0 \in \mathbf{C}\setminus\{0\}$ will converge in a neighborhood of z_0, provided α_n is bounded. Similar assertions hold for general T-fractions, associated continued fractions, and J-fractions.

If a subset of the Möbius group satisfies a certain contraction condition, then every sequence generated by elements of the set converges stably. This result has many consequences, especially for limit periodic continued fractions. Other applications include stability versions of the theorem of Pringsheim, the theorem of Worpitzky, and the uniform parabola theorem. A weaker version of stability is shown to imply stable convergence provided the s_n are contained in a compact subset of the Möbius group.

The results given (as well as the methods used) also hold for Möbius transformations in higher dimension.

Faber versus Chebyshev versus minimal polynomials on annular sectors
Prof. Gerhard Opfer, Universität Hamburg, Germany

In the context of the iterative solution of linear Systems $\mathbf{Ax} = \mathbf{b}$, annular sectors as sets which include the the spectrum of $\mathbf{A}$ have the advantage of being shape invariant under monomial mappings. (This is actually an idea of the late Glenn Schober). Thus, it is of interest to study the various polynomials (Faber, normalized Chebyshev, etc.) on these sectors as tools for creating (quasi-)optimal iteration parameters. Due to work by Coleman, Gatermann, Hoffmann, Myers, Opfer, and Smith (various papers), the Faber polynomials on annular sectors are explicitly computable by means of recursion formulae in dependence on the geometry of the sector. In the above mentioned context, norms of the mentioned polynomials and their relations with respect to each other are of great interest. The connections between the norms will be the topic of the lecture, and particularly the question

on whether it pays to use Chebyshev or minimal polynomials instead of the Faber polynomials will be investigated.

Convergence of some iteration processes
Prof. I. N. Baker, Imperial College, London, England

In addition to iterates f^n of a given complex map f one may consider more general compositions of the types $f_n \circ f_{n-1} \circ \cdots \circ f_1$ and $f_1 \circ f_2 \circ \cdots \circ f_n$. We consider the Julia sets and limit functions of such compositions in some simple cases.

(Work with R. Maalouf).

Tuesday 9:00am - 10:00am
Invited Speaker

Polynomial iteration and the geometry of discrete groups
Prof. Frederick W. Gehring, University of Michigan, Ann Arbor, USA

Let E_n denote the set of complex numbers which occur as the trace of the commutator of two elements in a discrete Möbius, one of which is of order n. We show how the set E_n can be analyzed using a family P of monic polynomials $p = p(z,x)$ in the variable z with parameter x and integer coefficients.

The family P is used with the computer program *Mathematica* to eliminate all but a finite set of possible small values in E_n. Examples from the families of tetrahedral or arithmetic groups then show which points of this finite set actually belong to E_n.

Finally we consider various filled in Julia sets $K(p,x)$ for the polynomials p in P and the corresponding Mandelbrot sets $M(p)$ of the parameter x for which the sets $K(p,x)$ are connected.

(Joint work with G.J. Martin)

Tuesday 10:30am -12:30pm
Room 1

Some recent results on the partial sums of convex and starlike functions
Prof. Ram Singh, Punjabi University, Patiala, India

Let us denote by S the class of functions $f(z) = z + \sum_{n=2}^{\infty} a_n z^n$ which are regular and univalent in the unit disc E. Let S_t, $S_t(\frac{1}{2})$, K and $K(\frac{1}{2})$ stand for subclasses of S consisting of functions which are starlike (w.r.t. the origin), starlike of order ½, convex and convex of order ½, respectively, in E. In this lecture we first review some of the classical results pertaining to partial sums, Cesáro and de la Vallee' Poussin means of functions belonging to these classes, which were obtained up to the end of 1980, and then discuss in detail some important results which have been added to the literature during the last 13 years.

Some of the interesting results we propose to discuss are under:

Theorem 1 [R. Singh] If $f \in S_t(\frac{1}{2})$, $f(z) = z + \sum_{n=2}^{\infty} a_n z^n$, and $s_n(z, f)$ is its nth partial sum, then $\mathrm{Re}\left(\frac{s_n(z,f)}{z}\right) > \frac{1}{2}$ in E. This result is sharp.

Theorem 2 [R. Singh] Let $f \in K(\frac{1}{2})$ and let r_n denote the positive root

$$\phi_n(r) = 1-(n+1)r^n - nr^{n+1} (n \in N).$$

Then for every $f \in K(\frac{1}{2})$, $s_n(z, f)$ maps the disc $|z| < r_n$ onto a convex domain. For even n the number r_n cannot be replaced by any larger one.

Theorem 3 [R. Singh and S. Singh] If $f(z) = z + \sum_{n=2}^{\infty} a_n z^n$ is regular in E and satisfies the condition

$$\mathrm{Re}(f'(z) + zf''(z)) > 0, \ (z \in E),$$

then for each $n \geq 1$, $s_n(z, f)$ is close-to-convex and hence univalent in E.

Theorem 4 [R. Singh and S. Singh] Let $f \in K$, $f(z) = z + \sum_{n=2}^{\infty} a_n z^n$. Then for every $n \geq 1$,

$$\mu_n(zf) = \frac{1}{z}\int_0^z s_n(z, f)dz \prec f(z)$$

in E.

Theorem 5 [R. Singh and S. Singh] If $f \in K$ and $\sigma_n^{(1)}(z, f)$ is the nth Cesáro mean of f of the first order, then

$$\frac{n}{n+1}\sigma_n^{(1)}(z, f) \prec f(z)$$

in E.

Extreme points and convolution properties of a class of analytic functions related to Ruscheweyh derivatives
Dr. O. P. Ahuja, University of Papua New Guinea, Papua New Guinea

Let $M_n(\alpha)$ be the class of functions of the form $f(z) = z + a_2z^2 + \cdots$ that are analytic in the unit disk $\Delta = \{z : |z| < 1\}$ and satisfy the condition $\mathrm{Re}(D^n f)' > \alpha$, $0 \leq \alpha < 1$ in Δ. Here $D^n f$ is the Ruscheweyh derivative of f, that is, the Hadamard product or convolution of f and $z/(1 - z)^{n+1}$. We (i) find the extreme points of closed convex hull, coefficient bounds, and distortion properties for functions in $M_n(\alpha)$, (ii) find lower bounds for $\mathrm{Re}(f(z)/z)$, and $\mathrm{Re}[S_m(z,f)/z]$ where f is in $M_n(\alpha)$, and $S_m(z,f)$ is the m-th partial sum of f, and (iii) show that the Hadamard product of any two functions in $M_n(\alpha)$ belongs to $M_n(\beta) \subset M_n(\alpha)$ where $\beta > \alpha$.

Joint work with M. Jahangiri.

Integrated univalent functions and a multiplier conjecture
Dr. Frode Rønning, Trondheim College of Education, Ranheim, Norway

Let S be the class of analytic and univalent functions f in the unit disk U normalized by $f(0) = f'(0) - 1 = 0$. We call g an integrated univalent function if $zg' \in S$. We say that $h \in S^2$ if

$$h(z) = \int_0^z (f * g)\frac{dt}{t}, \quad z \in U, f, g \in S,$$

where * denotes the Hadamard product. Finally we define D to be the class of functions, normalized as above, and with the property that $|f''(z)| \le \text{Re } f'(z)$ for $z \in U$, and D' to be the derivatives of functions in D. In a paper by Gruenberg, Ruscheweyh and the author, the following conjecture was proposed.

Conjecture. For $G \in D'$ and $h \in S^2$ we have

$$\text{Re}\left\{G(z) * \frac{h(z)}{z}\right\} > 0, \quad z \in U.$$

The conjecture has been proved in a number of special cases which in themselves represent considerable extensions of classical results from the theory of univalent functions. As an example we could mention a generalization of the Szegö $\frac{1}{4}$ theorem on partial sums of functions in S.

In this talk we shall discuss further progress on the conjecture, and one example will be the special choice of functions

$$G_n(z) = \sum_{k=1}^{n} \left(\frac{z}{2}\right)^{k-1} \in D', \quad n = 2, 3, \cdots$$

which will give an extension of an old result about partial sums of integrated univalent functions. Another example will be to choose

$$E_n(z) = \frac{1 + d_n z^n}{1 - d_n z^n} \in D', \quad d_n = \sqrt{n^2 + 1} - n, \; n \in N,$$

which Fournier and Ruscheweyh have proved are extreme points in D'. They also proved that for n sufficiently large, the conjecture holds for $G = E_n$. We will discuss the case $n = 1$, and the problems that arise in this case also turn out to be closely linked to the investigation of integrated univalent functions.

On certain class of multivalent functions defined by Ruscheweyh derivative
Prof. Ming-Po Chen, Academia Sinica, Taipei, Taiwan

Let $M_{n,p}(A,B,\alpha)$ denote the class of functions $f(z) = z^p + \sum_{k=1}^{\infty} a_{p+k} z^{p+k}$ which are regular in the unit disc $U = \{z: |z|<1\}$ and satisfy the condition

$$\frac{D^{n+p} f(z)}{z^p} \prec \frac{1 + \left[B+(A-B)\left(1-\frac{\alpha}{p}\right)\right] z}{1+Bz}, \; z \in U$$

where $-1 \le B < A \le 1$, $0 \le \alpha < p$, n is an integer such that $n > -p$ and $D^{n+p-1} f(z) = \frac{z^p (z^{n-1} f(z))^{(n+p-1)}}{(n+p-1)!}$. In this paper, we show that the functions in $M_{n,p}(A,B,\alpha)$ are p-valent. Then we obtain class preserving integral operator, sharp coefficient estimates, maximization of $\left|a_{p+2} - \mu a_{p+1}^2\right|$ and a closure theorem for the class $M_{n,p}(A,B,\alpha)$. We also obtain a sufficient condition, in terms of coefficients, for a function to be in $M_{n,p}(A,B,\alpha)$ when $-1 \le B < 0$.

