

(8) Construction and use of graphs of the type  $y = mx + c$ , based on experimental data (interpolation and extrapolation).

(9) Graphical treatment of the function:

$$y = Ax^3 + Bx^2 + Cx + D + \frac{E}{x} + \frac{F}{x^2}$$

where not less than three of the constants A, B, C, D, E, F are zero. The gradients of these graphs as determined by drawing.

(10) Trigonometric ratios for acute angles, with special reference to angles of  $0^\circ$ ,  $30^\circ$ ,  $45^\circ$ ,  $60^\circ$  and  $90^\circ$ . Use of four-figure trigonometric tables. Angular measure in radians.

(11) Problems based on the right-angled triangle such as problems involving angles of elevation and depression, and bearings and distances. Solution of triangles by the use of the sine and cosine formulae (acute-angled triangles only).

(12) Areas and perimeters of common plane figures. Surfaces areas, volumes and weights of common regular solids.

#### Science (in S.I. Units)

(1) Elements and molecules. Compounds and mixtures. Physical and chemical changes. Water — physical and chemical properties. Acids, bases and salts.

(2) Simple quantitative treatment of expansion of solids, liquids and gases. Relation between volume and temperature of a gas. Quantity of heat. The Joule and

## SDF Training Grants

### SDF Grants

The Skills Development Fund (SDF) has instituted a system of "Approved-in-Principle Courses" in its award of training grants. Employers enrolling their employees on these training courses will be assured of the appropriate SDF training grants if they meet

the criteria for "Eligibility for Grants" and the "Conditions of Award".

### Approved-in-Principle Courses

The SDF Council has designated the following Singapore Polytechnic part-time courses as "Approved-in-Principle":

Advanced Diploma Course:	SDF Grant (% of Course Fee)
Plastics Technology	70%
<b>Diploma Courses:</b>	
Architectural Technology	70%
Building	70%
Chemical Process Technology	70%
Civil Engineering	70%
Civil Engineering (Construction)	70%
Civil Engineering (Design)	70%
Electrical Engineering	70%
Electronics & Communication Engineering	70%
Industrial Management	70%
Land Surveying	70%
Maritime Studies	70%
Mechanical Engineering	70%
Manufacturing Engineering	70%
Quantity Surveying	70%
<b>Certificate Courses:</b>	
Aeronautical Maintenance Engineering	70%
Industrial Management	70%
Maritime Studies	70%
Plastics Mould Design	70%
Process Plant Engineering Design	70%

**4 Request for Grants for Other Courses**  
Companies wishing to seek grants for the following courses, which have not been listed as "Approved-in-Principle", may apply directly to the SDF, prior to the commencement of the course:

- (a) Advanced Diploma Courses  
Building Maintenance Management  
Food Technology  
Land Surveying  
Tool Engineering and Design.
- (b) Full-time Courses

**Eligibility for SDF Training Grants \***

1. Companies registered and incorporated in Singapore are eligible to apply for grants to defray the cost of training their employees in areas of direct benefit to the companies.

Support is, therefore, not provided where individuals enrol and finance their own training programmes partially or fully, and request their employers for sponsorship. Neither is support provided where companies bear the cost of external programmes only on successful completion by the trainees. Such reimbursements to the employees are normally provided under an 'Education Assistance Scheme' and are usually for courses not directly related to the companies' needs.

2. Trainees must be employees who are either Citizens or Permanent Residents of Singapore.

3. For associations which act as co-ordinating bodies on behalf of their members. Grants, if approved, will be awarded to the associations which will in turn distribute the grants to members.

**SDF Conditions of Awards \***

- (1) The course must be relevant to the company's needs. The SDF reserves the right to reject an application where the course is viewed as an individual's personal enrichment programme rather than one related to his job or company.

- (2) The trainee must complete the full programme and must have a minimum of 75% attendance at each and every module/term/semester and must sit for all examinations if the course leads to certification.

- (3) Employees eligible for grants must be Citizens or Permanent Residents of Singapore.

- (4) Any trainee employed on expatriate terms will not qualify.

**SDF Procedure for Application for Training Grants\***

**For Courses designated as "Approved-in-Principle"**

- (1) Application forms for "Approved-in-Principle" courses have been specially simplified into a two-page form. These "short-forms" are available from the Singapore Polytechnic's Admissions Counter.

- (2) They must be fully completed and signed by the requisite signatories. Incomplete applications will not be accepted by the Singapore Polytechnic as these will not be processed by the SDF.

- (3) The application forms must be returned to the Singapore Polytechnic as soon as the trainee is enrolled, for onward transmission to the SDF. Applications received more than one month after the commencement of the course will not be accepted by the Singapore Polytechnic as these will not be processed by the SDF.

- (4) A letter of approval will be sent to the company by the SDF, specifying the conditions of award and procedures for submitting claims.

- (5) Generally, claims for disbursement of the grant will only be entertained after the completion of the course. For courses longer than one year duration, pro-rated payment may be made at specified intervals.

- (6) Companies which need guidance in submitting a training proposal or which need to discuss the training programme ahead of application may contact the SDF officers for assistance.

**Grants for Other Courses**

Where companies wish to seek grants for other courses which have not been listed as "Approved-in-Principle", they may apply directly to the SDF, prior to the commencement of the course. Consideration will be given on the individual merit of the application. These applications must be made on the SDF's standard four-page application forms which are not available at the Singapore Polytechnic, but may be obtained from:

The Skills Development Fund Secretariat  
c/o National Productivity Board  
National Productivity Board Building  
2 Bukit Merah Central #17-00  
Singapore 0315

+ Acknowledgement: *Extracted from the Skills Development Fund Handbook — "Training Courses Approved-in-Principle".*

\* Acknowledgement: *Extracted from the Skills Development Fund Handbook — "An Applicant's Guide to The Training Grant Scheme SDF".*

## Fees

**Tuition Fees for Full-Time Courses**  
A student's education at the Singapore Polytechnic is subsidized by the Government of Singapore. The cost of providing technolo-

gical education to students is reflected in the following tuition fees which are payable by students who are admitted:-

Full-Time Diploma Courses	Duration (Years)	Fees Per Academic Year		Others \$
		Singapore Citizens/ Permanent Residents \$		
Engineering Courses				
Architectural Technology Building	3	6,130		6,130
Chemical Process Technology	3	6,130		6,130
Civil Engineering	3	6,130		6,130
Civil Engineering (Construction)	3	6,130		6,130
Civil Engineering (Design)	3	6,130		6,130
Electrical Engineering	3	6,130		6,130
Electronics & Communication Engineering	3	6,130		6,130
Land Surveying	3	6,130		6,130
Marine Engineering	3	6,130		6,130
Manufacturing Engineering	3 1/2*	6,130		6,130
Mechanical Engineering	3	6,130		6,130
Quantity Surveying	3	6,130		6,130
Business Course				
Business & Communications (Transport & Distribution)	3	6,130		6,130
Nautical Course				
Nautical Studies (Phase I: Pre-Sea Induction)	20 weeks	800		1,200

\* includes a period of six months of sea training

**Tuition Grants for Full-Time Students**  
To help students pay the tuition fees, the Singapore Government through the Ministry of Education, provides tuition grants to all full-time students (excluding the Diploma in Nautical Studies course) admitted to the polytechnic. The student will therefore pay only the difference between the fees and tuition grant (as shown in the table below), which is nominal in relation to the recurrent cost of providing such technological education. Students will be advised later, at the time of enrolment, on how to apply for the tuition grants.

Full-Time Diploma Courses	Duration Years	Singapore Citizens/ Permanent Residents		Direct Payment by Students \$	Tuition Grant \$	Others \$
		Direct Payment by Students \$	Tuition Grant \$			
Engineering Courses						
Architectural Technology Building	3	720	5,410	1,080	5,050	5,050
Chemical Process Technology	3	720	5,410	1,080	5,050	5,050
Civil Engineering	3	720	5,410	1,080	5,050	5,050
Civil Engineering (Construction)	3	720	5,410	1,080	5,050	5,050
Civil Engineering (Design)	3	720	5,410	1,080	5,050	5,050
Electrical Engineering	3	720	5,410	1,080	5,050	5,050
Electronics & Communication Engineering	3	720	5,410	1,080	5,050	5,050
Land Surveying	3	720	5,410	1,080	5,050	5,050
Marine Engineering	3 1/2*	720	5,410	1,080	5,050	5,050
Manufacturing Engineering	3	720	5,410	1,080	5,050	5,050
Mechanical Engineering	3	720	5,410	1,080	5,050	5,050
Quantity Surveying	3	720	5,410	1,080	5,050	5,050
Business Course						
Business & Communications (Transport & Distribution)	3	720	5,410	1,080	5,050	5,050

\* includes a period of six months of sea training.

## Tuition Fees for Part-Time Courses

Courses	Duration (Years)	@Fees Per Academic Year
<b>Day-Release Engineering Diploma Courses</b>		
Chemical Process Technology	5 years	\$360 (\$540)
<b>Day-Release Engineering Certificate Course</b>		
Aeronautical Maintenance Engineering	3 years	\$360 (\$540)
<b>Evenings-Only Engineering Diploma Courses</b>		
Architectural Technology Building	5 years	\$240 (\$360)
Chemical Process Technology	5 years	\$240 (\$360)
Civil Engineering	5 years	\$240 (\$360)
Civil Engineering (Construction)	5 years	\$240 (\$360)
Civil Engineering (Design)	5 years	\$240 (\$360)
Electrical Engineering	5 years	\$240 (\$360)
Electronics & Communication Engineering	5 years	\$240 (\$360)
Land Surveying	4 years	\$240 (\$360)
Mechanical Engineering	5 years	\$240 (\$360)
Manufacturing Engineering	5 years	\$240 (\$360)
Quantity Surveying	5 years	\$240 (\$360)
<b>Evenings-Only Engineering Certificate Courses**</b>		
Plastics Mould Design	1 year	\$2,100 (\$2,100)
Process Plant Engineering Design	1 year	\$1,000 (\$1,000)
<b>Evenings-Only Management Diploma Courses**</b>		
Industrial Management	1 year	\$1,000 (\$1,400)
Maritime Studies (Shipping Management)	1 year	\$1,200 (\$1,200)
<b>Evenings-Only Management Certificate Courses**</b>		
Industrial Management	2 years	\$600 (\$800)
Maritime Studies (Shipping Management)	2 years	\$1,000 (\$1,000)
<b>Evenings-Only Advanced Diploma Courses**</b>		
Land Surveying	4 years	\$2,300 (\$3,000)
Plastics Technology	2 years	\$2,300 (\$3,000)
Food Technology	2 years	\$1,500 (\$1,500)
Building Maintenance Management	2 years	\$1,500 (\$1,500)
Tool Engineering & Design	2 years	\$1,500 (\$1,500)

@ Amount in brackets indicates the fees payable by persons other than citizens and permanent residents of Singapore.

\*\* Full course fees are payable prior to the commencement of the academic year.

## Tuition Fees for Short Courses

Courses	Duration	Fees @
<b>Department of Nautical Studies</b>		
Foreign-Going Master (Class 1)	21 wks	\$1,800 (\$2,700)
1st Mate (Class 2)	21 wks	\$1,000 (\$1,500)
2nd Mate (Class 3)	21 wks	\$600 (\$900)
<b>Home-Trade</b>		
Master (Class 4)	17 wks	\$550 (\$825)
1st Mate (Class 5)	17 wks	\$400 (\$600)
Crude Oil Washing & Inert Gas	1 wk	\$400 (\$400)
Electronic Navigation Systems comprising:	5 wks	\$600 (\$900)
a) Radar Observer	2½ wks	\$300 (\$450)
b) Electronic Navigation Aids	2½ wks	\$300 (\$450)
Fire Fighting	1 wk	\$250 (\$250)
First Aid at Sea	1 wk	\$100 (\$150)
Navigation Control comprising:	2 wks	\$300 (\$450)
a) Radar Simulator	1 wk	\$150 (\$225)
b) Automatic Radar Plotting Aids	1 wk	\$150 (\$225)
Oil, Chemical & Liquefied Gas Tanker Familiarisation Course	2 wks	\$250 (\$375)
Personal Survival	2 wks	\$50 (\$75)
Proficiency in Survival Craft	1 wk	\$100 (\$150)
Radar Interpretation & Plotting Courses for Home-Trade Mate Candidates	2 wks	\$300 (\$450)
Radio-telephony (Restricted Class)	2 wks	\$100 (\$160)
Shipboard Management#	2 wks	\$350 (\$525)
Ship Captain's Medical	1 wk	\$100 (\$150)

@ Amount in brackets indicates the fees payable by persons other than citizens and permanent residents of Singapore.

# = per week

## Tuition Fees for Short Courses (cont'd)

Courses	Duration	Fees@
Correspondence Courses Foreign-Going ) Home-Trade )	approx. 24 mths	\$700 (\$1,050) \$300 (450)
Simulator	Variable	\$80 ph (\$120 ph)
Ad Hoc Tuition Master Foreign-Going ) 1st Mate Foreign-Going ) 2nd Mate Foreign-Going ) Master Home-Trade ) Mate Home-Trade )	Variable	\$30 pw (\$45 pw)
Any student attending part of a course will be required to pay a pro-rata fee.		
<b>Department of Marine Engineering</b>		
Engineering Certificate of Competency 2nd Class Part A (full-time) 2nd Class Part B (full-time)	13 wks 15 wks approx.	\$200 (\$300) \$180 (\$360)
1st Class Part A (full-time) 1st Class Part B (full-time)	13 wks 15 wks approx.	\$200 (\$300) \$250 (\$380)
Engine Driver Class 3 Class 2 Class 1	6 wks 6 wks 6 wks	\$50 (\$70) \$50 (\$70) \$50 (\$70)
(Above short courses will be run only if there are minimum eight students, if not, the particular course will be cancelled)		
Fire-Fighting First Aid at Sea Shipboard Management Tanker Technology and Safety	1 wk 1 wk 2 wks 2 wks	\$250 (\$250) \$100 (\$130) \$350 (\$525) \$75 (\$350)
<b>Other Departments</b> For details, please refer to department programmes		

@ Amount in brackets indicates the fees payable by persons other than citizens and permanent residents of Singapore.

ph = per hour; pw = per week

# Conducted jointly by the Marine Engineering and Nautical Studies Departments.

### Reserved Places for National Servicemen:

The tuition grant scheme will also apply to National Servicemen granted places on a reserved basis in previous years. Their tuition grants will be suitably adjusted such that their direct payment will be the same as that of other students who entered the Polytechnic at that time.

### Bond:

**Non-Singaporeans and Permanent Residents of Singapore** (except those already bonded by the YSC) will be bonded under the terms of tuition grants to work in Singapore for three years on completion of their courses. Besides enabling these students to discharge some of their obligations to the Singapore public for the high subsidy of their technological education paid out of public funds, the bond will help them secure employment after they complete their courses.

Singaporeans will not be bonded. However, those on PSC scholarships or bursaries will continue to be bonded under the terms of such scholarships or bursaries.

### Other Fees:

#### Endorsement Subjects

The fees payable are:

Tuition Fee - \$120 (\$180) per subject

Examination Fee - \$30 per academic year

Miscellaneous Fee - \$6 per academic year

#### Referred Subjects

Final-year students with referred papers from the Sessional Examination may attend classes for the relevant subjects at a rate of \$70 per subject, up to a maximum of \$120. A miscellaneous fee of \$6 per academic year is also payable.

#### Non-Graduating Students

The fees payable by non-graduating students are:

Tuition Fees - \$70 per subject (total tuition fee should not exceed \$420 per academic year).

Miscellaneous Fees - \$6 per academic year.

### Examination Fees

Except for self-financing courses which are indicated by a (\*\*\*) on Page 30, students enrolled in full-time, day-release and evenings-only courses leading to a Singapore Polytechnic academic award pay a fee of \$30 for each Sessional Examination. The payment will be made in three termly instalments of \$10. Students enrolled in short courses pay \$5 where applicable.

### Students' Medical Fee

All full-time students shall participate in the Polytechnic Students' Medical Scheme and pay a fee of \$12 per academic year of \$4 per term.

### Students' Union Fees

Union fees are payable as follows:

Entrance fees for all new students only \$5

Subscription fees - full-time students \$18 per academic year

- part-time students \$9 per academic year

Students attending short courses and courses indicated by a (\*\*\*) on Page 30 need not pay the union fees.

### Students' Insurance Fees

All full-time students must participate in the Polytechnic Students' Group Personal Accidents Insurance Scheme and pay a fee of \$2.50 per academic year.

### Miscellaneous Fees

All students shall pay a miscellaneous fee of \$6 per academic year or \$2 per term, except for students in courses which are indicated by a (\*\*\*) on Page 30.

### Polytechnic Tie

On admission, all male students will be required to purchase a Polytechnic tie at \$7 each.

### Sports Fees

All full-time students shall pay a sports fee of \$24/- per academic year or \$8/- per term. Part-time students may also make use of the sports facilities by paying a membership of \$12/- per academic year or \$4/- per term.

### Summary of Fees

In summary, the fees payable per academic year by full-time and part-time students in the

	Full-Time @Per Academic Year	Part-Time (Day-Release) @Per Academic Year	Part-Time (Evenings-Only) @Per Academic Year
Course Fees	\$720 (\$1,080)***	\$360 (\$540)	\$240 (\$360)
Examination Fees	30	.30	30
Medical Fees	12	-	-
Students' Union Fees:			
a) Entrance Fees	5	5	5
b) Subscription Fees	18	9	9
Insurance Fees	2.50	-	-
Sports Fees	24	-	-
Miscellaneous Fees	6	6	6
<b>Total Fees</b>	<b>\$817.50 (\$1,177.50)</b>	<b>\$410 (\$590)</b>	<b>\$290 (410)</b>

Diploma and Certificate courses for the 1986-87 Academic Year are as follows:

Other Fees	Amount Payable
(a) Registration Fee for Full-Time Courses	\$5
(b) Registration Fee for Part-Time Courses	\$5
(c) Registration Fee for Short Courses	\$1
(d) Entrance Test Fee	\$5 per subject
- When an application to sit the Entrance Test is approved	
(e) Locker Fee	\$3
- On hiring a locker	
(f) Replacement Fee for Documents:	\$2
(i) Library Membership Card	
(ii) Duplicate copy of any certificate issued through the Department of Nautical Studies	
- Such duplicate copies will be supplied only where a signed statement is given to the Department setting out the circumstances of the loss of the original certificate	\$10

pay their first term fees in cash or by cheque and will be given a GIRO application form to complete. The completed GIRO form should be returned to the Finance Department for processing. The payment of fees through GIRO will take effect from the second term onwards.

exceptional grounds may be allowed a full refund of fees paid. Students withdrawing from a course within the first week of a term for any other reasons may be allowed a refund of 75% of the fees paid. There will be no refund of fees for withdrawals after the first week of a term.

@ Amount in brackets indicates the fees payable by persons other than citizens and permanent residents of Singapore.

\*\*\* Direct Payment.

Fees can be paid on a termly basis.

### General Information

#### Free Tuition for Malays

Malay students who are Singapore citizens and who are attending a full-time course, may apply through the Public Service Commission (PSC) for free tuition grants. They should apply on application forms obtainable from the Admissions Office. They are, however, liable to pay all other fees.

#### Issue of Receipts

All fees are payable on demand and official receipts will be issued (except for payment through the GIRO Scheme). If no official receipts are received within seven days of payment, a written request should be made to the Head (Finance), Singapore Polytechnic.

A statement of fees paid will be issued to students who are participating in the GIRO Scheme upon request.

#### Payment of Fees

All newly-enrolled students, including re-enrolled students (with the exception of those pursuing short courses and ad-hoc courses) are required to pay their fees through GIRO. Non-first-year students who have been using the GIRO scheme will continue to do so.

GIRO is an easy and convenient way to pay fees through deduction from the student's or his guardian's savings or current account with the bank.

On the day of enrolment, new students will

#### Hiring of Lockers

Lockers are available for full-time students on a first-come-first-served basis, at \$3 a locker per academic year. Enquiries should be made at the Department of Student Affairs. Students should remove their locks and property from the lockers by the last day of each academic year. Any property found in students' lockers by the last day of the academic year shall be retained by the Administration for a period of two weeks, after which the Administration shall arrange for its disposal. The Singapore Polytechnic accepts no responsibility for the loss of any property kept in lockers.

#### Refund of Fees

Students withdrawing from a course before the commencement of an academic year or before the first week of a term on medical or

## Examinations

### Assessment For Polytechnic Awards

The Singapore Polytechnic issues awards at Diploma and Certificate level. To attain any of these awards, a student shall, unless authorised otherwise by the Polytechnic's Examinations Board, in an academic year be formally assessed by:

- (1) In-course assessment throughout the year which normally includes: a First Term Test to be held on the last week of the first term and a Second Term Test to be held on the last week of the second term.
- (2) A Sessional Examination which shall be held towards the end of the academic year.

Students who fail the Sessional Examination may, subject to the Polytechnic Examination By-laws, be eligible to sit for a supplementary to the Sessional Examination.

The weightage for the above-mentioned formal assessments in an academic year shall be decided by the Departmental Board of Examiners. In any case, the minimum weightage accorded for In-Course Assessment (inclusive of Term Tests) shall not be less than 20%.

### Eligibility To Sit For The Sessional/Supplementary Examinations

To be eligible to sit for the Sessional/Supplementary Examinations, a student should fulfil two conditions:

- (1) At least 75% of the total attendance in an academic year.
- (2) Show satisfactory progress in class work, course work and in-course assessment during a session.

### Admittance To The Sessional/Supplementary Examinations

Only students who have been certified by the Polytechnic as being eligible to sit the Sessional/Supplementary Examinations shall

be permitted entry to the approved examination centre.

Detailed examination lists indicating the students' candidature together with examination time-tables shall be published on the Polytechnic notice boards at least two weeks prior to the commencement of the Sessional and one week before the Supplementary Examinations. It is the responsibility of all students to check the examination time-table and examination lists.

### Conduct At Examinations

Students sitting for an examination must conduct themselves in a proper manner and observe all the rules and regulations governing the conduct of the examination. Failure to comply with these rules and regulations shall render students liable for disciplinary action.

### Students Are Particularly Advised to Comply With The Following:

- (1) To bring his or her admission card and place it at the right hand corner of the examination desk at the commencement of each examination.
- (2) To sign on the attendance lists which will be circulated during the examination.
- (3) To report at the approved centre not later than one hour after commencement of the examination.
- (4) Not to leave the examination centre before one hour has elapsed after the commencement of the examination.
- (5) Not to communicate by word of mouth or otherwise with other candidates during the examination.
- (6) Not to take into the examination centre any equipment, books, papers, written documents, pictures or drawings unless otherwise authorised.
- (7) For practical examination, to take into the examination centre clean copies only of such books or papers as are authorised by the examiners.

(8) To bring only battery-operated non-programmable approved calculators into the examination centre. Such calculators shall be for personal use only.

(9) Not to remove any written paper, drawing stationery, equipment or any other examination materials supplied by the Singapore Polytechnic from the examination room.

(10) Not to eat, drink, smoke or read newspapers in an examination room.

### Absence From Sessional/Supplementary Examinations

A student who because of medical or other acceptable reasons subsequently finds himself unable to be present at any examination(s) must obtain the prior approval of the Registrar for the intended absence.

If, due to sudden illness, any emergency or other unavoidable circumstances, this prior approval has not been obtained, the student seeking to be excused from attendance at any examination or part thereof, must within 48 hours thereafter inform the Registrar in writing of his absence. He must set out all the relevant circumstances which prevented his attendance and forward for inspection and retention, documentary evidence in support of his explanation. Students who are absent from the examinations on medical grounds must provide medical certificates from the Singapore Polytechnic panel of doctors for students or from Government doctors.

Absence from any examination, with special permission granted either before or after the examination, on medical or other exceptional grounds, normally entails a repetition of the same year of study in the following sessions.

Any student absenting himself from any Sessional or Supplementary Examination without good reason shall be considered as having sat and failed the subject in the examination.

**Maximum Period To Complete Course**  
Students registered to follow the full-time courses of the Polytechnic are subject to the

following limitations in respect of the maximum time permitted to complete their courses of study:

- (1) For a two-year full-time course of study, the maximum completion period is three years.
- (2) For a three-year full-time course of study, the maximum completion period is five years.

### Conditions For Supplementary Examinations

Students may be allowed to take the Supplementary Examination in not more than two subjects in a set of less than six; or three subjects in a set of six or more prescribed subjects where endorsement subjects and subjects where students are granted exemptions will not be counted as a prescribed subject.

If a final-year student is unsuccessful in his Supplementary Examination, he may be allowed one further attempt to pass the failed subject(s) at a subsequent Sessional Examination subject to the Examinations Board provided that this attempt is made within the next two sessions, except where call-up for National Service makes this impossible.

### Removals

The following categories of students shall be removed from their course:

- (1) Those who fail in the Sessional/Supplementary Examination and are not allowed to repeat.
- (2) Those who repeat any year of their course and fail.
- (3) Those who are unable to complete their course of study within the maximum time permitted.

### Repeats

The following students may be allowed to repeat the course subject to the approval of the Examinations Board:

- (1) A student who fails in any Sessional Examination.

(\*) A student who is unsuccessful in any subject of the Supplementary Examination.

#### Exemptions

Exemption from any year of the course may be granted if the applicant produces proof that he has satisfactorily completed a similar year of study in another institution of adequate standing. The subjects studied and the contents of the syllabi must substantially cover work prescribed for the year of the course from which exemption is sought.

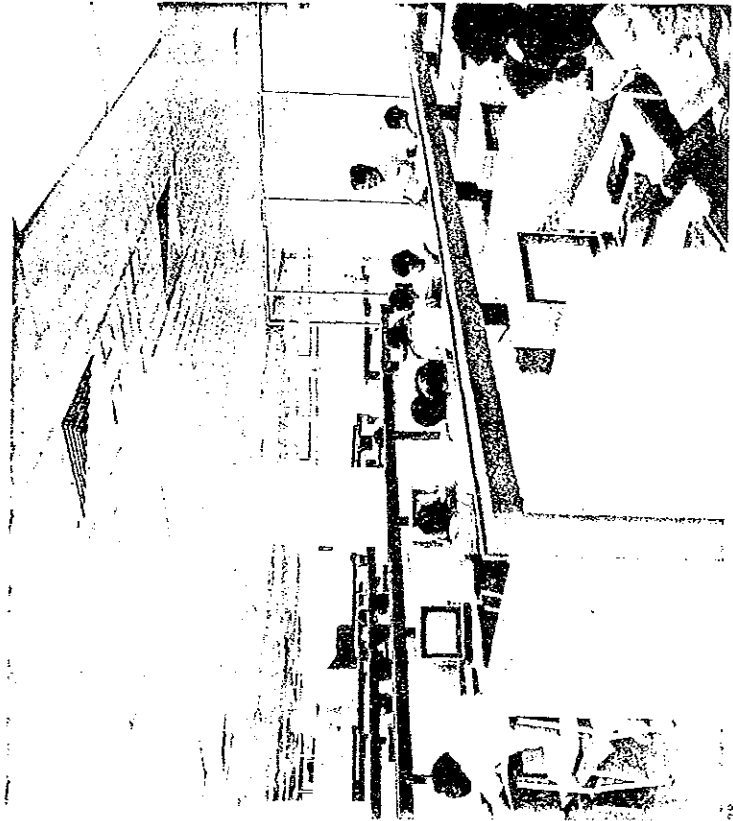
Exemption from not more than two subjects for repeating part-time students and three subjects for full-time students, prescribed for

any year of a course, may be granted only to an applicant who has obtained a grade C or above for those subjects in the previous year's examinations at the Singapore Polytechnic. No credit will be given for passing any subject unless the student has achieved a minimum level at grade C.

Applications for exemption should be submitted during the period publicised.

These should be directed to:

The Registrar  
Singapore Polytechnic  
500 Dover Road  
Singapore 0513



The reception area of the new Students' Clinic.

## Student Services

The Polytechnic provides a range of services for all students through the Department of Student & Public Affairs (DSPA).

#### Student Liaison Office

The Student Liaison Office (SLO) serves as a liaison body between student organisations in the Polytechnic and the Polytechnic Administration.

It channels problems of student organisations to the Administration for action. Besides providing assistance and guidance to student organisations in organising recreational, cultural and educational activities, it also provides services for the welfare of students such as:

- 1) applications and renewals of SBS bus passes;
- 2) applications for lockers;
- 3) printing service for student organisations, etc. . .

Two of its major functions are to oversee the activities of student organisations and to

organise elections to the Students' Union and student clubs. Orientation/departamental talks are also organised by the SLO for the benefit of new students.

Other secondary functions of the SLO are:

- 1) Handling bookings of Polytechnic premises from student organisations.
- 2) Organising lunch-time music listening sessions for the general students.
- 3) Issuing testimonials (for student leaders) on extra-curricular activities.
- 4) Organising get-togethers of student leaders and staff.
- 5) Organising leadership training courses for student leaders.

#### Practical Attachments for Students

Besides the exposure to practical training which they receive in laboratories and workshops, all second-year full-time students are liable for eight weeks of industrial training under a Vacation Training Programme arranged by the Industrial Liaison Office.



### Job Placement

The Industrial Liaison Office also assists graduates in finding appropriate employment on graduation or upon completion of their National Service. Students are also advised on job opportunities, conduct at interviews, salary expectations and other employment matters.

### Student Financial Assistance

Full-time students may apply for financial assistance through bursaries, scholarships and study loans. A list of these can be found in Appendix II. Details are available from the Student Counselling & Guidance Office.

### Students' Clinic

The new Students' Clinic, manned by two doctors, two staff-nurses and a clerk, is located next to the POSB Branch.

Access to the Clinic is by the second level.

