DUT
DURBAN UNIVERSITY OF TECHNOLOGY

2016 HANDBOOK
ELECTRONIC ENGINEERING

FACULTY OF ENGINEERING & THE BUILT ENVIRONMENT

HANDBOOK FOR 2016

FACULTY OF ENGINEERING AND THE BUIILT ENVIRONMENT

DEPARTMENT of ELECTRONIC ENGINEERING

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IMPORTANT NOTICE

The departmental rules in this handbook must be read in conjunction with the Durban University of Technology's General Rules contained in the current General Handbook for Students.

NOTE TO ALL REGISTERED STUDENTS

Your registration is in accordance with all current rules of the Institution. If, for whatever reason, you do not register consecutively for every year/semester of your programme, your existing registration contract with the Institution will cease. Your re-registration anytime thereafter will be at the discretion of the Institution and, if permitted, will be in accordance with the rules applicable at that time.

STAFF

Head of Department:	Mr K E Moorgas, N Dip (MLST); B Tech (DIT); M Tech (DUT); MSAIEE, Pr. Techni. Eng;
Deputy Head of Department:	Dr OA Sokoya, BSc(Eng)(OAU), M.Eng(UKZN); PhD(UP)
Director:	Mr K S Moodley, NDT (MLST); MDipTech (MLST); MSAIEE
Associate Professor:	Prof B Nleya; Pr. Eng, ECSA, MSc, PhD (SUT, St. Petersburg), SMIEEE, SMIEICE, Japan
Associate Directors:	Mr S D MacPherson, Pr. Tech. Eng; NDT (TN); M Dip Tech (TN); MSAIEE
Senior Lecturers:	Dr P Govender, HDE (UN); M Tech (TN); D Tech (DIT) Mr G P Janse van Vuuren, Pr. Tech. Eng; NDT (TN); M Dip Tech (TN); SMSAIMC Mr A Moolla, NHD (PSE); (MLST); MDipTech (MLST) Mr B Saligram, MDipTech (MLST) Dr N Singh, Pr.Eng; BSc (Eng) (UN); MSc (Eng) (UN); MBA (UN); PhD(UKZN)
Lecturers:	Mr M R A Bera, BSc (Eng) (UDW); MSAIEE Mr V Beerajh, NHD (MLST); NHD (PSE) Mr L G Budula, N Dip (MLST); B Tech (MLST) Mr S A K Essack, NDT (MLST); M Dip Tech (MLST); MSAIEE Mr P A Howells, N Dip (TN); B Tech (TN) Mr T Pillay, Pr. Tech. Eng; N Dip (MLS); B Tech (DIT); M Tech (DUT) Mrs A Pillay, NDip (TN); B Tech (DIT); M Tech (DUT) Mr S Reddy, BSc(Eng) (UND); M. Eng (UP) Mr R Sewsunker, BSc (Eng) (UKZN); M Sc (Eng)(UKZN), MSc in E Eng (MSEE) (WSU, USA), ECSA; SAIEE
Junior Lecturers:	Mr S Sewdass, NDip (DIT); B Tech (DUT)
Senior Technicians:	Mr P Morris, NDip (TN); B Tech (DUT) Mr I Haniff, BSc(Eng)(UKZN); SMSAIEE (Contract)
Technicians:	Mr G Gramanie, Pr. Techni. Eng; NHD (MLST); SMSAIMC Mr P Hendry, NDip (MLST) Mr N Ragbeer, NHD (MLST)
Senior Technical Assistants:	Mr N Rupnarain Mr R Ebrahim Mr K Naidoo, BTech (DUT) (Contract)
Technical Assistant:	Mr A Jooravan, NDip (DIT); BTech (DUT), MBA
Secretary:	Mrs D Chetty, NHD (MLST)

GENERAL INFORMATION

Important contact information

Department of Electronic Engineering, DUT

Block S8, Level 3, Steve Biko Campus, Steve Biko Road, Durban 4001.
Postal Address: PO Box 1334 Durban, KwaZulu-Natal, RSA. 4000

All Departmental queries to:-

Secretary	Mrs Premi Chetty
Telephone	031-373 2932
Fax	031-373 2744
Email	premi@dut.ac.za
Website	http://cs.dut.ac.za