(Joint work with M.K. Aouf)

Tuesday 10:30am -12:30pm
Room 2

Nevanlinna functions with small values on prescribed sequences in the unit disk
Prof. Nikolaos Danikas, Aristotle University, Thessaloniki, Greece

We ask the question how small can be the values of a non-identically vanishing Nevanlinna function on a given non-Blaschke sequence in the unit disk. In this connection, we prove the following theorem: Let f be in the Nevanlinna class $\mathcal{N}$ and let z_n be distinct points in the unit disk D with $\sum_{n=1}^{\infty} (1-|z_n|) = \infty$. Further, let $\lambda_n > 0$, $\lambda_n \to \infty$ as $n \to \infty$ and $\varepsilon_n > 0$, $\sum_{n=1}^{\infty} \varepsilon_n < \infty$.

If

$$|f(z_n)| < \exp\left[-\frac{\lambda_n}{1-|z_n|} - \frac{1}{\delta_n^2}\right], \; n = 1, 2, \cdots,$$

where $\delta_n = \min\left\{\varepsilon_n, \frac{1}{2} \inf_{\substack{i \in N \\ i \ne n}} |z_n - z_i|\right\}$, $n \in N$, then $f \equiv 0$.

This result is an extension of the classical theorem of Blaschke about the zeros of functions in the Nevanlinna class $\mathcal{N}$ in the case when these zeros are distinct.

G.C.D. and L.C.M. of two entire functions
Prof. Chung-Chun Yang, The Hong Kong University of Science & Technology, Hong Kong

Let K, H, f, g, h and k denote entire functions and $h \mid f$ denote h is a right factor of f or $f = \alpha o(h)$ for some entire α. h is called a G.C.D. of f and g iff $h \mid f$, $h \mid g$ and if any other k has this property, then $h \mid k$. Similarly H is called a L.C.M. of f and g iff $f \mid H$, $g \mid H$ and if any other K has this property, then $H \mid K$. In this talk, results on

the existence of G.C.D. or L.C.M. of certain classes of functions will be reported.

Singularities of analytic functions given in terims of continued fractions
Prof. Wolfgang J. Thorn, University of Colorado, Boulder, USA

Integral inequalities for entire functions of exponential type
Prof. Gerhard Schmeisser, Universität Erlangen-Nürnberg, Germany

There are two types of Bernstein inequalities, namely estimates of a derivative f' in terms of f and estimates of a function f outside a set S in terms of its restriction to S. For entire functions of exponential type τ and the L^p norm, they read as follows:

$$(1)\quad \|f'\|_p \le \tau\|f\|_p \text{ and } \|f(.+iy)\|_p \le e^{\tau|y|}\|f\|_p \ , \ y \in \mathbf{R},$$

where

$$\|g\|_p := \left(\int_{-\infty}^{\infty}|g(x)|^p dx\right)^{1/p} \ , \ p \ge 1.$$

These inequalities have been extensively studied and refined in various ways. Stronger conclusions without and with an additional hypothesis have been obtained. Further, attempts were made to find analogues with $\|g\|_p^p$ replaced by $\int_{-\infty}^{\infty}\phi(|g(x)|)dx$, where ϕ belongs to a class of functions including $\phi(x)=x^p$. In many situations, the case $p \in (0,1)$, where $\|\ .\ \|_p$ is not a norm, was an open problem.

We present a unified approach leading to a theorem which is not only a common source for both of the inequalities (1) but yields also six refinements due to Achieser, Boas, and Rahman and extends them all to integral inequalities with a function ϕ as mentioned above, thereby giving an affirmative answer to the question concerning $p \in (0,1)$.

Tuesday 2:30pm - 3:30pm
Invited Speaker

Domain decomposition methods for numerical conformal mapping
Prof. Nicholas Papamichael, University of Cyprus, Nicosia, Cyprus

A system consisting of a Jordan domain Ω and four points z_j, j = 1, 2, 3, 4, in counterclockwise order on its boundary is said to be a quadrilateral

$$Q := \{\Omega; z_1, z_2, z_3, z_4\} \ .$$

Such a quadrilateral Q is conformally equivalent to a rectangle

$$R_H := \{(\xi,\eta) : 0 < \xi < 1, \ 0 < \eta < H\},$$

in the sense that for a certain unique value of H (which is called the "*conformal module*" m(Q) of Q) there exists a conformal map $F : \Omega \to R_H$ which takes the four points z_j, j = 1, 2, 3, 4 respectively onto the four vertices of R_H. The conformal map F has many important applications, and in these the value of the conformal module m(Q) is often of special significance.

In this talk, we review the theory and area of applicability of a domain decomposition method for computing approximations to F and m(Q). Further, by making use of the available theory, we investigate the validity of certain heuristic results which are proposed in the VLSI literature for the approximation of m(Q).

This is a report of joint work with N.S. Stylianopoulos.

Tuesday 4:00pm - 6:00pm
Room 1

Integral means of harmonic univalent functions
Dr. T.S. Taha, Kuwait University, Safat, Kuwait

Two-variable Wiman-Valiron theory
Dr. Peter C. Fenton, University of Otago, Dunedin, New Zealand

Wiman-Valiron theory involves the analysis of the behaviour of entire functions by means of auxiliary functions associated with their Taylor series, principally the maximum term of the series and the central index, which is the index of the maximum term. The case of functions of a single variable is well understood. Some progress has been made in the several-variable case, notably by Schumitzky in his thesis [1965], but the development is less coherent. I will discuss a two-variable formulation of the so-called comparison version of the one-variable theory due to Saxer [1923], Clunie [1953, 1955], Kovari [1961] and Hayman [1974].

On a local limiting behavior of zeros of approximating polynomials
Dr. Mehrdad Simkani, The University of Michigan-Flint, USA

Let f be a piecewise analytic (but not analytic) function in $C^k[a, b]$, $k \ge 0$, and let p_n^* be the sequence of polynomials of best uniform approximation to f on [a, b]. It is well-known that every point of [a, b] is a limit point of zeros of p_n^*'s. Let $x \in [a, b]$, and suppose that f is analytic at x and $f(x) \ne 0$. The main purpose of this paper is to show that there exists a constant γ (which depends only on x) such that there is no zero of p_n^* within the circle of radius (γ/n) log n centered at x, for all sufficiently large values of n.

Approximation on unbounded sets
Prof. Paul M. Gauthier, Universite de Montreal, Canada

We give a survey of the state of approximation on unbounded sets by harmonic, (pluri) subharmonic, or holomorphic functions.

Tuesday 4:00pm - 6:00pm
Room 2

Numerical conformal mapping methods based on Faber series
Prof. Thomas K. DeLillo, Wichita State University, Wichita, U.S.A

This is a report on joint work with Alan R. Elcrat of Wichita State University and John A. Pfaltzgraff of the University of North Carolina at Chapel Hill. Methods are presented for approximating the conformal map from the interior of an ellipse or a cross-shaped region to the interior of a simply-connected target region with a smooth boundary. These methods constitute a reformulation and extension of the methods for the disk due to Fornberg (1980) and for the ellipse due to DeLillo and Elcrat (1993) and are attempts to circumvent the severe ill-conditioning due to the crowding phenomenon suffered by conformal maps from the unit disk to target regions with elongated sections while preserving the fast Fourier methods available on the disk. The methods are based on expanding the mapping function in the Faber series for the ellipse or cross regions. All of these methods proceed by approximating the boundary correspondence of the map with a Newton-like iteration. At each Newton step, a system of linear equations is solved using the conjugate gradient method. The matrix-vector multiplication in this inner iteration can be implemented with fast Fourier transforms at a cost of O(NlogN). The basic operator equations are formulated and the spectra of the linear systems is discussed. Several computational examples are given along with a discussion of the accuracy of the methods. The application of these methods to transplanting and solving the Dirichlet problem for the Laplace equation is also discussed.

A numerical conformal mapping technique for harmonic mixed boundary value problems
Dr. Andreas Karageorghis, University of Cyprus, Nicosia, Cyprus

We propose a numerical conformal mapping technique for solving harmonic mixed boundary value problems in simply connected domains. The domain of the problem under consideration is transformed into the upper half plane by existing numerical conformal mapping packages. The solution of the problem at any point of the domain may then be expressed as a finite sum of Cauchy singular integrals. These are computed using existing quadrature packages. Several test problems are considered.

Rational interpolation of the exponential function
Prof. Laurent L. Baratchart, INRIA, France

Minimal discrete energy on the sphere
Prof. Edward B. Saff, University of South Florida, Tampa, USA

We investigate the energy of arrangements of N points on the surface of a sphere in $\mathbf{R}^3$, interacting through a power law potential $V = r^{\alpha}$, $-2 < \alpha < 2$, where r is Euclidean distance. For $\alpha = 0$, we take $V = \log(1/r)$. An area-regular partitioning scheme of the sphere is devised for the purpose of obtaining bounds for the extremal (equilibrium) energy for such points. For $\alpha = 0$, finer estimates are obtained for the dominant terms in the minimal energy by considering stereographical projections on the plane and analyzing certain logarithmic potentials. A general conjecture on the asymptotic form (as $N \to \infty$) of the extremal energy, along with its supporting numerical evidence, is presented. Also we introduce explicit sets of points, called "generalized spiral points", that yield good estimates for the extremal energy. At least for $N \leq 10{,}000$ these points provide a reasonable solution to a problem of S. Smale arising in complexity theory.