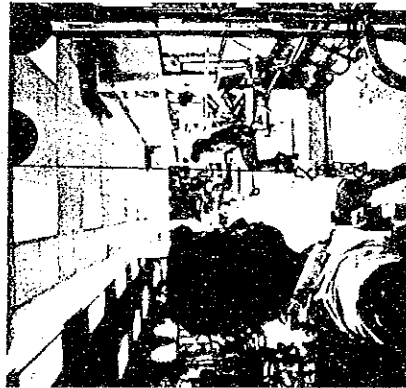
It is open during the following hours during term-time and vacation:

Mondays to Fridays : 9.00 am - 12.30 pm  
2.00 pm - 4.30 pm

Saturdays : 9.00 am - 12.30 pm

Telephone Nos. : 7721143 or 7751133 Ext. 1143

Ambulance Tel No. : 995



The new fitness room is equipped with modern training equipment.

### Student Counselling & Guidance Office

During their time at the Polytechnic, all students can approach the Student Counsellors. Any problem, concern or anxiety, whether about personal adjustment or educational matters, can be shared with the Counsellors in full confidence.

The Student Counselling & Guidance Office is located in the Student Affairs Centre and is open during the following hours:

Mondays to Fridays : 8.30 am - 1.00 pm  
2.00 pm - 5.00 pm

Saturdays : 8.30 am - 1.00 pm

### Personal Tutors

Each student on admission is assigned a Personal Tutor for the first year of his or her course and a study group. Besides participating fully in the activities of the study group, students are encouraged to approach their Personal Tutors freely for assistance, whether on personal problems or studies.

### Student Insurance Scheme

All full-time students of regular courses of the Singapore Polytechnic are required to participate in a Group Personal Accident Insurance Scheme. The insurance premium of \$2.50 per year must be paid together with the tuition fee at the start of the academic year.

This Scheme provides 24-hour worldwide insurance coverage for accidents sustained by students. The benefits include compensation of up to \$10,000 per student upon death or a proportion thereof for permanent injuries sustained. Students will be reimbursed for medical expenses up to a maximum of \$500 for injuries suffered in an accident. Further details on the benefits and exclusions can be obtained from the Students' Handbook or the Industrial Liaison Office of the Department of Student & Public Affairs.

### Sports Activities

The Polytechnic is well-equipped with the following facilities:

Fitness Area with 5 Stations

### Multi-purpose Field

Students are encouraged to participate in beginners' courses and coaching sessions if they wish to learn a sport, improve their skills or represent the Polytechnic in the annual Institute-Varsity-Polytechnic competitions and other tournaments conducted by national bodies.

Besides the Open Championships in badminton, squash, table-tennis and tennis, the DSPA and Sports Club also organise Orientation Games and various competitions on an inter-class/inter-club basis.

One of the highlights of each year's sporting activities is the 'POLY 50' Campus Relay which normally attracts more than 1,500 participants. Other major annual events are the sports awards' presentation for outstanding and dedicated sportsmen and the games tour to neighbouring countries.

Polytechnic Centre

3 badminton courts  
4 table-tennis tables  
2 squash courts

### Squash Centre

6 courts

### Tennis Courts

4 courts and 1 practice wall

### New Sports Hall

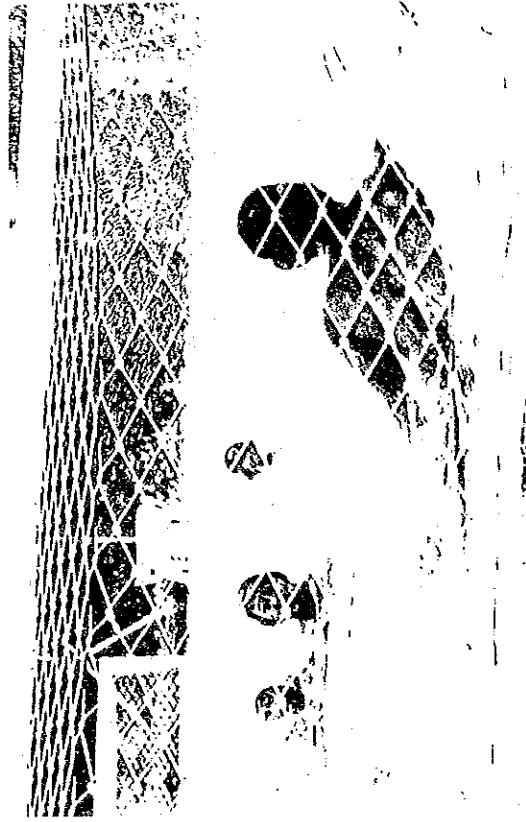
4 badminton-cum-basketball courts  
2 table-tennis tables  
10 carrom/chess tables  
1 fitness room equipped with modern training machines

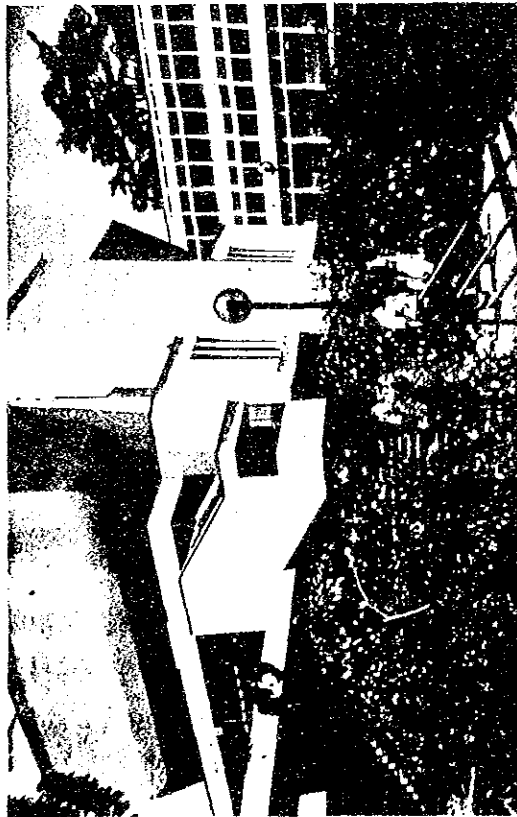
### Swimming Complex

1 standard-size pool  
1 warming-up pool  
1 wading pool

### Two Multi-Purpose Out-door Courts

for basketball, volleyball, netball, sepak takraw, martial arts, hand-ball etc. . .





## Student Organisations

### Singapore Polytechnic Students' Union & Student Clubs

The objectives of the Singapore Polytechnic Students' Union (SPSU) are to:

- (a) Promote and safeguard the interest of the Polytechnic and the Union.
- (b) Promote social, cultural and educational activities and sports among its members.
- (c) Foster among its members a college spirit which shall not have any religious, racial or political bias.
- (d) Promote a spirit of unity and patriotism.

The student clubs which are constituent bodies of the SPSU are:

- Academic Clubs
- Chemical Process Technology Club
- Civil Engineering & Building Club
- Electrical Engineering Club

Electronics & Communication Engineering Club

Marine Engineering Club

Mechanical & Manufacturing Engineering Club

Nautical Studies Club

Non-Academic Clubs

Community Service & Cultural Club

Current Affairs & Debating Club

Sports Club

### Membership

- (a) Membership of the Union and the academic clubs is compulsory for all students. Full-time students are automatically Ordinary Members of the Union as well as the club relevant to the department in which they are enrolled as students. Part-time students are Associate Members of the Union as well

as the club relevant to the department where they are enrolled as students.

- (b) Membership to the non-academic clubs is optional.

Application forms for membership in the non-academic clubs can be obtained either from the Department of Student & Public Affairs at the Student Affairs Centre or from the respective non-academic clubs.

### Management

- (a) The administration of the SPSU is vested in the Union Council which comprises Union representatives and Executive Committee members.

- (b) The administration of each student club is vested in a Management Committee.

### Election of Office-Bearers

Ordinary members of each student club will elect either one or more members from among themselves to the SPSU Executive Committee.

Ordinary members of each student club will elect its own Management Committee. The Management Committee will in turn elect among its members one or more representatives to sit in the SPSU Union Council.

Ordinary members are, therefore, required to:

- (a) elect one or more members to the Club's Management Committee; and
- (b) elect one or more members from the Club to the Union's Executive Committee.

### Subscription

All new Ordinary and Associate Members must each pay an entrance fee of \$5.

Ordinary Members must each pay a subscription fee of \$6 per academic year.

Associate Members must each pay a subscription fee of \$3 per academic term.

All students must pay their Union fees together with their tuition fees.

### Other Student Bodies

Besides the SPSU and its constituent bodies, there are other student organisations, viz:

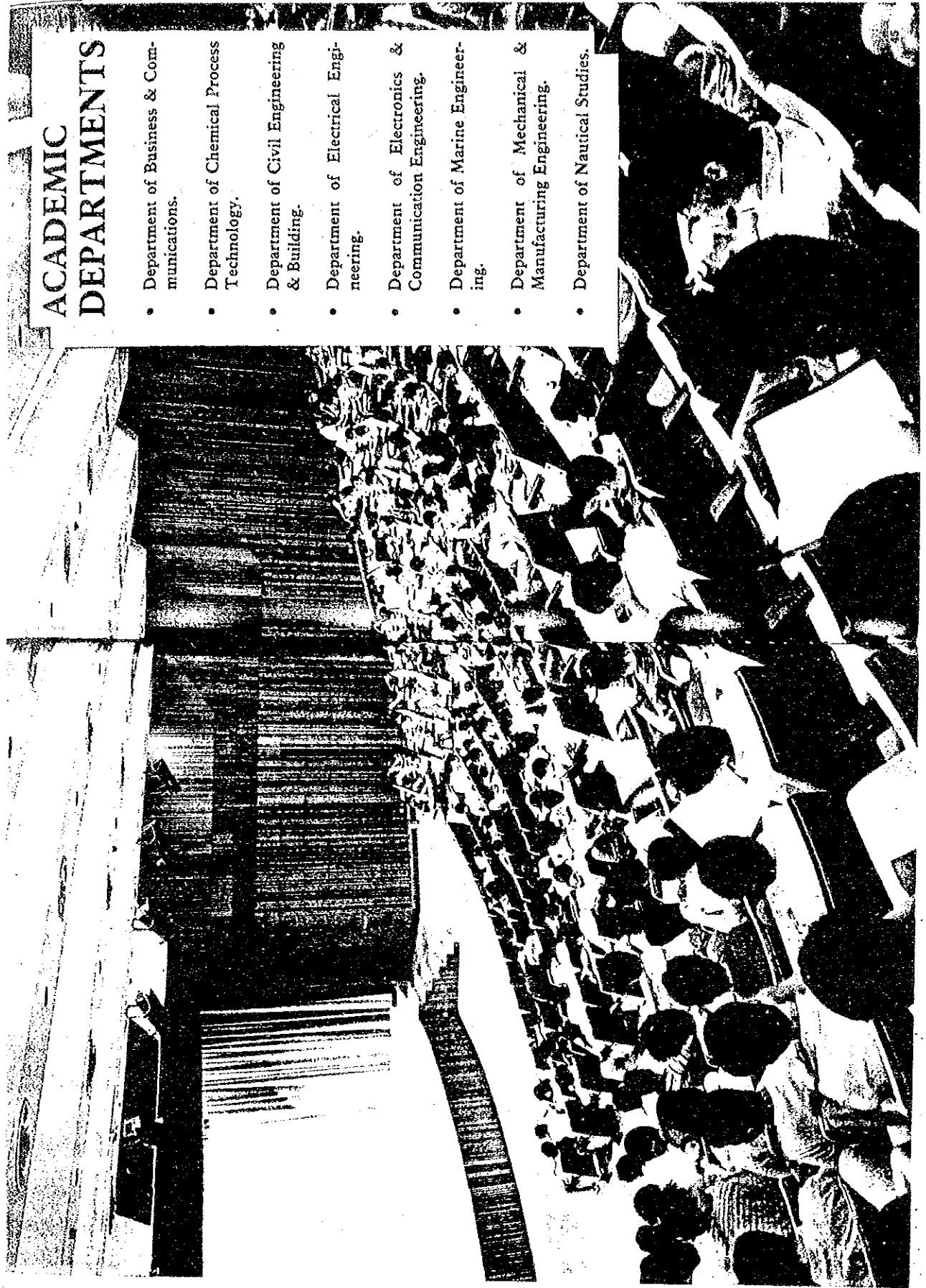
- Adventure Club
- Buddhist Society
- CADD (Computer-Aided Design & Drafting) Club
- Campus Crusade for Christ
- Catholic Students' Society
- Chinese Language Society
- Goju-Kai Karate Club
- Indian Cultural Society
- Legion of Mary
- Malay Language Society
- Navigators
- Polytechnic Band
- Polytechnic Choir
- Polytechnic Christian Fellowship
- Photographic Society
- Rover Scout Unit
- Tae-Kwon-Do Club
- Welfare Services Club

The student organisations are located in the Polytechnic Centre and the Student Affairs Centre.



# ACADEMIC DEPARTMENTS

- Department of Business & Communications.
- Department of Chemical Process Technology.
- Department of Civil Engineering & Building.
- Department of Electrical Engineering.
- Department of Electronics & Communication Engineering.
- Department of Marine Engineering.
- Department of Mechanical & Manufacturing Engineering.
- Department of Nautical Studies.



professional and computer services companies.

- (iii) Commerce sector as junior supervisors in wholesale and retail trades.

A small number of graduates may find employment as junior administrative officers in the public service.

**Subjects of Study**

- Full-Time First Year**
- 1009 Fundamentals of Computer Systems
  - 1511 Business English I
  - 9011 Business Accounting I
  - 9012 Business Law
  - 9013 Economics
  - 9014 Human Resource Management I
  - 9015 Quantitative Methods I

- Full-Time Second Year**
- 1512 Business English II
  - 9021 Business Accounting II
  - 9022 Human Resource Management II
  - 9023 Quantitative Methods II

- Transport and Distribution Option**
- 9124 Law of Business and Carriage
  - 9125 Principles and Economics of Transport
  - 9126 Transport Management Practice I

- Marketing Option**
- 9224 Principles of Marketing
  - 9225 Business Economics
  - 9226 Marketing Research and Consumer Behaviour

- Information Systems Option**
- 9324 Business Organisation
  - 9325 Systems Analysis and Database Design
  - 9326 Programming

- Full-Time Third Year**
- 9031 Business and Communications
  - 9032 Project

- Transport and Distribution Option**
- 9133 Insurance of Carriage
  - 9134 Physical Distribution Management
  - 9135 Transport Management Practice II
  - 9136 Transport Policy and Planning

The services sector comprises four main categories, namely transport and communications, business services (professional and computer services), personnel and social services and financial services. Together with the commerce sector, which comprises wholesale and retail trade, restaurants and hotels, it contributed to no less than 50% of our GDP. The high GDP growth of the first half of the 80's was generated largely by strong growth of services. Hence the provision of sufficient well-trained diploma graduates for the services and commerce sectors is vital to continuous growth of our economy.

The newly-formed Department of Business & Communications conducts a three-year full-time Diploma in Business & Communications course in response to these needs.

**Diploma in Business & Communications**

This is a three-year full-time course.

**Practical Training**

Full-time students undergo about eight weeks of practical training with industry during the long vacation at the end of the second year of their three-year course.

During each year, special lecturers are delivered to students by specialists invited from industries and institutions. Day visits to the various commercial and industrial companies are also organised every term.

**Assessment**

Assessment during each year of the course will be by means of written examinations and continuous assessment. A satisfactory standard will be required in both course work and examination.

**Career Prospects**

- Business & Communications graduates will find employment in the following industries:
- (i) Transport and communications sector, as junior executives and supervisors in freight forwarding firms, airline and shipping companies, port and agencies.
  - (ii) Business services sector as marketing personnel and junior sales executives in



At the Business & Communications Department's Micro Laboratory, first-year students are taught computer applications.

**Department of Business & Communications**

**Staff**

**Acting Head**  
Soh Eng Sim  
MSc, MBIM, MCIT

**Senior Lecturers**

- J T Maciel  
Master (FG), LL.B (Hons), DMS (Shipping), FICS, MCIT, MBIM, MSNI
- R V Sehamani  
Master (FG), MCIT, MBIM, MSNI

**Lecturers**

- Ang Chin Eng  
Master (FG), MBA, Dip Naut Sc, MCIT, MSNI, AAIM
- Chew Cheah Boon  
BSc (Hons), MCIT
- Lu Geok Lan (Mrs)  
B Accy, Dip Ed

Vijayarengan Maheantharan  
BSc (Hons), LL.M

Ng-Chin Li Seong, Dorreen (Mrs)  
BBA

Ong Tiong Hui  
BA, AMSIM

Poon Choon Gek (Ms)  
B Accy, Dip Ed

Tan Joseph  
BA (Hons), MSc

Tan Keng Hock, Roland  
BSc (Hons), MCIT

Tan Yeow Huat (on study leave)  
BSc (Hons)

Ying-Chan Chee Meng Christine (Mrs)  
BBA, Dip Ed

**Senior Instructor**

C G De Souza  
Dip, MCIT

- Marketing Option**  
 9233 Business Policy and Finance  
 9234 International Marketing  
 9235 Marketing Communication and Advertising  
 9236 Marketing Planning and Control
- Information Systems Option**  
 9333 Decision Support Systems  
 9334 Business and Data Communications Systems  
 9335 Computer Operations and Management  
 9336 Marketing
- Synopses of Subjects**
- 1009 Fundamentals of Computer Systems**  
 Role of data and information in an organisation, data processing system, development of the computers, trends in computing, data processing department, architecture and organisation of a computer, physical characteristics, data communications, local area network architecture, software program, operating system, word processing features and power, spreadsheet features and power, database management system features and power, applications of software packages in a business environment.
- 1511 Business English I**  
 Developing of communication skills, integration of language skills with skills needed for Quantitative Methods, core skills such as reading, comprehension, note-taking, summarising, report writing, discussion and oral presentation.
- 1512 Business English II**  
 Integration of some language skills with skills needed in Quantitative Methods, core skills include memo and letter writing, report writing skills for job interviews, telephone communication skills for functioning in meetings, effective communicative skills.
- 9011 Business Accounting I**  
 Accounting conventions and principles, double entry concepts, financial statements of a business concern, control of assets and liabilities.
- Business Law**  
 General principles of Singapore law, the law of contract, torts, agency, sale of goods, hire purchase, guarantees and indemnities, negotiable instruments, insurance, company law, trusts, carriage of land, sea, air, employment law.
- Economics**  
 Price mechanism, production and costs, project completion and economic efficiency, monopoly, oligopoly, monopolistic competition, measuring gross national product, classical economics and Keynesian revolution, stabilization policies, unemployment and inflation, productivity and growth, international trade, exchange rates and balance of payments, the Singapore economy.
- Human Resource Management I**  
 Nature and scope of human resources management, the management framework and the personnel function, management process, planning, controlling, and organisation function, decision making and problem solving, supervisory role and responsibility.
- Quantitative Methods I**  
 The principles and applications of statistical analysis, organisation and analysis of statistical data, probability distributions, statistical sampling, hypothesis testing, analysis of variances, non-parametric statistics and linear regression, application techniques including software packages.
- Business Accounting II**  
 Comprehensive knowledge of accounting for limited companies, basic principles in management accounting, financial statements, basic management accounting techniques for decision making, planning and control.
- Human Resource Management II**  
 Employee compensation benefits, assessing and rewarding good performance — performance appraisal, wage and salary administration, trouble-shooting, organizational behaviour problems, conflict stress, behaviour modification and application of learning theory, career planning for human resources, human resources training and development.
- Quantitative Methods II**  
 Modelling and Markov chain, decision theory, Bayes rules, inventory control linear programming, simplex transportation, assignment techniques, network analysis, CPM and PERT, queuing theory, simulation, Monte Carlo technique, forecasting, basic and qualitative techniques, time series projections, causal models.
- Business and Communications**  
 Business and Communications is the main core subject by which integration of learning from amongst the various disciplines may be successfully achieved. Students will be given plenty of opportunity to discuss the requirements of business and the qualities sought in them when applying for supervisory posts. Lectures are a combination of the traditional techniques supplemented by audiovisual materials.
- Insurance of Carriage**  
 General principles of law practice of insurance, insurance contracts, marine insurance craft and cargo, air insurance craft and cargo, commercial motor insurance, insurance of road freight, types of insurance on multi-modal and intermodal freight transport.
- Physical Distribution Management (PDM)**  
 Background to physical distribution management, customer service, levels of customer service, total distribution concept, roles of depots, depot planning, cost reduction approach, distribution demand forecast, depot location, vehicle utilisation, company organisation and role of PDM, warehousing, material handling, transport modes and distribution management, packing, unitisation, containerisation, their functions and policies, freighting and vehicle distribution, controls in distribution management.

**9135 Transport Management Practice II**

Land transport terminals, locational aspects and layout of bus stations, basic traffic management practices, MRT station design and principles of station control. Airport terminals, airport passenger flow, functional elements in airport terminals, airport terminal layout, air freight terminal design and functions, seaport characteristics, functions and scope of seaports, port planning and development, port capacity utilisation, multimodal transport terminal, inland terminal requirements, modal land terminal requirements, modal transfers in seaports, function and planning of inland container depots.

9136

**Transport Policy and Planning**

Transport and land use, transportation planning, organisation and machinery of government in relation to transport policies, current local transport problems, sociological transport perspectives.

9224

**Principles of Marketing**

Basic concepts of marketing, the organisation, its role, and its interaction with the various factors in marketing environment, consumer behaviour, the marketing mix, market segmentation, marketing research and plans, marketing mix variable, product, distribution, pricing and promotion, the basic concepts, their relationship, the methods management and control.

9225

**Business Economics**

Meaning of industry, significance and measurement of market structure, objectives and the growth of firms, theory of pricing, product differentiation, technological innovations, public policy and performance of industrial sector, monopoly and merger policy.

9226

**Market Research and Consumer Behaviour**

Consumer behaviour and consumer purchase decisions, basic determinants of consumer behaviour, environmental influences, business

technology management.

9324

**Business Organisation**

Business environment in Singapore, management, planning, organisation, coordinating and controlling, evolution of management theory, decision making, introduction to personnel management, introduction to production management, introduction to financial management and introduction to marketing management.

9325

**Systems Analysis and Data Base Design**

Systems concepts, behaviour of systems, control mechanisms, business representation, information system, operational research and work study, system life cycle, role of systems analyst, communication, user involvement, feasibility assessment, investigation, system design, subsystems, file types and designs, access methods, transportation techniques, logical and physical data, database design, dialogue design, code maintenance and review, documentation and management.

9326

**Programming**

Rudiments of computing language and program, various levels of program language including compiler, assembler, translator and interpreter. Syntax, semantics, classes of binding times, data types storage management, syntactic elements, grammar patch program, flow charting, testing and debugging documentation, structural programming, maintenance of programs.

9333

**Decision Support Systems**

Nature and scope of decision support systems, managerial decision-making process, systematic thinkers, instructive thinkers, application of database, report generators and spreadsheets by a manager, types of decision support systems, relationship with management information system, procedures in the design of a decision support

system, levels of technology including the specific, generator and tools, roles in the system including the user, intermediary, facilitator, technical supporter, toolsmith, data system, model sub-system, user system interface, cost and benefits, users' creativity.

9334

**Data and Communications Systems**

Nature and functions of conventional office, constituents of an office system, office environment, basic office equipment and machines, impact of electronics in office automation, telecommunications technology, digestion of text, image and speech telex, reletex, facsimile, optical character recognition, local area network, configuration of networking transmission modes, interface standards, circuit switching, packet switching, message switching, artificial intelligence expert systems, cellular mobile radio technology, value-added networks, low-risks and high opportunity systems.

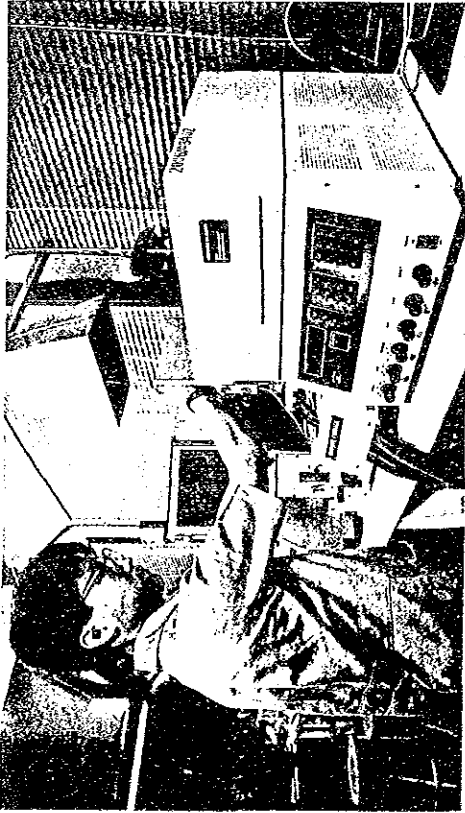
**Computer Operations and Management**

Hardware structures, selection methodology, proposal evaluation, installation planning, system orientation, system start-up, initial training, scheduling, control and measurement, pricing, user friendliness, software structures, language classification, batch processing, time-sharing distributed computing, real-time, software implementation cycle, staffing and task setting, organisational classification, interfaces to computer centre, links with business organisations and departments, system maintenance, security.

9336

**Marketing**

Basic concepts of marketing, the marketing management process, marketing research and marketing information system. The marketing environment, consumer behaviour, target market selection. The marketing mix, management of the marketing effort.



A third-year Industrial Chemistry option student analysing environmental samples in the Chemical Analysis Laboratory.

## Department of Chemical Process Technology

### Staff

#### Head

Yeow Kian Peng  
B Sc (Eng) (Hons) Chem Eng, ACGI

#### Deputy Heads

Doreen A L Cheong (Dr) (on study leave)  
B Sc (Hons), Ph D, CChem, MRIC, MSNIC  
Leong Chee Lu (Dr)  
B Sc (Hons), Ph D, CChem, DIC, MRIC, AMIC

#### Chemical Engineering Section

##### Section Head

Paul Yap Yeow Pin  
B Sc (Hons), Dip Ed, M Sc (Food Mgt Sc), ASIFST

#### Senior Lecturers

Poh Hee Seng  
B Sc (Chem Eng), M S (Macro Sc), MACS, MSPE, MAAAI  
Soo Tong Min (Dr)  
BSc (Chem Eng), M Sc (Chem Eng), DIC, Ph D (Chem Eng)

#### Lecturers

Christopher Kuok Sze Tong  
B E (Chem Eng) (Hons)  
Lee Kwee Lar (Mrs)  
Dip (CPT), LPRI, B Eng (Chem), M Sc (Chem Eng)  
Lim Swee Ling  
B Sc (App Chem) (Hons), Grad Dip (Marketing Mgmt), Dip in Marketing (IMUK), MSNIC, MRIC(UK), Chartered Chem, MSPE(INC)

Mak Fong Keng (Dr)  
B E (Chem), Ph D, MIE (Aust), MAWWA, MIES

Ng Courvoisier Lucas  
B Sc (Eng) (Hons) Chem Eng, ACGI M Sc (Control), DIC

Ng Tong Huat  
B Sc (Chem Eng), M Sc (Chem Eng), DIC, MAIChemE

Shannugam Pillai  
B Sc (Hons), AMIEE (UK), ISA (Member)

Tay Kheng Siang  
B Eng (Chem) (Hons), M Sc (Industrial Eng), C Eng, MChemE(UK), MIE(USA), MIE (S), MIES

Joseph Teo Poh Leng  
B E (Chem Eng)

Tham Guat Suan (Mrs)  
B Sc (Hons) (Bio Chem Eng)

### Chemistry Section

#### Section Head

Leong Chee Lu (Dr)  
B Sc (Hons), Ph D, DIC, CChem, MRIC, AMIC

#### Senior Lecturers

Janice Chow Chui Fong (Mrs)  
B Sc, Dip Ed, M Sc, MSNIC, ARACI

Shum Siew Khoon  
B Sc (Chemistry) (Hons), M Sc (Chemistry), MRSC, MSNIC

#### Lecturers

Kuo Yian Lin (Mrs)  
B Sc (Hons), Dip Ed, M Chem, ARACI, MSNIC

Leong Choo Hia (Mrs)  
B Sc (Hons), M Sc (Adhesion Sc), MSNIC

Ma Chi Wan (Mdm)  
B Sc (MLS), M Sc, RT(CSLT, Canada), MT (ASCP, USA), SACB, SBS

Ong Chin Choon (Dr)  
B Sc (Hons), Ph D (Chemistry), MNZIC

Yap Kon Sang  
B Sc (Chem), M Sc, CChem, MRSC, Assoc UMIST (Chem Eng), AMIC, MSNIC

### Food Technology Section

#### Section Head

Ong Kim Lian (Mrs)  
B Pharm, M Sc (Food Tech), AIFST, ASIFST

#### Lecturers

Ku Lee Fong (Mrs)  
B Sc (Chem), M Sc (Food Mgt Sc), ASIFST, MIFT

Lok Swee Wah  
B Sc (Biotech), M Sc (Biochem)

Loong Mann Na (Miss)  
Dip (CPT), B Sc (Hons) (Food Eng)

Mah Mon Moey (Mdm)  
B Sc (Biochem), M Sc (Biochem)

Mok Chee Ho  
B Sc (Hons), M Sc, MIBiol, ASIFST

Ser-Low Wai Ming (Mrs)  
B Sc (Hons), D'S, M Sc (Food Eng)

Tay Siang Yeh (Mrs)  
B Sc (Food Sc), ASIFST

#### Teaching Assistant

Koh Siok Im (Mrs) (on study leave)  
Dip (CPT)

### Polymer Technology Section

#### Acting Section Head

Tay Chin How  
M Sc (Polymer Chem & Tech), MPRI, MSNIC

#### Lecturers

Honmayoun Khalifi  
B Sc (Mar Sc & Eng), M Sc (Plastics Eng), MSAMPBE

Leong-Chia Kim Yen (Mrs)  
Dip (CPT), M Sc (Polymer Tech), GPRI

Ng Kam Fong  
HND (App Chem), GPRI Cert. (Plastics Mould Design)

Ng Pek Choo (Miss)  
HND (Chem Eng), GPRI, M Sc (Polymer Tech)

**Tin Hsiang**  
B.F. (Chem), B.A., M.Sc. (Polymer Chem & Tech), MPRI

**Nee Pui How**  
Dip. (CPT), MPRI, M.Sc. (Polymer Tech)

#### Principal Instructors

**Lee Wah Ling z**  
Dip. (CPT), MPRI, MSPE

**Lau Hua Hui**  
Dip. (CPT), MPRI

**Tan Yew Yeow**  
Dip. (CPT), Dip. M.M., Dip. M. (IMUK), AMM, MPRI, MSPE

#### Instructor

**Mok Bee Li (Mrs)**  
Dip. (CPT), LPRI

The Department of Chemical Process Technology is the only tertiary body involved in the education and training of technologists for the chemical process industries and its allied health sector. The course options offered include Polymer Technology, Food Technology, Process Engineering, Industrial Chemistry and Medical Laboratory Technology, the last option being conducted jointly with the Ministry of Health.