All Faculty queries to:-

Faculty Officer	Ms N Singh
Telephone	031-373 2718
Fax	031-373 2719
Location of Faculty Office:	Steve Biko Campus, S4 Level 3

Executive Dean	Prof T Andrew
Dean's Secretary	Ms P Nadar
Telephone	031-373 2762
Fax	031-373 2724

Location of Executive Dean's Office: Steve Biko Campus, S6 Level 5

Central Applications Office (CAO)
Private Bag X06, Dalbridge 4014. Tel: 031-2684444, website: www.cao.ac.za

Engineering Council of South Africa (ECSA)
Private Bag X691, Bruma, 2026. Tel: 011-6079500, Fax: 011-6229295
Email: engineer@ecsa.co.za, website: www.ecsa.co.za

South African Institute of Measurement and Control
Tel. /Fax: 011-888 8332
Email: ctr@SAIMC.org.za, website: www.saimc.org.za

South African Institute of Electrical Engineers (SAIEE)
Secretary: Ms Gill Nortier, PO Box 22222, Glenashley, 4022.
Tel/fax: 031-5725838
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South African Qualifications Authority (SAQA)
Postnet Suite 248, Private Bag X06, Waterkloof, 0145.
Tel: 012-4315000 Fax: 012-4315039, website: www.saqa.org.za

Departmental Vision Statement
To be known for excellence in producing electronic engineering professionals who use engineering and technology for societal development in South Africa.

Departmental Mission Statement
To produce socially responsible graduates attuned to the needs of industry, the environment and the community.

To ensure that teaching and learning follows best practice.

To engage in research and development activities that are responsive to national and international challenges, in clearly defined areas of strength.

What is a University of Technology?

A university of technology is characterized by being research informed rather than research driven where the focus is on strategic and applied research that can be translated into professional practice. Furthermore, research output is commercialized thus providing a source of income for the institution. Learning programmes, in which the emphasis on technological capability is as important as cognitive skills, are developed around graduate profiles as defined by industry and the professions.

INSTRUCTIONAL PROGRAMMES OFFERED BY THE DEPARTMENT

Programmes are offered in this Department which, upon successful completion, lead to the award of the following qualifications:-

Qualification	Qualification Code	SAQA NLRD Number
National Diploma: Engineering: Electrical (Light Current)	NDELC2	72228
National Diploma : Engineering : Computer Systems	NDCSY2	72227
Bachelor of Technology : Engineering : Electrical	BTELC1	72129
Master of Engineering (Electronic)	MNELC1	96827
Doctor of Engineering (Electronic)	DNELC1	96812

Description of the National Diploma: Engineering: Electrical (Light Current) Programme

At DUT you will receive a vocationally oriented education that will prepare you to be functional in the field of Instrumentation and Control OR Electronic Communications, so that you will be able to make a meaningful contribution to industry. Students completing the National Diploma, function at the level of a technician and students completing the Bachelor of Technology degree will function at the level of a technologist.

To be successful in a career in the electronic engineering industry you must have the following traits:

Be able to think logically and creatively;
Be willing to work hard and have a positive attitude;
Have a passion for all technology and specifically electronics;
Be prepared for life-long learning;
Have excellent technical communication skills;
Be prepared to master new technology on a daily basis.

CAREER CHOICES:
INSTRUMENTATION AND CONTROL

As an electronic engineering professional you should be able to justify, design, construct, commission and maintain instrumentation and control systems in a wide range of industries including paper, sugar, vehicle manufacturing, refining, water reticulation and chemical.

Qualified electronic engineering professionals specializing in instrumentation are highly sought after by industry.

The Diploma course includes basic electronics, digital systems, electrical engineering, mathematics, software design and networking. This enables the student to specialise in instrumentation. Some examples of the course material include:
Measurements of variables including pressure, flow, level, temperature, position and mass;
Unit operations (e.g. boilers, distillation columns, refrigeration);
Control systems;
Software design (e.g. PLCs, high level programming);
Final control elements (e.g. drives and valves).

The necessary control theory to effectively utilise systems is also included. All subjects are supported by relevant practical work.