(Joint work with E.A. Rakhmanov and Y.M. Zhou)

Wednesday 9:00am - 10:00am
Invited Speaker

The Denjoy-Wolf Theorem and some generalisations
Dr. Alan F. Beardon, University of Cambridge, England

The Denjoy-Wolf Theorem is that if f is an analytic map of the unit disc into itself, but not a Mobius map, then the iterates of f converge locally uniformly to a constant. Such an f is a contraction in the hyperbolic metric and, using only the properties of a contraction, one can extend the result to contractions of a large class of Riemannian manifolds of negative curvature and any dimension.

We shall also discuss the Euclidean version of the theorem in which f is an analytic Euclidean contraction of a bounded convex domain in the plane, and mention some unsolved problems in this area.

Wednesday 10:30am - 12:30pm
Room 1

On various integral operators
Dr. G.L. Reddy, University of Hyderabad, India

Let A denote the set of functions $f(z) = z + a_2 z^2 + \cdots$ which are analytic in the unit disc, and let S denote the subset of A consisting of univalent functions. With suitable conditions on the constants α, β, γ and δ and on the analytic functions $\phi(z)$ and $\Phi(z)$, it is shown that the integral operator

$$I(f)(z) = \left[\frac{\beta+\gamma}{z^{\gamma}\Phi(z)} \int_0^z f^{\alpha}(t)\phi(t)t^{\delta-1}dt\right]^{1/\beta} = z + b_2 z^2 + \cdots$$

maps certain subsets of A into S. This result is then modified to obtain integral operators mapping S*, K, S* x K and K x K into S* . Here S* and K denote the subsets of S consisting of starlike and convex functions respectively.

Certain properties of the class of uniformly convex functions
Dr. T.N. Shanmugam, Anna University, Madras, India

The class of uniformly convex functions was introduced and studied in 1991 by A.W. Goodman and its properties were studied by several authors thereafter. The class UCV of uniformly convex functions consists of those functions

$$f(z) = z + \sum_{n=2}^{\infty} a_n z^n \qquad (1)$$

analytic in the open unit disk $U = \{z: |z| < 1\}$ which satisfy the condition

$$\mathrm{Re}\left\{1 + (z-\zeta)\frac{f''(z)}{f'(z)}\right\} > 0$$

for all $z, \zeta \in U$. It was observed that the class UCV is a subclass of the class of convex functions. A function f of the form (1) is said to be uniformly starlike if

$$\mathrm{Re}\left\{\frac{(z-\zeta)f'(z)}{f(z) - f(\zeta)}\right\} > 0, \; z, \zeta \in U.$$

In this paper, the class of uniformly convex functions is shown to be closed under convolution with convex functions. As a consequence of this result, UCV is invariant under the Bernardi operator. Further, a sufficient condition for a function to be in UCV, some radius problem concerning the class UCV and a coefficient estimate for functions in UCV are also discussed.

A new criterion for meromorphic p-valent starlike functions
Prof. M.K. Aouf, University of Mansoura, Egypt

Let M_n be the class of functions of the form

$$f(z) = \frac{1}{z^p} + \sum_{k=0}^{\infty} a_k z^k \qquad (p \in N = \{1, 2, \cdots\})$$

which are regular in the punctured disc $U^* = \{z: 0 < |z| < 1\}$ and satisfying

$$\mathrm{Re}\left\{\frac{D^{n+1}f(z)}{D^n f(z)} - (p+1)\right\} < -p\frac{n}{n+1} \quad \left(n \in N_0 = \{0, 1, \cdots\}, \; |z| < 1\right),$$

where

$$D^n f(z) = \frac{1}{z^p}\left(\frac{z^{n+p} f(z)}{n!}\right)^{(n)}$$

It is proved that $M_{n+1} \subset M_n$. Since M_0 is the class of meromorphically p-valent starlike functions, all functions in M_n are p-valent starlike. Further we consider the integrals of functions in M_n.

On the theory of first order differential subordination
Dr. S. Ponnusamy, SPIC Science Foundation, Madras, India

In a series of articles, many authors studied the applications of differential subordination and convolution concerning certain classes of analytic functions in the unit disc. In this paper, we shall list some of the recently known published results for the classes of Bazilevic functions, starlike functions, etc,. We then present some new theorems and finally suggest some open problems in connection with these techniques.

Wednesday 10:30am - 12:30pm
Room 2

Local compactness in the automorphism space $\Sigma(G)$
Mr Wolfgang Lauf, Universität Würzburg, Germany

In 1984 D. Gaier introduced the automorphism space $\Sigma(G)$, i.e. the set of all conformal self-mappings of some simply-connected domain G in the plane endowed with the topology of (chordally) uniform convergence in the whole domain G. He raised the question, whether and under which conditions the space $\Sigma(G)$ can be locally compact.

We will answer this question by proving that usually $\Sigma(G)$ is either discrete or not locally compact and by characterizing all those spaces $\Sigma(G)$ which are locally compact. Furthermore, using so-called spike functions defined by $f(z) = \sum_{k=0}^{n} r_k e^{i\alpha_k}\left(1 - (1 - ze^{-i\alpha_k})^{\lambda_k}\right)$, $n \in N$, $r_k \in R^+$, $\alpha_k \in [0, 2\pi)$, $\lambda_k \in (0, 1)$, $z \in D$, we will present a method to construct simply-connected domains with an arbitrarily complicated boundary, but non-discrete and non-locally compact automorphism space $\Sigma(G)$.

The Marden constant in several complex variables
Prof. Carl H. FitzGerald, University of California, San Diego, USA

Recently, Minda developed ideas of Bonk to study the Marden constant in one complex variable. In this paper, this theory is extended to several complex variables. The new theory applies to some classical domains. For each such domain, there exists a positive constant c such that for every holomorphic mapping f on the domain, there exists a hyperbolic ball of radius c in the domain on which f is one to one. The constant c is the Marden constant. Estimates of the constant are obtained for various domains.

Joint work with Sheng Gong.

Asymptotic behavior of solutions of three term Poincaré difference equations

Prof. Lisa Lorentzen, University of Trondheim, Norway

Let $\{P_n\}_{n=-1}^{\infty}$ be the solution of the Poincaré difference equation

$P_n = b_n P_{n-1} + a_n P_{n-2}$; $n = 1, 2, 3, \cdots$, where all $a_n \neq 0$

with initial values $P_{-1} = 0$, $P_0 = 1$, where a_n, b_n are complex numbers or complex valued functions, such that

$a_n \to a$, $b_n \to b$, a/b^2 has values in $\mathbb{C}\setminus(-\infty,-1/4]$.

Let further

$$x := b\left(\sqrt{1+4a/b^2}-1\right)/2 \text{ where } \Re\sqrt{1+4a/b^2} > 0.$$

It is then well known that if $\sum|a_n - a| < \infty$ and $\sum|b_n - b| < \infty$, then the limit

$$P := \lim_{n\to\infty} P_n/(b+x)^n$$

exists (and is finite). We show that this limit also holds in cases where the series $\sum(a_n - a)$ and $\sum(b_n - b)$ only converge conditionally. Such results have applications to, for instance, orthogonal polynomials, continued fractions and special functions.

It is easy to see that if the finite limit P exists and is non-zero, then $\lim_{n\to\infty} X_n/(b+x)^n$ exists for every solution $\{X_n\}$ of the given difference equation.

On geometrical properties of certain quasiconformal curves

Prof. Vladimir Ya. Gutlyanskii, Ukrainian Academy of Sciences, Donetsk, Ukraine

Let f be a quasiconformal self-mapping of the complex plane C with complex dilation μ. We introduce a notion of asymptotical homogeneity of the mapping f at a prescribed point and in these terms give equivalent conditions for a quasiconformal curve $\Gamma = f(\partial D)$, $D = \{z: |z| < 1\}$ to be asymptotically conformal. In particular, we prove that if for some $\alpha > 0$,

$$\iint_{|\eta - z| \le t} \frac{|\mu(z)|^{\alpha}}{|\eta - z|^2}\, dm_z$$

converges uniformly with respect to $\eta \in \partial D$, then Γ is asymptotically conformal. Note that the convergence of the above integral does not imply that $\operatorname{ess\,sup}_{1\le|z|\le t} |\mu(z)| \to 0$, $t \to 1$. The proofs are based on a fundamental geometrical criterion of asymptotically conformal curves obtained by Ch. Pommerenke and J. Becker.

It is well-known that quasiconformal curves need not be rectifiable, even if they are asymptotically conformal. We give new applications of the Bojarski representation theorem and a regularity theorem for a quasiconformal mapping due to 0. Teichmuller, H. Wittich and P. Belinskii to the problem of finding sufficient conditions for rectifiability and smoothness of a quasiconformal curve. In particular, we show that the uniform convergence of the above integral with $\alpha = 1$ implies that Γ is smooth. Close questions have been investigated, for instance, by L. Carleson, Ch. Pommerenke, J. Becker, F. Lesly, S. Warschawski, J.M. Anderson and A. Hinkkanen.

Then we consider analytic and univalent functions f in the unit disk D which map it onto a Jordan domain in C. Using the previous results, we study boundary properties of such mappings in terms of the mean area growth of their Schwarzian and logarithmic derivative.