#### Practical Training

Full-time students undergo eight weeks of practical training with industry during the long vacation at the end of the second year of their three-year course. Students who opt for the Medical Laboratory Technology programme are required to undergo a 14-week attachment programme at selected hospitals or medical laboratories. Part-time students are normally in employment relevant to their course of study and therefore receive the necessary practical training on the job.

During the year, special lectures are given to students by specialists invited from industries and institutions.

#### Assessment

Assessment during each year of the course will be by means of written examinations and continuous assessment. A satisfactory standard will be required in both course work and examinations.

#### Career Prospects

Chemical process technologists find employment in the following industries:

- Plastics and related industries: as shop-floor supervisors and production technologists.
- Rubber and related industries: as technologists in fabrication, compounding and milling processes.
- Food industries: as technologists in product formulation, product development and quality control and processing.
- Chemical industries: as technologists and supervisors in product formulation, testing, quality control and production.
- Heavy chemical industries: as technologists and supervisors in plant operations in the petroleum and petrochemical industries.
- Medical and allied health sector: as medical laboratory technologists in the study, diagnosis and promotion of health in general.

A number of graduates find employment as technical personnel in marketing customer services and other management-related positions.

#### Diploma in Chemical Process Technology

This is a three-year full-time or five-year part-time course.

#### Full-Time First Year

- 1004 FORTRAN Programming  
1052 Engineering Mathematics  
1501 English for Academic Purposes  
7101 Chemistry  
7102 Food Studies  
7103 Polymer Studies

- 7104 Chemical Process Principles  
7105 Applied Electricity & Electronics  
7106 Engineering Drawing
- Full-Time Second Year**  
7201 Chemical Analysis  
7202 Food Science & Processes  
7203 Polymer Science & Applications  
7204 Chemical Engineering Principles  
7205 Process Instrumentation  
7206 Engineering Drawing  
7207 Applied Chemistry  
7208 Computer Studies (Module 3)
- Full-Time Third Year**  
(Except Medical Laboratory Technology Option)  
1502 English for Occupational Purposes  
7301 Project  
7302 Supervisory Studies  
7303 Quality Assurance & Statistics  
7304 Process Control & Microprocessor Appreciation

**Polymer Technology Option**  
7305 Polymer Science & Technology I (Materials)  
7306 Polymer Science & Technology II (Processes)  
7307 Polymer Science & Technology III (Control & Design)

**Food Technology Option**  
7308 Food Science & Technology I (Food Processing)  
7309 Food Science & Technology II (Applied Microbiology)  
7310 Food Science & Technology III (Food Quality & Legislation)

**Process Engineering Option**  
7311 Process Engineering I (Mass Transfer Operations)  
7312 Process Engineering II (Chemical Process Industries)  
7313 Process Engineering III (Process & Plant Design)

**Industrial Chemistry Option**  
7314 Industrial Chemistry I (Laboratory Techniques & Administration)  
7315 Industrial Chemistry II (Materials & Processes)  
7316 Industrial Chemistry III (Biomaterials & Processes)

- Medical Laboratory Technology Option**  
1502 English for Occupational Purposes  
7302 Supervisory Studies  
7317 Medical Laboratory Technology I (Laboratory Techniques & Administration)  
7318 Medical Laboratory Technology II (Haematology & Blood Banking)  
7319 Medical Laboratory Technology III (Histopathology & Immunology)  
7320 Medical Laboratory Technology IV (Microbiology)  
7321 Medical Laboratory Technology V (Biochemistry & Physiology)

**Evenings-Only First Year**  
1052 Engineering Mathematics  
7181 Chemistry  
7182 Applied Electricity & Electronics  
7183 Engineering Drawing

**Evenings-Only Second Year**  
1004 FORTRAN Programming  
7281 Applied Chemistry  
7282 Food Studies  
7283 Polymer Studies  
7284 Chemical Process Principles

**Evenings-Only Third Year**  
7381 Chemical Analysis  
7382 Food Science & Processes  
7383 Polymer Science & Applications  
7384 Chemical Engineering Principles

**Evenings-Only Fourth Year**  
7480 Quality Assurance & Statistics  
7481 Process Instrumentation

**Polymer Technology Option**  
7482 Polymer Science & Technology I  
7483 Polymer Science & Technology IIA  
7490 Computer-Aided Design

**Food Technology Option**  
7484 Food Science & Technology I  
7485 Food Science & Technology IIA

**Process Engineering Option**  
7486 Process Engineering I  
7487 Process Engineering IIA  
7490 Computer-Aided Design



Industrial Chemistry Option  
7488 Industrial Chemistry I  
7489 Industrial Chemistry IIIA

Evenings-Only Fifth Year  
7580 Supervisory Studies  
7581 Process Control  
7590 Project

#### Polymer Technology Option

7582 Polymer Science & Technology IIB  
7583 Polymer Science & Technology III

#### Food Technology Option

7584 Food Science & Technology IIB  
7585 Food Science & Technology III

#### Process Engineering Option

7586 Process Engineering IIB  
7587 Process Engineering III

#### Industrial Chemistry Option

7588 Industrial Chemistry IIB  
7589 Industrial Chemistry III

#### Exemption

Holders of the Diploma in Chemical Process Technology (Polymer Technology Option) are given full exemption from the Diploma examinations (DPR) of the Plastics & Rubber Institute of the United Kingdom. Graduates with relevant working experience are eligible for election to the Licentiatehip of the Institute (LPI). Diplomates can now be enrolled directly for the Institute's Graduate-ship Course (Grad PR).

#### Certificate in Plastics Mould Design

This is a one-year evenings-only course which aims to impart design theory and practice to technologists who already have elements of plastics mould-making, plastics processing and drafting experience.

#### Subjects of Study

7001 Mould Design  
7002 Plastics Technology  
7003 Workshop Technology

### Advanced Diploma in Food Technology

The Advanced Diploma is offered as a two-year part-time (evenings only) programme to prepare graduates and upgrade their skills in process supervision and technical support in the food and related industries. Our graduates are expected to fill the roles of tertiary qualified food technologists as there is at present no degree training being offered locally. The discipline of Food Technology and Food Science, together with engineering, chemistry, biological sciences and management are integrated throughout the course.

#### Aim of the Course

The aim of the course is to train personnel to a level which enables them to perform a leading role in process supervision, product and research-oriented development and technical-related activities.

#### Course Assessment

The course is practical-oriented, with emphasis on practical assessment which contributes some 40 to 50 percent of the final marks.

Other assessments include 10 to 20 percent for written assignments and 40 to 50 percent for the final term examinations. A final-year project is also required.

#### Career Prospects

The course is designed to equip students for leading roles in the food industry in the areas of:

Food processing and engineering.  
Technical support in quality control, product development programmes.  
Supervision in fast food and other retail outlets.

#### Entry Requirements

Applicants must:

- possess a Polytechnic Diploma in Chemical Process Technology (Food Option).
- be at least 24 years of age at the time of application.
- have at least two years of working experience.

Those offering other appropriate equivalent qualifications are also invited to apply.

#### Course Modules

##### Year I

7030 Food Engineering  
7031 Food Chemistry  
7032 Food Microbiology  
7033 Food Processing  
7034 Food Additives  
7035 Food Pathogens  
7036 Process Automation & Control  
7037 Food Rheology  
7038 Food Packaging

##### Course Modules

##### Year II

7040 Biotechnology: Basic Principles  
7041 Quality Control  
7042 Project Management  
7043 Biotechnology: Fermentation  
7044 Nutrition  
7045 Financial Management  
7046 Biotechnology: Downstream Processing  
7047 Food Sensory Evaluation  
7048 Marketing Management  
7049 Project

### Advanced Diploma in Plastics Technology

Singapore Polytechnic is the only tertiary institution in Singapore which offers training in Plastics Technology at both Diploma and Advanced Diploma levels.

The main objective of the two-year part-time Advanced Diploma course is to upgrade the level of technical skills and knowledge of plastics technologists to meet the requirements of the local plastics industry, which is moving from a relatively low value-added to higher value-added product manufacture.

Graduates of the Advanced Diploma are normally eligible for election by exemption, to the Graduatehip of the Plastics and Rubber Institute of the UK upon application to the Institute.

#### Assessment

Assessment will take the form of:-

- Written examination at the end of each term.
- In-course assessment.

#### Career Prospects

Graduates of the Advanced Diploma find employment in the plastics and related industries as senior technologists in plastics products manufacturing, research and development, and quality control.

They are also employed in such management-related positions like marketing, technical services, and customer services.

#### Entry Requirements

Applicants may offer:

- Singapore Polytechnic Diploma in either Rubber and Plastics Technology or Chemical Process Technology (Polymer Technology Option) or equivalent, or
- A recognised degree in Chemistry, Chemical Engineering, or equivalent.

Applicants should also be in relevant employment and have preferably been working in the plastics or polymer-related industries for at least two years.

#### Course Modules

##### Year I

7011 Chain-Growth Polymerisations  
7012 Step-Growth Polymerisations  
7013 Properties of Polymer Molecules  
7014 Polymer Molecular Weight Determination

##### Year II

7015 Polymer Physics  
7016 Polymer Analysis  
7017 Commodity Thermoplastics/Additives  
7018 Engineering Thermoplastics  
7019 Major Thermosets

##### Year II

7020 Plastics Processing Equipment and Controls

- 7021 Injection Mould Design  
 7022 Product Design and Testing  
 7023 Plastics Moulding Technology  
 7024 Plastics Extrusion Technology  
 7025 Other Plastics Processes  
 7026 Industrial Management  
 7027 Financial Management  
 7028 Marketing  
 7029 Project

### Continuing Education

The Department does from time to time conduct short courses for personnel from industries to upgrade their knowledge and skills in various disciplines related to the Department's activities. Available courses include Food Hygiene, Microbiological Examination of Foods, Introduction to Plastics Technology, Atomic and Molecular Spectroscopy, Plant Sanitation & Pest Control. Details of courses available are included in the Handbook of the Continuing Education Department.

### Laboratories/Workshops

The Polymer Workshop houses a wide range of equipment for the processing of plastics and rubbers, e.g. injection moulding machines, blow moulding machine, twin-screw extruders, rotational moulding machine, vacuum forming machines and blow-film extruder.

The Polymer Characterisation Laboratory has equipment for testing and characterisation of polymers, e.g. tensile testing machine, abrasion testing machine, melt flow indexer, impact strength tester, differential scanning calorimeter and thermogravimetric analyser.

The Polymer/Petroleum Chemistry Laboratory houses a full-range of equipment for the testing and characterisation of polymer and petroleum products, e.g. gas chromatograph, Pensky-Martens apparatus, Orsat gas analyser, Engler distillation unit, flash point apparatus.

The Microbiology Laboratory provides facilities to support the curriculum on food microbiology, e.g. total bacterial count, smear preparation and staining, sanitation testing and sterility studies. Equipment available include autoclaves, stomacher, blenders/homogenisers, laminar flow cabinets, low tem-

perature incubators, shaker incubators, colony counters, UV sterilisers, cold room.

The Food Processing Laboratory houses a wide range of food processing equipment which includes the line exhauster and canning machine, cryogenic freezer, Brabender extruder, spray dryer, UF unit, homogenizer, packaging machines, freeze dryer, fermenters. Facilities for certain aspects of biotechnology work, e.g. enzyme analysis and genetic studies, are also available.

The Food Quality and Sensory Evaluation Laboratory has facilities for food product development and evaluation, using the experimental kitchen and tasting booths. Equipment available includes rheometer, viscometer, gelometer, testurometer, farinograph, noodle making machine and cake and bread baking facilities.

The Food Technology Laboratory provides facilities for students to gain experience in the fundamentals of food chemistry and analysis e.g. Dean and Stark apparatus, Kjeldhal distillation apparatus, viscometer, refractometer, fibre analyser, fat analyser, foam tester.

The Industrial Unit Operations Laboratory has equipment for the study of separation and transfer processes, e.g. sieves for size distribution analysis, fluid flow unit, pump test rig, climbing film evaporator, packed tower absorber, packed and bubble-cap tray distillation columns, liquid-liquid extraction unit, leaching unit, crystalliser pilot plant, reactors, flow visualisation unit, filter press.

The Instrumentation and Control Laboratory provides facilities for hands-on experience on standard process instrumentation, e.g. measurement of flow, level, pressure, temperature; transmitters; transducers; PID controllers. Students are also exposed to control strategies for pilot plant operations, e.g. controller tuning, ratio control and cascade control, using the on-line process control computer. There is also full-range equipment for illustrating basic principles of applied electricity and electronics, pneumatic and hydraulic control circuitry, microprocessor applications and robotics.

The Chemical Analysis Laboratory provides students with practical experience on analytical techniques, e.g. UV, visible, IR and atomic absorption spectrophotometry, flame emission photometry, fluorimetry, calorimetry, electrogravimetry, potentiometry, conductometry, ion-exchange separation, solvent partition separation, TLC, liquid chromatography, gas chromatography and polarimetry. There is also an electroplating facility for various plating applications, including plating on metals and plastics.

The Chemistry Laboratory has equipment for developing the student's basic skills in chemistry and applied chemistry, e.g. electronic balance, pH meter and standard laboratory equipment for qualitative and quantitative analytical work.

The Design Room houses drafting facilities for mould design and process design.

### Synopses of Subjects

#### 1004 FORTRAN Programming

Functions of the main elements of a digital computer and its peripherals. Basic concepts of operating systems and high level languages. Flow charts for programming algorithms. Correct usage of common FORTRAN statements. Arithmetic expression and assignment statements. DO loops, decision statements and control loops. Use of formatted Input/Output and data types. Arrays and variables. Subprograms. COMMON block of storage. Use of sequential files in file handling. Design and coding programs for engineering applications. Documentation techniques. Use of selected application software packages.

#### 1052

#### Engineering Mathematics

Indices and logarithms; interpretation of experimental data; determinants; solution of algebraic equations; binomial expansion; radian measure; differentiation; indefinite and definite differentiation and integration and their applications; solution and appli-

cation of first order ordinary differential equations. Frequency distribution; mean, median and mode of a distribution, dispersion and standard deviation of a sample numerical data. Forces in equilibrium; Newton's law of motion; friction; stress-strain relationship; Young's modulus.

#### English for Academic Purposes

The course helps students acquire skills required to function effectively in their studies. Core skills are intensive and extensive reading skills, listening and note-taking, summarising, answering examination questions and writing project reports.

#### English for Occupational Purposes

The course teaches the skills required when applying for a job and functioning at work. The former includes reading and interpreting job advertisements, writing job application letters and attending job interviews. The latter skills include those for functioning at meetings, making oral proposals, telephone techniques and writing memoranda and business letters.

#### Mould Design

Mould design technology. The technologist's role in the preparation of working drawings for mould making. Mould classification. Moulds for compression and transfer moulding. Injection moulding and functions of each component. Shrinkage calculation for piece parts. Mould cooling. Split moulds. Unscrewing moulds. Collapsible cores. Multicomponent mouldings. Product design. Insulated and hot-runner systems.

#### Plastics Technology

Molecular structure of polymers and properties of common polymeric materials. Processing properties of thermoplastics. Injection moulding technology. Blow moulding technology. Thermofforming technology. Rotational moulding technology. Extrusion and film blowing technology.

7003 **Workshop Technology**  
 Engineering metrology. Introduction to industrial metallurgy. Machine tools: metal cutting processes, metal removal by EDM. Principles of copying systems. Preventive maintenance of machine tools.

7011 **Chain-Growth Polymerisations**  
 Free radical addition polymerisations. Ionic polymerisations. Coordination polymerisations. Addition copolymerisations.

7012 **Step-Growth Polymerisations and Polymer Reactions**  
 Condensation polymerisations. Polymer modification reactions. Degradation and stabilisation of polymers.

7013 **Properties of Polymer Molecules**  
 Polymer stereochemistry. Solution properties of polymers. Polymer structure and properties relationship.

7014 **Polymer Molecular Weight Determinations**  
 Average molecular weight and molecular weight distributions. Osmometry, viscometry, light scattering, gel permeation chromatography.

7015 **Polymer Physics**  
 Polymer Rheology. Polymer Morphology. Mechanical Properties of Polymers.

7016 **Polymer Analysis**  
 Polymer Analysis by:  
 - IR & UV spectroscopy  
 - Thermal Analysis  
 - Microscopy  
 - Chromatography

7017 **Commodity Thermoplastics/ Additives**  
 Polyolefins. Styrenics. Vinyls. Acrylics. Antioxidants. Heat and light stabilisers. Lubricants, colorants, plasticisers, fillers, flame retardants and fibrous reinforcement. Flammability and toxicity of materials and additives.

7018 **Engineering Thermoplastics**  
 Polyamides, polyacetals and polycarbonates. Modified PPO. Polyphenylene sulphides and polysulphones. Saturated polyesters. Polyarylates. Fluoro polymers.

7019 **Major Thermosets**  
 Phenol, urea and melamine formaldehyde. Epoxy resins and related polymers. Unsaturated polyesters and related polymers. Polyurethanes and related polymers. Silicones and related polymers.

7020 **Plastics Processing Equipment and Control**  
 Hydraulics. Electrical/Electronics. Temperature control. Design of plastics processing equipment.

7021 **Injection Mould Design**  
 2 and 3-plate moulds. Split moulds/ side core moulds/moulds for threaded components. Hot runner/insulated runner moulds. Mould components and mould design. Mould flow software.

7022 **Product Design and Testing**  
 Application of plastics as engineering materials. Design calculations, procedures and features. Design for structural applications. Design for optical applications.  
 Testings: Philosophy of testing. Destructive and non-destructive testing. Material and product testing. Design data.

7023 **Plastics Moulding Technology**  
 Injection Moulding: Moulding process and parameters. Moulding faults and remedies. Cavity pressure studies. Optimising processing parameters. Auxiliary equipment. Moulding of thermosets. Structural foam and reaction injection moulding. Assembly techniques. Decorative processes.

7024 **Plastics Extrusion Technology**  
 Mixing and compounding processes. Features of single-screw, vented and

multi-screw extruders. Extrusion of rods/tubes/film/sheet wire coating/laminates.

7025 **Other Plastics Processes**  
 Powder coating. Rotational moulding casting, vinyl dispersions. Blow moulding, vacuum forming, calendaring. Plastics Composite Technology.

7026 **Industrial Management**  
 Engineering Economy. Transportation. Project planning/scheduling. Inventory control. Decision Theory.

7027 **Financial Management**  
 Financial analysis of company's balance sheet. Appraisal of stock and credit control. Assessment of actual performance of companies. Decision-making with management accounting. Evaluation of manufacturing costs. Budget-making.

7028 **Marketing**  
 Planning and control. Organisation and communication. International aspects of marketing.

7030 **Food Engineering**  
 Conversion operations: Filtration, membrane separations. Centrifugation, mixing, emulsification.

7031 **Food Chemistry**  
 Carbohydrates, lipids, proteins and water. Instrumental analysis.

7032 **Food Microbiology**  
 Food spoilage, preservation principles, cleaning, food sanitation. Food regulations: Microbial criteria and specifications.

7033 **Food Processing**  
 Preservation operations, heating, dehydration, irradiation.

7034 **Food Additives**  
 Colour agents, preservatives, antioxidants, emulsifiers, stabilisers, anticaking agents, food regulations and

control of food additives and supplements.

7035 **Food Pathogens**  
 Characteristics. Activities of food pathogens. Mycotoxins. Identification of food pathogens.

7036 **Process Automation and Control**  
 Pneumatic circuitry, process automation, hydraulics, process control of industrial processes.

7037 **Food Rheology**  
 Principles of deformation, stress, strain. Viscoelastic behaviours. Importance of rheological models.

7038 **Food Packaging**  
 Types of packaging materials, packaging of specific food products. Gas permeability measurement. Physical testing.

7040 **Biotechnology — Basic Principles**  
 Basic principles. Microbial physiology and growth. Microbial genetics. Microbial enzymes. Molecular cloning.

7041 **Quality Control**  
 Development of grades and standards of quality. Acceptance sampling and inspection.

7042 **Project Management**  
 Engineering economy. Operations research — transportation costs. Inventory costs.

7043 **Biotechnology — Fermentation**  
 Biochemistry of fermentation processes, fermentation kinetics, fermentation engineering.

7044 **Nutrition**  
 Human nutrition requirements, primary nutritional diseases, public health, nutrition in food handling and packaging.

- 7045 Financial Management**  
Principles of accounting. Financial situations of companies. Appraisal of stock and credit control. Manufacturing costs.
- 7046 Biotechnology — Downstream Processing**  
Recovery of fermentation processes. Immobilised cells and enzymes. Effluent disposal.
- 7047 Food Sensory Evaluation**  
Principles of sensory evaluation. Scope and importance in R & D. QC/QA. Difference/preference testing methods.
- 7048 Marketing Management**  
Role of marketing to corporate strategy. Formulations of marketing, nature and scope of international aspects of marketing.
- 7049 Project**
- 7101 Chemistry**  
Atomic structure and atomic theory. The Periodic Table. Chemical bonding: ionic and covalent bonds; hydrogen bonds. Principles of volumetric and gravimetric analysis. Chemical equilibria: pH, acid base titration, equilibrium constants, solubility product, hydrolysis. Acid-base titrations. Redox reactions. Oxidation number. Physical and chemical properties of hydrocarbons. Isomerism. Preparation and reaction of alkyl halides, alcohols, ethers, amines, aldehydes and ketones, carboxylic acids, amino acids.
- 7102 Food Studies**  
Structure and properties of water, carbohydrates, proteins, lipids, vitamins and minerals. Composition and chemistry of flavour ingredients. Structure and properties of food pigments and colours. Enzymic activities. Basic nutrition. Basic cell biology.
- 7103 Polymer Studies**  
Properties of common thermoplastic and thermosetting materials. Addi-
- 7045** tives and their influence on bulk properties of polymers. Basic processing: mixing technologies, principles of compression moulding, extrusion, injection moulding and vacuum forming. Preparation, properties and uses of natural rubber and synthetic rubber. Compounding and vulcanisation of rubber.
- 7104 Chemical Process Principles**  
Units and dimensions. Ideal gas laws, Raoult's and Henry's Laws. Stoichiometry. Material balance; recycle and by-pass streams. Heat capacities. Latent heat. Enthalpy. First law of thermodynamics. Heat of reaction and combustion. Hess' Law. Energy balance on physical and chemical processes. Unit operations involving size reduction, size analysis, filtration and sedimentation.
- 7105 Applied Electricity & Electronics**  
Basic concepts of simple electrical circuits. Ohm's law and Kirchhoff's law. Laws of electromagnetic induction: generators, motor and transformers. Characteristics of alternating current: rms and power factor, capacitors, Q-factor, phasor diagrams, LRC circuits. Principles of measuring instruments: potentiometer, multi-meters, recorders, plotters and digital instruments. Electronic components and basic electronic circuits: diodes, triodes, transistors, amplifiers. Simple logic theory and applications.
- 7106 Engineering Drawing**  
Correct usage of drawing instruments. Geometric construction of circles, polygons, tangents, bisection of lines. Lettering and dimensioning. Orthographic drawing in both first and third angle projections. Layout and sectioning. Isometric projection. Introduction to computer-aided design: basic concepts.
- 7201 Chemical Analysis**  
Basic problems of quantitative analysis. Pretreatment concepts and separation. Instrumental methods: molecular spectroscopy — UV, visi-
- 7202 Food Science & Processes**  
Basic microbiology: general features of bacteria, fungi and viruses. Harmful microbes: food spoilage, food-borne intoxications and infections. Food fermentations. Technology of edible fats and oils, meat, fish, egg, milk and dairy products. Cereals processing and products. Soyabean products. Sugar, starch and other carbohydrates.
- 7203 Polymer Science & Applications**  
Polymerisation techniques. Applications of plastics materials. Commodity thermoplastics: polyolefins, PVC and vinyl co-polymers, and styrene-based polymers. Synthetic and speciality rubbers. Testing of polymers: mechanical, thermal, electrical, chemical and weathering tests.
- 7204 Chemical Engineering Principles**  
Bernoulli's equation, friction losses in pipes and fittings. Fanning friction factor. Flow measurement. Pump characteristics. Compressor performance. Flow through porous media; fluidisation phenomenon. Mixing. Heat transfer and applications: conduction, resistance concept. Natural and forced convection. Radiation. Boiling and condensation, heat exchanger performance. Process steam generation. Refrigeration and cryogenic processes. Electrical power supply. Standard practices for transporting, storing and handling of dangerous chemicals. Boiler water treatment. Fuels and combustion: wet and dry analysis. Materials of construction in the CPI. Corrosion control. Principles of planned and preventive maintenance.
- 7205 Process Instrumentation**  
Process measurement: temperature, pressure, level, flow. Transducers. Control valves: flow characteristics; components and accessories; sizing and selection. Instrument calibration. Instrumentation for making equipment safe for hazardous applications. Pneumatics: compressed air production and distribution; pneumatic power components and circuits. Hydraulics: Pascal's Law; hydraulic power components and circuits.
- 7206 Engineering Drawing**  
Constructional diagram of screw threads and fastener in plastics processing machinery. Simple pictorial drawing. Assembly drawing of mould-making components. Flow chart drawing of a process plant. Introduction to CAD: appreciation of CAD in mould design diagram. Two-dimensional CAD applications.
- 7207 Applied Chemistry**  
Principles of electrochemistry: Kohlrausch's law; Nernst equation. Tafel equation; electrodeposition principles; plating of metals, plastics, principles of anodising. Surface chemistry principles: surfactants. Environmental pollution and control: air pollution monitoring and legislation; water pollution, water and waste water treatment and legislation.
- 7208 Computer Studies (Module 3)**  
Basic numerical techniques: continuous substitution, bisection method, Newton method. Use of standard computer software packages for solving engineering problems.
- 7301 Project**  
The final-year project allows students to apply their theoretical knowledge to solve practical problems. Students work in small groups of two or three to a project under the supervision of an academic staff. The project may involve project development, product design or analysis. Assessment is by continuous assessment and project seminar.

**Supervisory Studies**  
Productivity concept; need for productivity movement. Management concepts and systems; people-centred management. QC circles, work improvement teams and work excellence committees. Supervisory skills: leadership qualities, communication methods, motivation and team building. Project planning with critical path methods; project management with linear programming techniques. Safety and health in the chemical process industries: legislation, accident investigation and reporting; accident prevention.

7303

**Quality Assurance & Statistics**  
Quality concepts; zero defect and total quality control. Control charts. Tests of significance. Acceptance sampling. Reliability concept. Presentation and interpretation of statistical data; frequency distribution and probability functions; normal distribution.

7304

**Process Control & Microprocessor Appreciation**  
Open and closed loop control, feed-forward and feedback control. Controllers and control modes, controller tuning. Complex control systems: cascade and ratio control. Applications to industrial processes, e.g. distillation column, furnace and reactor control. Microprocessor fundamentals: definition of terms, machine-coded language, instructions and programming.



Second-year students learning the basic principles of hydraulics at the Instrumentation & Control Laboratory.

7305

**Polymer Science & Technology I (Materials)**  
Preparation, properties and applications of thermoplastics, e.g. olefin polymers, vinyl chloride polymers, styrene-based polymers, acrylics, polyamides, acetals, thermoplastic polyesters, polycarbonates, modified polyethylene oxides, polysulphones, polyphenylene sulphides and fluoropolymers. Preparation, properties and usage of thermosetting materials, e.g. phenoplasts, aminoplasts, polyurethanes, polyesters, silicone polymers, and epoxy resins. Additives. Toxicity of materials.

7306

**Polymer Science & Technology II (Processes)**  
Injection moulding, extrusion, blow moulding, vacuum forming, rotational moulding, compression and transfer moulding, calendaring and powder coating. Secondary operations, e.g. shape modification, finishing operations, joining methods and decoration processes. Glass reinforced plastics technology.

7307

**Polymer Science & Technology III (Control and Design)**  
Compression and transfer mould design. Injection mould design: mould construction, ejection and feed systems, parting surface and cooling systems. Shrinkage calculations. Split moulds, sidecore moulds, undercut moulds. Three-plate moulds and unscrewing moulds. Design of collapsible cores and insulated hot-runner systems. Product design. Hydraulic, pneumatic and electrical systems for processing equipment. Heating systems. Quality control and costing in the plastics industry.

7308

**Food Science & Technology I (Food Processing)**  
Principles of heat processing. Cooling processes. Food dehydration. Food extrusion. Enzyme applications, fermentation processes. Food processing as an integral operation. Packaging.