CAREER CHOICES:
ELECTRONIC COMMUNICATIONS

As an electronic engineering professional you will be able to justify, design, construct, commission and maintain electronic and communication systems in a wide range of industry including the telecommunications, mobile wireless, cellular and general electronic manufacturing industries.

Qualified electronic engineering professionals specialising in communications are highly sought after by industry.

The Diploma program includes core subjects such as electronics, digital systems, electrical engineering, mathematics, software design and network systems, with specialist subjects such as electronic communications, radio engineering and microwave communications. All subjects are supported by relevant laboratory work which include:

- To fabricate and test electronic circuits
- Manufacturing, testing and maintenance of electronic devices and systems.
- To understand the construction, identification, characteristics, specifications, merits, limitations and applications of electronic components and materials
- To understand lines communication, audio and video communication, and microwave communication

Description of the National Diploma: Computer Systems Programme
At DUT you will receive a vocationally oriented education that will prepare you to be functional in the field of Computer Systems, so that you will be able to make a meaningful contribution to industry. Students completing the National Diploma, function at the level of a technician and students completing the Bachelor of Technology degree will function at the level of a technologist.

To be successful in a career in the computer systems industry you must have the following traits:
Be able to think logically and creatively;
Be willing to work hard and have a positive attitude;
Have a passion for all technology and specifically electronics and computer technology
Be prepared for life-long learning;
Have excellent technical communication skills;
Be prepared to master new technology on a daily basis.

This qualification is a hybrid electronic engineering and computer engineering course.

It is envisaged that the learner obtaining this Diploma will be exposed to the following areas of learning :-
Fundamental Electronics and Electrical Engineering
Data Communication and Networking
Computer Systems architecture
Embedded Systems (Microcontrollers)
Computer Programming
Operating Systems

Career opportunities
Our graduates find work opportunities in a wide spectrum of industries.

The following are some of the major destinations: Telecommunication and data networking companies, embedded systems designers, IT infrastructure (design, installation and support), Industry Programmers.

Purpose Statement: National Diploma: Engineering: Electrical

The purpose of the National Diploma: Engineering: Electrical (Light Current) is to provide a career oriented education that will prepare students to be functional in the field of Instrumentation and Control Engineering or Electronic Communications in order to make a meaningful contribution to Industry.

The engineering profession contributes to the technical, social, economic and environmental infrastructure of the country, leading to socio-economic growth. A framework of engineering qualifications develops the human resources essential for sustaining the profession.

Within that framework, this qualification is designed for the development of engineering technicians.

A graduate with this qualification will be:-

1. Competent to apply technical knowledge, engineering principles and problem-solving techniques in the field of Electrical Engineering by operating within the relevant standards and codes
2. Able to work independently, and as a member of a team.

The qualified person will be able to register with the Engineering Council of South Africa (ECSA) as a Technician-in-Training in the field of Electrical Engineering.

Purpose Statement: National Diploma: Engineering: Computer Systems

The purpose of the National Diploma: Engineering: Computer Systems is to provide a foundation in both hardware and software; and prepare students for a career demanding specialist knowledge in Computer Programming, Computer Systems, Embedded Systems, Systems Analysis and Computer Engineering.

The engineering profession contributes to the technical, social, economic and environmental development of the country, leading to socio-economic growth. A framework of engineering qualifications develops the human resources essential for sustaining the profession.

Within that framework, this qualification is designed for the development of computer engineering technicians.

A graduate with this qualification will be:-

1. Competent to apply the theoretical and practical knowledge and skills of the following: hardware, software, networking and basic engineering aspects in the environment of the computer industry.
2. Competent to apply the integration of theory, principles, proven techniques, practical experience and appropriate skills, to the solution of well-defined problems in the field of computer engineering.
3. Competent in providing professional, technical and developmental support in the computer industry
4. Able to work independently, and as a member of a team.

The qualified person will be able to register with the Engineering Council of South Africa (ECSA) as a Technician-in-Training in the field of Computer Systems.