Wednesday 10:30am - 12:30pm
Room 3

On Salagean - Pascu type of generalised Sakaguchi class of functions

Ms. L. Nalinakshi, Stella Maris College, Madras, India

Let A denote the class of functions f analytic in the open unit disc $E = \{z \in C : |z| < 1\}$ normalized by $f(0) = f'(0) - 1 = 0$. Then $f \in A$ has the expansion $f(z) = z + \sum_{k=2}^{\infty} a_k z^k$. We define $I^n f(z) = z + \sum_{k=2}^{\infty} k^{-n} a_k z^k$ for all integer values of n. We observe that $I^{-n} f(z) = z + \sum_{k=2}^{\infty} k^n a_k z^k = D^n f(z)$ where D is an operator defined by Salagean. In this paper we define some new classes of functions using the differential operator I^n and examine their properties.

On uniformly convex functions with negative coefficients

Prof. K.S. Padmanabhan, Madras, India

Recently A.W. Goodman introduced the class of uniformly convex (starlike) functions on the unit disk denoted by UCV (UST) and raised the question whether $f \in$ UCV implies $zf' \in$ UST. While this question has not been settled, we prove that if f belongs to the class UCV and has negative coefficients, then the answer to the question is in the affirmative. We also investigate other properties of such functions.

Zeros of simple Laguerre polynomials and Hermite polynomials are irrational

Prof. P. R. Subramanian, University of Madras, India

We show that the zeros of simple Laguerre polynomials of degree greater than unity and all the zeros of the Hermite polynomials of even degree (≥ 2) are irrational. Moreover, the one and only rational zero of any Hermite polynomial of odd degree is at the origin and all the remaining zeros are irrational. Familiarity with gaussian quadrature (numerical integration) leads to a general awareness that the zeros of $L_n(s)$, $2 \le n \le 15$ (say), and the non-zero zeros of $H_n(s)$, $2 \le n \le 20$ (say), are

irrational. This awareness can be not only complemented and completed but also converted into a realization by our proofs.

Transformation of series and some applications
Dr. U. Balakrishnan, Tata Institute of Fundamental Research, Bombay, India

By a sequence of rearrangements of the series

$$(1 - 2^{1-s})\zeta(s) = 1 - 2^{-s} + 3^{-s} - 4^{-s} + \cdots,$$

we arrive at a series representation for $2^k(1 - 2^{1-s})\zeta(s)$, which is convergent in $\Re s > -k$. Thus, for example,

$$4(1 - 2^{1-s})\zeta(s) = 1 - (2^{-s} - 2) + (3^{-s} - 2.2^{-s} + 1) - (4^{-s} - 2.3^{-s} + 2^{-s}) + \cdots,$$

holds for $\Re s > -2$.

A rearrangement of the same type but with a twist results in Euler's transformation of series

$$\sum_{n=0}^{\infty} (-1)^n a_n = \frac{1}{2} \sum_{t=0}^{\infty} \frac{1}{2^t} \Delta^t(a_x, x = 0),$$

where $\Delta(f(x)) = f(x + 1) - f(x)$; $\Delta^{t+1} = \Delta^t(\Delta)$. In fact, in the case of Riemann zeta function this transformation applied to the above series for $(1 - 2^{1-s})\zeta(s)$ results in a series which is convergent in the entire complex plane. Further we could effect a more general transformation

$$\sum_{n=0}^{\infty} (-1)^n a_n = \frac{1}{c} \sum_{t=0}^{\infty} b^t \Delta^t_{1/(c-1)} (a_x, x = 0),$$

where $1 - b = 1/c$, provided the rearrangement thus done to the series in the process is valid in the particular case in our hand.

As corollaries, we can get formulae for Bernoulli numbers and also practically computable series representations for Euler's constant γ and other constants. We just note a new series for γ:

$$\gamma = 1 - \frac{1}{2} \sum_{n=0}^{\infty} \frac{1}{2^n(n + 1)} \sum_{r=1}^{\infty} 1/\binom{2^r + n + 1}{n + 1}$$

Thursday 9:00am - 10:00pm
Invited Speaker

Simultaneous rational approximation
Prof. Herbert Stahl, TFH-Berlin, Germany

Simultaneous rational approximants generalize Padé approximants and continued fractions in a very natural way. Instead of a single function, all components of a vector of functions are approximated simultaneously by rationals with a common denominator. The definition itself is rather old; it goes back to Ch. Hermite, and was used by him in his proof of the transcendency of the number e. As in the case of Padé approximants so also here Markov functions are of special interest and specially important. The common denominator of the simultaneously approximants satisfies a multiple orthogonality relation, which in the case of Markov functions is defined by m positive Borel measures supported on the real line. Thus, multiple orthogonal polynomials take the place of orthogonal polynomials in the classical theory of continued fractions and Padé approximation.

Despite the many parallels, there are essential differences in both the formal algebraic theory and the convergence theory. Not only do everything become more complicated, but also positive results are more seldom found. For instance, up to now only in the case of two types of systems do we know how to generalize the powerful results of the theory of Padé approximants to Markov and Stieltjes functions. The two types are the **Angelesco** and the **Nikishin** systems.

In the talk, we shall review results about the generalization of classical orthogonal polynomials and about Angelesco systems. New results will be presented for Nikishin systems. Special emphasis will be given to the convergence theory. Here, potential theory and a special equilibrium problem, defined for vector potentials, will be the key to the analysis.

Thursday 10:30pm - 12:30pm
Room 1

On coefficients of polynomial compositions
Prof. Arcadii Grinshpan, University of South Florida, Tampa, USA

Let $\mathcal{A}$ be some class of analytic functions $\varphi(z) = a_1 z + \cdots$ in the open unit disk $E = \{z : |z| < 1\}$ and let $\mathcal{P}_p$ be the class of all polynomials P(z) of degree not more than $p \geq 1$. The class $\mathcal{M}_p(\mathcal{A})$ of polynomial compositions is defined by

$$\mathcal{M}_p(\mathcal{A}) = \{f = P \circ \varphi : \varphi \in \mathcal{A}, P \in \mathcal{P}_p\}.$$

Some deep properties of coefficients of functions from $\mathcal{M}_p(\mathcal{A})$ are connected (generally) with properties of formal power series and (if $\mathcal{A}$ is a class of univalent functions) with famous Goodman's conjecture for p-valent functions.

The purpose of the paper is to propose support and some extension of Goodman's conjecture for polynomial compositions $P \circ \varphi$ where φ has real coefficients.

Positivity of some classical trigonometric sums
Prof. Gavin Brown, University of Adelaide, Australia

Wang, Wilson and I have shown that all partial sums of $1 + \Sigma k^{-\alpha} \cos k\theta$ are non-negative for $\alpha \geq \alpha_0$, where α_0 is the unique root of $\int_0^{3\pi/2} t^{-\alpha} \cos t \, dt = 0$. As $\alpha_0 \doteqdot .30844$ this is a substantial improvement on Young's inequality. Moreover the partial sums are unbounded for all $\alpha < \alpha_0$, so the result is best possible. Subsequent work with Koumandos and Wang has provided analogous results for sums of ultraspherical polynomials.

Orthogonal rational functions
Dr. Xin Li, University of Central Florida, Orlando, USA

In this talk, we will discuss both algebraic and analytic properties of rational functions orthogonal with respect to a positive measure on the unit circle in the complex plane. The poles of the rational functions are prescribed by an infinite triangular matrix of entries in $|z| > 1$. We will pay special attention on the asymptotic behavior of these rational functions.

Approximation of Schwarz-Christoffel mappings by polynomials
Prof. Ted Suffridge, University of Kentucky, Lexington, USA

Polynomials that are univalent in the unit disk and have the property that all zeros of the derivative lie on the unit circle have a striking geometric property. Namely, the tangent line to the boundary curve turns at a constant rate as one moves around the circle, with cusps where the derivative is zero. The rate at which the tangent line turns depends on the degree of the polynominal, namely the angle through which the tangent line turns is (n+1)/2 times the change of the argument on the circle, when the degree of the polynomial is n. This property can be exploited to force the boundary curve to have the following property. The circle can be divided into finitely many prescribed arcs. Exterior angles will be prescribed at the endpoints of these arcs. Then polynomials of increasing degree can be found that will have the property that the image of the prescribed arcs will be tangent to fixed lines at equally spaced points on the arc and the exterior angles between the lines will be as prescribed. The number of points of tangency increases with the degree. Some graphics will be presented to show how the method works in practice. Similar methods can be used to approximate mappings to the exterior of a polygon with a simple pole at the origin.

Thursday 10:30am - 12:30pm
Room 2

A numerical method for conformal mapping
Prof. Mohd. Rashidi Bin Md. Razali, Universiti Teknologi Malaysia, Johor Bahru, Malaysia

Conformal mapping has an important role in solving various physical problems. As such, methods for determining this conformal mapping function have to be devised. In this paper, a numerical method for conformal mapping is suggested. The result of using this method is then compared with known methods.

Inverse theorems for Padé approximants and their generalizations
Dr. Le Ba Khanh Trinh, University of Hochiminh, Vietnam

The meromorphic continuation of a function is studied on the basis of the asymptotic behavior of the poles of the local rational approximants (rows or diagonal of the Padé table and their generalizations).

Projection iterative methods for solving boundary value problems in theory of complex functions
Prof. Ngo Van Luoc, Institute of Mathematics, Hanoi, Vietnam

The paper deals with projection iterative methods for solving the following boundary value problems of analytic functions : Carleman and Gazeman problems in the plane and Riemann problem in the space. Convergence theorems for these problems are given. Note that the convergence rate of our method is better than one of other iterative methods. Some numerical experiments for considered problems are presented.