7309

**Food Science and Technology II (Food Microbiology)**  
Classification of bacteria. Nutrition of microorganisms. Microorganisms and their environment. Cultivation and growth of microorganisms. Serology. Virology. Microbial genetics. Food poisoning microorganisms: mycotoxins. Food spoilage microorganisms and their control. Plant sanitation. Microbiological food standard and safety assurance. Rapid microbiological methods. Industrial microbiology: principles and potential of genetic engineering, typical fermentation products, immobilised cells and enzymes.

7310

**Food Science and Technology III (Food Quality and Legislation)**  
Food laws and standards. Sale of Food Act 1973. Food Regulations 1974 and Food (Amendment) Regulations 1979. Singapore standards on specific food products. Food quality control. Colour evaluation, texture and viscosity measurements. Sensory evaluation. Chemical analysis of foods. Food additives. Food toxicity. Nutrition: adequate diets, nutritional status, nutritional problems and their prevention. Improvement of the nutritional status of the population.

7311

**Process Engineering I (Mass Transfer Operations)**  
Fick's law, mass transfer coefficients. Raoult's law, relative volatility, Txy diagrams, azeotropes. McCabe-Thiele binary distillation calculations. Rayleigh's equation. Plate and packed column dynamics. NTU, HTU, flooding, loading point. Gas absorption. Liquid-liquid extraction, selection of solvents, extraction equipment. Leaching: single and multistage operations. Crystallizer operations. Drying.

7312

**Process Engineering II (Chemical Process Industries)**  
Petroleum industry: sources of fuel and materials, petroleum crudes, preliminary treatment of crude oil. Con-

version processes: thermal cracking, catalytic cracking, visbreaking. Upgrading processes: alkylation, sulphur recovery. Refinery products: properties, usage and testing of petroleum products. Lubricating oil production and testing. Petrochemical industry: olefine derivatives, aromatics, fine chemicals. Efficient process control of petrochemical industry. Manufacture and purification of industrial gases. Acid, alkali, cement, glass, paint, varnish, oleochemical, soap and detergent industries. Fermentation industries.

7313

**Process Engineering III (Process and Plant Design)**  
Flow diagrams. Safety in plant design. Process design specifications. Plant locations, layout, piping system. Economic evaluation. Scale-up in chemical plant design. Design assignment. Reactor kinetics: rate parameters, residence time distribution. Reactor design. Fundamentals of biotechnology: enzyme kinetics, fermentation processes.

7314

**Industrial Chemistry I (Laboratory Techniques and Administration)**  
Sample handling. Qualitative analysis. Spectroscopic techniques: UV-VIS spectroscopy, IR, ICP. Relative merits of flame, electro-thermal and vapour generation techniques. NMR, MS. Electrochemical techniques: ion selective electrodes. Chromatographic techniques: GC and LC (choice of stationary phases, solvents, sample pre-treatment). Electrophoresis. Titrimetric methods. Kinetic methods: enzyme-substrate reactions. Immunoassay. Automation in laboratory. Laboratory management. Quality control and statistics.

7315

**Industrial Chemistry II (Materials and Processes)**  
Commodity chemicals: sulphuric acid, caustic soda. Basic building blocks of petroleum and chemical industries. Industrial gases. Detergents. Surface coatings: linseed oil-

based paints and coating formulations; coating of metals. Speciality chemicals: high purity chemicals used in electronic industry, solvents, etchants, photosensitizers, encapsulation compounds. Physical processes: concepts of distillation, gas absorption, drying, leaching. Liquid-liquid extraction, crystallization.

### 7316 Industrial Chemistry III (Bio-materials & Processes)

Introduction to biotechnology: cultivation, growth and genetics of microorganisms. Microorganisms and enzymes. Molecular cloning. Fermentation processes and kinetics in industrial fermentations. Theory and applications of reactors: functions of CSTR, tubular and tower reactors. Function of sterilisation and fixed bed reactors. Recovery of fermentation products. Immobilized cells and enzymes. Cost consideration in biological processes. Fundamentals of chemical processes: rate law and order of reactions, catalysis. Fine chemicals: penicillin, aspirin, vaccines, dyestuffs and pigments, pesticides.

### 7317 Medical Laboratory Technology I (Laboratory Techniques & Administration)

As in 7314

### 7318 Medical Laboratory Technology II (Haematology & Blood Banking)

Haemopoiesis and blood cell maturation. Cellular morphologies in bone marrow and peripheral blood smear. Functions of erythrocytes, leucocytes and platelets. Anaemia: iron-deficiency, megaloblastic, haemolytic, haemoglobinopathy and symptomatic. Leukaemia: lymphocytic, myelocytic and monocytic types. Haemostasis and haemorrhagic disorders. Immunohaematology: blood grouping and cross-matching. Blood transfusion: preparation of blood components, undesirable effects of transfusion.

7319 Medical Laboratory Technology III (Histopathology & Immunology)  
Structure of cell. Types of human tissues. Histopathological techniques: fixation, dehydration, clearing, embedding, section cutting, floating, staining and mounting. Special stain for some cellular components. Decalcification. Principle of electron microscopy. Nature of malignant disease and its application to exfoliative cytology.

Immune response: cell-mediated and humoral immunity. Classes of immunoglobulin. Immune reactions. Transplantation and histocompatibility. Radioisotopes and modes of radioactive decay. Radioimmunoassay and enzyme immunoassay.

### 7320 Medical Laboratory Technology IV (Microbiology)

Classification of bacteria. Nutrition of microorganism. Growth of microorganism and their cultivation. Maintenance of microorganism. Microorganism and their environment. Food poisoning, pathogens, mycotoxins. Food spoilage microorganism and their control. Rapid microbiological methods.

Microorganism of medical importance, their pathogenicity and laboratory diagnosis. Antimicrobial agents. Nosocomial infections. Principles of industrial microbiology and biotechnology. Principles and potential of genetic engineering. Diagnostic and therapeutic applications.

### 7321 Medical Laboratory Technology V (Biochemistry & Physiology)

Basic Physiology: structure and function of brain, heart, liver, gastrointestinal tract. Kidney and blood. Biochemistry: Metabolism of carbohydrates and lipids in normal and diseased states; glucose tolerance tests. Functions and dysfunctions of kidney and liver; clearance tests and function tests. Proteins, enzymes.

7484 Food Science & Technology I  
As in 7308

7485 Food Science & Technology IIA  
As in 7309 (Part)

7486 Process Engineering I  
As in 7311

7487 Process Engineering IIA  
As in 7312 (Part)

7488 Industrial Chemistry I  
As in 7314

7489 Industrial Chemistry IIA  
As in 7315 (Part)

7580 Supervisory Studies  
As in 7302

7581 Process Control  
As in 7304

7582 Polymer Science & Technology IIB  
As in 7306 (Part)

7583 Polymer Science & Technology III  
As in 7307

7584 Food Science & Technology IIB  
As in 7309 (Part)

7585 Food Science & Technology III  
As in 7310

7586 Process Engineering IIB  
As in 7312 (Part)

7587 Process Engineering III  
As in 7313

7588 Industrial Chemistry IIB  
As in 7315 (Part)

7589 Industrial Chemistry III  
As in 7316

7590 Project  
As in 7301

blood pH and blood gases levels in normal and diseased states; electrophoresis and enzyme assays. Endocrinology: hormonal effects and diagnostic values. Toxicology: drugs and poisons monitoring for diagnostic and therapeutic purposes. Case studies.

7181 Chemistry  
As in 7101

7182 Applied Electricity & Electronics  
As in 7105

7183 Engineering Drawing  
As in 7106 (a) and 7206 (a)

7281 Applied Chemistry  
As in 7207

7282 Food Studies  
As in 7102

7283 Polymer Studies  
As in 7102

7284 Chemical Process Principles  
As in 7104

7381 Chemical Analysis  
As in 7201

7382 Food Science & Processes  
As in 7202

7383 Polymer Studies  
As in 7203

7384 Chemical Engineering Principles  
As in 7204

7480 Quality Assurance & Statistics  
As in 7303

7481 Process Instrumentation  
As in 7205

7482 Polymer Science & Technology I  
As in 7305

7483 Polymer Science & Technology IIA  
As in 7306 (Part)



Architectural model-making is a second-year subject in the Diploma in Architectural Technology course.

## Department of Civil Engineering & Building

### Staff

#### Head

Ong Boon Ling  
B E, MIES, M I Eng

#### Deputy Heads

Lim Meng Tong  
B Sc (Bldg), B Sc (Bldg),  
M Sc (Const Eng), MSISV, MSIB

Theresa Lim M S (Mrs)  
B Arch, FRAIA, ARIBA, MSIA

J B Senanayake

B Sc (Civil), M Sc (Civil), P Eng, C Eng,  
MICE, MIES, MSI Arb

Alice Tham Y S (Mrs)  
ARIBA, MSIA

### Architectural Section

#### Section Heads

Charles D Middleton  
B Arch, Trop. Cert (AA), MES, MRAIC,  
MCIP

Lily Siow (Mrs)  
B Arch, ARIBA, MSIA

#### Principal Lecturer

Horst Wilhelm Erxleben-Messer  
B Arch (Toronto), MAIBC

#### Senior Lecturers

Desiree Hsu Mei Hsin (Mdm)

A Arch, WAIT, ARIBA, FRAIA, MSIA

Yeoh Chiew Ming (Mdm)  
B Arch, RIBA, ARAIA

### Lecturers

Alexander Brown  
Dip Arch, Dip UD

Benjamin C Camacho  
B Sc (Arch), MUAP (Phils)

Chua Choy Ling (Mrs)  
B Arch

Koh Boon Wan

Tech Dip (Arch D'ship), B Arch

Lee Hoong Fat, Peter

B Arch, Dip UD, MSIA, MSIP

Ling Ai Choo (Miss)

Tech Dip (Arch D'ship), B Arch (Hons)

Loh-Lee Ee Ser (Mrs)

B Arch (Aust), AMSIA

Pang Yang Gek (Miss)

Tech Dip (Arch D'ship), B Arch

Roger F Wilson

RIBA, D Arch (Kingston)

### Principal Instructor

Francis Lee Chan Cheong

Tech Dip (Arch D'ship), MNZID

### Instructors

Nang Amayar (Mdm)

B Arch

Oon Siew Heok (Mrs)

Tech Dip (Arch D'ship)

### Teaching Assistants

Lee Keng Keng (Miss) (on study leave)

Tech Dip (Arch D'ship)

Zainon bte Salleh (Mdm) (on study leave)

Tech Cert & Tech Dip (Arch D'ship)

### Building Section

#### Section Heads

Aw Teik Soon

FRICS, FRVA, ACI Arb, MSISV

Balbir Singh

B Sc (Quant Surv), M Sc (Bldg Maint Mgt),

ARICS, MSISV

Julian Richard Clarke  
B Sc (Bldg)(Hons), MCIQB

### Senior Lecturers

Ian McGunnigle

ARICS, MCIQB

Norman E Devall

FCIOB, MBIM

### Lecturers

Chan Kok Wah

Tech Dip (Bldg), B Sc (Bldg)(Hons)

Chan Kin Kee

B App Sc (Bldg Tech), C&GFTC (Builders' Quant), ACIB

Chee Sing Fong

ARICS, MSISV

Chew Sin Fye

B Sc (Bldg)

Chua Bee Gee (Miss)

B Sc (Bldg)(Hons)

Chung Weng Kwai, Michael

B Sc (BE & QS), MSISV

Michael W Coffey

B Sc (QS), M Sc (Const. Man.), ARICS,

MCIQS

Chua Fung Geok (Mrs)

B Sc (Bldg), MSIB

Dawnee Ho (Mrs)

LLB (Hons)

Hong Kim Hua

B Sc (Bldg)

Lee Ling Ling (Miss)

B Sc (Bldg Tech)(Hons), MSISV

Lee Mee Fah (Mrs)

B Sc, BE & QS (Hons), ACIOB, MSIB, MSCl

Lim Cher Yam

Tech Dip (Bldg), B Sc BE & QS (Hons)

Ng Man Choong

B Sc (Bldg)(Hons)

Ng Weng Fai

B Sc (Bldg), M Sc (Bldg Serv Eng)

Tan Kok Yang

B Sc (Bldg), MSIB, ACIBSE

Benjamin Tan Lin Hoon  
B Sc (Bldg)

Tang Ah Lek  
B App Sc (Bldg Tech)(Aust), TTC, Dip in  
Bldg Sc, MSIB, AMIE, FROP

Tan Siu Huang (Miss)  
B Sc (Bldg)(Hons), Tech Dip (Bldg)

Albert Thong Wing Yip  
BE (Civil), P Eng, C Eng, MICE, MIE (Aust),  
MIES

Wong Chi Meng (Mrs)  
B Sc (Quant Surv)(Hons), ARICS, MSISV

#### Principal Instructor

Hj Osman B Mohamed  
FSIET, FFB, MSIB, MSE, PE (UK),  
MIE (UK)

#### Senior Instructors

Koh Soo Seng  
C & G (Conc. Prac), Tech Dip (Bldg)

Wai Kum Chin  
AIIIM, MIBIM, AITO

#### Instructor

Koh Boon Heng

#### Teaching Assistants

Florence Goh Chor Luan (Mrs)  
(on study leave)

Tech Dip (Bldg)

Tan Shia Tew (on study leave)

Tech Dip (Bldg)

Wee Bee Cheng (Miss) (on study leave)

Tech Dip (Bldg)

Yeo Huang Kiat (on study leave)

Tech Dip (Bldg)

#### Civil Engineering Section

##### Section Heads

M Krishnaswamy  
BE (Civil), M Eng (Envir), AIBA

Mohd Sirajul Islam

B Sc Eng (Civil), M Eng (Water Sc), M Sc  
(Const Eng), P Eng (M), AMIE

#### Teo Teng Kwee

B Eng (Civil), MIE (Aust), C Eng (Aust)

Yek Poh Yeng (Mdm)  
P Eng, C Eng, MIE (Aust), MACE, MASCE

#### Senior Lecturers

T Dharmarajah  
Dip (Civil), B Sc (Civil), Post grad Dip  
(Highway Eng), MIE, MIES

D A Jayaseelan  
B Sc (Eng) (Hon), M Sc (Civil), C Eng, MICE  
M Sc (Eng) (Lond)

Wong Kok Loong  
BE (Civil), C Eng, MICE, MIE (S), MASCE,  
P Eng (S), P Eng (M)

#### Lecturers

Chua Hai Siang  
B Sc (Civil) (Hons), MSIM, MIE (Aust),  
C Eng (Aust), M Inst B E, P Eng (S), MASCE

Fan Ban Ec (Mrs)  
B Sc (Civil)

Fan Kee Seng  
B Sc (Civil) (Hons), M Sc (Civil)

R Ganeswaran  
B Sc (Hons), M Sc (Const Eng), P Eng, C Eng,  
MICE, MIES, MIE (Aust)

Goh Hai Kok  
Tech Dip (Struct), B Sc (Civil) (Hons)

Rose Huang (Mdm)  
B Eng (Civil), M Sc (Const Eng)

Kan Sook Ngoh (Mrs)  
B Sc (Civil) (Hons), M Sc (Const Eng)

Lai Sing Man  
B Sc (Civil) (Hons), M Sc (Civil Eng),  
MIE (Aust), C Eng

Lai Wong Kuen (Mdm)  
B Eng (Civil)

Lim Chwee Eng (Miss)  
Tech Dip (Civil), B Sc (Civil) (Hons)

Leong-Ng Geck Nai (Mrs)  
B Eng (Civil)

Ngo Hong Hock  
Dip (Civil)

#### Ong Ann Kok

Tech Dip (Struct) & (Mech), HNC (Bldg),  
Teacher's Cert (Tech), B Sc (Civil) (Hons)

John Ooi Peng Lee  
B Eng (Civil) (Hons)

Quah Hong Pin  
B Eng (Civil) (Hons)

Sam Man Kseong  
BE (Civil) (Hons), Grad Dip App Stats, M Sc  
(Civil Eng), MSIB, MCSI, MSE, P Eng (UK)

Saw Jin Hai  
FRMIT (Civil), MIE (Aust), MIES, P Eng (M)

Sia Chiaw Hui  
BE (Civil) (Hons), ME (Civil)

Nachatar Singh  
B Eng (Civil), AMICE, M Sc (Civil)

Soh Siao Pee (Mdm)  
B Sc (Civil), M Sc (Civil)

Tan Poh Seng  
B Sc (Civil) (Hons)

Alphonus Wong Lock Sek  
BE (Civil), M Sc (Const Eng), MBA, MSIM

Wong Loke Hai  
B Sc (Eng)

Wu Siew Li (Miss)  
B Sc (Civil) (Hons)

Yap-Yeo Siew Lay (Mrs)  
Tech Dip (Civil), B Eng (Civil) (Hons), M Sc  
(Civil Eng)

Yoong Yuen Soo  
B Eng (Civil), M Sc (Civil)

Yu Yat Hong  
B Eng (Civil)

#### Teaching Assistants

Chan Choi Ung (Mdm) (on study leave)

Tech Dip (Struct)

Yoon Yee Khuan (Miss) (on study leave)

Tech Dip (Civil)

#### Land Surveying Section

##### Section Heads

Maik Seck Hoe  
B (Surv), MIS (Aust), MSISV,  
Reg. Surveyor (S)

Ian Ong Kah Chai  
B App Sc (Surv) (Dist), MSISV, MIS (Aust),  
Reg Surveyor (S)

#### Senior Lecturers

Knight Brian W (Visiting Lecturer)  
MNZID, MNZIS, REA, RS (Fiji), A S (Qld)

Price V J S

B Sc (Land Survey) (Cape Town), B Sc (E M)  
(Reading), ARICS, MSISV

Yeong Fook Cheong

Tech Dip (Land Surv), CNA, Postgrad Dip  
(Hydro Surv), MIS (Aust), MRIN

#### Lecturers

Chan Wing Kong, Steven  
B Surv (Hons), MIS (Aust), MSISV

Francis Chan Eng Jeow  
Tech Dip (Land Surv), B App Sc (Surv)  
(Dist), MSISV (Prob)

Clement L Orehian  
B Surv, MIS Aust (Lic'd Surv Qld), MSISV

Geoffrey Richard Roland Morris  
B App Sc (Surv), Dip Eng Surv, MIS (Aust),  
Lic Surv (W.A., P.N.G.), MSISV

#### Principal Instructor

Thong Sai Soh

Tech Dip (Land Surv), Dip Photogr (ITC)

#### Teaching Assistants

Lai Woh Chiong (on study leave)

Tech Dip (Land Surv), Adv Dip (Surv)

Lim How Kim (on study leave)

Tech Dip (Land Surv)

Tan Eng Fei (on study leave)

Tech Dip (Land Surv), AMSST (UK)



The Department of Civil Engineering & Building offers courses in architectural technology, building, civil engineering, civil engineering construction, civil engineering design, land surveying and quantity surveying.

The construction industry, which encompasses building and civil engineering works, plays an important role in the life of the people, particularly in the provision of better housing, transport facilities and municipal services. Other building and civil engineering works of particular interest to Singapore are the construction of commercial and industrial buildings, land reclamation, airport and harbour works. Architecture plays a role in the aesthetic and functional aspects of buildings while land surveying encompasses both building and civil engineering works.

### Diploma in Architectural Technology

This is a three-year full-time or five-year part-time evenings-only course.

#### Practical Training

Full-time students will have about eight weeks of practical training with Industry during the long vacation at the end of the second year of their three-year full-time course. Part-time students should normally be in employment relevant to their course of study, thus receiving the necessary practical training.

#### Assessment

Assessment during each year of the course will be by means of course work and written/practical examinations. A satisfactory standard will be required in both course work and examinations.

#### Career Prospects

This course is designed with a view to equip students with the knowledge and practice of architectural draughtsmanship. While the theoretical content is appropriately wide, the course includes practical exercises, projects and assignments.

The course will equip the graduate with technical skills to obtain employment in

architectural and building firms or in engineering consultancy firms.

#### Subjects of Study

##### Full-Time First Year

- 1501 English for Academic Purposes
- 2100 Technical Drawing
- 2101 Surveying & Levelling
- 2111 Building Construction I
- 2117 Building Materials
- 2118 Building Science
- 2120 Studio & Architectural Drawing I

##### Full-Time Second Year

- 1005 BASIC Programming
- 2109 Building Services I
- 2113 Building Construction II
- 2119 Architectural Model-Making Project
- 2122 Studio & Architectural Drawing II
- 2129 Elements of Structures & Detailing
- 2130 Specifications & General Building Regulations

##### Full-Time Third Year

- 1502 English for Occupational Purposes
- 2110 Building Services II
- 2127 Studio & Architectural Drawing III
- 2128 Building Construction III
- 2149 Principles of Architectural Practice A
- 2152 Principles of Architectural Practice B
- 2050 Supervisory Studies

##### Evenings-Only First Year

- 2100 Technical Drawing
- 2112 Building Construction IE
- 2117 Building Materials
- 2121 Studio & Architectural Drawing IE

##### Evenings-Only Second Year

- 2101 Surveying & Levelling
- 2114 Building Construction IIE
- 2123 Studio & Architectural Drawing IIE
- 2131 Building Science & Services

##### Evenings-Only Third Year

- 2115 Building Construction IIIE
- 2124 Studio & Architectural Drawing IIIE
- 2129 Elements of Structures & Detailing
- 2130 Specifications & General Building By-Laws

#### Evenings-Only Fourth Year

- 1005 BASIC Programming
- 2110 Building Services II
- 2116 Building Construction IVE
- 2125 Studio & Architectural Drawing IVE

#### Evenings-Only Fifth Year

- 2126 Studio & Architectural Drawing VE
- 2132 Building Construction VE
- 2149 Principles of Architectural Practice A
- 2152 Principles of Architectural Practice B

Students with the Singapore Polytechnic Certificate in Architectural Draughtsmanship may apply for admission to the last two years of the part-time evenings-only course leading to the award of the Architectural Technology Diploma. Applicants must be in relevant employment and recommended by employers who are architects. Applicants will be selected for the course and their overall academic performance in the Certificate course will be taken into consideration.

### Diploma in Building

This is a three-year full-time or five-year part-time evenings-only course.

#### Practical Training

Full-time students will have about eight weeks of practical training with Industry during the long vacation at the end of the second year of their three-year course.

Part-time students should normally be in employment relevant to their course of study, thus receiving the necessary practical training.

#### Assessment

Assessment during each year of the course will be by means of written examinations and continuous assessment programmes. A satisfactory standard will be required in both course work and examinations.

#### Career Prospects

This course is designed with a view to equip students with knowledge of building technology with particular emphasis on the costing of building projects and site management and

control. Whilst the theoretical content is appropriately wide, the course includes practical exercises, projects and assignments. The course will allow the graduate to obtain employment primarily in construction firms.

#### Subjects of Study

##### Full-Time First Year

- 1501 English for Academic Purposes
- 2020 Construction Technology I
- 2021 Construction Materials
- 2022 Environmental Science
- 2023 Elements of Financial, Accounts & Economics of Industries
- 2024 Surveying & Levelling
- 2025 Elementary Theory of Structure & Design

##### Full-Time Second Year

- 1052 Elementary Statistics & Computer Programming
- 2250 Construction Technology II
- 2251 Site Organisation & Management I
- 2252 Building Quantities I
- 2253 Building Law
- 2254 Building Services I

##### Full-Time Third Year

- 1502 English for Occupational Purposes
- 2255 Construction Technology III
- 2256 Site Organisation & Management II
- 2257 Building Quantities II
- 2258 Building Services II
- 2259 Building Maintenance
- 2260 Builders Estimating & Accounts
- 2272 Building Project

##### Evenings-Only First Year

- 2020 Construction Technology I
- 2021 Construction Materials
- 2022 Environmental Science
- 2024 Surveying & Levelling

##### Evenings-Only Second Year

- 2023 Elements of Financial, Accounts & Economics of Industry
- 2025 Elementary Theory of Structures & Design
- 2250 Construction Technology II
- 2254 Building Services I

**Evenings-Only Third Year**  
 1033 Elementary Statistic & Computer Programming  
 2253 Building Law  
 2255 Construction Technology III  
 2258 Building Services II

**Evenings-Only Fourth Year**

2251 Site Organisation & Management I  
 2252 Building Quantities I  
 2259 Building Maintenance

**Evenings-Only Fifth Year**

2256 Site Organisation & Management II  
 2260 Builders Estimating & Accounts  
 2257 Building Quantities II

**Diploma in Civil Engineering**

This has replaced the Diploma in Civil Engineering Construction and Diploma in Civil Engineering Design as of the 1986/87 session. The first batch of students in the new course will graduate at the end of the 1988/89 session.

**Practical Training**

Full-time students will have about eight weeks practical training with industry during the long vacation at the end of the second year of their three-year course. Part-time evening students should normally be in employment relevant to their course of study, thus receiving the necessary practical training.

**Assessment**

Assessment during each year of the course is by means of course and laboratory work and written examinations. Assessment for project work for third-year full-time students is through continuous assessment, final report and viva.

**Career Prospects**

The civil engineering technologist performs a supporting role to the civil engineer and is taught site investigation, planning and design, draughting and detailing, writing of specifications, costing of projects, and documentation of contracts.

The course has been designed to prepare him for eventual design and supervision of civil

engineering works. The course will enable the graduate to obtain employment in civil engineering and building firms or with government and statutory bodies dealing with civil engineering works.

**Subjects of Study**

**Full-Time First Year**

1025 Mathematics I  
 1501 English for Academic Purposes  
 2031 Structural Mechanics  
 2033 Construction Technology  
 2035 Engineering Science  
 2060 Technical Drawing  
 2061 Surveying & Levelling  
 2062 Construction Materials

**Full-Time Second Year**

1027 Mathematics II  
 2700 Computer Applications in Civil Engineering  
 2701 Theory of Structures  
 2702 Geology & Soil Mechanics  
 2703 Hydraulics, Water Supply & Sewerage  
 2704 R C & P S C Design  
 2705 Civil Engineering Construction I

**Full-Time Third Year**

1502 English for Occupational Purposes  
 2050 Supervisory Studies  
 2706 Structural Steel Design  
 2707 Structural Detailing  
 2708 Foundation Engineering  
 2709 Transportation Engineering  
 2710 Civil Engineering Practice  
 2711 Civil Engineering Construction II  
 2712 Civil Engineering Project

**Evenings-Only First Year**

1025 Mathematics I  
 2035 Engineering Science  
 2060 Technical Drawing  
 2062 Construction Materials

**Evenings-Only Second Year**

1027 Mathematics II  
 2031 Structural Mechanics  
 2033 Construction Technology  
 2061 Surveying & Levelling

**Evenings-Only Third Year**

2700 Computer Applications in Civil Engineering

2701 Theory of Structures  
 2702 Geology & Soil Mechanics  
 2705 Civil Engineering Construction I

**Evenings-Only Fourth Year**

2703 Hydraulics, Water Supply & Sewerage  
 2704 R C & P S C Design  
 2708 Foundation Engineering  
 2711 Civil Engineering Construction II

**Evenings-Only Fifth Year**

2706 Structural Steel Design  
 2707 Structural Detailing  
 2709 Transportation Engineering  
 2710 Civil Engineering Practice

**Full-Time ('A' Level) — Direct Entry to Second Year**

**Full-Time Second Year**

2061 Surveying & Levelling  
 2315 Materials and Construction Technology  
 2316 Structural Analysis  
 2700 Computer Applications in Civil Engineering

**Full-Time Third Year**

2702 Geology & Soil Mechanics  
 2703 Hydraulics, Water Supply & Sewerage  
 2705 Civil Engineering Construction I  
 2710 Civil Engineering Practice

**Full-Time Third Year**

1502 English for Occupational Purposes  
 2050 Supervisory Studies  
 2704 R C & P S C Design  
 2706 Structural Steel Design  
 2707 Structural Detailing  
 2708 Foundation Engineering  
 2709 Transportation Engineering  
 2711 Civil Engineering Construction II  
 2712 Civil Engineering Project

**Part-Time ('A' Level) — Direct Entry to Second Year**

**Evenings-Only Second Year**  
 2031 Structural Mechanics  
 2033 Construction Technology  
 2061 Surveying & Levelling  
 2062 Construction Materials

**Evenings-Only Third Year**

2700 Computer Applications in Civil Engineering

2701 Theory of Structures  
 2702 Geology & Soil Mechanics  
 2705 Civil Engineering Construction I

**Evenings-Only Fourth Year**

2703 Hydraulics, Water Supply & Sewerage  
 2704 R C & P S C Design  
 2708 Foundation Engineering  
 2711 Civil Engineering Construction II

**Evenings-Only Fifth Year**

2706 Structural Steel Design  
 2707 Structural Detailing  
 2709 Transportation Engineering  
 2710 Civil Engineering Practice

**Diploma in Civil Engineering Construction**

Students admitted prior to the 1986/87 session will continue with the following course syllabi.

**Full-Time Third Year**

1052 English for Occupational Purposes  
 2050 Supervisory Studies  
 2307 Structural Design  
 2310 Transportation Technology  
 2313 Civil Engineering Project  
 2342 Ground Engineering  
 2363 Civil Engineering Construction II  
 2364 Structural Construction  
 2366 Site Organisation & Management

**Evenings-Only Fourth Year**

2303 Geology & Soil Mechanics  
 2307 Structural Design  
 2336 Structural Drawing & Measurements  
 2363 Civil Engineering Construction II

**Evenings-Only Fifth Year**

2310 Transportation Technology  
 2342 Ground Engineering  
 2364 Structural Construction  
 2366 Site Organisation & Management

**Diploma in Civil Engineering Design**

Students admitted prior to the 1986/87 session will continue with the following course syllabi.