Purpose Statement: Bachelor of Technology: Engineering: Electrical
The engineering profession contributes to the technical, social, economic and environmental infrastructure of the country, leading to socio-economic growth. A framework of engineering qualifications develops the human resources essential for sustaining the profession. Within that framework, this qualification is designed for the development of engineering technologists to enhance a student's knowledge within a specialized discipline

A graduate with this qualification will be able to:-

1. Apply engineering principles to systematically diagnose and solve well-defined as well as ill-defined problems in an engineering environment within a chosen field of specialization.
2. Communicate technical, supervisory and general management information effectively.
3. Apply management principles and concepts to manage projects and/or operations within an engineering environment.
4. Conduct and manage an industrial project.
5. Exercise independent technological judgment and responsible decision making by taking into account the relevant financial, economic, commercial, social, environmental and statutory factors.

The qualified person will be able to register with the Engineering Council of South Africa (ECSA) as a Professional Technologist in the field of Electrical Engineering.

Purpose Statement: Master of Engineering
This qualification is intended for persons who will make a contribution, through research, to understanding the application and evaluation of existing knowledge in a specialized area of technology. They will also demonstrate a high level of overall knowledge in that area, ranging from fundamental concepts to advanced theoretical or applied knowledge.

Purpose Statement: Doctor of Engineering
This qualification is intended for persons who will make a significant and original contribution to knowledge in a specialised area of technology. They will have a high level of overall knowledge in that specialised area ranging from fundamental concepts to advanced theoretical or applied knowledge.

DEPARTMENTAL RULES FOR THE NATIONAL DIPLOMA: ENGINEERING: ELECTRICAL & COMPUTER SYSTEMS

EL1 MINIMUM ADMISSION REQUIREMENTS

In addition to the general admission requirements as stated in the General Rules, the following minimum requirements (or their equivalent) shall apply:

(1) **Senior Certificate Requirements:**

Mathematics : E (HG) C (SG)
Physical Science (or equivalent): E (HG) C (SG)

In addition, a learner must obtain a minimum score of 35 using the scoring system listed in Table 1 to be conditionally accepted into the programme. The scores for each Senior Certificate subject result obtained are added together, with the Mathematics and Physical Science scores multiplied by a factor of 2.

Symbol	A	B	C	D	E	F
SC Higher Grade		7	6	5	4	3
SC Standard Grade		5	4	3	2	1
NSC		6	5	4	3	2

(2) **National Senior Certificate Requirements:**

Mathematics: 4 (Adequate achievement)
Physical Science: 4 (Adequate achievement)
English (Primary): 4 (Adequate achievement)
OR
English (First additional): 4 (Adequate achievement)

Note (1) The subject Mathematical literacy will not be accepted as a substitute for the subject Mathematics.
(2) Paper Three in Mathematics (Geometry) is a co-requisite for Engineering Mathematics 1 and is compulsory for all applicants unless the applicant has passed Paper Three with a minimum rating of 4 (Adequate achievement).

In addition, a learner must obtain a minimum score of 28 using the scoring system listed in Table 1 to be conditionally accepted into the programme. The scores for each National Senior Certificate subject result obtained are added together, with the Mathematics and Physical Science scores multiplied by a factor of 2.

(3) **National Technical Certificate N4:**

A student having an N4 Certificate with passes of 50% or higher in four (4) relevant subjects including Mathematics and Electrotechnics, or an equivalent SAQA NQF Level 4 qualification, as well as compliance with the English language requirements as stated in the General Rules, will be accepted provided there is sufficient space.
S1 credits may be given for equivalent subjects passed, with a minimum of 50%, at both the N5 **and** N6 level.

(4) **National Certificate Vocational Level 4**

National Certificate Vocational with a minimum mark of 60% in English, Mathematics, Physical Science or equivalent, Life Orientation *and* 2 vocational subjects relevant to the field of electrical engineering.

EL2 SELECTION

Due to the limited number of places available, the final selection for the purpose of admission to the programme will be done taking the following factors into consideration:

(1) Academic performance at Senior Certificate, National Senior Certificate, N4 certificate, National Certificate Vocational, or equivalent SAQA NQF level 4.

EL3 DURATION OF STUDIES

The minimum duration of academic studies at the Durban University of Technology shall be four semesters (2 years), unless credits for studies at another institution have been granted.