Simultaneous rational approximants to a Nikishin system of two functions
Prof. Kathy Driver, University of the Witwatersrand, Johannesburg, South Africa

Simultaneous rational approximants to a vector of functions (f_1, f_2) that form a Nikishin System are investigated. Each function in a Nikishin System is a Markov function (or its negative). The uniqueness and convergence behavior of the rational approximants to a single Markov function are well known (cf. Markov's Theorem 1885) and the orthogonality of the denominator polynomials in the diagonal case is classical. We shall discuss the orthogonality of the common denominator polynomials in simultaneous rational approximants to (f_1, f_2) and the implications for uniqueness of these approximants. In addition, error formulae will be presented and an interlacing property proved for the finite zeros of the two associated error functions in the diagonal case.

(Joint work with H. Stahl)

Thursday 2:30pm - 3:30pm
Room 1

A note on an oscillation problem of $y'' + (e^z - k)y = 0$ and a result of Bank, Laine and Langley
Dr. Yik-Man Chiang, Hong Kong University of Science & Technology, Hong Kong

Bank, Laine and Langley showed that when a solution $f(z)$ *of* $y'' + (e^z - k)y = 0$ has finite exponent of convergence on its zero-sequence, then $k = (2n + 1)^2/16$, n is a non-negative integer. The converse is also true. We improve their result by using a different approach.

On the Laurent coefficients of generalized powers
Prof. Heinrich Renelt, Martin-Luther-Universität, Halle (Saale), Germany

Let $w_{\bar{z}} = \mu(z)\overline{w_z}$ (*) be a special generalized Cauchy-Riemann system with $\mu(z) = 0$ in a neighborhood of $z = 0$ and of $z = \infty$. A corresponding generalized power $\left[cz^n\right]$, with n any positive integer and c any nonzero complex number, then admits a Laurent expansion

$$a_n z^n + a_{n-1} z^{n-1} + \cdots + a_1 z^1 + a_0 + O(z^{-1})$$

at $z = \infty$, where the a_j are uniquely determined by c and n, by general results on existence and uniqueness. We ask for the concrete form of this relationship and obtain finally a system of linear algebraic equations with nonvanishing determinant. As a by-product we get a criterion for a function analytic in a neighborhood of infinity to possess a continuation to a solution of (*) in the whole plane.

Thursday 2:30pm - 3:30pm
Room 2

The resolution of some conjectures via a Remez-type inequality for Muntz spaces
Dr. Tamas Erdelyi, Simon Fraser University, Burnaby, Canada

Muntz's beautiful, classical theorem (1914) characterizes when the linear span of a given sequence of monomials is dense in C[0,1]. The talk discusses various extensions of this result. We focus on a crucial (Remez-type) inequality for Muntz "polynomials" which turns out to be an extremely powerful tool. Most notably, it settles two long standing conjectures in a short and beautiful fashion.

The first one says that the interval [0,1] in Muntz's Theorem can be replaced by an arbitrary closed subset of [0,1] of positive Lebesgue measure. Speculations about this are probably as old as Muntz's Theorem itself. For example, a seminal paper of Clarkson and Erdos (1943) and a book of L. Schwartz (1958) deal with the case when this subset contains an interval; however, their methods fail to work on a Cantor-type set of positive Lebesgue measure.

The second one is a "very sane, if very prosaic question" of D. Newman (1978) about the denseness of products of Muntz "polynomials".

The results are joint with P. Borwein.

Solution of potential problems using integral equations
Dr. James Caldwell, City Polytechnic of Hong Kong, Hong Kong

Many problems in the applied sciences involve the solution of Laplace's or Poisson's equation both for analytic or nonanalytic three-dimensional geometries. Among the variety of numerical techniques, the relaxation method is particularly suited to a digital computer owing to the method's intrinsic simplicity. However, since relaxation is an iterative method over a three-dimensional mesh, the large number of mesh points necessary to solve typical problems has resulted in heavy demands on memory space and computer time. This problem can be overcome to some extent by considering an alternative approach to the solution of potential problems by reducing them to Fredholm integral equations. In fact, the solution of boundary value problems in potential theory leads to one of the most important achievements of the theory of integral equations. The boundary value problems for equations of elliptic type lead to Fredholm equations, while the boundary value problems for parabolic and hyperbolic equations yield Volterra integral equations.

For the reasons explained above, an alterative approach to the numerical solution of potential problems was considered by Caldwell [1]. In this work, the method used was to reduce the potential problems to Fredholm integral equations of the first and second kinds. The method was illustrated for potential problems of the Dirichlet type and solutions have been obtained for the case of a unit sphere. The method used overcomes some of the difficulties associated with the classical approach.

Caldwell [2] improves on this method by using an iterative solution to overcome the peaked nature of the kernel in the integral equations. Essentially, this involves a further reduction of the singular nature of the kernel by subtracting away the singularity. The charge density was then obtained iteratively using the Neumann series method. This work also includes a discussion of convergence and error accumulation.

This paper builds on previous work by Caldwell on the integral equation formulation for the numerical solution of potential problems and, in particular, the Dirichlet problem. Improvements on Caldwell [2] are possible by noting that the Neumann series is formally equivalent to the classical Jacobi iterative scheme. The additional complication of the singularity is considered. Also, in this paper, a comparison is made of the accuracy of results obtained by direct matrix methods with and without removal of the singularity.

Friday 9:00am - 10:00am
Invited Speaker

Chebychev problems for polynomials with integer coefficients
Dr. Peter Borwein, Simon Fraser University, Burnaby, Canada

A number of classical and not so classical problems in analysis and number theory concern finding "small" polynomials with integer coefficients. The most basic of these is to find a non-trivial polynomial of degree n with integer coefficients of minimal sup norm on [a,b]. This is the "Integer Chebychev" or "Integer Transfinite Diameter" problem and is very subtle.

Other problems include some old chestnuts like the Tarry-Escott problem and the "easier" Waring Problem. All of these problems include some analysis, some number theory and a non-trivial computational component.

Friday 10:30am - 12:30pm
Room 1

Univalent integral operators and their applications
Prof. Yong Chan Kim, Yeungnam University, Gyongsan, Korea

By making use of the concept of subordination, a number of classes of analytic functions have been introduced and studied in the literature rather systematically. The main object of the present paper is to study the mapping

properties of functions belonging to these classes under certain families of univalent and starlike integral operators. Relationships of these classes with various other interesting subsets of analytic functions are also pointed out.

On α-convex functions in a sector
Mr. Marjono, Brawijaya University, Malang, Indonesia.

Denote by A the class of functions f which are analytic in $D = \{z: |z|<1\}$ and normalised so that $f(0) = f'(0)-1 = 0$. For $\alpha > 0$ and $0<\beta\leq 1$, the exact $\gamma(\beta,\alpha)$ such that for $f \in A$ and $z \in D$,

$$(1-\alpha)\frac{z\,f'(z)}{f(z)} + \alpha\left(1 + \frac{z\,f'(z)}{f(z)}\right) \prec \left(\frac{1+z}{1-z}\right)^{\gamma(\beta,\alpha)}$$

implies

$$\frac{z\,f'(z)}{f(z)} \prec \left(\frac{1+z}{1-z}\right)^{\beta}$$

is found.

On the fourth and fifth coefficients of strongly starlike functions
Dr. Rosihan M. Ali, Universiti Sains Malaysia, Penang, Malaysia

For $0 < \alpha \leq 1$, analytic functions

$$f(z) = z + a_2z^2 + a_3z^3 + \cdots$$

in the unit disk U are strongly starlike of order α if

$$\left|\arg\left\{\frac{zf'(z)}{f(z)}\right\}\right| < \frac{\pi\alpha}{2}, \quad z \in U.$$

We show that in this class,

$$|a_4| \leq \begin{cases} \frac{2\alpha}{9}\left(1 + 17\alpha^2\right) & \sqrt{\frac{2}{17}} \leq \alpha \leq 1 \\ \frac{2\alpha}{3} & 0 < \alpha \leq \sqrt{\frac{2}{17}} \end{cases}$$

and

$$|a_5| \leq \begin{cases} \frac{\alpha^2}{9}(7 + 38\alpha^2), & 38\alpha^3 - 30\alpha^2 + 16\alpha \geq \frac{9}{2} \\ \frac{\alpha}{2}, & 228\alpha^4 - 194\alpha^3 + 2\alpha^2 + 39\alpha - 9 \leq 0 \end{cases}$$

These estimates are sharp.

(Joint work with V. Singh)

On the Fekete-Szegö problem for close-to-convex functions
Dr. D. K. Thomas, University of Wales, Swansea, UK

Let A be the set of functions f which are analytic and univalent in the open unit disc D and normalised so that $f(0)=f'(0)-1=0$. For $0\leq\alpha<1$, $0\leq\beta<1$ and $0\leq\gamma<1$, let $C(\alpha,\beta,\gamma)$ denote the class of functions $f \in A$ such that for $z \in D$,

$$\mathrm{Re}\, e^{i\gamma}\frac{zf'(z)}{g(z)} > \alpha,$$

where g is such that

$$\mathrm{Re}\,\frac{zg'(z)}{g(z)} > \beta$$

For $f \in C(\alpha,\beta,\gamma)$ with $f(z) = z + a_2z^2 + a_3z^3 + \cdots$, a complete solution to the upper estimates for the Fekete-Szegö functional $\left|a_3 - \mu a_2^2\right|$ is given for all real μ.

Joint work with M. Darus.

Friday 10:30am - 12:30pm
Room 2

Zeros of Faber polynomials
Dr. Michael Eiermann, Universität Karlsruhe, Germany

We consider Faber polynomials $\{F_m\}_{m=0}^{\infty}$ associated with a compact set $\Omega \subset C$, not a single point, whose complement $C_\infty\backslash\Omega$ (with respect to the extended plane) is simply connected.