- Full-Time Third Year**  
 2415 Reinforced Concrete & Prestressed Concrete Design  
 2416 Reinforced Concrete & Prestressed Concrete Drawing & Measurements  
 2417 Civil Engineering Practice & Procedure  
 2418 Transportation Engineering  
 2419 Foundation Engineering  
 2420 Environmental Engineering  
 2421 Civil Engineering Project
- Evenings-Only Fourth Year**  
 2419 Foundation Engineering  
 2420 Environmental Engineering  
 2460 Structural Steel Design  
 2461 Structural Steel Drawing & Measurements

- Evenings-Only Fifth Year**  
 2415 Reinforced Concrete & Prestressed Concrete Design  
 2416 Reinforced Concrete & Prestressed Concrete Drawing & Measurements  
 2417 Civil Engineering Practice & Procedure  
 2418 Transportation Engineering

### Diploma in Land Surveying

This is a three-year full-time or a four-year part-time (evenings-only) course. The objective of the course is to train technologists in the field of land surveying and mapping.

#### Practical Training

Field and laboratory exercises are conducted to demonstrate the application and the use of various surveying techniques and instruments. Full-time students are also required to attend survey camps, field excursions and industrial practical training. Part-time students should normally be in employment relevant to their course of study, thus receiving the necessary practical experience.

#### Assessment

Assessment during each year of the course will be by means of course work and written/practical examinations. A satisfactory standard will be required in both practical work and examinations.

#### Career Prospects

As all types of construction work require surveying application throughout the project, the prospects for land surveying technologists, especially in developing countries are good. There is a demand for land surveying technologists in both the private and public sectors to assist professional land surveyors in executing topographical, engineering, hydrographic and cadastral surveys.

Graduates from this course may continue to study for an Advanced Diploma in Land Surveying.

#### Subjects of Study

- Full-Time First Year**  
 1004 FORTRAN Programming  
 1041 Mathematics I  
 1046 Physics  
 1501 English for Academic Purposes  
 2500 Technical & Fair Drawing  
 2529 Geology & Land Classifications  
 2535 Elements of Construction  
 2540 Land Surveying I (Elementary & Topo)

- Full-Time Second Year**  
 1042 Mathematics II  
 2530 Town & Country Planning  
 2538 Field Astronomy  
 2541 Engineering Surveying  
 2542 Land Surveying II (Cadastral & Law)  
 2501 Survey Computations

- Full-Time Third Year**  
 1502 English for Occupational Purposes  
 2050 Supervisory Studies  
 2531 Land Valuation  
 2532 Cartography & Map Projection  
 2537 Photogrammetry  
 2543 Hydrographic Surveying  
 2544 Geodetic Surveying  
 2545 Project

- Evenings-Only First Year**  
 1041 Mathematics I  
 1046 Physics  
 2500 Technical & Fair Drawing  
 2540 Land Surveying I (Elementary & Topo)

- Evenings-Only Second Year**  
 1004 FORTRAN Programming  
 1042 Mathematics II  
 2501 Survey Computations  
 2535 Elements of Construction  
 2542 Land Surveying II (Cadastral & Law)

- Evenings-Only Third Year**  
 2529 Geology & Land Classification  
 2530 Town & Country Planning  
 2538 Field Astronomy  
 2546 Land Surveying III (Engineering & Hydrographic Surveying)

- Evenings-Only Fourth Year**  
 2531 Land Valuation  
 2532 Cartography & Map Projection  
 2537 Photogrammetry  
 2544 Geodetic Surveying

### Diploma in Quantity Surveying

This is a three-year full-time or a five-year part-time evenings-only course. The subjects of study in the first year of the full-time and the first and second year of the part-time course will be common with the Diploma in Building course.

#### Practical Training

Full-time students will have about eight weeks of practical training with industry during the long vacation at the end of the second year of their three-year course. Part-time students should normally be in employment relevant to their course of study, thus receiving the necessary practical training.

#### Assessment

Assessment during each year of the course will be by means of written examinations and continuous assessment programmes. A satisfactory standard will be required in both course work and examinations.

#### Career Prospects

This course is designed to give students knowledge of building technology, measurement and estimating of building works, quantity surveying practice and procedure. The course has a large practical content of exercises, assignments and projects. It trains the

students to be quantity surveying assistants with government and statutory boards, contractors organisations, private quantity surveying practitioners and with consultants.

#### Subjects of Study

- Full-Time First Year**  
 1501 English for Academic Purposes  
 2020 Construction Technology I  
 2021 Construction Materials  
 2022 Environmental Science  
 2023 Elements of Financial Accounts & Economics of Industry  
 2024 Surveying & Levelling  
 2025 Elementary Theory of Structures & Design

- Full-Time Second Year**  
 1032 Elementary Statistics & Computer Programming  
 2250 Construction Technology II  
 2254 Building Services I  
 2261 Quantity Surveying I  
 2262 Principles of Law  
 2263 Quantity Surveying Practice & Procedure I

- Full-Time Third Year**  
 1502 English for Occupational Purposes  
 2255 Construction Technology III  
 2258 Building Services II  
 2264 Quantity Surveying II  
 2266 Estimating & Pricing for Quantity Surveying  
 2267 Quantity Surveying Practice & Procedure II  
 2268 Quantity Surveying Project  
 2275 Site Organisation & Supervisory Studies

- Evenings-Only First Year**  
 2020 Construction Technology I  
 2021 Construction Materials  
 2022 Environmental Science  
 2024 Surveying & Levelling

- Evenings-Only Second Year**  
 2023 Elements of Financial Accounts & Economics of Industry  
 2025 Elementary Theory of Structures & Design  
 2250 Construction Technology II  
 2254 Building Services I

- Evenings-Only Third Year  
 1033 Elementary Statistics & Computer Programming  
 2255 Construction Technology III  
 2258 Building Services II  
 2269 Quantity Surveying IE
- Evenings-Only Fourth Year  
 2262 Principles of Law  
 2263 Quantity Surveying Practice & Procedure I  
 2265 Site Organisation  
 2270 Quantity Surveying IIE
- Evenings-Only Fifth Year  
 2266 Estimating & Pricing for Quantity Surveying  
 2267 Quantity Surveying Practice & Procedure II  
 2271 Quantity Surveying III E

### Advanced Diploma in Land Surveying (ADLS)

The offer of the ADLS course is governed by demand. It is for working personnel in the land surveying field. For details, please contact the departmental office.

### Endorsement Subject

Graduates holding the Singapore Polytechnic Diploma in the various courses while in relevant employment may apply to attend the following endorsement subject:

#### 2231 Building Maintenance

This course is conducted over a period of thirty-two weeks. At the end of the course, candidates are required to sit for an examination.

### Extra-Mural Courses

Graduates holding a relevant Singapore Polytechnic Diploma from this Department may apply to attend the following extra-mural courses:

- Pre-stressed Concrete Design
- Retaining Structures
- Civil Engineering Contract & Quantities

Each of these courses is held in the evenings over a period which varies from ten to twelve

weeks. Other extra-mural courses are to be offered from time to time and prior announcement of the introduction of such courses will be made in the Press.

### Laboratories/Workshops

The Architectural Model-Making Workshop was set up with the primary aim of enabling draughtsmanship students to transpose two-dimensional drawings into three-dimensional scale models. Through the making of these models, students will derive a better understanding of the planning, setting up, construction and finalising of a construction project. Students will be taught the appropriate usage of various types of model-making materials, together with the proper handling of various tools used in connection with the finer techniques of making models.

The Building Science & Services Laboratory is designed to facilitate the study and understanding of "Building Science", "Building Services" and "Environmental Science". The Laboratory comprises six sections: (a) Heat Transmission Room, for experiments related to the mode of heat transfer in materials and buildings, (b) Environmental Room, for experiments related to factors of thermal comfort, ventilation and airconditioning, (c) Lighting Room, for experiments related to day-lighting and artificial lighting, (d) Acoustics Room, for experiments related to sound transmission and insulation, (e) Water Supply & Plumbing Section, for workshop practice and experiments related to hot and cold water supply, plumbing and sanitation installation, and (f) Fire Protection & Related Services, where there is a display and demonstration of building services and equipment for fire prevention and control.

The Construction Technology Workshop was set up with the aim of giving students the opportunity to gain insight into the principal trades and procedures involved in the building industry. By means of practical assignments in each of the six sections of the Workshop, students are taught the salient points in good workmanship. The six sections are: (a) Carpentry & Joinery Section, where students learn the principles and practice related to

woodworking and fabrication, (b) Concrete Practice Section, where students learn the preparation of formwork, steel reinforcement and placing of concrete, (c) Brickwork/Blockwork Section, where practice is provided in the mixing of cement, mortar and erection of brick/block walls, (d) Bar Bending Section where students learn to cut and bend reinforcement according to bar bending schedule, (e) Paving & Plastering Section, where practice is given in the application of plastering, paving and fixing of floors and wall tiles and (f) Painting Section, where students learn the principles and practice of painting on timber, metal and plastered surfaces.

The Geology & Soil Mechanics Laboratory is set up to supplement the theoretical study of rocks and soils which form the foundation for buildings and roads. Samples of various types of rocks and soils in geological cycle together with landscape models are available as teaching aids. A range of equipment for the determination of various physical properties, strength and compressibility of soil is also available.

The Hydraulics Laboratory is set up to enable students to gain a clearer understanding of elementary fluid mechanics. In addition to demonstration models, there are basic equipment available for pressure and flow measurement of liquids (water). Facilities are also available to demonstrate water and sewerage treatment techniques.

The Materials Testing Laboratory provides the facilities for experimental studies on the properties and strengths of various materials encountered in building and civil engineering work. Apparatus is available for the various standard tests on cement, aggregate, concrete, bricks and materials for roads. Facilities are also available for the students to try out the various procedures such as mixing, placing, curing and testing concrete.

The Structures Laboratory aims to complement the theoretical study of "Theory of Structures". Simple models of structures are used to study structural behaviour and to illustrate the fundamental concepts of structural mechanics. Experiments can be performed on simple structural elements for the

measurement of relevant forces and displacements.

The Survey & Photogrammetry Laboratory services the architectural, building, civil engineering, and land surveying courses conducted by the Department by providing land and engineering surveying practical lessons. The fundamental equipment and instruments available are the levels and theodolites which are used to establish levels, distances and bearings. There are also facilities in the Photogrammetry Section for the plotting of topographical maps from aerial photographs.

### Advanced Diploma in Building Maintenance Management

#### Meeting the Demand for Building Maintenance Personnel

The building industry in Singapore needs to be concerned with identifying and studying the process of managing building maintenance, and with restructuring its organisation, to implement maintenance techniques and procedures effectively. This Advanced Diploma course in Building Maintenance Management will assist in achieving this objective.

Independent surveys conducted by the Singapore Polytechnic and the Construction Industry Development Board point to an increasing need for maintenance over the next five years as new construction work decreases and the need for trained maintenance staff increases.

#### Course Objectives

This Advanced Diploma in Building Maintenance Management course is designed to achieve the objective of fulfilling the needs of the building industry in:

- identifying and studying the process of managing building maintenance.
- implementing maintenance techniques and procedures effectively.

This course is designed for Polytechnic Diploma holders who are employed in the maintenance of building estates, and in consulting organisations that provide main-

ance services. This course will improve their knowledge and skills and enable them to advance their careers in the field of building maintenance management.

**Course Duration**

The duration of the course will be two years and will require attendance for three evenings per week, a maximum of ten hours per week, for thirty weeks per year. Participants will also be required to complete the course in not more than five years.

**Course Structure**

The course consists of seven subjects of study, representing a total of 540 hours of course work spread over a period of two years. Another 60 hours will also be allocated to project work in the programme.

**Year I**

**Subjects of Study**

- Maintenance Technology
- 3001 Maintenance Technology I
- 3002 Maintenance Technology II
- 3003 Maintenance Technology III

**Maintenance Management**

- 3004 Maintenance Management I
- 3005 Maintenance Management II
- 3006 Maintenance Management III

**Building Law & Regulations**

- 3007 Building Law & Regulations I
- 3008 Building Law & Regulations II
- 3009 Building Law & Regulations III

**Year II**

**Project**

**Building Defects & Rectification**

- 3010 Building Defects & Rectification I
- 3011 Building Defects & Rectification II
- 3012 Building Defects & Rectification III

**Building Economics & Practice**

- 3013 Building Economics & Practice I
- 3014 Building Economics & Practice II
- 3015 Building Economics & Practice III

- Building Services
- 3016 Building Services I
- 3017 Building Services II
- 3018 Maintenance Productivity & Control

**Synopses of Subjects**

**1004 FORTRAN Programming**

Introduction to computer systems. Problem solving procedure, logic flowchart/pseudocode. FORTRAN 77 constants, variables and expressions. Intrinsic functions. Stream and formatted I/O. Control statements. Looping statements. Arrays. Data statement and data file. Function subprograms and subroutines. Sequential file processing. Applications in computer programming. Use of selected application software packages.

**1005 BASIC Programming**

Introduction to computer systems and terminologies. Algorithm and flowcharts. Elements of BASIC language. Assignment statements. Print statements. Control statements. Loop creation statements. Arrays. Library and user defined functions. Subroutines. Documentation. File processing. Application programming and using application packages.

**1025 Mathematics I**

Indices and logarithms. Determination of laws. Determinants and matrices. Radian measure and circular functions. Basic identities, compound-angle, double-angle and factor formulae. Trigonometric equations. Differentiation of algebraic and transcendental functions with applications. Simple integration and applications.

**1027 Mathematics II**

Inverse circular functions. Hyperbolic and inverse hyperbolic functions. Partial differentiation. Methods of integration. Numerical integration.

Arc length of curve by integration. First order differentiation equation. Second order linear differential coefficients with constant coefficients and application to deflexion of beams. Statistics — histograms, measures of central tendency and dispersion. Use of the standard normal distribution table. Least square line.

**Elementary Statistics & Computer Programming**  
An awareness of the possible uses of statistical and mathematical techniques in the solution of problems concerned with the construction industry. Introduction to the computer system. Historic development of computers. Flow charts. Programming in BASIC. Application of computer programming.

**Mathematics I**  
Indices and logarithms. Use of the binomial expansions. Determinants and matrices. Trigonometric identities and formulae. Analytical geometry of the straight line and conic sections. Differentiation of algebraic and transcendental functions and applications. Simple integration and its applications. Partial differentiation. Manipulation with complex numbers including use of de Moivre's theorem.

**Mathematics II**  
Use of Newton's 2nd Law. Concepts of centroid and simple harmonic motion. Maclaurin and Taylor's theorems. Properties and applications of spherical triangles. Three-dimensional analytical geometry. Statistics-frequency distributions, measures of central tendency and dispersion. Binomial and normal distributions. Concepts of standard error, simple hypothesis tests, correlation. Linear regression and least square line.

**Physics**  
Hydrostatics. Elasticity of solids. Surface tensions. Calorimetry, latent heat

and changes of state. Properties of light and optical instruments, photography. Terrestrial magnetism. Electrostatics, current electricity, electromagnetic induction and A.C. theory. Characteristics and propagation of waves.

**English for Academic Purposes**  
The course helps students acquire the skills required to function effectively in their studies at the Polytechnic. Students will practise reading, listening to lectures, note-making, note-taking and oral interaction. They will have practice in writing laboratory, project and workshop reports as well as answering examination questions.

**English for Occupational Purposes**  
The course teaches the language skills required when applying for a job and functioning at work. Part I covers job advertisements, job application letters and job interviews. Part II covers meetings, oral proposals, telephone calls, business letters and memoranda.

**Construction Technology I**  
This subject will cover the following sub-divisions:

(a) Construction Technology: The study of the elements of construction of a simple two-storey load bearing wall and r.c. framed building with particular attention paid to the sequence of construction.

(b) Building and Geometrical Drawing: Architectural and structural plan interpretation for a two-storey building with attention paid to the co-relation of drawings and construction details.

(c) Construction Workshops: Workshop practice to augment the theory of construction; attention will be paid to salient points involved in good workmanship and the recognising of defects in finished work.

- 2021 Construction Materials**  
A study of properties and uses of materials in the construction industry. Such study will include laboratory work and references will also be made to relevant Singapore standards.
- 2022 Environmental Science**  
Studies of factors and problems related to the environmental conditions and comfort requirements of buildings and spaces with regard to heat, ventilation, light and sound.
- 2023 Elements of Financial Accounts & Economics of Industry**  
(a) Economics of Industry: The students will be taught general economic principles and their application to the construction industry.  
(b) Elements of Accounting: The students will be taught the preparation of the trading accounts of a construction firm.
- 2024 Surveying & Levelling**  
Students will be taught the use of surveying equipment and its applications to the construction industry. Emphasis will be placed on errors and corrections, contouring areas and volume calculation and setting out.
- 2025 Elementary Theory of Structure and Design**  
An introduction to theory on shear, bending moment, and deflection, simple stress and strain, combined bending and direct stresses. Simple reinforced concrete and structural steel design.
- 2031 Structural Mechanics**  
Equilibrium of forces; application to statically determinate structures. Stresses and strains. Beams: shearing force and bending moment in simply supported and cantilevered beams, slope and deflection by area moment theorem. Combined stresses. Columns. Two-dimensional stresses. Experimental work in the laboratory.
- 2033 Construction Technology**  
Mechanics of construction industry. Agencies involved in construction projects, governing regulations. Elements of construction. Structure types foundations, walls, floors, roofs, stairs, doors, windows, finishes and decoration. External works. Tutorial exercises and blue print reading. Workshop practice identifying defects in finished work.
- 2035 Engineering Science**  
Interdisciplinary topics related to building and civil engineering works. Heat transmission. Environmental conditioning. Lighting. Mechanical behaviour and operation of work site tools and equipment. Electrical requirements in buildings. Corrosion control. Practical work in the laboratory.
- 2050 Supervisory Studies**  
Productivity concepts and productivity improvement. Management concepts and systems, labour management relations. Quality control circles, work improvement teams. Supervisory skills, communication and feedback.
- 2060 Technical Drawing**  
Drawings for construction work. Basic draughting techniques. Lining, dimensioning, units and scales. Projections. Plan views, elevations and sections of three-dimensional objects. Simple building layouts, structural and non-structural elements. Drawings for retaining walls, channels, culverts and roadways. Service drawings.
- 2061 Surveying & Levelling**  
Chain surveying: principles and equipment used. Levelling principles, methods, errors and corrections. Contouring, cross and longitudinal sections. Theodolite surveying: application, traversing and computation. Areas and volumes. Curves: calculation and setting out. Field Work.
- 2062 Construction Materials**  
Types and characteristics of materials used in construction works; to include concrete and its constituents, bricks, timber, structural steel, cast iron, paints, plastics and road-work materials. Standards and specifications. Laboratory testing of materials.
- 2100 Technical Drawing**  
Emphasis on application of orthographic projection of solids and of simple building problems.
- 2101 Surveying & Levelling**  
Leveling. Chain and theodolite survey. Contouring. Area and volume calculation. Field work.
- 2109 Building Services I**  
Lectures on water supply, drainage and sanitation plumbing in multi-storey buildings and refuse disposal.
- 2110 Building Services II**  
Understanding of the importance of mechanical and electrical services in buildings such as ventilation, air-conditioning, electrical and gas installations, lift and escalator installations and fire protection installation.
- 2111 Building Construction I**  
Studies of current building construction of simple-span structures from foundation to roofs, joinery work and standard construction of timber and steel windows, doors and staircases.
- 2112 Building Construction IE**  
Studies of current building construction of simple buildings from foundation to roofs.
- 2113 Building Construction II**  
Studies of current building construction of medium-span and high-rise structures and detailed study of building components — claddings, partitions, windows, doors and staircases.
- 2114 Building Construction IIE**  
Studies of current building construction of medium-span structures and
- 2115 Building Construction IIE**  
Studies of current building construction of high-rise structures and detailed study of building components — claddings, partitions.
- 2116 Building Construction IVE**  
Studies of current building construction of large-span industrial buildings and other sophisticated and advanced methods of building construction.
- 2117 Building Materials**  
A study of the architectural uses of building materials with special emphasis on field studies of materials, elements and assemblies.
- 2118 Building Science**  
A study of the problems of environmental conditions and comfort requirement with regard to heat, light, sound and ventilation.
- 2119 Architectural Model-Making Project**  
Practice in architectural model-making of buildings.
- 2120 Studio & Architectural Drawing I**  
Lectures and studio work on draughting techniques, communication of ideas and the preparation of simple working drawings.
- 2121 Studio & Architectural Drawing IE**  
Lectures and studio work on draughting techniques, communication of ideas and the preparation of simple working drawings.
- 2122 Studio & Architectural Drawing II**  
Problems on measured drawings, service drawings and colouring. Emphasis on production drawings and detailing of a complex domestic building. Basic computer architectural draughting.

- 2123 **Studio & Architectural Drawing IIE**  
Application of anthropometric study and shadow projection. Problems on measured drawings, service drawings and colouring. Preparation of production drawings of a simple domestic building.
- 2124 **Studio & Architectural Drawing IIIE**  
Preparation of presentation drawings and models of a complex domestic building. Emphasis on production drawings and detailing of a complex domestic building.
- 2125 **Studio & Architectural Drawing IVE**  
Draughting of presentation drawings and production drawings of a complex multi-storey building. Preparation of working details of the scheme.
- 2126 **Studio & Architectural Drawing VE**  
Draughting of presentation drawings and working drawings of a large complex project.
- 2127 **Studio & Architectural Drawing III**  
Draughting of presentation drawings and preparing production drawings of a complex project from an architect's final design. Advanced computer architectural draughting.
- 2128 **Building Construction III**  
Studies of current sophisticated and advanced methods of building construction of a complex project including detailing of all parts of the scheme.
- 2129 **Elements of Structure & Detailing**  
An introduction to the principles of building and structural engineering. Detailing of reinforced concrete and structural steel elements.
- 2130 **Specifications & General Building Regulations**  
Basic principles of specification writing. Method of specifying building construction and building materials and a study of the general building regulations.
- 2131 **Building Science & Services**  
A study of problems of environmental conditions and comfort requirements with regard to heat, light, sound and ventilation and lectures on water supply, drainage and sanitation, plumbing in buildings and refuse disposal.
- 2132 **Building Construction VE**  
Studies of the construction of a large complex scheme including detailing of all parts of the scheme.
- 2149 **Principles of Architectural Practice A**  
An introduction to local architectural practice and building industry from the technologist's standpoint.
- 2152 **Principles of Architectural Practice B**  
A study of the legislation in relation to the construction and sanitation of buildings in Singapore.
- 2250 **Construction Technology II**  
Site investigations. Independent pad foundations, combined column foundations. Retaining structures and basement construction. Reinforced concrete and steel framed structures. Infill panel walls and partitions. Reinforced concrete floors and stairs. Medium and large span roof structures and coverings. Metal sliding and folding doors and windows. Specification writing.
- 2251 **Site Organisation & Management I**  
Management techniques required in administering, organising and completing a construction project, general management principles. Building acts and regulations.
- 2252 **Building Quantities I**  
Basic principles of taking off. Understanding and interpretation of Bills of Quantities and measurement of simple building work. Trade and Elemental Bill preparation procedure.
- 2253 **Building Law**  
Nature and sources of law; court structure; legal procedure; basic principles of contract and tort. Standard forms of building contract.
- 2254 **Building Services I**  
Water supply, drainage and sanitation. Sewerage collection and disposal. Refuse collection and disposal. Environmental pollution and control. Laboratory work in connection with lectures.
- 2255 **Construction Technology III**  
Preliminaries and temporary work. Dewatering systems. Prestressed reinforced concrete structure and floor systems. Portal frames, shell roof construction. Curtain walls and cladding. Suspended ceiling construction. Culvert, road and drainage work.
- 2256 **Site Organisation & Management II**  
Studies of the management techniques required in administering, organising and completing a construction project within the least possible cost, in the shortest possible time and with the highest standard of workmanship obtained in accordance with the Contract Documents. The first year introduces the students to basic management principles and the organisation of the construction industry for the supervisory role of the foreman. The second year concentrates on the application of management principles to production for his career as a site agent.
- 2257 **Building Quantities II**  
This is a continuation of Building Quantities I. The students will be taught measurement and taking off from drawings, of reinforced concrete and steel structures, building services including an understanding of Civil Engineering Quantities.
- 2258 **Building Services II**  
Basic design requirements and installation in services such as lifts, ventilation and airconditioning systems, lighting and electrical systems, telephone and communication systems and fire protection systems. Understanding the importance and the coordination work for these systems in buildings.
- 2259 **Building Maintenance**  
To develop (a) an appreciation of the organisation and management of maintenance (b) an understanding of the legal obligation of building owners to maintain their properties (c) an understanding of building maintenance, its technology and the ability to identify and to diagnose causes of defects and to decide the remedial and preventive measures.
- 2260 **Builders' Estimating and Accounts**  
The objective of the syllabus is to prepare students to perform the functions of an estimator in a contractor's organisation. Students should have a clear understanding of the tender system, the procedure for estimating and tendering, analysing and building-up of unit rates for building trades and the valuation of work in progress.
- 2261 **Quantity Surveying I**  
Functions of a quantity surveyor; use of bills of quantities; taking off principles. Measurement of quantities of work for various elements of simple buildings. Working up and billing.
- 2262 **Principles of Law**  
The legal system and structure of the courts. Basic principles of the law of contracts and torts. Arbitration. Bankruptcy and liquidation.
- 2263 **Quantity Surveying Practice and Procedure I**  
Structure of the construction industry; roles and relationships of the parties involved in the construction process. Types of construction contracts; tendering procedures. History and development of quantity surveying.

ing. Quantity surveying organisations; production processes of bills of quantities. Report writing.

**2264** **Quantity Surveying II**  
Different forms of bills of quantities; preliminaries, p.c. and provisional sums; cut and shuffle system. Measurement of quantities for more complex structures, demolition, earthworks, piling, basements structural steelwork, services and external works.

**2265** **Site Organisation**  
Pre- & post-contract planning; site layout; materials and plant management; employment and control of labour; project budgets and cost control; safety requirements; insurance requirements.

**2266** **Estimating and Pricing**  
Estimating of building costs; basic principles of building up unit rates for all trades; tendering.

**2267** **Quantity Surveying Practice and Procedure II**  
Standard forms of building contract and contract administration; cost planning, post-contract cost control; variations and final accounts; report writing.

**2268** **Quantity Surveying Project**  
i) Simulation of practical quantity surveying work. Students in teams prepare a complete set of tender documents including bills of quantities after measurement of simple building projects, or  
ii) A study of some area of contract administration, quantity surveying practice or computer applications in quantity surveying.

**2269** **Quantity Surveying IE**

**2270** **Quantity Surveying IIE**

**2271** **Quantity Surveying IIIE**

The subject matter covered in the above three subjects is the same as in

Quantity Surveying I (2261) and Quantity Surveying II (2264) in the full-time course, but is spread over three years for the part-time course.

**2272** **Building Project**  
i) Simulated study in planning and organising construction activities for a building project. Students prepare site organisation and project planning from a set of architectural and engineering drawings, including analysis of cost, labour requirement and plant utilisation.  
ii) A study of some area in building construction, building services, environmental science, building maintenance, computer application.

**2275** **Site Organisation & Supervisory Studies**  
Pre- and post-contract planning; site layout; materials and plant management; employment and control of labour; project budgets and cost control; safety requirements; insurance requirements. Productivity concepts and productivity improvement. Management concepts and systems; labour management relations. Quality control circles, work improvement teams. Supervisory skills, communication and feedback.

**2305** **Geology & Soil Mechanics**  
Engineering geology, geology cycle, minerals, rocks, erosion, structural



Second-year Diploma in Land Surveying students do surveying computations with a total station and a microcomputer.

geology and maps. Soil classification, physical properties of soil. Stresses in soil. Permeability. Compressibility. Shear strength and effect of compaction. Laboratory experiments.

**2307** **Structural Design**  
Introduction to CP110, CP3 and BS449. Analysis and design of R.C. beams, slabs, columns, staircases, foundations. Elementary prestressed concrete design. Structural steel design. Universal and compound beams, columns and connections.

**2310** **Transportation Technology**  
Highway planning; urban and rural roads. Traffic: composition, surveys and speeds. Parking: surveys and types. Geometric design: sight distance, horizontal and vertical curves intersections. Traffic management: signals channelisation, signs. Highway: construction, surveying, plans and specifications, materials, drainage. Road maintenance. Laboratory work.

**2313** **Civil Engineering Project**  
The project work may range from a literature survey to experimental work or design calculations. To be carried out jointly by a small group of students under guidance of an academic staff. A formal written report has to be compiled and submitted by each group.

**2336** **Structural Drawing & Measurements**  
Drawing of reinforced concrete and steel structures. Civil engineering standard method of measurements. Taking off and preparation of Bill of Quantities.

**2342** **Ground Engineering**  
Site investigation, field tests and soil sampling. Construction of caissons, cofferdams, deep basements, tunneling and shaft construction. Various methods of ground treatment. Instrumentation and control of ground movements due to underground works.

**2363** **Civil Engineering Construction II**  
Engineering fundamentals. Identification and operation of construction plant and equipment in light and heavy civil engineering works. Productivity of equipment. General specifications and design aspects of major projects. Job planning. Site safety.

**2364** **Structural Construction**  
Buildings: functional requirements, methods, economic aspects. Contemporary multi-storey structures: layout types, lateral load behaviour, design/construction relationships, erection methods, materials. Contemporary bridges: types, erection, approaches. Water and solid retaining structures. Failure of structures: cases, summary. Repair of structures. Site safety: factory aids, officer responsibility, procedures, cases, practical guides.

**2366** **Site Organisation & Management**  
Contracts; tendering procedures. Roles and responsibilities. Personnel management. Site resources; administration, meetings and cost control, planning and programming. Quality control of site production activities. Safety, health and welfare. Communications.

**2415** **Reinforced Concrete & Prestressed Concrete Design**

Reinforced Concrete: design concept based on ultimate limit state theory. Prestressed Concrete Design: current design practices. Use of relevant clauses and charts in BS8110 for the design of reinforced and prestressed concrete structures.