EL4 AWARD OF DIPLOMA

(1) The diploma will only be awarded where a learner has successfully completed the requisite number of subjects, as listed in the relevant field of study, and in addition has completed a minimum of two semesters of appropriate work integrated learning. The diploma will be awarded after a minimum period of three years.

(2) All subjects, as listed under the relevant field of study, are to be completed at DUT unless prior written permission is granted by the HOD for the student to register at an alternative institution.

EL5 REGISTRATION

(1) All learners registering for the programme for the first time will be required to pay a toolkit levy in addition to the standard course fee.

(2) No registration for any subject will be allowed later than one week after commencement of lectures without prior written permission from the Head of Department. Furthermore any late registration is conditional, subject to the student having attended all lectures and practical sessions during the late registration week.

(3) No learner will be allowed to register for a subject if there is a timetable clash with any other subject.

EL6 STUDENT CONDUCT

(1) Eating, smoking or drinking in any lecture venue or laboratory is forbidden.

(2) Safety rules are to be strictly observed at all times.

(3) Learners are required to have a toolkit for laboratory sessions.

(4) All equipment issued to a learner during a laboratory session must be returned at the end of the laboratory session.

(5) Mobile phones are to be switched off during lecture, laboratory and assessment sessions.

EL7 PROMOTION TO A HIGHER LEVEL

(1) A learner may not register for higher level academic subjects unless all prerequisites are complied with.

(2) A learner may not register for any semester 3 academic subjects without having obtained credits for all semester 1 academic subjects.

(3) A learner may not register for any semester 4 academic subjects without having obtained credits for all semester 2 academic subjects.

EL8 UNSATISFACTORY ACADEMIC PROGRESS

(1) A learner who does not obtain a credit for a subject after having twice been registered for that subject will be given a warning of slow progress. If after a third registration a credit is not obtained the learner will not be allowed to re-register for the programme.

(2) A student must pass ALL the specified subjects for the diploma within eight registered semesters of study. A student wishing to appeal against the application of this rule, must submit to the Department an application to appeal for re-registration. Re-registration will be granted at the discretion of the Appeals Committee.

EL9 SEMESTER MARK

(1) The semester mark for all examinable subjects is set at 40% of the final mark.

(2) A learner who for any reason is absent from a particular test, assessment, or scheduled laboratory period, must provide acceptable proof of their reason for absence to the lecturer concerned within two days after returning to classes. Failure to provide proof of acceptable reasons for absence, or failure to undergo a specified alternative assessment, shall result in a zero mark for that test/assessment.

EL10 METHOD OF ASSESSMENT

Subjects are evaluated through a minimum of two class tests of one hour duration each, one three-hour examination and a practical/assignment mark. Those subjects marked with # are evaluated through a process of continuous assessment. Further details of the method of assessment are included in the subject study guide.

EL11 SUB-MINIMUM

(1) A sub-minimum of 50% will apply to the practical component of all semester marks.

(2) A sub-minimum of 40% will apply to all semester marks.

(3) A sub-minimum of 40% will apply to all written examinations.

EL12 SUPPLEMENTARY EXAMINATIONS

(1) Supplementary examinations are offered for all examinable subjects. Learners who have failed an examinable subject qualify for the supplementary examination provided that they have obtained a final mark (semester mark and examination mark) of at least 45%. A semester mark is only valid for one examination and one supplementary session.

(2) A final examination is not written in subjects evaluated through continuous assessment and if the required pass mark is not attained the subject must be repeated.

EL13 WORK INTEGRATED LEARNING

(1) Learners may register for work integrated learning at any point in the programme after completing semester 1.

(2) A learner must register for work integrated learning with the department immediately on starting a period of learning in industry. Registration forms are available in the departmental offices. Unregistered periods of work integrated learning will not be considered for credit purposes.

(3) If any of the registered details regarding work integrated learning change (e.g. employer, supervisor, address, telephone numbers etc.), the learner must advise the department in writing within two weeks of the changes.

(4) A learner may not register for the second period of work integrated learning without having submitted the manual for the first period of work integrated learning.