More precisely, we are interested in the zeros of these polynomials and in the set

$$\mathcal{Z} := \{z \in C: z = \lim_{k\to\infty} z_k, \text{ where } F_{m(k)}(z_k) = 0 \text{ and } \lim_{k\to\infty} m(k) = \infty\}$$

which, in a sense, is "filled in" by the zeros of F_m as $m \to \infty$.

Under various assumptions on the exterior mapping function ψ of Ω, we determine the structure of $\mathcal{Z}$: Eg., if ψ is a Laurent polynomial, a complete description of $\mathcal{Z}$ (in terms of ψ) can be derived.

Generalized incomplete gamma functions with applications
Dr. M. Aslam Chaudhry, Dhahran, Saudi Arabia

On the convergence of a class of generalized Goncarov polynomials
Dr. J. A. Adepoju, University of Lagos, Nigeria

We investigate in this paper the effectiveness properties of the simple set $\{Q_n(z;z_0,\ldots,z_{n-1})\}$ of polynomials belonging to the D_q-derivative operator and given by

$$Q_0(z)=1;\ \frac{z^n}{[n]!} = \sum_{k=0}^{n}\frac{z_k^{n-k}}{[n-k]!}\,Q_k(z;z_0,\ldots,z_{k-1});\ (n\geq 1)$$

where [n]! is the q-analogue of n! and $(z_n)_0^\infty$ are complex numbers. Results are obtained for $q < 1$ when $(z_n)_0^\infty$ lie in the closed unit disk $U = \{z: |z| \le 1\}$, and for $q > 1$ when $|z_n| \le q^{-n}$, $(n \ge 0)$.

Convergence of orthogonal rational functions
Prof. Olav Njåstad, University of Trondheim, Norway

Let $\{\alpha_n\}$ be a sequence of (not necessarily distinct) points in the open unit disk D, and set

$$B_0 = 1,\ B_n(z) = \prod_{m=1}^{n} \frac{\overline{\alpha}_m}{|\alpha_m|}\frac{\alpha_m - z}{1-\overline{\alpha}_m z},\ n = 1,2,\cdots$$

$\left(\frac{\overline{\alpha}_n}{|\alpha_n|} = -1 \text{ when } \alpha_n = 0.\right)$ Let μ be a finite (positive) Borel measure on the unit circle T, and let $\{\varphi_n(z)\}$ be orthonormal functions obtained by orthogonalization of $\{B_n(z) : n = 0,1,2,\cdots\}$ with respect to μ. Together with the reciprocal orthogonal functions $\varphi_n^*(z) = B_n(z)\overline{\varphi_n(1/\overline{z})}$, they satisfy recurrence relations (for $n = 1,2,\cdots$)

$$\varphi_n(z) = \frac{\kappa_n}{\kappa_{n-1}}\left[\varepsilon_n \frac{z-\alpha_{n-1}}{1-\overline{\alpha}_n z}\varphi_{n-1}(z) + \delta_n \frac{1-\overline{\alpha}_{n-1}z}{1-\overline{\alpha}_n z}\varphi_{n-1}^*(z)\right]$$

$$\varphi_n^*(z) = -\frac{\overline{\alpha}_n}{|\alpha_n|}\frac{\kappa_n}{\kappa_{n-1}}\left[\overline{\delta}_n \frac{z-\alpha_{n-1}}{1-\overline{\alpha}_n z}\varphi_{n-1}(z) + \overline{\varepsilon}_n \frac{1-\overline{\alpha}_{n-1}z}{1-\overline{\alpha}_n z}\varphi_{n-1}^*(z)\right]$$

with $\kappa_n = \varphi_n^*(\alpha_n)$, $\alpha_0 = 0$, $\varphi_0 = \kappa_0$, $\varphi_0^* = \kappa_0$,

$$\delta_n = \frac{(1-\alpha_{n-1}\overline{\alpha}_n)\varphi_n(\alpha_{n-1})}{\left(1-|\alpha_{n-1}|^2\right)\kappa_n},\quad \overline{\varepsilon}_n = -\frac{\overline{\alpha}_n}{|\alpha_n|}\frac{(1-\overline{\alpha}_{n-1}\alpha_n)\overline{\varphi_n^*(\alpha_{n-1})}}{\left(1-|\alpha_{n-1}|^2\right)\kappa_n}$$

When $\{\alpha_n\}$ converges to a limit α in D, the infinite product $\prod_{n=1}^{\infty}\left[|\varepsilon_n|^2 - |\delta_n|^2\right]$ converges if and only if the measure μ satisfies the Szegö condition $\int_{-\pi}^{\pi} \ln \mu'(\theta)\, d\theta > -\infty$. When these equivalent conditions are satisfied, $\{\varphi_n^*(z)\}$ converges to the function

$$\pi_\alpha(z) = \frac{e^{iv}\sqrt{1-|\alpha|^2}}{\sqrt{2\pi}(1-\overline{\alpha}z)}\exp\left[\frac{1}{4\pi}\int_{-\pi}^{\pi}\frac{e^{i\theta}+z}{e^{i\theta}-z}\ln \mu'(\theta)\, d\theta\right],\ v \in \mathbf{R},$$

Rlocally uniformly on D. When the stronger condition $\sum_{n=1}^{\infty}\left[\left|1+\frac{\overline{\alpha}_n}{|\alpha_n|}\overline{\varepsilon}_n\right| + |\delta_n|\right] < \infty$ is satisfied, $\{\varphi_n^*(z)\}$ converges uniformly on $D \cup T$ to a nonvanishing continuous extension of $\pi_\alpha(z)$.

The results reduce to results from the classical theory of Szegö polynomials when $\alpha_n = 0$ for all n.

Friday 3:00pm - 5:00pm
Room 1

On sequences of compositions of analytic functions
Dr. Antonio Córdova, Universität Würzburg, Germany

Let $\mathcal{F}$ be a family of analytic functions, mapping the unit disk $\mathbb{D} = \{z \in \mathbb{C}: |z| < 1\}$ into itself. Let $\{f_n\} \subset \mathcal{F}$ and consider the sequence of compositions $\{F_n\}$ defined by

$$F_n := f_1 \circ f_2 \circ \cdots \circ f_n.$$

Observe that $F_1(\mathbb{D}) \supset F_2(\mathbb{D}) \supset \cdots$ is a nested sequence of domains. If the semigroup of analytic functions generated by $\mathcal{F}$ (taking all finite compositions of functions in $\mathcal{F}$) does not contain the identity in its closure, then $F_n'(z) \to 0$ locally uniformly in $\mathbb{D}$. This suggests the following question:

Which families $\mathcal{F}$ have the property that every $\{F_n\}$ converges locally uniformly in $\mathbb{D}$ to a constant?

We show that the family $\mathcal{G}$ defined by:

For each $f \in \mathcal{G}$ there is a disk $D_f \subset \mathbb{D}$ of radius $\rho < 1$ (independently of f) with $f(\mathbb{D}) \subset D_f$,

has that property. This solves (essentially) a conjecture posed by L. Lorentzen and St. Ruscheweyh in the theory of convergence of continued fractions.

Padé approximation for e^x and tan x
Dr. Faiz Ahmad, Quaid-i-Azam University, Islamabad, Pakistan

The Legendre polynomial of order n, $P_n(x)$, is orthogonal on [-1,1] to every polynomial of degree less than n. We use this property of $P_n(x)$ to derive analytical expressions for the diagonal Padé approximants for e^x and tan x. Coefficients appearing in the expressions turn out to be simply various derivatives of $P_n(x)$ evaluated at $x = 1$.

Sampling series and approximation of functions
Prof. Dinh Dung, Institute of Information Technology, Hanoi, Vietnam

The background of this paper is the well-known Whittaker-Kotelnikov-Shannon classical sampling theorem. It states that every signal function $f \in L^2(\mathbf{R})$ bandlimited to $[-\sigma,\sigma]$ can be completely reconstructed from its sample values $f(\pi k/\sigma)$, $k \in \mathbf{Z}$, by the cardinal sampling series. However, this series is not too satisfactory for approximation or recovery in many cases, especially, for non-bandlimited functions. In this paper we discuss approximations and recoveries of functions by modifications of the cardinal sampling series and their applications to a multidimensional version of a Shannon-Kotelnikov problem.

For recovering functions on $\mathbf{R}^d$ we use a more suitable sampling series constituted by an integrable kernel whose Fourier transform is slightly modified from multidimensional sinc kernel. The most interesting and difficult is the recovery in the metric of $L^p(\mathbf{R}^d)$ $(1 \le p < \infty)$ when the operator associated with this sampling series is unbounded. For non-bandlimited functions we establish error

estimates of this recovery in comparing with the best approximation by bandlimited functions. For smooth functions of Besov spaces error estimates are expressed in terms of traditional theorems of norm equivalence.

Discovering the information sense of their sampling theorem, Kotelnikov and Shannon noted that the information quantity needed for reconstructing in the time interval [-T, T] the signal function f bandlimited to [-σ,σ] is asymptotically equal to the information quantity for determining $2\sigma T/\pi$ real numbers. We proved a version of this hypothesis for multivariate functions bandlimited to an arbitrary Jordan measurable subset G of $\mathbf{R}^d$ in terms of the mean ε-entropy and ε-dimension in the space $L^q(\mathbf{R}^d)$ of the function set $SB_{G,p} = \left\{f : \|f\|_{L^p} \le 1, \text{supp } \hat{f} \subset G\right\}$. On the other hand, the Shannon-Kotelnikov hypothesis is not true in many cases. We presented and proved a replacing hypothesis for the mean ε-entropy and ε-dimension in the space $L^q(\mathbf{R}^d)$ of $SB_{G,p}$ with $1 \le p < q \le \infty$. We established also the asymptotic degree of the mean ε-entropy and ε-dimension of Sobolev classes.