**2416** **Reinforced Concrete & Prestressed Concrete Drawing & Measurements**  
Drawing of reinforced and prestressed concrete elements. Detailing practice. Bending schedules for steel reinforcement. Standard method of measurements and taking off quantities.



- 2417 **Civil Engineering Practice & Procedure**  
Project administration: roles and responsibilities, personnel management, office organisation, planning and programming, report writing, safety health and welfare. Civil Engineering contract procedures.
- 2418 **Transportation Engineering**  
Traffic surveys and management. Geometric design and drawing plans. Taking off quantities. Roads: surveying and setting out, plans and equipment for construction works. Laboratory and field tests. Road maintenance. Project work.
- 2419 **Foundation Engineering**  
Site investigation. Field tests. Stresses in soil and settlement analysis. Soil sampling, bearing capacity. Design of footings. Shallow and deep foundations. Retaining walls, sheet piles. Stability of slopes. Cofferdams.
- 2420 **Environmental Engineering**  
Water and waste water: sources, collection and treatment/disposal. Air pollution: problems and control.
- 2421 **Civil Engineering Project**  
As in 2313
- 2460 **Structural Steel Design**  
Design of beams, girders, columns and roof trusses in structural steel. Welded and bolted connections and their design.
- 2461 **Structural Steel Drawing & Measurements**  
Drawing of structural steel elements. Detailing practice. Standard method of measurements. Taking off and preparation of Bill of Quantities.
- 2500 **Technical & Fair Drawing**  
Geometrical construction of figures. Use of scales. Orthographic projection of solids. Conventional signs and lettering on plans. Production of survey plans.
- 2501 **Survey Computations**  
Co-ordinate systems. Plane trigonometry and its application to survey problems. Traversing, intersection and resection problems. Standards of accuracy in surveying. Subdivision computations. Areas.
- 2537 **Photogrammetry**  
Geometry, scale and distortions of photograph. Rectifications and interpretation of air-photos. Types of plotting instruments and their principles. Inner, relative and absolute orientations. Introduction to aerial triangulations.
- 2538 **Field Astronomy**  
Application of spherical trigonometry to astronomy. Errors and corrections in observations. General and precise determination of azimuth, latitude time, and longitude by sun, star, etc.
- 2540 **Land Surveying I (Elementary and Topo)**  
Introduction to land surveying. Chain surveying, levelling and the use of auxiliary equipment. Adjustments and use of theodolite, route surveys. Plane tabling.
- 2541 **Engineering Surveying**  
Contouring for engineering purposes, precise levelling. Tacheometric surveying. Road and railway curves including compound, transition and vertical curves. Profile and cross-sections. Earth quantities. Location and setting out survey. Electronic measuring equipment. Underground survey.
- 2542 **Land Surveying II (Cadastral & Law)**  
Brief history of Land Laws in Singapore Acts, laws and regulations affecting title surveys. Rules for the conduct of title surveys.
- 2543 **Hydrographic Surveying**  
Properties and characteristics of sea water and sea floor. Principles of echo sounding. Reduction to datum and production of fair sheet. Tides and currents. Establishment and transfer of datum. Position-fixing by optical and electronic means. Sweeping by
- 2544 **Geodetic Surveying**  
Precise distance and angular measurements. Equipment used. Triangulation, trilateration. Adjustments of survey and levels by methods of least squares. Theory of errors. Computations on the spheroid.
- 2545 **Project**  
Each final-year student is allocated a study/practical project. The student is expected to investigate in depth some topic in land surveying of particular interest to him.
- 2546 **Land Surveying III (Engineering & Hydrographic Surveying)**  
Contouring, precise levelling and tacheometric surveying. Road and railway curves. Longitudinal and cross-sections. Earthwork calculations. Location and setting out survey. Electronic measuring equipment. Under-ground survey. Properties and characteristics of sea water and sea floor, tides and currents. Echo sounding. Reduction to datum. Position fixing. Sweeping by wire and sonar. Introduction to seismic, gravity and magnetism surveys.
- 2700 **Computer Application in Civil Engineering**  
Introduction to digital computer systems. Problem-solving procedure. Elements of programming in FORTRAN 77. Sequential file processing. Applications in computer programming. Use of selected application software packages. Appreciation of CADD technology and its potential. CADD system overview. Use of CADD workstations to produce 2-D working drawings. Utilities, digitizing and plotting. Elements of 3-D graphics. Surface and solid elements.
- 2701 **Theory of Structures**  
Analysis of statically determinate beams. Three hinged arches. Deflec-

tions in statically determinate beams and arches. Statically indeterminate beams and trusses. Methods of consistent deformation, three moment equation; moment distribution. Influence lines for simple beams.

2702 **Geology & Soil Mechanics**  
As in 2303

2703 **Hydraulics, Water Supply & Sewerage**  
Fundamental theories of hydrostatics, close conduit flow and open channel flow. Analysis of fluid motion. Design and construction aspects of water supply and sewerage systems. Laboratory experiments on model scale hydraulics, water supply and sewerage equipment/plant.

2704 **Reinforced Concrete & Prestressed Concrete Design**  
As in 2415

2705 **Civil Engineering Construction I**  
Preliminary site works. Earth works. Ground water control. Shallow foundations. Retaining walls. Bearing and sheet piles. Formwork, shoring and scaffolding. Reinforcement. Insitu, precast and prestressed concrete.

2706 **Structural Steel Design**  
As in 2460

**Structural Detailing**

The detailing of reinforced, prestressed concrete and structural steel elements. Civil engineering standard method of measurements. Taking off and preparation of bill of quantities. Computer-aided design software application packages for concrete and steel detailing.

2708 **Foundation Engineering**  
As in 2419

2709 **Transportation Engineering**  
As in 2418

2710 **Civil Engineering Practice**  
General basic principles of managing construction contracts from conception to completion. Planning, programming and roles of parties to a contract. Allocation of financial, manpower, material and plant resources.

2711 **Civil Engineering Construction II**  
As in 2363

2712 **Civil Engineering Project**  
As in 2313



Third-year Electrical Engineering students study the properties of a transmission line demonstrator.

## Department of Electrical Engineering

**Staff**

**Head**

Teo Chye Poh  
Dip E, E, B Sc (Hons), M Sc, C Eng, FIEE, FIERE, Cert Ed, P Eng

**Deputy Head**

Philip Chin Sim Moo (Dr)  
B E (Elec), M Eng Sc, Ph D

**Circuit & Control Section**

**Section Head**

Philip Chin Sim Moo (Dr)  
B E (Elec), M Eng Sc, Ph D

**Senior Lecturers**

M Banerjee (Mrs)  
B Sc (Hons), M Tech, M Sc, C Eng, MIEE

Ting Siok Hoon (Mrs)  
B Sc (Hons), M Sc, C Eng, MIEE

**Lecturers**

Lim Thiam Choi  
B Sc (Physics), Cert Ed, Tech Dip (Electr & Tele)

Low Kay Soon  
B Eng (Elect) (Hons)

Loh Wai Kuan (Dr)  
B Sc (Hons), M Sc, Ph D, Assoc (UMIST), ALIM, AMIEE, MIEEE

N Rajkumar  
Dip Eng, M Sc, C Eng, MIEE, MIEEE, M Inst M C



At the Building Science Laboratories, students work on the thermal comfort meter, indoor climatic analyser and stress monitor.

**Teaching Assistant**  
 Tay Kwee Phuan  
 B Sc (Elec & Elect Eng) (Hons), M Sc  
 Thein Lwin  
 B Eng (Elec), M Sc, C Eng, MIEE  
 Thio Choy Yong (Mrs)  
 B Sc (Elect & Electn Eng) (Hons)

**Senior Instructor**  
 Lau Hong Lian  
 Tech Dip (Elec), C&GFTC (Elec Eng  
 Prac), MIEE, T Eng (CEI)

**Teaching Assistant**  
 Tan Gek Keow (Miss) (on study leave)  
 Tech Dip (Elec)

### Electronics Section

#### Section Head

Ng Sui Onn  
 B E (Elect), C Eng, MIEE

#### Lecturers

Steven Chew Lai Keat  
 B Eng (Elect) (Hons)

Lau Lee Yee  
 B Eng (Elec) (Hons), M Sc

Lee Kheng Kwang  
 B Sc (Elec & Electn Eng) (Hons)

Lily Leong (Mrs)  
 B Eng (Hons), AMIEE

Liemburg-Sim Lye Seok (Mrs)  
 B Eng (Elect) (Hons)

N Madhavan  
 Assoc Member IERE, T Eng (CEI),  
 C&GFTC (Telecom & Elect Eng Prac)

Ng Weng Lam  
 B Sc (Elec & Elect Eng) (Hons),  
 M Sc (Microprocessor Eng)

Yap Kin Leng (Mrs)  
 B Eng (Elec), MIEE

Yeo Eng Hung  
 B Sc (Eng) (Hons)

#### Teaching Assistant

Mok Sau Chin (Miss) (on study leave)  
 Tech Dip (Elec), SIM

### Installation Section

#### Section Head

Chin Jeck Swee  
 B E (Elec), P Eng, C Eng, FIES, MIEE,  
 MIEE, MIProdE, AMBIM

#### Senior Lecturer

Hsieh Kwang Hua  
 B E (Elec), P Eng, C Eng, MIEE, 1st Grade  
 Elect Eng (M)

#### Lecturers

Hema E Goonewardena  
 B Sc (Eng) (Hons), M Sc (Syst Eng), AMIEE

Ho Sou Weng  
 B Sc (Elec & Electn Eng), P Eng, MIES

Lim Peng Hun  
 B Eng (Elect & Electn Eng), MIEE

Ong Choon Teck  
 B Sc (Elect & Electn Eng) (Hons)

#### Principal Instructor

Yat Khai Hong  
 HNC (Elec), T Eng (CEI), AFSLAET,  
 FSERT, FSIET

#### Senior Instructor

A Achuthan  
 MASEE, C&GFTC (Trans & Dist),  
 C&GFTC (Elec Installation Wk), C&GFTC  
 (Elec Mech)

#### Teaching Assistant

Wong Mei Lai (Miss) (on study leave)  
 Tech Dip (Elec)

### Power Section

#### Section Head

Chair You Wah  
 Dip E E, C Eng, MIEE

The Department of Electrical Engineering offers the Diploma course in Electrical Engineering. This course prepares students for a career in the generation, transmission and utilisation of electrical energy. Two options are offered in the final year, namely Electrical Power Engineering Practice and Electrical Installation Design & Practice.

The Department, in conjunction with the Singapore Armed Forces, also offers GCE O-level leavers, who are interested in a technological career with the SAF, the prospect of sponsorship during their training at the Singapore Polytechnic.

Full details on the SP-SAF Diploma Scheme may be found on Page 16 of the Prospectus.

#### Practical Training

Great emphasis is placed on the practical aspects of the course. Lectures for all subjects are supplemented by training in the handling of electrical machinery and equipment in the laboratories and workshops. Students also gain practical experience in techniques such as coil and transformer winding, industrial wiring and electrical installation.

Full-time students receive additional practical training in industry for eight weeks during the long vacation at the end of the second year of the course. Part-time students should normally be in employment relevant to their course of study, thus receiving the necessary practical training. Students in the SP-SAF Diploma Scheme are provided with full practical training during all the semester vacations.

#### Assessment

Assessment during each year of the course will be by means of course work and written/practical examinations. A satisfactory standard will be required in both course work and examinations. Students in the SP-SAF Diploma Scheme are also required to successfully complete the vacation training conducted at the respective SAF training schools.

#### Career Prospects

Graduates in both options will find employment in public sector organisations such as

the Public Utilities Board, Public Works Department, Housing & Development Board, Port of Singapore Authority, Telecoms, Singapore Airlines and the Mass Rapid Transit Corporation. They will also find employment in private sector organisations such as oil companies, factories, sales, electrical consulting firms and electrical contracting companies. The need for our graduates is expected to grow as the economy in Singapore is bound to expand in the years ahead. Graduates in the SP-SAF Diploma Scheme will be employed by the SAF in the Army, Navy or the Air Force.

**Diploma in Electrical Engineering**

This is a three-year full-time or five-year part-time day-release/evenings-only course.

**Subjects Of Study**

- Full-time First Year
- 1004 FORTRAN Programming
- 1065 Mathematics I
- 1501 English for Academic Purposes
- 3069 Electrical Engineering I
- 3071 Electronics
- 5106 Engineering Drawing
- 5107 Mechanical Engineering Science
- 6102 Workshop Technology & Practice
- #CADD (Non-examinable)

- SP-SAF Diploma Scheme (Air Force) —
- First Year
- 1004 FORTRAN Programming
- 1065 Mathematics I
- 3012 Aero-Engineering
- 3069 Electrical Engineering I
- 3071 Electronics
- 5106 Engineering Drawing
- 5107 Mechanical Engineering Science
- 6102 Workshop Technology & Practice
- #CADD (Non-examinable)

**SP-SAF Diploma Scheme (Navy) —**

- First Year
- 1004 FORTRAN Programming
- 1065 Mathematics I
- 3069 Electrical Engineering I
- 3071 Electronics
- 5106 Engineering Drawing
- 5107 Mechanical Engineering Science
- 6102 Workshop Technology & Practice
- #CADD (Non-examinable)

#All first-year students will also take an appreciation course on microcomputer-based computer-aided drafting and design (CADD).

**Full-time Second Year (New Curriculum)**

- 1066 Mathematics II
- 3300 Electrical Installation
- 3301 Electrical Engineering II
- 3302 Electrical Machines I
- 3303 Electronic Engineering
- 3304 Digital Electronics & Microprocessors
- 3306 Instrumentation & Measurement
- 3307 Project I (including CADD)

**Full-time Second Year ("A" Level Intake)\***

- 1004 FORTRAN Programming
- 1066 Mathematics II
- 3300 Electrical Installation
- 3301 Electrical Engineering II
- 3302 Electrical Machines I
- 3303 Electronic Engineering
- 3304 Digital Electronics & Microprocessors
- 3306 Instrumentation & Measurement
- 3307 Project I (including CADD)
- \* (30 hours bridging per subject will be provided for Electrical Engineering I (3069) and Electronics (3071). These subjects are non-examinable.)

**SP-SAF Diploma Scheme (Air Force) —**

- Second Year (New Curriculum)
- 1066 Mathematics II
- 3017 Aircraft Electrical Systems I
- 3018 Aircraft Instrumentation Systems I
- 3301 Electrical Engineering II
- 3302 Electrical Machines I
- 3303 Electronic Engineering
- 3304 Digital Electronics & Microprocessors
- 3306 Instrumentation & Measurement
- 3307 Project I (including CADD)

**SP-SAF Diploma Scheme (Navy) —**

- Second Year (New Curriculum)
- 1066 Mathematics II
- 3021 Naval Armament Systems I
- 3301 Electrical Engineering II
- 3302 Electrical Machines I
- 3303 Electronic Engineering
- 3304 Digital Electronics & Microprocessors

- 3319 Power Electronics
- 6302 Supervisory Studies

**Day-Release/Evenings-Only First Year**

- 1172 Mathematics I
- 3069 Electrical Engineering I
- 3071 Electronics
- 5107 Mechanical Engineering Science

**Day-Release/Evenings-Only Second Year**

- (New Curriculum)
- 1272 Mathematics II
- 3300 Electrical Installation
- 3301 Electrical Engineering II
- 5106 Engineering Drawing

**Day-Release/Evenings-Only Second Year**

- (Direct Entry)
- 1272 Mathematics II
- 3069 Electrical Engineering I
- 3071 Electronics
- 3301 Electrical Engineering II

**Day-Release/Evenings-Only Third Year**

- (1987/88 Session)
- 1372 Mathematics & Computer Programming
- 3300 Electrical Installation
- 3303 Electronic Engineering
- 3306 Instrumentation & Measurement

**Day-Release/Evenings-Only Third Year**

- (1988/89 Session)
- 1372 Mathematics & Computer Programming
- 3303 Electronic Engineering
- 3306 Instrumentation & Measurement
- 3307 Project I (including CADD)

**Day-Release/Evenings-Only Fourth Year**

- 3302 Electrical Machines I
- 3304 Digital Electronics & Microprocessors
- 3312 Circuit Analysis & Measurements
- 3319 Power Electronics

**Day Release/Evenings-Only Fifth Year**

- 3311 Electrical Machines II
- 3313 Electrical Power
- 3315 Instrumentation & Control Engineering
- 3318 Microcomputer Engineering

- 3306 Instrumentation & Measurement
- 3307 Project I (including CADD)

**Full-time Third Year**

**Electrical Power Engineering Practice Option**

- 1502 English for Occupational Purposes
- 3311 Electrical Machines II
- 3312 Circuit Analysis & Measurements
- 3313 Electrical Power
- 3315 Instrumentation & Control Engineering
- 3318 Microcomputer Engineering
- 3319 Power Electronics
- 3320 Project Work
- 6302 Supervisory Studies

**Electrical Installation Design & Practice Option**

- 1502 English for Occupational Purposes
- 3311 Electrical Machines II
- 3312 Circuit Analysis & Measurements
- 3318 Microcomputer Engineering
- 3324 Power Distribution and Protection in Commercial & Industrial Installation
- 3325 Electrical Installation Design & Energy Conservation
- 3326 Electrical Contracting & Management
- 3327 Field Work
- 6302 Supervisory Studies

**SP-SAF Diploma Scheme (Air Force) —**

- Third Year
- 3019 Aircraft Electrical Systems II
- 3020 Aircraft Instrumentation Systems II
- 3311 Electrical Machines II
- 3312 Circuit Analysis & Measurements
- 3315 Instrumentation & Control Engineering
- 3318 Microcomputer Engineering
- 3319 Power Electronics
- 6302 Supervisory Studies

**SP-SAF Diploma Scheme (Navy) —**

- Third Year
- 3015 Naval Armament Systems II
- 3016 Naval Electrical Systems II
- 3311 Electrical Machines II
- 3312 Circuit Analysis & Measurements
- 3313 Electrical Power
- 3315 Instrumentation & Control Engineering

### Laboratories/Workshops

**Electrical Engineering Science Laboratory I**  
The Electrical Engineering Science Laboratory I is used by first-year engineering students to acquire a basic practical knowledge in electrical engineering. Experiments are conducted by students in the laboratory to study effects of electric current and magnetism, the operation of various types of measuring instruments and to observe waveforms using oscilloscopes.

**Electrical Engineering Science Laboratory II and III**  
Electrical Engineering Science Laboratory II and III are similarly equipped as Electrical Engineering Science Laboratory I and serve a similar purpose.

**Electrical Installation Laboratory**  
The Electrical Installation Laboratory is designed to meet the practical aspects of the syllabus covered under Electrical Installation. It offers basic training on electrical wiring and installation ranging from surface wiring, conduit wiring, fire alarm circuits, manual and automatic motor starter installations to neon sign wirings.

**Electrical Machines Laboratory I**  
The Electrical Machines Laboratory I contains the basic AC and DC machines and is designed to provide practical work aspects of the subject Electrical Machines I for full-time second-year Electrical Engineering students. Experiments include determining the open-circuit characteristics, load characteristics, speed-torque characteristics and efficiency tests of electrical machines.

**Electrical Machines Laboratory II**  
The Electrical Machines Laboratory II contains specialised machines such as generalised machines and metadyne and amplidyne. A wide range of resistive, inductive and capacitive load banks are available for full-load tests. This laboratory is entirely used by final-year Electrical Engineering students for experiments relating to the subject Electrical Machines II.

### Electrical Measurements Laboratory

The Electrical Measurements Laboratory includes equipment such as DC and AC potentiometers, bridges, oscilloscopes and a harmonic analyser. Standard apparatus such as Weston-Cadmium cells, resistors, inductors, capacitors and mutual inductometers are also available. This laboratory is adequately equipped for experimental work on electric and magnetic fields, circuits and measurements of electrical quantities.

### Electrical Engineering II Laboratory

The Electrical Engineering II Laboratory provides a range of power supplies for various tests and measurements on AC and DC circuits including the verification of network theorems. It provides practical work for the subject Electrical Engineering II.

### EMTC Power Control Laboratory

The EMTC Power Control Laboratory has an alternator set, a switchboard including a synchronising panel, protective relays and metering equipment. It simulates a power station control room and is used to demonstrate synchronisation procedures, the effects of varying excitation, power input and loading conditions, together with the operation of associated relays.

### Electronics Laboratory I

The Electronics Laboratory I serves mainly first-year Electrical Engineering students. It is equipped with electronic equipment such as digital multimeters, oscillators and CROs which may be used to study the characteristics and properties of electronic devices (FET, transistors and diodes) and circuits (amplifiers and rectifiers) which are included in the experiments to be conducted.

### Electronics Laboratory II

The Electronics Laboratory II mainly serves second-year Electrical Engineering students. It is sufficiently equipped for these students to carry out experiments designed to enable them to understand more about semi-conductors and their applications. The experiments include the following major fields: regulators, amplifiers, oscillators, uses of inte-

grated circuits. The students are also expected to troubleshoot faulty circuits.

### Power Electronics Laboratory

The Power Electronics Laboratory is equipped for experiments to support the subject Power Electronics: natural commutation circuits e.g. single-phase and three-phase AC controllers, single-phase and three-phase controlled rectifiers; forced commutation circuits, e.g. DC and AC variable speed control and drive systems; switched mode power supplies; and uninterruptible power supplies.

### Digital Electronics & Microprocessor Laboratory

This laboratory is equipped with a range of digital equipment and several microprocessor sets. Students perform experiments in digital electronics. They are introduced to the microprocessor; its physical characteristics, its use in digital computing and industrial applications. These experiments constitute the practical aspects of the subject Digital Electronics & Microprocessors.

### Microcomputer Engineering Laboratory

The Microcomputer Engineering Laboratory is used by final-year students for experiments on computer and microprocessor applications. The laboratory is equipped with numerous sets of microprocessors, microcomputers, peripherals, interfaces and troubleshooting equipment. Students perform experiments on programming using machine language, assembly language and high-level languages, troubleshooting microprocessor-based equipment and the use of microcomputers in industrial control systems.

### Electrical Power Laboratory

The Electrical Power Laboratory is equipped with various types of mechanical and solid state protective relays, normally used in electrical distribution systems and electrical installations. Also available are test instruments such as current injection testers, insulation testers, high frequency oscilloscopes, harmonic analysers for testing of relays, insulation materials and for measurements of transients and harmonics of voltages. The laboratory also has generator sets, circuit breakers modified for laboratory use, types of

cables and cable joints, required to enhance teaching. It is used mainly by final-year students.

### Project Laboratory I

The Project Laboratory I is equipped with a range of basic electronics equipment, including digital multimeters, function generators and oscilloscopes, and mechanical machines including drilling machines, sheet metal cutting and bending machines. Second-year full-time students will be using the equipment to construct some simple projects as well as to carry out some maintenance testings on common electric machines.

### Project Laboratory II

This laboratory is similarly equipped as Project Laboratory I. It enables full-time final-year students to construct a wide variety of projects as well as to carry out a range of tests and measurements which their projects entail.

### Electrical Design & Energy Conservation Laboratory

The Electrical Design & Energy Conservation Laboratory is used by final-year Electrical Engineering students who are taking the course option in Electrical Installation Design & Practice. It is equipped with comprehensive drawing equipment, drawing tables and drawing instruments to enable students to make drawings which their installation design assignments would entail.

**Instrumentation & Measurement Laboratory**  
The Instrumentation & Measurement Laboratory is equipped with transducers (e.g. strain gauges, current-pressure, differential pressure etc.), programmable logic controllers (i.e. ladder and flow chart type). The experiments conducted in this laboratory are designed to supplement the theory.

### Instrumentation & Control Laboratory

The Instrumentation & Control Laboratory is used for giving practical training in the field of industrial instrumentation and control techniques to the final-year students. To complement the study in the subject of Instrumentation & Control, students receive training on the various types of measuring and control equipment and control systems as

used in industries. The laboratory is equipped with a wide range of pneumatic, electrical and electronic equipment including analogue computers, microcomputers and model plant control systems.

### Synopses of Subjects

**1004 FORTRAN Programming**  
Introduction to computer systems. Problem solving procedure, logic flowchart/pseudocode. FORTRAN 77 constants, variables and expressions. Intrinsic functions. Stream and formatted I/O. Control statements. Looping statements. Arrays. Data statement and data file. Function subprograms and subroutines. Sequential file processing. Applications in computer programming. Use of selected application software packages.

### 1065 Mathematics I

Laws of indices and logarithms. Determination of laws. Binomial theorem. Determinants. Vector algebra. Complex numbers. Trigonometry. Differentiation of algebraic and transcendental functions with applications. Simple integration and its application.

### 1066 Mathematics II

Matrices. Methods of integration. Partial differentiation. MacLaurin's and Taylor's series. Fourier series. Solutions of 1st and 2nd order differential equations. Laplace transformation and its applications. Introduction to statistics, probability, normal, binomial and Poisson distribution. Elementary quality control.

### 1172 Mathematics I

Quadratic equation. Remainder and Factor theorems. Laws of indices and logarithms. Determination of laws. Binomial theorem. Vector algebra. Complex numbers. Trigonometry.

### 3012

#### Aero-Engineering

Theory of flight, helicopter flight. Aircraft hydraulics: basic principles and typical system. Aircraft miscellaneous system: fire protection, ice protection, cabin atmospheric control, pneumatic, oxygen and fuel. Basic piston-engine. Governor and ignition. Basic gas turbine engine. Jet propulsion. Propeller fundamental: propellers and terminologies. Aircraft switch gear. Aircraft testmeters. Aircraft wiring and related components.

### 3015

#### Naval Armament Systems II

General description, construction and operating principles of Bofors: 57 mm/L70 and 76.2 mm/L50 Guns. Hoist machinery, hydraulic servo group and electrical circuits.

### 3016

#### Naval Electrical Systems II

Introduction to MGB Craft. Technical data construction and operation main switchboard. Working principles and operating procedure of generators, main engine control and alarm circuit, auxiliary machinery.

### 3017

#### Aircraft Electrical Systems I

Aircraft batteries: functions, types. Charging, capacity test, leakage test and insulation test. AC and DC power supply system and protection: Generators, voltage regulations. DC to AC inversion and AC to DC conversion: inverters. Rotary and static former rectifier assembly. Aircraft starting and ignition system. Function test on high energy and high frequency ignition units and construction. Aircraft lighting.

### 3018

#### (a) Aircraft Instrumentation Systems I

Introduction to aircraft instruments. Pressure instruments: Leakage test, ranging test, hysteresis test, friction test, timing corrections for barometer pressures, ranging test. Sense test and heater functional and insulation test. Electrical instruments: Insulation test, functional test, position test.

Synchronous-data transmission instruments. Functional test and simple faults finding. Fuel quantity indicating system. Ranging test and functional tests of tank units. Gyroscopic instruments. Rotor Governing Test, Start Test and Zero Error Test for turn and slip indicators.

### (b) Aircraft Assisted Escape Systems\*

Introduction, essential features of an ejection system, typical sequence of an ejection system, Martin Baker type 4 seat, Escapac 1A-1 seat, safety precautions.

\* Subject for the Armament Course

### 3019

#### Aircraft Electrical Systems II

Aircraft actuators and its applications. Functional test and servicing of actuators. Landing gear system: in situation demonstrations. Fire warning and extinguisher. Inspections of extinguishers. Inertia switches and detectors. Caution, warning and indication system. Centralised warning system. Cockpit airconditioning and temperature control system. Mixing valves and temperature control system. Engine, propeller, wing & windshield de-icing. Deflogging, propeller feathering.

### 3020

#### (a) Aircraft Instrumentation Systems II

Aircraft stress recording instruments. Functional test and recordings. Oxygen equipment and systems. Cabin pressurization and air conditioning. Aircraft compass. Fundamental test, synchronizing test, error test, precision rate test and deviations correction test. Compass swing data recording and graph plotting. Autopilots. Optical sighting systems. Ballistics and Bombing Theory, Gunsight Theory.

### (b) Gun Theory, Ammunition and Cartridges\*

Gun Theory. Ammunition and cartridges. Cartridge system, small arms

ammunition. Electrically initiated cartridges, aircraft assisted escape system cartridges.

\* *Subject for the Armament Course*

**3021 Naval Armament Systems I**  
Introduction to RSN weapons, terms and definitions, basic construction and operational principles of Oerlikon 20 mm, Bofors 40 mm/L70 guns. Basic ammunition study.

**3069 Electrical Engineering I**  
Basic electricity. Magnetic effect of an electric current. The magnetic circuit. Electro-magnetic induction. The capacitor. AC principles. AC circuits. Power and power factor. Three-phase circuits.

**3071 Electronics**  
Simplified schematic diagram of CRT and deflection calculations. Introduction to semiconductors. Junction diodes and their applications. Principles of operation of unipolar and bipolar transistors and their different modes of operations. Use of bipolar and unipolar transistors in single stage amplifiers. Graphical analysis of these amplifiers and analysis using small signal models of these transistors.

**3300 Electrical Installation**  
CPS regulations on domestic and industrial installations. Electrical symbols and diagrams. Layout of lighting and power circuits. Switchboards, circuit breaker, cables, trunkings, conduits and accessories used in electrical installations. Motor installation and maintenance. Alarm system. Methods of earthing. Protection and safety requirements. Testing and inspection.

**3301 Electrical Engineering II**  
SI units. Elementary dimensional analysis. Series and parallel circuits. Inductively-coupled circuit. Simple network theorems. Locus diagram. Three-phase circuit and power mea-

surement. Simple DC transient calculation. Elementary electro-static and electro-magnetic theory. Basic measurements.