(5) Registration for the second period of work integrated learning will be treated as provisional until such time as the department has approved the learner's completion of the requirements for the first period of work integrated learning.

(6) A learner may not register for more than one academic subject with the department while registered for work integrated learning.

EL14 SERVICE DEPARTMENTS

Learners are referred to the departmental handbooks and subject study guides for information regarding the rules applicable to subjects serviced by other departments.

EL15 FIELDS OF STUDY

The department offers the following fields of study:

(1) Field of study one: National Diploma: Engineering: Electrical (LC): Instrumentation and Control (NDEIN1)

(2) Field of study two: National Diploma: Engineering: Electrical (LC): Electronic Communications (NDECM1)

(3) Field of study three: National Diploma: Engineering: Computer Systems (NDCSY2)

DEPARTMENTAL RULES FOR THE BACHELOR'S DEGREE IN TECHNOLOGY: ENGINEERING: ELECTRICAL & COMPUTER SYSTEMS

BT1 MINIMUM ADMISSION REQUIREMENTS

(1) National Diploma: Engineering: Electrical (Light Current)
National Diploma: Engineering: Computer Systems

(2) Credits must be obtained for all prerequisite subjects as listed in the relevant field of study, *prior* to first time registration for the degree.

BT2 DURATION OF STUDIES

(1) The minimum duration of academic studies at the Durban University of Technology shall be two semesters (1 year), unless credits for studies at another institution have been granted.

(2) The minimum duration of registration for Industrial Project 4 shall be one semester and the maximum duration three consecutive semesters. If a learner has not completed all the requirements for this subject within three *consecutive* semesters the learner will be required to pay the full registration fee for the subject on the next registration.

(3) A learner may not register for Industrial Project 4 until written approval of the proposed project has been obtained from a committee comprised of academic staff from the relevant field of study.

BT3 AWARD OF DEGREE

(1) The degree will only be awarded where a learner has successfully completed the requisite number of subjects, as listed in the relevant field of study. The degree will be awarded after a minimum period of one year.

(2) All subjects, as listed under the relevant field of study, are to be completed at DUT unless *prior* written permission is granted by the HOD for the student to register at an alternative institution.

BT4 UNSATISFACTORY ACADEMIC PROGRESS

A learner who does not obtain a credit for a subject after having twice been registered for that subject will be given a warning of slow progress. If after a third registration a credit is not obtained the learner will not be allowed to re-register for the programme.

BT5 SEMESTER MARK

(1) For all examinable Level 4 subjects the semester mark is set at 40% of the final mark.

(2) A learner who for any reason is absent from a particular test, assessment, or scheduled laboratory period, must provide acceptable proof of their reason for absence to the lecturer concerned within two days after returning to classes. Failure to provide proof of acceptable reasons for absence, or failure to undergo a specified alternative assessment, shall result in a zero mark for that test/assessment.

BT6 METHOD OF ASSESSMENT

Subjects are evaluated through a *minimum* of two class tests of one hour duration each, one three-hour examination and a practical/assignment mark. Those subjects marked with # are evaluated through a process of continuous assessment. Further details of the method of assessment are included in the subject study guide.

BT7 SUB-MINIMUM

(1) A sub-minimum of 50% will apply to the practical component of all semester marks.
(2) A sub-minimum of 40% will apply to all semester marks.
(3) A sub-minimum of 40% will apply to all written examinations.

BT8 SUPPLEMENTARY EXAMINATIONS

(1) Supplementary examinations are offered for all *examinable* subjects. Learners who have failed an examinable subject qualify for the supplementary examination provided that they have obtained a final mark (semester mark and examination mark) of at least 45%. A semester mark is only valid for one examination and one supplementary session.
(2) A final examination is not written in subjects evaluated through continuous assessment and if the required pass mark is not attained the subject must be repeated.