A problem closely related to the Shannon-Kotelnikov problem, is to determine the minimal number of sample values needed for recovery of signal functions within to arbitrary $\varepsilon > 0$ in the time interval [-T, T]. For functions bandlimited to [-σ, σ] this number is asymptotically equal to $2T\sigma/\pi$ when $T \to \infty$. We proved that for smooth signal functions from Hölder class SH_p^{α}, $1 \le p \le \infty$, $\alpha > 1/p$, this number isasymptotically proportional to $T\varepsilon^{-1/\alpha}$ when $T \to \infty$, and constructed a corresponding recovery by a generalized sampling series.

In proofs of the above mentioned results, technique of harmonic analysis and truncation approximations by generalized sampling series are employed. In particular, we presented some multidimensional modifications of the classical sampling theorem and Marcinkiewicz theorem which play a central role in these truncation approximations.

Friday 3:00pm - 5:00pm
Room 2

Singularities of generalized Airy-Weber functions
Dr. Nguyen Huu Duc, University of Dalat, Vietnam

Let $\varphi(q,z)$ be a r-reticular phase function on QxC^m satisfying "non-degeneracy condition," where Q is a manifold of the dimension n. We call a generalized Airy-Weber function with monodromy exponent s a function defined on $Qx\tilde{C}^*$, where $\tilde{C}^*$ is the universal covering of $C^* = C\backslash(0)$ by

$$A^{\varphi}_{s,\Gamma}(q, x) = \int_{\Gamma} e^{-x\varphi(q,z)} z_1^{s_1} \cdots z_r^{s_r} dz_1 \cdots dz_m$$

where

$$s=(s_1,\cdots,s_r)\in C^r, \quad x=-ik,$$

and Γ is non-compact m-cycle of $\tilde{C}^{*r}xC^{m-r}$ depending continuously on Arg x and q and verifying "the Steepest descent condition" (so that the integrand decreases exponentially). This integral is a generalization of Airy integral (defined by oscillatory integral having the phase being an universal deformation of isolated critical point) and Weber integral (defined by oscillatory integral having the phase being an universal deformation of function on manifold with boundary). In this talk, we try to characterize generalized Airy-Weber functions by systems of microdifferential equations that they satisfy.

The distribution of sign changes in best L^p-approximation
Prof. H.-P. Blatt, Katholische Universität Eichstätt, Germany

Let w be a suitable weight function, $B_{n,p}$ denote the polynomial of best approximation to a function f in $L^p_w[-1, 1]$, ν_n be the measure that associates a mass of $1/(n + 1)$ with each of the $n + 1$ zeros of $B_{n+1,p} - B_{n,p}$ and μ be the arcsine measure defined by $d\mu := \left(\pi\sqrt{1 - x^2}\right)^{-1} dx$

We estimate the rate at which the sequence ν_n converges to μ in the weak-* topology. In particular, our theorem applies to the zeros of monic polynomials of minimal L^p_w norm. In special cases, estimates for the distribution of the interpolation points of $B_{n,p}$ to the function f can be obtained.

Min-constant for polynomials
Dr. G.B. Thapa, Tribhuvan University, Nepal

Friday 3:00pm - 5:00pm
Room 3

Interpolation - A functional analytic approach
Dr. M.S. Ganesan, Tamilnadu, India

In this short lecture, we would like to take into consideration the study of interpolation by holomorphic functions from a different point of view. The Germay theorem says that there exists an entire function that interpolates given values at a given sequence of points. Here we aim at presenting the proof of the extended interpolation theorem, using a functional analytic approach. We briefly summarize below the various steps involved in developing the proof.

An important functional analytic prerequisite for proving our main theorem is the Banach - Dieudonne theorem. The Banach - Dieudonne theorem says that closure is equivalent to sequential closure, in special circumstances. For this we require some standard results in the theory of Frechet spaces and some additional results on topological vector spaces in general. The main theme involves the introduction of a topology on the dual of a topological vector space, called the b w* - topology.

We then discuss the concept of totally linearly independent sequence and obtain criteria for a sequence to be totally linearly independent. We present necessary and

sufficient conditions for a sequence to be interpolating in the dual of a separable Frechet space.

It is worthwhile noting here that the space of holomorphic functions H(G) on an open set G in C is a separable Frechet space. Further the duality theorem for H(G) associates with each element of its dual H(G)* a germ of an analytic function.

The final step consists of showing how the extended interpolation theorem could be proved by using the results presented above. We prove the existence of a holomorphic function f defined on an open set G in C such that $f^k(z_n) = a_{n,k}$ for all n and k, k = 0, 1, $\cdots$ p_{n-1}; n = 1, 2, 3, $\cdots$ where $a_{n,k}$ is a given family of complex numbers, z_n is an admissible sequence in G and p_i is a sequence of positive integers.

On gamma-starlike functions

Prof. Mamoru Nunokawa, Gunma University, Maebashi, Japan

In this paper, the author will give some criteria for strongly gamma-starlike functions.

On the convergence of Fourier-Laplace series

Prof. Wang Kun-Yang, Beijing Normal University, China

Some problems on meromorphic functions

Dr. Yuefei Wang, Academia Sinica, Beijing, People's Republic of China

We shall talk about the following results:

(i) A precise estimate of the total deficiencies of meromorphic derivatives
(ii) A negative answer to a problem of Frank
(iii) A general criterion for normal families

Quasi-conformal self-mappings with smooth boundary values

Prof. J.M. Anderson, University College London, England

Let ψ be a sense-preserving quasi-symmetric homeomorphism of the unit circle onto itself having a quasi conformal extension Φ of the unit disk onto itself. Suppose that the complex dilatation $\mu(z, \Phi)$ of Φ satisfies $|\mu(z)| = O(K(1 - |z|))$ as $|z| \to 1$ for a.e. z for a suitable decreasing function K(t). It is shown that if $K(t) \downarrow 0$ as $t \to 0$ sufficiently rapidly then ψ must be smooth in some appropriate sense depending on K(t).

(Joint work with A. Hinkkanen)

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- Southeast Asian Mathematical Society
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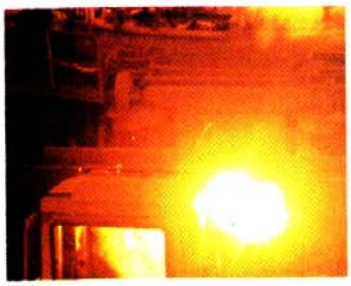
“Without such a force as vision, we will forever remain on the ground when others are already taking flight to new dimensions”

Malaysia - known worldwide as a fascinating place. And it will, in the near future, be known worldwide as an industrialised nation. These notable characteristics of Malaysia did not happen by chance or luck. The identity came about through the efforts of people with vision, people who were dedicated to the good of the nation and by people who worked together.

Patience, perseverance and cooperation - these are the qualities that make a person succeed and what makes a corporation or nation succeed.

Such character qualities can be found inherent and exercised by the people who make up Perwaja Steel, from the top to the bottom of



our corporate structure. Along with these we have developed other characteristics that bind us all into achieving Perwaja's goals; discipline, awareness, responsibility and accountability.

Indeed the objective is to make Perwaja Steel succeed, but in doing so, our people will have earned success as well.

Perwaja's Goals For The 90's

Malaysia is on the right road towards an industrialised nation status. Our nation's abundant natural and human resources are being realised if not already put to use. Our nation's industries are growing and improving each and every year with goals to meet, as well as to set anew.

Perwaja has scheduled goals to meet. These goals are set down in tiered terms; short, medium and long with the ultimate goal to produce the best steel products for the Malaysian and the world markets.

Recently, we achieved certain goals that would help us and other industries to keep in step with the country's fast rate of industrialisation.

In retrospect, this past year, Perwaja Steel finalised a contract in September of 1990 for the construction of a new Direct Reduction Plant (DR Plant) with a German company. The DR Plant will allow us to produce purer quality steels and if used in combination with scrap iron or steel, Perwaja will be able to produce a much wider range of high quality steels. Thus giving us many new manufacturing openings for downstream business activities.

On 2nd April 1991, Perwaja Steel and an Italian company signed an agreement for a new rolling mill. This rolling mill is fully automated and equipped with other high tech electronic devices. This will be one of the most modern and sophisticated in the world. The mill is scheduled to be operational by November 1992. This specialised mill basically rolls steel billets and blooms into finished products such as wires and bars designed for appropriate usage in the mechanical and automative industry.

Shortly afterwards, Perwaja made two separate agreements for the supply of magnetite iron ore pellets from Sweden and then Chile. These two agreements will guarantee a steady supply of high-grade iron ore pellets in early 1993. The use of this type of iron ore, being a special grade and ideal for the DR Plant will help reduce energy costs, increase productivity and minimise the percentage of under-metallised direct reduced iron plus minimise rejected billets, blooms and bars which Perwaja produces.

The objective of course, is to produce the best steel around for local consumers and for export. For this goal, Perwaja needed a complete system that incorporates an efficient and accountable workforce looking after an efficient and responsive factory. We believe, this has been achieved and will be practised over the years. We are prepared to continue to move ahead in the years to come for the good of the people that serve us, for the good of the customers we service and for the good of the nation we are proud to be part of.

Perwaja Steel Sdn. Bhd.