**3302 Electrical Machines I**  
Construction, principles of working, characteristics, control, testing, applications and simple calculations of the following machines: DC machines, separately and self-excited generators and motors. Transformers, single-phase and auto. Three-phase synchronous machines. Three-phase induction motor. Single-phase induction motor.

**3303 Electronic Engineering**  
Analysis of small signal multistage amplifiers. Frequency response of a single stage amplifier at high frequencies. Feedback in amplifiers and oscillators. Large signal amplifiers. Rectifiers and power supplies. Operational amplifiers and its applications. Introduction to Power FETS. Introduction to various types of communication systems.

**3304 Digital Electronics & Microprocessors**  
Number systems, Boolean algebra, combinational logic circuits, logic families, digital troubleshooting, sequential logic design, architecture (6502), instruction set, addressing mode and programming, memory interfacing.

**3306 Instrumentation & Measurement**  
Students are given exposure of the instruments used in the industry (e.g. transducer, digital meters, and programmable logic controllers and measurements being used to retrieve data.)

**3307 Project I (including CADD)**  
Construction of an electronic instrument which includes construction of chassis, design and fabrication of printed circuit board, wiring and assembly of the complete instrument.

Practice in winding of transformer. Study of the construction and operation of motors and generators. CADD — Use of computer to generate two-dimensional engineering drawings. Covers system overview, element placement (lines, arcs, circles), element manipulation, view control, hatching, dimensioning, text placement, library symbols and plotting. On completion, the student will be able to prepare an engineering drawing in 2-D from initial setup to final plot output.

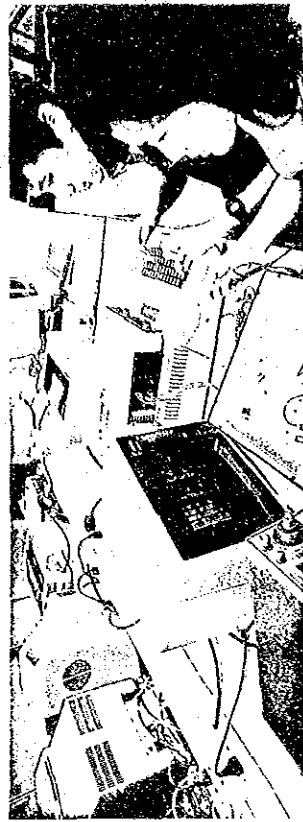
**3311 Electrical Machines II**  
Transformers — parallel operation, three-phase transformer connections. General principles of rotating machines. Synchronous machines. Three-phase induction motors — equivalent circuit, circle diagram. Speed control. Variable speed drive. The DC cross-field machine, metadyne and amplitudync. Static converters. Ratings of machines.

**3312 Circuit Analysis & Measurements**  
Linear circuit theorems. Transient analysis using Laplace transforms. Two-port networks. Harmonics. Application of matrix algebra for network analysis. Advanced three-phase theory. Symmetrical components. Measurement by AC potentiometers and measuring bridges. Current transformer. Power and energy metering.

**3313 Electrical Power**  
General arrangement of power systems. Methods of generation. Performance of synchronous machines on infinite busbars. Underground and overhead transmission and distribution. Method of voltage control. Symmetrical and asymmetrical faults. Protective relaying and circuit breakers. Tariff, power factor improvement and economic considerations.

**3315 Instrumentation & Control Engineering**  
Basic concepts of feedback control. Block diagrams. Mathematical models of physical systems. Transient response analysis. Modes of control. Stability analysis. Frequency response analysis. Advanced control techniques. Analogue computer. Controllers. Regulating units. Basic concepts of instrumentation. Transducers. Measurement of temperature, pressure, level, flow, angular position, speed, acceleration, humidity, pH and viscosity. Data handling.

**3318 Microcomputer Engineering**  
Microprocessor I/O techniques, interrupts techniques, A/D and D/A conversion methods, data acquisition techniques, industrial standard interfaces, serial and parallel communication methods, design consideration, software and hardware trade off, software debugging, troubleshooting techniques and use of microcomputer



An interfacing unit and controlling stepper motor is used to teach third-year Electrical Engineering students interfacing techniques with a microcomputer.

and digital troubleshooting equipment.

3319

**Power Electronics**  
Ratings and characteristics of power semiconductor devices, eg power diode, SCR, triac, power transistor and MOSFET. AC voltage controller and various types of power converters and their application in industry. Introduction to DC and AC motor drives. Switched-mode power conversion and UPS.

3320

**Project Work**  
There is no syllabus for this subject. However, a list of projects are suggested by the lecturers. Students select their projects in consultation with the lecturers.

3324

**Power Distribution & Protection in Commercial & Industrial Installation**  
Electrical Power distribution schemes for buildings. Load assessment. Electrical distribution and installation equipment, oil and vacuum circuit breakers, transformers, cables, isolating switches. Types of switchboard. Installation and testing of switchgear and cables. Typical protective schemes, pilot wire, differential, over-current and earth fault. Earthing. Fault calculations. Selections of over-current relays. Lighting protection. Relay co-ordination.

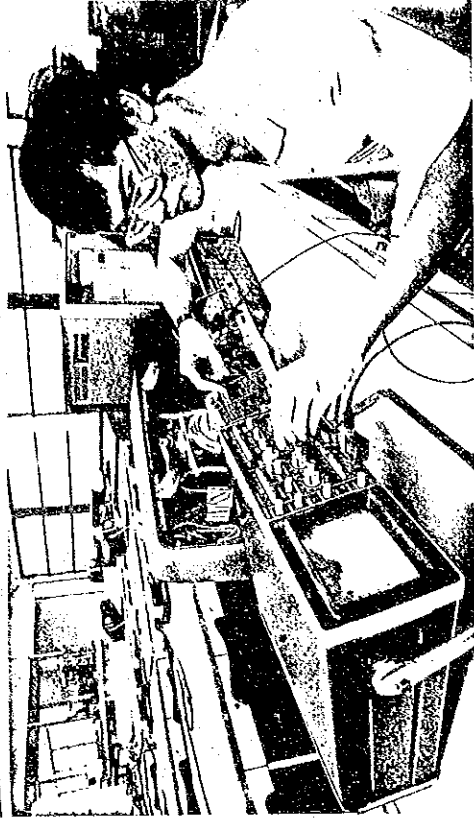
3325

**Electrical Installation Design & Energy Conservation**  
Detailed study of electrical installations. Application of various SISIR codes. PUB and BCD regulations. Electrical drafting for commercial, industrial and domestic installations. Drafting for Telecoms. CATV, lighting and fire protection in buildings. Designing of interior and exterior lighting and application of IES and BCD guidance. Energy conservation and economics.

3326

**Electrical Contracting & Management**  
Legal aspects of contracting, including

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At the Television Laboratory, Communications option students measure the performance of a CTV using a TV generator pattern.

## Department of Electronics & Communication Engineering

### Staff

**Senior Lecturer**  
Soh Guan Cheng  
M. Sc (Telematics)

### Head

**Khoo Poon Tong (Dr)**  
B Sc, M Phil, Ph D, M Inst P, C Eng, MIERE, MIEE

### Visiting Lecturer

Jiri Jaros  
M.Sc E.E., B.Sc E.E., Dip Tech (Telecom), P. Eng

### Deputy Heads

**Vongpanitlerd Sumeth (Dr)**  
B E (Hons), M E, Ph D

**Yee Fook Hwa**  
B Sc (Elect) (Hons), M. Sc (Microprocessor Eng)

### Lecturers

Ang Ban Liong  
B Engg (Elect), MIEEE  
Ang Teck Sing  
B Sc (Elec Engg)

### Computer Engineering Section

#### Section Head

**Yee Fook Hwa**  
B Sc (Elect) (Hons), M. Sc (Microprocessor Eng)

**Chew Moi Tin (Miss)**  
B Sc (Elec & Elect) (Hons)

**Joseph Cheng Hark Ning**  
B Sc (Hons), M Sc

**Chow Sin Hung**  
B Sc (Computer & Communication) (Hons)

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Rodney Derville  
B Eng (Elect), MSc (Computer Science)

David W Egan  
B App Sc, Prof Engr

Kwan Yuen Huan (Mrs)  
B Eng (Elect)

Lam Fong Keng (Mrs)  
Tech Dip (Elect & Comm), Postgrad Dip in  
Computer Programming & Microprocessor  
Applications, M Sc (Computer Studies)

Leung Kar Hung  
M Sc (Microprocessor Engg & Digital Elec-  
tronics)

Loo Yee Leong  
B Sc (Hons), MIEEE, AMIEE

Mak Hon Wing  
Tech Dip (Elect & Comm Engg), B A

Gaetan Cecil Roche  
B Sc (Comp & Micro)

Allan J Rollinson  
B Engg

Karl Tan  
Dipl. Eng

Tang Chong Miang (Mrs)  
B Eng (Elect), M Sc (Computer Studies)

Wong Ah Hoon (Miss)  
Tech Dip (Elect & Comm), B Sc (Hons),  
AMIEE

Wong Hong Kee  
B Eng

Withaya Withayachamnanakul  
B Sc (Elect), M Sc (Elect)

### Integrated Electronics Section

#### Section Head

Geoffrey Ng Chak Ki  
B Sc, M Applied Sc, MIEEE, P Eng

#### Visiting Lecturer

Gordon R Hogan  
B Eng (Elec Eng), Prof Engr

#### Lecturers

Auyong Choong Peng  
B Eng (Elect)

### Instrumentation and Control Section

#### Section Head

T K M Babu (Dr)  
B E, M Tech, Ph D, C Eng, MIEE, MIEEE

#### Senior Lecturer

Ang Keng Loo  
B E (Hons), M Sc

#### Visiting Lecturers

John C Bathory  
B Sc

David J Parker  
B Sc (Hons), Prof Engr

#### Lecturers

Chua Low Boon  
B Sc (Electrical) (Control & Communication)

David John Curran  
B Sc (Hons), AMIEE

Fung Chun Che  
B Sc (Hons), M Eng (System Test Techno-  
logy)

Goh Poh Heng  
Tech Dip (Elect & Comm), B Sc (Elec &  
Elect) (Hons), M Sc (Sys & Cont), AMIEE,  
MISA

Ho Man On  
B Sc (Eng) (Hons), APHK, C Eng, MIERE,  
MIEEE, MHKIE

Dr Jagannathan Kanniah  
B E, M Sc (Engg), Ph D

Lew Tong Yong  
B Sc (Elec & Elect) (Hons), M Engg

Lim Boon Seng  
B Eng (Elec)

Ng Kai Meng  
B Sc (Hons), M Sc (Power Electronics),  
AMIEE

Soh Choon Siong  
B Eng (Elect) (Hons)

Tan Chin Liong  
B Sc, M Sc

Wong Mee Choy  
B Sc (Instrumentation & Control) (Hons),  
Tech Dip (Elect)

Dr Wong Tak Wing  
B Sc (Hons), Ph D, AMIEE

Wu Nan Wah  
FRMIT, B Sc, MIE (Aust)

Yeh Min Shon

B Sc (Elec & Elect) (Hons), M Sc (Control  
Systems), D/C, AMIEE, AISA

### Telecommunication Engineering Section

#### Section Head

Vongpanitlerd Sumeih (Dr)  
B E (Hons), M E, Ph D

#### Visiting Lecturer

Geoffrey Edge  
B Eng (Elect) (Hons), M Eng (Comm),  
C Eng, MIEEE

#### Senior Lecturers

Goh Tech Heng  
Tech Dip (Telecom), Tech Dip (Elect), M Sc  
(Telecom Systems), C Eng, MIEE, MIERE

Teo Tek Moh (Dr)  
B Sc (Physics), M Sc, Ph D

Brian Walker  
M Sc Tech, MIERE, C Eng (Comm Engg)

#### Lecturers

Anne Chan (Miss)  
B Sc (Hons), AMIEE

Chung Chok Hin  
B Sc, M Sc, C Eng, MIEE, MIES

Fwa Gee Kheng (Mrs)  
B Eng (Elect) (Hons), M Sc (Information &  
Systems Eng)

Goh Boon Kheng  
B Eng (Hons), M Sc (Electrical)

Ho Hooi Chee  
B Sc (Hons), M Eng, MIEEE, AMIEE, SPIE,  
OSA

Kam Lup Fai

Tech Dip (Elect & Comm), B Sc (Elect)  
(Hons)

Leo Teng Yong

Tech Dip (Telecom), C Eng, MIERE,  
MIEEE, MBUM, AISA

Leong Chuen Weng  
Tech Dip (Elect & Comm), B Sc (Telecom)  
(Hons)

Lo Fook Loong  
B A, M Sc (Elec Eng)

Mohammad Hadi Paydar  
MSEE

Ng Choon Chiang  
B Sc (Comp & Comm) (Hons), M Sc (Com  
Eng), DIC, MIEEE

A L Satya Prakash  
B Sc (Hons), B Eng, M Tech, M Eng

Quek Tee Thye  
B Sc (Hons), M Sc

Tan Yeow Kee  
B Sc (Hons), PMG (1st Class), C&GFTIC,  
Tech Dip (Elect & Comm), Radar Maint,  
CIM

Toh Peng Kuan  
C Eng, MIERE

Peter C Wait  
B Sc (Elect) (Hons), Assoc Member IEE

Yim Tien Hua (Mrs)  
Tech Dip (Elect & Comm), B Sc (Comp &  
Comm) (Hons), AMIEE, MIEEE

#### Principal Instructor

Chi Tien Hsuan  
Tech Dip (Elect & Comm), B Sc (Elect)

#### Teaching Assistants

Eric Ang Seng Leo (on study leave)  
Tech Dip (Elect & Comm Engg), Dip in Mgt  
Studies

Low Lee Ngo (Miss) (on study leave)  
Tech Dip (Elect & Comm Engg)

#### See Tow Pak Cheong

Tech Dip (Elect & Comm Engg)

Sing Mong Nguang (on study leave)

Tech Dip (Elect & Comm Engg)

Siti Rohana bte Kasbol (Miss) (on study leave)

Tech Dip (Elect & Comm Engg)

Sng Hong Lian (on study leave)

Tech Dip (Elect & Comm Engg)

#### Assessment

Assessment during each session of the course will be by means of course work and written examinations. A satisfactory standard will be required in both course work and examinations. Students in the SP-SAF Diploma scheme are also required to successfully complete the vacation training conducted at the respective SAF training school.

#### Career Opportunities

Graduates of the Electronics & Communication Engineering course are well absorbed by the telecommunication, broadcasting and the Singapore Armed Forces, electronic components/equipment manufacturers, consumer electronics/audio and video equipment manufacturers and computer-related manufacturing and services. Graduates in the SP-SAF Diploma scheme will be employed by the SAF in the Army, Navy or the Air Force.

#### Diploma in Electronics & Communication Engineering

This is a three-year full-time or five-year part-time evenings-only course.

#### Subjects of Study

##### Full-Time First Year

1109 Mathematics I  
1501 English for Academic Purposes  
5107 Mechanical Engineering Science  
5108 Engineering Drawing and Drafting  
6101 Mechanical Workshop Practice  
8101 Electrical Engineering I  
8102 Electronics  
8103 Digital Electronics & PASCAL Programming  
8104 Electronic Workshop Practice

##### SP-SAF Diploma Scheme (Air-Force) —

First Year  
1109 Mathematics I  
5108 Engineering Drawing & Drafting  
5111 Aircraft Mechanical Workshop  
8101 Electrical Engineering I  
8102 Electronics  
8103 Digital Electronics & PASCAL Programming

8104 Electronic Workshop Practice  
8191 Aero-Engineering

##### SP-SAF Diploma Scheme (Army) —

First Year  
1109 Mathematics I  
1501 English for Academic Purposes  
5107 Mechanical Engineering Science  
5108 Engineering Drawing & Drafting  
6101 Mechanical Workshop Practice  
8101 Electrical Engineering I  
8102 Electronics  
8103 Digital Electronics & PASCAL Programming  
8104 Electronic Workshop Practice

##### SP-SAF Diploma Scheme (Navy) —

First Year  
1109 Mathematics I  
5107 Mechanical Engineering Science  
5108 Engineering Drawing & Drafting  
6101 Mechanical Workshop Practice  
8101 Electrical Engineering I  
8102 Electronics  
8103 Digital Electronics & PASCAL Programming  
8104 Electronic Workshop Practice

##### Full-Time Second Year

1209 Mathematics II  
8201 Electronic Project I  
8202 Linear Network & Systems  
8203 Electrical Engineering II  
8204 Analog Systems  
8205 Digital Systems  
8206 Analog Communication Systems

##### SP-SAF Diploma Scheme (Air Force) —

Second Year  
1209 Mathematics II  
8202 Linear Network & Systems  
8203 Electrical Engineering II  
8204 Analog Systems  
8205 Digital Systems  
8206 Analog Communication Systems  
8291 Radar Systems I

##### SP-SAF Diploma Scheme (Army) —

Second Year  
1209 Mathematics II  
8201 Electronic Project I  
8202 Linear Network & Systems

8203 Electrical Engineering II  
 8204 Analog Systems  
 8205 Digital Systems  
 8206 Analog Communication Systems

**SP-SAF Diploma Scheme (Navy) — Second Year**  
 1209 Mathematics II  
 8201 Electronic Project I  
 8202 Linear Network & Systems  
 8203 Electrical Engineering II  
 8204 Analog Systems  
 8205 Digital Systems  
 8206 Analog Communication Systems

**For A-Level Direct Entry — Second Year Full-Time**  
 1209 Mathematics II  
 8104 Electronic Workshop Practice  
 8251 Analog Electronics  
 8252 Digital Electronics  
 8253 Electrical & Electronics Principles  
 8254 Linear Network Analysis  
 8255 Microprocessor Principles and PASCAL Programming

**Full-Time Third Year**  
 1502 English for Occupational Purposes  
 6302 Supervisory Studies  
 8301 Electronic Project II  
 8302 Data Communications  
 8303 Computer & Microprocessor Applications  
 and three option additional subjects

**Computer Engineering Option**  
 8311 Computer Operations & Maintenance  
 8312 Software Engineering  
 8313 Microprocessor Systems Design

**Instrumentation & Control Option**  
 8321 Power Electronics  
 8322 Instrumentation  
 8323 Control Engineering

**Integrated Electronics Option**  
 8331 Microelectronic Engineering  
 8332 Automated Test Systems  
 8333 Product Assurance Techniques

**Telecommunication Engineering Option**  
 8341 Digital Communication Systems  
 8342 Transmission Systems  
 8343 Television Engineering

**SP-SAF Diploma Scheme (Air-Force) — Third Year**  
 6302 Supervisory Studies  
 8301 Electronic Project  
 8303 Computer & Microprocessor Applications

8341 Digital Communication Systems  
 8391 Radar Systems II  
 8392 Avionics Systems  
 8393 Guided Weapon Control Systems

**SP-SAF Diploma Scheme (Army) — Third Year**  
 1502 English for Occupational Purposes  
 6302 Supervisory Studies  
 8301 Electronic Project II  
 8302 Data Communications  
 8303 Computer & Microprocessor Applications

8341 Digital Communication Systems  
 8342 Transmission Systems  
 8343 Television Engineering

**SP-SAF Diploma Scheme (Navy) — Third Year**  
 8301 Electronic Project II  
 8302 Data Communications  
 8303 Computer & Microprocessor Applications

8323 Control Engineering  
 8342 Transmission Systems  
 8397 Supervisory Studies

**Plus one of the following optional subjects:**  
 8394 Navigational Systems  
 8395 Naval Fire Control Systems  
 8396 Naval Guided Weapon Systems

**For A-level Direct Entry — Third Year Full-Time**  
 1502 English for Occupational Purposes  
 6302 Supervisory Studies  
 8301 Electronic Project II  
 8302 Data Communications  
 8311 Computer Operations & Maintenance  
 8312 Software Engineering  
 8351 Microprocessor-based Systems  
 8352 Information Processing Technology

**Evenings-Only First Year**  
 1169 Mathematics I  
 5107 Mechanical Engineering Science  
 8101 Electrical Engineering I  
 8102 Electronics

The Digital Electronics Laboratory has 24 sets of microcomputers for the training of PASCAL programming. Experiments using basic digital logic gates, combinational logic and synchronous logic circuits are also performed here.

The Analog Systems Laboratory cater for the second-year subject, Analog Systems. The work involved enables the students to have an understanding of the engineering and practical aspects of analog electronics. More advanced practical circuits are investigated, using various devices such as FETs, transistors, operational amplifiers and the like.

The Digital Systems Laboratory not only provides practical training on more complicated digital electronics circuits but also allows students to perform work on digital electronics from the system view point. Students receive hands-on training on basic microprocessor hardware and software based on the popular Intel Microprocessor 8085.

In the Linear Network and Systems Laboratory, students verify various network theories such as Thevenin, Norton, Superposition etc. Students also perform work on conditioning and processing of various electronic signals. Operations of various oscillatory circuits are investigated. Measurement techniques using various standard test instruments are also introduced.

In the Analog Communication Laboratory, students investigate various aspects of communication engineering such as measurement of noise, telephony, radio propagation, AM/FM/SSB transmitters/receivers, filter circuits etc.

In the Data Communications Laboratory, students familiarize themselves with data terminal equipment, data communication equipment as well as various communication test equipment. Wide area networks are investigated. Communication protocols and network operations are monitored. Students also perform work on local area networks.

The Computer and Microprocessor Applications Laboratory allows students in various

**Evenings-Only Second Year**  
 1269 Mathematics II  
 8261 Digital Electronics I  
 8262 Analog Electronics  
 8263 Network & Electrical Systems I

**For A-Level Direct Entry — Evenings-Only Second Year**  
 1369 Mathematics III  
 8102 Electronics  
 8261 Digital Electronics I  
 8264 Network & Electrical Systems A

**Evenings-Only Third Year**  
 1368 Statistics and Computer Programming  
 1369 Mathematics III  
 8361 Digital Electronics II  
 8362 Network & Electrical Systems II

**For A-Level Direct Entry — Evenings-Only Third Year**  
 1368 Statistics and Computer Programming  
 8262 Analog Electronics  
 8361 Digital Electronics II  
 8362 Network & Electrical Systems II

**Evenings-Only Fourth Year**  
 8206 Analog Communication Systems  
 8302 Data Communications  
 8303 Computer and Microprocessor Applications

**Evenings-Only Fifth Year**  
 3252 Television Engineering  
 3253 Electronics Communication Systems  
 3254 Instrumentation & Control

*(N.B. — The Department does not conduct any day-release courses)*

**Laboratories/Workshops**  
 The Electronics Laboratory is where first-year students investigate the characteristics of basic electronic devices such as bipolar junction transistors, FETs, UJTs, semi-conductor diodes and the like. Students also perform work on the applications of these devices in various electronic circuits.

optimal studies to further their practical knowledge on microprocessor I/O interfacing techniques, microcontrollers and real-time programming. Student also receive hands-on training on software applications packages such as electronic CAD/CAE packages, electronic spreadsheets, etc.

**In the Digital Communication Laboratory**, students perform investigations on signal processing, Pulse-Code-Modulation and various digital techniques used in communications. Systems such as cellular radio, SPC switch networks, integrated services digital networks are also investigated.

**In the Transmission Systems Laboratory**, various transmission media such as coaxial cables, twisted-pair wires, optical links and microwave links are investigated. Students are also familiarized with components such as antennas, wave guide, carrier sources.

**The Industrial Electronics Laboratory** enables students to get familiarised with the various electronic fixtures employed in industry. It conducts work on the thyristor family, electronic motor speed and directional control, timers and sequential controllers, resistance weldings, power rectification, inverters, converters and opto-electronic devices.

**In the Electrical Engineering I and II Laboratories**, students are exposed to the heavy-current circuits and machines operations, enabling them to appreciate characteristics and principles of single- and three-phase supplies, transformers, DC machines and induction motors.

**In the Television Laboratory**, students investigate the operation of the various sections in both black and white and colour television receivers. Practical work includes waveform analysis, fault-finding and fault rectification.

**The Computer Operations Laboratory** allows students to have hands-on experience on trouble shooting and maintenance of computers and its peripheral devices using appropriate diagnostic software and hardware tools.

**In the Software Engineering Laboratory**, students practise on software design methodology, implementation techniques and documentation standards. Students also receive additional training on various high level programming languages such as C and PASCAL.

**The Microprocessor Systems Design Laboratory** provides practical training on the use of various hardware and software tools available on a microprocessor development system. Students perform work on bit-slice-processors, multi-processor systems and the like. Familiarization of advanced microprocessors supporting chips, such as DMA and interrupt controllers, bus arbitrators, disk controllers and memory management unit, etc. are also part of the practical training.

**In the Electronic Instrumentation Laboratory**, students perform work on signal conditioning circuits and data acquisition systems. The characteristics of various electronic transducers and their applications are examined. Various analog and digital techniques employed in instrumentation are investigated.

**In the Control Laboratory**, practical work on process control and industrial automation are carried out. Students receive hands-on training on robots, NC machines, pattern recognition as well as programmable logic controllers.

**In the Microelectronic Engineering Laboratory**, students trace the I.C. layout and use a micromanipulator to isolate and probe various components inside an integrated circuit chip. Students also perform experiments on the effect of electrostatic discharge on integrated circuits. Simple integrated circuit design, circuit performance simulation and layout are also introduced using appropriate CAD software packages.

**In the Automatic Test Systems Laboratory**, students write programs that run on an automatic test system to test analog/digital/analog converters, TTL, linear as well as memory devices. Students also perform fault isolation, system maintenance, program

documentation as well as device characterization for various electronic devices and integrated circuits.

**In the Product Assurance Laboratory**, students perform wire bond and pull test analysis on integrated circuits. They are also exposed to such failure analysis techniques as micro-sectioning, decapsulation and fault verification.

**The Electronic Workshops** provide students with hands-on training on the use of basic hand tools as well as familiarization of various types of electronics test equipment. Students also construct simple yet useful electronic gadgets.

**In the Project I Laboratories**, second-year students learn chassis construction, printed circuit board design and fabrication, wiring and soldering techniques and the operation of various test instruments to troubleshoot and rectify faults.

**In the Project II Laboratories**, final-year students undertake projects such as designing and building of amplifiers, oscilloscopes, modems, digital systems and controllers, digital instruments and the like.

### Synopses of Subjects

#### 1109

##### Mathematics I

Laws of indices and logarithms. Binomial expansion. Trigonometry. Hyperbolic functions. Determinants and simultaneous linear equations. Complex numbers. Differentiation and applications. Integration and methods of integration. Numerical integration.

#### 1169

##### Mathematics I

Laws of indices and logarithms. Binomial expansion. Trigonometry. Determinants and simultaneous linear

equations. Complex numbers. Differentiation. Simple integration.

#### Mathematics II

Vector and matrix algebra. Solutions of simultaneous linear equations. Methods of integrations. Solutions of first and second order linear ordinary differential equations. Laplace transformation and application. MacLaurin's and Taylor's series. Fourier series and Fourier transforms. Partial differentiation. Introduction to statistics, probability, normal, binomial and Poisson distributions. Elementary quality control.

#### Mathematics II

Application of differentiation. Integration and methods of integration. Numerical integration. Matrix and solution of linear simultaneous equations. Solutions of first order ordinary differential equations. Hyperbolic functions. Introduction to statistics.

#### Statistics & Computer Programming

Statistics:  
Elementary probability. Normal, binomial and Poisson distributions. Elementary quality control. Regression line and linear correlation.

#### Computer Programming:

Introduction to BASIC programming; assignment statements; control statements; input and output arrays; functions and subroutines; software design techniques.

#### Mathematics III

MacLaurin's and Taylor's Series. Fourier Series and Fourier transforms. Laplace transformation and applications. Introduction to vector algebra. Partial differentiation.

#### English for Academic Purposes

The course helps students acquire skills required to function effectively

#### 1209

documentation as well as device characterization for various electronic devices and integrated circuits.

**In the Product Assurance Laboratory**, students perform wire bond and pull test analysis on integrated circuits. They are also exposed to such failure analysis techniques as micro-sectioning, decapsulation and fault verification.

**The Electronic Workshops** provide students with hands-on training on the use of basic hand tools as well as familiarization of various types of electronics test equipment. Students also construct simple yet useful electronic gadgets.

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### Synopses of Subjects

#### 1109

##### Mathematics I

Laws of indices and logarithms. Binomial expansion. Trigonometry. Hyperbolic functions. Determinants and simultaneous linear equations. Complex numbers. Differentiation and applications. Integration and methods of integration. Numerical integration.

#### 1169

##### Mathematics I

Laws of indices and logarithms. Binomial expansion. Trigonometry. Determinants and simultaneous linear

- in their studies. Core skills are intensive and extensive reading skills, listening and note-taking, summarising, answering examination questions and writing project reports.
- 5108** **Engineering Drawing & Drafting**  
Use of drawing instruments. Perspective, isometric and oblique drawing. Orthographic projections. Sections. Geometrical constructions. Electrical drawings. Graphical symbols for various electronic components. Schematic circuit diagrams. P.C. board design. Data presentation. Documentation.
- 5111** **Aircraft Mechanical Workshop**  
Students are taught practical aviation skills under controlled conditions and acceptable airworthiness standards. Aircraft safety. Basic tools. Aircraft sheetmetal layout and precision measurements. Bending and forming work on aircraft sheetmetal. Aircraft solid rivets and riveting using pneumatic tools. Aircraft special fasteners. Locking devices and cable tensioning. Aircraft bolts and nuts. Pipe bending and fitting. Working with plastics and fibre-glass. Aircraft repair schemes.
- 6101** **Mechanical Workshop Practice**  
Actual training on shop floor practices including the use and care of tools, safety considerations. Metal joining techniques using oxy-acetylene and arc welding. Sheetmetal work, marking, use of tools and equipment. Inspection and dimensional control using measuring instruments and gauges. Machining components, use of lathes.
- 6302** **Supervisory Studies**  
Useful concepts for supervisors:  
(i) the need for productivity improvement  
(ii) management systems  
(iii) people-centred management  
(iv) supervisory skills  
Case studies.
- 8101** **Electrical Engineering I**  
Fundamental circuit laws. Electric field. Magnetic field. Electromagnetic induction. Introduction to circuit
- theory. Alternation current theory. Simple AC circuits. Magnetic circuits.
- 8102** **Electronics**  
Basic solid-state physics. Junction diodes. Zener diode. Tunnel diode. Junction transistors. Transistor biasing. Small-signal transistor amplifiers. Emitter follower. Junction FET. MOSFET. UJT. CRT.
- 8103** **Digital Electronics & PASCAL PROGRAMMING**  
Introduction to PASCAL programming. Types, constants and variables. Control structures. Input and Output. Logic Circuits: Number systems. Boolean algebra. Logic gates and combinational logic. Flip-flops. Counters. IC fabrication. Logic family.
- 8104** **Electronic Workshop Practice**  
Use of hand tools and common measuring equipment. Safety measure. Construction techniques. Soldering techniques. Design and fabrication of PCB. Identification of common electronic parts. Chassis design and construction.
- 8191** **Aero-Engineering**  
Theory of Flight; Principle of Hydraulic, miscellaneous systems; airfield procedures; air administration and documentation; aircraft wiring and related components; introduction to A/C battery.
- 8201** **Electronic Project I**  
The subject is designed to provide students with further experience in soldering techniques, printed circuit board design and fabrication, chassis construction. Familiarisation with various testing equipment is enforced.
- 8202** **Linear Network & Systems**  
Definition of linear systems. Transfer and impedance functions. Network response. Sinusoidal analysis. Fre-
- quency response and resonance. Passive and active filters. Two-port descriptions. Fourier series analysis. Use of Laplace transforms. Elementary control principles. Stability consideration. Examples of position and speed control.
- 8203** **Electrical Engineering II**  
Electromagnetic theory and Maxwell's equations. Single and poly-phase systems. Balance and unbalance connected loads. Phase sequence identification. Power factor correction. Transformers and impedance matching. Theory of machines, DC and AC machines. Measurement techniques and electronic instrumentation.
- 8204** **Analog Systems**  
Multistage amplifiers. Cascodes and Darlingtons pairs. Bias stabilization. Power amplifiers. Differential amplifiers. Operational amplifiers and their users. Rectification and filtering. Voltage regulators and regulated power supply. Switched-mode power supply.
- 8205** **Digital Systems**  
Multivibrators. Schmitt trigger. Sequential logic. Counters and shift registers. Memory devices. RAM and ROM. ALU. Computer and microprocessor architecture. Machine and assembly language programming. Memory addressing modes.
- 8206** **Analog Communication Systems**  
Basic elements of a communication system. Noise consideration and representation. Principles of telephony. Amplitude and angle modulation techniques. Circuit description of AM and FM receivers. Superhetrodyne and FM stereo system. Single-sideband and receivers. Principles of radio propagation.
- 8251** **Analog Electronics**  
CRT. Solid-state fundamentals. Diodes and transistors. FET and UJT. Theory and design of small-signal
- 3252** **Television Engineering**  
TV cameras and associated system. Pulse and video signal delay techniques. Monochrome TV receivers. Fundamental theory of colour and colour perception. NTSC and PAL transmission systems. Colour TV receivers.
- 3253** **Electronic Communication Systems**  
Pulse and digital modulation, transmission lines, wave-guide and cavity resonators, microwave devices, antennae, propagation. Stereo transmission and reception. VHF radio telephony, PCM telephony, radio telemetry, pulse radar, earth-satellite link and multiple access links.
- 3254** **Instrumentation & Control**  
Basic control theory. Open and closed-loop process. Transient response and stability considerations. Pneumatic controllers. Transducers, transmitters and sensors. Servomechanism. Industrial process control.
- 5107** **Mechanical Engineering Science**  
Force, torque and motion. Work, power and energy. Equations of motion. Momentum and moment of inertia. Elasticity and Hook's law. Friction. Pressure, fluid and pneumatic. Heat and temperature, heat engines. Pneumatic control devices.

- 8252 Digital Electronics  
Number systems. Boolean algebra. Logic gates and combinational logic design. Flip-flops and counters. Decoders. Registers. Sequential logic design. Logic family. Memories. RAM and ROM.
- 8253 Electrical and Electronics Principles  
Electromagnetic theory. Single and polyphase system. Transformers. AC and DC machines. Rectification and regulated power supply. Principle of feedback. Oscillators and clock signal generation.
- 8254 Linear Network Analysis  
Fundamental circuit laws. Linear circuit elements. Linear network theorems. AC circuit analysis. Frequency responses. Transfer and impedance functions. Passive and active filters. Laplace transform and applications.
- 8255 Microprocessor Principles & PASCAL Programming  
Introduction to PASCAL programming. Types, constants and variables. Input and output. Control structure. Overview of microprocessor system configuration. Hardware and software. Microprocessor architecture. Assembly and machine code programming. Software development aids. System development and maintenance.
- 8261 Digital Electronics I  
Number systems. Boolean algebra. Logic gates and combinational logic. Flip-flop and counters. IC fabrication. Logic family. Multivibrators. Schmitt trigger.
- 8262 Analog Electronics  
Multistage amplifiers. Power amplifiers. Differential amplifiers and operational amplifiers. Rectifiers and filtering. Regulated power supply.
- 8263 Network & Electrical Systems I  
Network theorems and principles. Single and polyphase systems. Transformers. 2-port networks. Frequency response and resonance. Theory of measurement.
- 8264 Network & Electrical Systems A  
Fundamental circuit laws. Network theorems and principles. AC circuit analysis. Single and polyphase systems. Transformers. Frequency response and resonance. Theory of measurement.
- 8291 Radar Systems I  
Fundamentals of radar; radar transmitter systems; waveguide and components; radar aerial systems; radar receiver systems.
- 8301 Electronic Project II  
Each student is required to complete a project approved by the lecturer-in-charge and submit a report. An interview will be conducted based on the project of the student.
- 8302 Data Communications  
Concept of data communications. Various types of transmission codes. Control characters. Transmission modes. Synchronization. Synchronous and asynchronous. Network configurations. Terminal equipment. Modem and interfaces. Error detection and correction. Network protocols.
- 8303 Computer & Microprocessor Applications  
Digital representations and codes. Higher arithmetic functions and dynamic calculations. Errors in computation. A/D and D/A conversions. System bus standards. I/O interfacing techniques. Real-time programming. Man-machine interface considerations. Applications software.
- 8311 Computer Operations & Maintenance  
Computer peripherals devices and controllers. Secondary storage devices and their drive mechanisms, record-
- 8312 Software Engineering  
Software life cycle. Software requirement documentation. Software design and methodology. Design validation and verification. Implementation of software design. Programming languages. Programming practices. Tools and environment. Program portability. Testing and debugging of software. Design of test cases. Testing documentation and maintenance. User interface design. User documentation. Software management.
- 8313 Microprocessor System Design  
Memory organisation and decoding schemes. Advanced microprocessor architectures. Advanced I/O techniques. Interrupt mechanism and handling. Hardware/software development tools. Testing and debugging during development. Microprocessors trouble-shooting techniques. Bit-slice microprocessors. Multi-processor systems. Advanced support chips. Comparison and evaluation of microprocessors. Hardware/software trade-offs.
- 8321 Power Electronics  
Opto-electronics. Thyristor. Converters. Inverters and rectifiers for poly-phase supply. Electronic control of electrical machines. Programmable controller. Digital control of resistance welding.
- 8322 Instrumentation  
Programmable instrumentation amplifiers and linear multipliers. Analog signal processing. Sampling. Digital signal processing. Data acquisition. Characteristics of measurement systems. Various types of transducers. Pressure transmitters. pH measurement and oxygen analyser. Medical electronics.
- 8323 Control Engineering  
Control system analysis. Compensation. Process characteristics and control modes. PID controllers. Tuning of controller. Process plant testing. Advanced control techniques. Dynamic compensation. Discrete-time control systems. Direct digital control. Set-point control. Total distributed control.
- 8331 Microelectronic Engineering  
Device physics. Basic monolithic integrated circuit technology. Basic I.C. design techniques. Hybrid technology. Product engineering techniques. Circuit and systems manufacturing. Electrostatic discharge precaution. Computer-aided circuit simulation.
- 8332 Automated Test Systems  
Applications. Types of electrical tests (data sheet). Modules of an automatic test system. Device handler, testing digital devices. Linear devices and circuit boards. Survey of various automatic test systems. Test program generation. Test equipment maintenance. Data collection. Analysis and characterization.
- 8333 Product Assurance Techniques  
Basic statistical control tools. Process and machine control. Defects. MIL-STD-105D sampling plan. Advantages and disadvantages in sampling. Monitoring quality performance. Quality control points in manufacturing environment. Failure analysis. Reliability and environmental testing. Material testing techniques.
- 8341 Digital Communication Systems  
Signal processing. Principles of pulse modulation. Multiplexing and synchronization. Digital modulation techniques. PCM telephony. Picture phone digital radio systems. Earth satellite link.
- 8342 Transmission Systems  
Transmission lines. Microwaves — waveguide sources and components.

Propagation of waves, antennas, Radar, VHF/UHF radio systems, Optical communication.

**8343** **Television Engineering**  
TV cameras and associated systems. Pulse and video signal delay techniques. Monochrome TV receivers. Fundamental theory of colour and colour perception. NTSC, PAL and SECAM transmission systems. Colour TV receivers.

**8351** **Microprocessor-based Systems**  
Review of U<sub>p</sub> systems. Input/output techniques. Analog vs digital signals. A/D and D/A converters. Interfacing bus. Memory organisation and decoding. Interrupt operations. Timers. Transducers and controllers. Case studies.

**8352** **Information Processing Techniques**  
Overview of information. Computer and telecommunication. Information transmissions and interference. Digital vs analog communication. Facsimile. Video display techniques.

**8361** **Digital Electronics II**  
Registers. Counters. Sequential logic. Decoders. Memories. Arithmetic logic unit. Computer architecture. Machine language programming.

**8362** **Network & Electrical Systems II**  
AC and DC machines; Fourier series and spectrum analysis; filters; network responses; Laplace transform and applications.

**8391** **Radar Systems II**  
Radar receiver system; types of displays and operation principles. Types of radar systems; MTI; IFF; TACAN; electronic counter-counter measure. Microwave measurement and microwave equipment.

**8392** **Avionics Systems**  
Simple and modified resonant aeriels; aircraft aeriels. Automatic directional finding system. VHF omnirange. Instrument landing system. Frequency

synthesizer. Omega navigational system. Inertial navigational system.

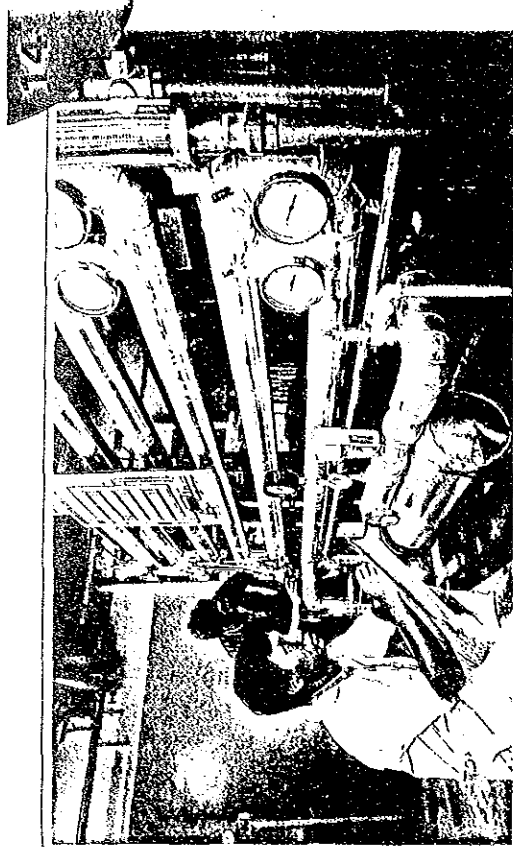
**8393** **Guided Weapon Control Systems**  
Introduction to guided missile control systems. Components of guided missile control systems. Components of guided missile guidance systems. Guided missile instrumentation.

**8394** **Navigational Systems**  
Theory and principles of RADAR. IFF RADAR; interrogator; defruiter/decoder; transponder. Satellite navigator. Electro-magnetic log. Loran receiver.

**8395** **Naval Fire Control Systems**  
Theory and principles of RADAR. Tracking RADAR. Search RADAR. Electronic counter-counter measures. Fire control computer and solutions. Electro-optics. Gyro principles and gyro compass; accelerometer; stable platform; inertia navigational system.

**8396** **Naval Guided Weapon Systems**  
Theory and principle of RADAR. Introduction to missile control system; propulsion sub-system; launcher or delivery sub-systems; autopilot system; missile instrumentation; safety and arming unit. Introduction to fire control system.

**8397** **Supervisory Studies**  
Introduction to instructional techniques (IT); tools of IT; productivity in the work context; importance of productivity in national defence; elements of supervision.



Marine Engineering students study heat exchange between two fluids, both under parallel and counter current flow conditions.

## Department of Marine Engineering

### Staff

#### Head

**John Campbell Thompson**  
M Sc (Tribology), C Eng, Extra First Class Engineer (Combined), FIMarE, MRINA

#### Deputy Head

**Chan Lee Mun**  
B Sc (Mech) (Hons), M Eng, MSNAMES

#### Basic Engineering Section

##### Section Head

**Chan Lee Mun**  
B Sc (Mech)(Hons), M Eng, MSNAMES

##### Lecturers

**Ang Ler Hwi**  
B Sc (Mar Eng), Tech Dip (Mech)

**Brian Noronha**  
First Class Engineer, T Eng (CEI)

**Chai Yee Kwek**

B Sc (Marine Eng)(Hons) Tech Dip (Mar),  
C Eng, MIMarE, MIRINA

**Choo Hock Cheng**  
B Eng (Mech), P Eng, C Eng, MIMarE,  
MSNAMES, MIES

**George Kenneway**  
B Sc (Hons), C Eng, MIMarE, MIMechE

**Thoo Sin Fah**  
B Sc (Marine Eng), Postgrad Dip,  
MSNAMES

**Toh Choong Sang**  
Tech Dip (Marine), First Class Engineer

##### Senior Instructors

**Lim Hock Lai**  
Tech Dip (Mar), Second Class Engineer

**Tan Yeo Khon**  
Tech Dip (Ship & Bldg), CIM, MSWS

##### Instructors

**Ker Ssu Huat**  
C&G Adv Craft Cert (Welding), C&GFTC

(ing Prod, Prod Design, Jig & Tools Design), Cert Edu (Tech), CIS, CMS (Work Study), CIM, AIM

Koh Meng Chong  
Tech Dip (Mech)

Lee Wai Tuck

C&G (Full Tech Prod Eng), CIM, AIM

Mak Sek Hung

C&G (Full Tech Mech), Tech Dip (Prod),

Cert Ed (Tech), CIM, DIM

Seow Sim Hoek

Tech Dip (Mech)

Wong Yui Hong

C&G (Full-Tech), Tech Dip (Mech), Cert

(Process Plant Eng Design), Endorsement

Cert (Ship Constr)

### Electrical/Control Section

#### Section Head

Ho Hon Wai

B Sc (Mar Eng)(Hons), M Sc (Mech Eng), C

Eng, MIMarE, MIRINA, MSNAMES, Sr

MISA, Sr MICS

#### Lecturers

A K Banerjee

First Class Engineer (Combined), C Eng,

MIMarE, Member AMA, Member SMS

R Bhandari

First Class (Motor), MIE, MIMarE

Lee Fui Ling

First Class Engineer (Motorship)

Lim Jit Cheng

Tech Dip (Mar), First Class Engineer (Motor-

ship)

Pang Tow Min

Tech Dip (Marine), First Class Engineer, B Sc

(Elect)

Sheikh Shahabuddin

B A, First Class Engineer, MSNAMES

### Engineering Systems Section

#### Section Head

R K Agrawal

C Eng, FIMarE, MIRINA, FSNAMES, First

Class Engineer (Combined)

### Senior Lecturer

Subir Mukerji

First Class Engineer, FIDiagE, MIE,

MSNAMES, T Eng (CEI)

#### Lecturers

Evangelina Goh Mui Cheng (Mrs) (seconded

to ETD)

B Sc (Naval Arch & Ship Bldg) (Hons), Tech

Dip (Ship Constr)

Peter Ng Tiang Hai

BSE, Dip MS, C Eng, MIMarE

Mantena S Raju

B E (Mech-Marine), C Eng, First Class

Engineer (Combined)

Adrian Teo Boon Chuan

First Class (Motor), MIMarE

#### Instructor

Low Chong Swee

First Class Engine Driver

### Power Plant Section

#### Section Head

S Das Sarma

First Class Engineer (Combined), First Grade

Engineer (Steam & I.C.E.), MSNAMES,

MIE, T Eng (CEI), FIDiagE, AMIMarE

#### Principal Lecturer

K Venkataraman

First Class Engineer (Combined), C Eng,

MIMarE, MIE (IND), FSNAMES, MTMar-

Tech

#### Lecturers

Aji Pal

B E (Mech), C Eng, FIMarE, Extra First Class

Engineer (Combined), MSNAMES

MIE, FIMarE,

MSNAMES, First Class Engi-

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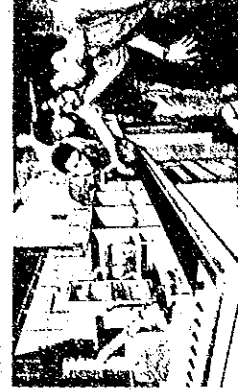
T Eng (CEI), First Class Engineer, LME,

MSNAMES

Jasmit Ahuja Singh

Extra First Class Engineer, C Eng, MIMarE,

M Sc (Ngt Studies)



At the Safety Laboratory, this model is used to demonstrate to students the importance of an inert gas system in tanker safety.

### Practical Training

The course structure provides for intensive training in our own fully-equipped Machining and Welding Workshops, training in our Plant and Systems Workshop and in the various laboratories, vacation training in an approved shipyard or workshop and a minimum of six months training on board ships. Students taking the SP-SAF Diploma scheme are provided with full practical training during all the semester vacations.

In addition, the following practical courses are arranged for students who are required to pay the necessary fees where applicable:

Shipyard Safety Orientation Course

Swimming Course

Basic Fire Fighting Course

Proficiency in Survival Craft Course

First Aid at Sea Course

### Career Prospects

Marine Engineering is a challenging profession with very good monetary rewards. It offers the additional advantage of travel around the world. At present, well-trained and qualified marine engineers are in demand and employment prospects are bright. As well as Singapore shipping companies, many foreign companies employ marine engineers from Singapore.

To become a fully-qualified marine engineer, a student has to complete the course and obtain a Diploma. In addition, he would also have to complete the required sea-service periods and obtain, in accordance with the Merchant Shipping Act, Class 2 and Class 1

Traditionally this department has been charged with the task of educating and training young Singaporeans for the role of sea-going Engineer Officers. Such a role requires that the Engineer Officer be able to operate, manage and maintain complex interactive and dynamic systems ranging from very heavy main engines to delicate monitoring and control equipment.

The role also requires that the Engineer Officer has all-round capabilities, able to work with others as a team but at the same time required to make sound individual judgments.

The education and training process is demanding since it involves the management of technology and the technology of management. Modern ships are very complex vehicles for the transportation of cargo and are also self-contained engineering systems. The management of such systems requires personnel with a strong technological foundation proficient in interpersonal communication skills.

This department recognises that these requirements are not just limited to off-shore operations personnel but are also necessary wherever engineering plant and associated systems need to be managed. As a result, the Department is simultaneously consolidating its programs for the off-shore sector while diversifying into related activities in the onshore sector. This means that the Department's modern technical resources and considerable expertise in plant management will be further gainfully employed.

The Department, in conjunction with the Singapore Armed Forces, also offers GCE O-level school leavers, who are interested in a technical career with the SAF, the prospect of sponsorship during their training at the Singapore Polytechnic.

Singapore is the world's second busiest port and most of the imports and exports are transported in ships, from small coasters to giant supertankers. Sea-going marine engineers are responsible for the day-to-day operations, management and maintenance of all ship-board machinery and equipment.



Certificate of Competency by passing appropriate examinations conducted by the Marine Department, Singapore.

A minimum of eighteen months' sea-service as a Junior Engineer Officer is required before a candidate may sit for Part B of the Second Class Engineer Examination. Further sea experience is necessary for the examination leading to a First Class Certificate which is the minimum requirement for appointment as a sea-going Chief Engineer. Qualified and experienced marine engineers can also obtain rewarding jobs ashore. Graduates in the SP-SAF Diploma scheme will be employed by the SAF in the Republic of Singapore Navy.

**Diploma in Marine Engineering**

**Subjects of Study**

- First Year
- 1501 English for Academic Purposes
- 4111 Engineering Mathematics I
- 4121 Engineering Drawing I
- 4131 Applied Heat I
- 4141 Applied Mechanics I
- 4151 Marine Electrotechnology I
- 4161 Workshop Technology
- 4171 Workshop Practice I
- Swimming

**SP-SAF Diploma Scheme (Navy) — First Year**

- 4111 Engineering Mathematics I
- 4121 Engineering Drawing I
- 4131 Applied Heat I
- 4141 Applied Mechanics I
- 4151 Marine Electrotechnology I
- 4161 Workshop Technology
- 4171 Workshop Practice I
- Swimming

**Second Year**

- 1502 English for Occupational Purposes
- 4211 Engineering Mathematics II
- 4221 Engineering Drawing II
- 4231 Applied Heat II
- 4241 Applied Mechanics II
- 4251 Marine Electrotechnology II
- 4261 Instrumentation
- 4271 Marine Systems I
- 4281 Marine Power Plant I
- 4291 Workshop Practice II
- 120

There will be two months of practical training in an approved shipyard or workshop commencing at the beginning of the long vacation.

**SP-SAF Diploma Scheme (Navy) — Second Year**

- 1502 English for Occupational Purposes
- 4211 Engineering Mathematics II
- 4221 Engineering Drawing II
- 4231 Applied Heat II
- 4241 Applied Mechanics II
- 4251 Marine Electrotechnology II
- 4261 Instrumentation
- 4272 Marine Systems I
- 4282 Marine Power Plant I
- 4291 Workshop Practice II

**Third Year (Two Terms)**

- 1010 Introduction to Computer Applications
- 4351 Marine Electrotechnology III
- 4361 Marine Automation
- 4371 Marine Systems II
- 4381 Marine Power Plant II
- 4392 Naval Architecture
- 4375 Marine Workshop Simulator
- Project

**Pre-Sea Programme (Final Term)**

- Module 1 Fire Fighting
- Module 2 Proficiency in Survival Craft
- Module 3 First Aid At Sea
- Module 4 Tanker Safety
- Module 5 Management For Engineers
- Module 6 Navigation & Seamanship
- Module 7 Simulator Sessions

**SP-SAF Diploma Scheme (Navy) — Third Year**

- 1010 Introduction to Computer Applications
- 4351 Marine Electrotechnology III
- 4361 Marine Automation
- 4372 Marine Systems II
- 4375 Marine Workshop
- 4382 Marine Power Plant II
- 4392 Naval Architecture Simulator
- Project

Pre-Sea programme (Proficiency in Personal Survival Craft, First Aid at Sea, Tanker Safety, WJT Leaders Course, Navigation & Seamanship, Simulator Sessions).

**Vacation Training**

During the vacation, the student will report to the Naval Technical Training School (NTTS) for on-the-job training (OJT) to prepare him to work in the technical environment where he will be employed upon graduation.

**Fourth Year**

Training for six months as an assistant engineer on board ship.

During this period, a correspondence course is provided and the student must follow and complete this satisfactorily. An assistant engineer will normally receive an allowance to cover expenses.

**Assessment**

Assessment during each year of the course will be by means of course work and written/practical examinations. A satisfactory standard will be required in both course work and examinations. Satisfactory performance during practical training periods and satisfactory completion of the correspondence course (while training at sea) are also essential for the award of the Diploma. Students in the SP-SAF Diploma scheme are also required to successfully complete the vacation training conducted at the respective SAF training schools.

**Exemption**

Upon successful completion of the Marine Engineering course and having been awarded the Diploma, one is eligible for exemption from Part A of both the Class 2 and Class 1 Engineer Examinations and is then qualified to serve on board ships as an Engineer Officer.

**Applications Resource**

By providing broad-based, practice-oriented facilities with the latest technology, a learning environment has been established to complement academic studies. The resource includes:

**Basic Engineering Applications**

This has been designed to handle 80 students at a time and provides three functions:

- Fundamental application of machine-tool practice using a variety of machine tools.

- Fundamental applications of welding technology using both electric arc and gas systems.

- Fundamental applications of bench fitting using the full range of hand tools.

**Electrical Engineering Applications**

This can handle up to 60 students at a time. It provides the following functions:

- Familiarisation with construction and materials used in modern electrical systems.
- Familiarisation of the characteristics of electrical machines and their controls.
- Applications of circuit tracing and building.
- Trouble-shooting, diagnostics and safety management

**Mechanical and Thermal Systems Applications**

This resource, which can handle up to 20 students at a time, provides the stimulus for analysis and evaluation of mechanical and thermal systems found in modern industrial applications. It provides several distinct learning environments namely:

- Fundamental analysis of static and dynamic mechanical systems using simple mechanisms and simulated machines.
- Analysis of combustion and energy transfer through the operation and management of I.C. engines.
- Evaluation of energy conservation and conversion for environment control by the application of thermodynamic machines.

- Boiler-house applications of water treatment and steam generation using modern fully-automated steam raising systems.

**Safety Systems Application**

Students study the fundamentals and procedures for fire and personal safety using actual installations and equipment of the latest design. It is designed to support courses in:

- Basic Fire Fighting (Principles and Practice)

- Advanced Fire Fighting (Strategy and Tactics)
- Command and Damage Control
- Dangerous Cargo Transportation
- Shipboard Safety Management

The resource provides the following functions:

- Familiarisation with fire fighting installation and safety appliances.
- Exposure to the maintenance requirements of modern fire detection and extinguishing systems.
- Hands-on experience in the use of portable extinguishers, breathing apparatus, resuscitation and atmosphere testing equipment.
- Reinforcement of design considerations and statutory requirements for safety equipment and appliances.

#### Control Systems Application

Equipped with modern monitoring and control devices incorporated in electronic, pneumatic and hydraulic systems, it supports the following:

- Familiarisation with sensors and transducers used in the management of engineering systems.
  - Reinforcement of principles of control and control loops.
  - Trouble-shooting, diagnostics and maintenance of control systems.
  - Fundamentals of data acquisition and display.
  - Hands-on experience of portable data acquisition and diagnostic equipment.
- Advanced Engineering Applications**  
The resource is provided with heavy equipment to support:
- Exposure to the practicalities of handling large and heavy equipment.

Application programs; word processing; electronic spreadsheet; etc. Role of application softwares; selection criteria; overview and uses.

1501

#### English for Academic Purposes

The course helps students acquire skills required to function effectively in their studies. Core skills are intensive and extensive reading skills, listening and note-taking, summarising, answering examination questions and writing project reports.

1502

#### English for Occupational Purposes

The course teaches the skills required when applying for a job and those for functioning at work. The former includes reading and interpreting job advertisements, writing job application letters and attending job interviews. On-the-job skills include those for functioning at meetings, making oral proposals, telephone techniques and writing memoranda and business letters.

4111

#### Engineering Mathematics I

Laws of indices and logarithms: Determination of laws. Remainder Theorem. Graphical methods. Trigonometric and inverse trigonometric functions. Simultaneous equations. Binomial Theorem. Differentiation of algebraic and simple transcendental functions with applications. Integration of algebraic and simple transcendental functions with engineering applications. Partial fraction integration by parts. Numerical integration. Trapezoidal Rule. Simpson's rule.

4121

#### Engineering Drawing I

Drawing practice and standards. Geometrical construction. Loci. Orthographic projection. Dimensioning. Sectioning. Isometric and oblique projection. Interpretation of working drawings: electrical, piping, welding. Auxiliary projection. Interpenetration.

of surfaces. Development. Cam. Screw threads, screw fasteners. Locking devices. Conventional representation. Detailed and assembly drawings.

#### Applied Heat I

Fundamental concepts of thermodynamic systems. Properties of the working fluid. Heat, work and internal energy. First law of thermodynamics. Non-flow and steady-flow processes. Enthalpy. Reversibility. Properties of liquids and vapours. Phase diagrams. Use of steam tables. Various processes with steam. Separating and throttling calorimeter. Perfect gas laws. Equation of state. Specific law of thermodynamics. Reversible heat engine. Entropy and its application. Carnot cycle. Available energy. Air-standard cycles — Otto, Diesel, Dual-combustion, Brayton cycles. Performance of I.C. engines and boilers — Indicator diagrams. Performance measurements. Energy balance. Boiler efficiency and equivalent evaporation.

4141

#### Applied Mechanics I

S.I. Units. Scalars and vectors. Statics. Equilibrium of coplanar concurrent and non-concurrent forces. Resolution of forces. Principles of moment. Centre of gravity and centroid. Equations of uniform linear and angular motion. Motion due to gravity and projectiles. Resultant and relative velocities. Newton's laws of motion. Force, momentum and impulse. Conservation of momentum. Torque. Moment of inertia, radius of gyration. Angular momentum. Centripetal and centrifugal force. Work, power and energy. Conservation of energy. Laws of friction. Friction on inclined plane. Screwthreads. Mechanical advantage, velocity ratio and efficiency of simple machines. Law of the machine. Direct stress and strain. Hooke's Law. Young's modulus. Load-extension graph. Temperature stresses. Shear stress and strain. Modulus of rigidity.