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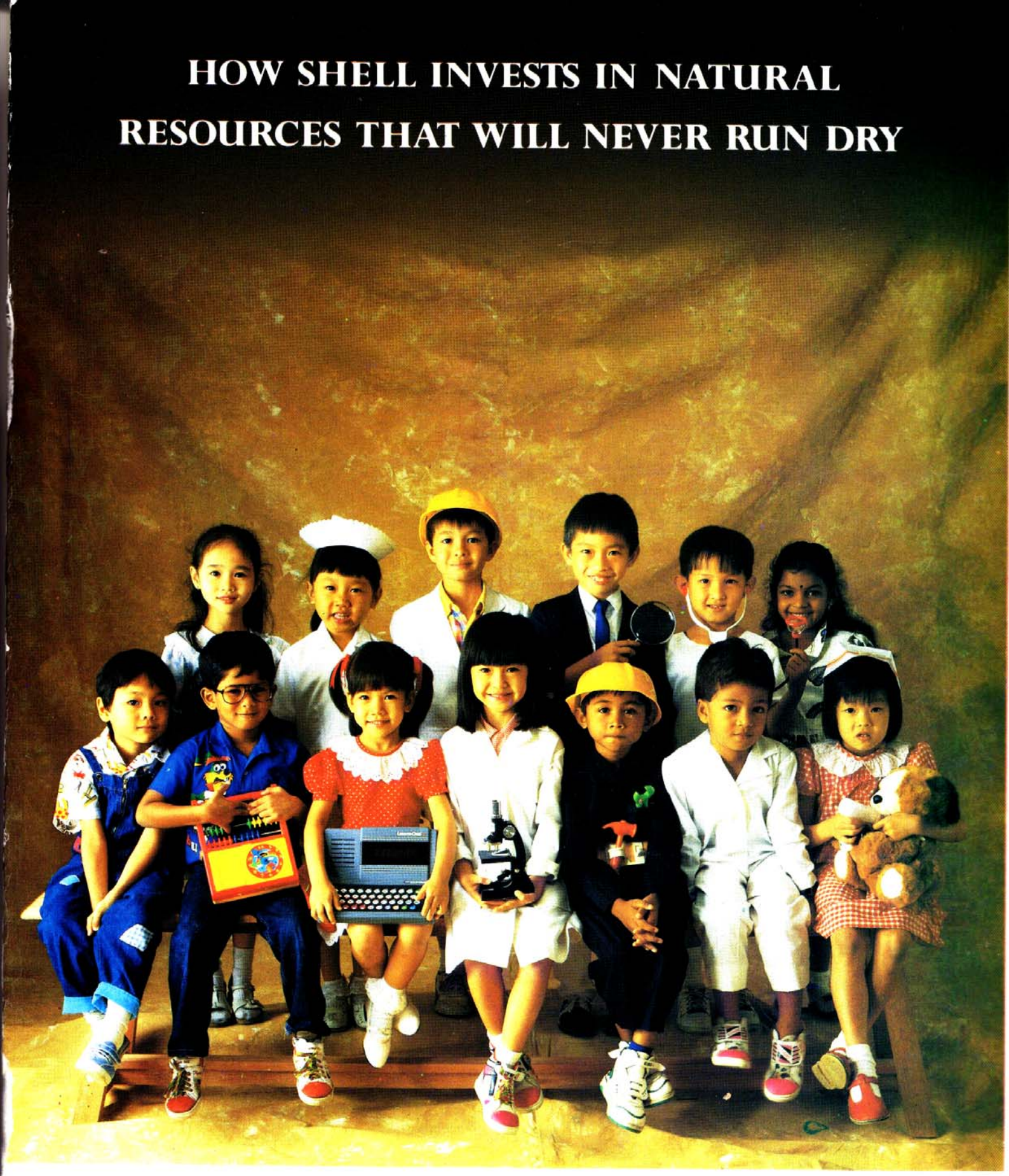
HOW SHELL INVESTS IN NATURAL RESOURCES THAT WILL NEVER RUN DRY



Children. If only all our natural resources are as reliable as they are.

Or as versatile.

Teach a child and you start a ball rolling.

There will come a time when children will discover more for themselves than the knowledge which you give them.

What could be a better investment than that?

That's why, at Shell, we believe that children are Malaysia's most valuable natural resources.

Every year, millions of dollars are invested in the form of scholarships and bursaries for hundreds of young Malaysians.

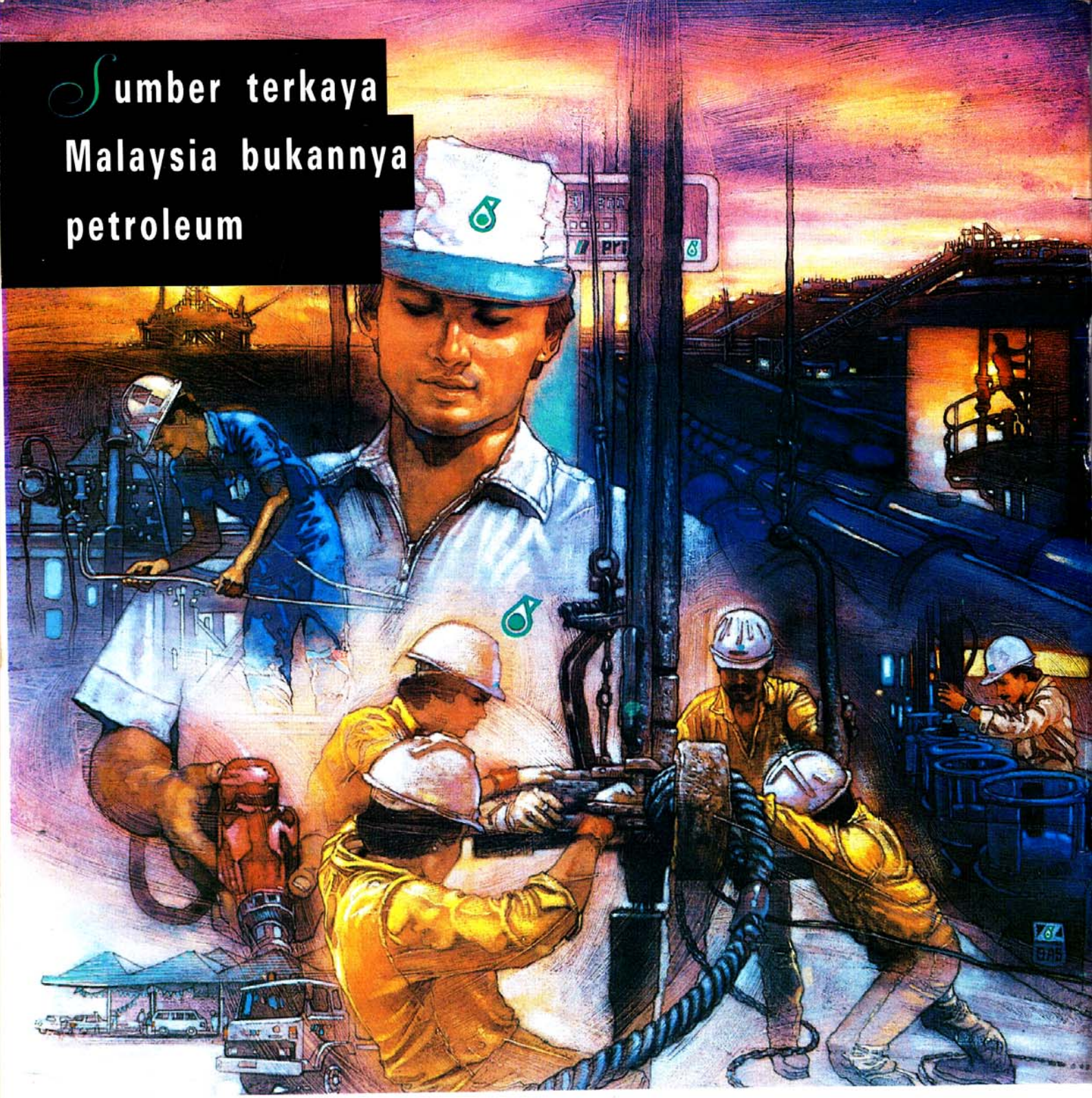
(Not to mention the training and cross-posting abroad of our Malaysian staff here at Shell.)

And not just scholarships, but also sponsorship for books, exhibitions, special courses and the presentation of merit prizes.

But looking at the success of our past scholars and schemes we can't help but think.

Our faith and confidence in Malaysia and her children, will never run dry.

YOU CAN BE SURE OF SHELL



Malaysia sungguh bertuah kerana tidak sahaja memiliki banyak sumber petroleum, tetapi, lebih penting daripada itu, ia mempunyai rakyat yang inovatif dan rajin bekerja.

Kini, di PETRONAS, rakyat Malaysia dengan pelbagai kemahiran memainkan peranan yang semakin penting dalam industri petroleum yang terus berkembang. Selama lebih sedekad, mereka telah menerima latihan luas lagi khusus dalam semua aspek industri ini.

Hasilnya, rakyat Malaysia yang berkelayakan kini mengendalikan semua operasi utama PETRONAS dalam bidang *Eksplorasi *Pengeluaran *Pemprosesan *Penapisan dan *Perkilangan. Rakyat Malaysia yang berkhidmat dengan Perbadanan Petroleum Negara telah membantu untuk mencurahkan sumbangan besar kepada industri petroleum dan juga ekonomi negara.

Industri petroleum kini telah berkembang luas hingga merangkumi kehidupan segenap lapisan rakyat Malaysia dengan menyediakan peluang-peluang pekerjaan dan perniagaan di samping meningkatkan kemahiran dan mutu kehidupan.

PETRONAS

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