BT9 FIELDS OF STUDY

(1) Field of study one: BTECH: ENGINEERING: ELECTRICAL (LC): (Instrumentation and control) BTEIN1
(2) Field of study two: BTECH: ENGINEERING: ELECTRICAL (LC):(Electronic Communications) BTECM1
(3) Field of study three: BTECH: ENGINEERING: ELECTRICAL:(Computer Systems) BTECS1

Field of Study One:

BTECH: ENGINEERING: ELECTRICAL (Light Current): (Instrumentation and control) BTEIN1

SUBJECTS	PREREQUISITES	Semester offered (Subject to change)	Subject Codes
Process Control 4 #	Process Instrumentation 3	1 Only	PRCT401
Engineering Management 4 #	None	1 and 2	EMGT402
Engineering Mathematics 4	Mathematics 3	1 and 2	EMTH402
Microcontroller Systems 4 #	Digital Systems 3	1 Only	MCSY401
Control Systems 4 #	Control Systems 3	2 Only	CSYS402
Digital Signal Processing 4 #	Engineering Mathematics 4	2 Only	DSPR401
Process Instrumentation 4 #	Process Instrumentation 3	2 Only	PRSI401
Industrial Project #	Design Project 3	1 and 2	IPRJ401 (1ST Reg) IPRJ411 (2nd Reg) IPRJ421 (3rd Reg)

# Denotes continuous assessment

Field of Study Two:

BTECH: ENGINEERING: ELECTRICAL (Light Current): (Electronic Communications) BTECM1

SUBJECTS	PREREQUISITES	Semester offered (Subject to change)	Subject Codes
Electronic Comm. Systems 4 #	Radio Engineering 3	1 Only	ECMS401
Engineering Management 4 #	None	1 and 2	EMGT402
Engineering Mathematics 4	Mathematics 3	1 and 2	EMTH402
Microcontroller Systems 4 #	Digital Systems 3	1 Only	MCSY401
Digital Signal Processing 4 #	Engineering Mathematics 4	2 Only	DSPR401
Microwave Engineering 4#	Microwave Comm. 3	1 Only	MCWE 401
Electronic Communications 4#	Engineering Mathematics 4 Radio Engineering 3	2 Only	ECOM 402
Computer Networks 4	Computer Networks 3	2 Only	CNET402
*Circuit Analysis 4	None	1 Only	CRTA401
Industrial Project 4 #	Design Project 3	1 and 2	IPRJ401(1STReg) IPRJ411 (2ndReg) IPRJ421 (3rdReg)

# Denotes continuous assessment

Field of Study Three:

B.TECH: ENGINEERING: ELECTRICAL: (Computer Systems) BTECS1

SUBJECTS	PREREQUISITES	Semester offered (Subject to change)	Subject Codes
Engineering Management 4#	None	1 and 2	EMGT402
Computer Networks 4	Network Systems 3	2 Only	CNET402
*Database Programming 4	Database Principles 3 Software Engineering 3	1 Only (once in two years) See note*	DBPR401
Engineering Mathematics 4	Mathematics 3	1 and 2	EMTH402
Microcontroller Systems 4#	Digital Systems 3	1 Only	MCSY401
*Software Engineering 4 #	Logic Design 3 Microprocessors 3 Software Engineering 3	2 Only (once in two years) See note*	SWEN401
Digital Signal Processing 4 #	Engineering Mathematics 4	2 only	DSPR401
Industrial Project 4 #	Design Project 3	1 and 2	IPRJ401 (1st Reg) IPRJ411 (2nd Reg) IPRJ421 (3rd Reg)

# Denotes continuous assessment
*Database Programming 4 offered part-time in 2017A, 2019A, etc
*Software Engineering 4 offered part-time in 2016B, 2018B, etc
Students registering for Industrial Project 4 must please take note of Rule BT2 (3)

NOTE:
The following are the core subjects for the B. Tech qualification:-

- Engineering Mathematics 4
- Engineering Management 4
- Microcontroller Systems 4
- Digital Signal Processing 4
- Industrial Project 4

*Please note that students can only register for the subject Circuit Analysis 4 with prior approval from the Department

DIPLOMA PHASE-OUT PLAN

1. Phase-out rules for the National Diploma : Engineering : Computer Systems

Important information for current and prospective students (effective as of January 2016):

The current National Diploma: Engineering: Computer Systems will be phased out starting in 2016 to allow for the introduction of the new Bachelor of Engineering Technology in Electronic Engineering.

The last cohort of first-time entering students admitted to this National Diploma qualification will be in January 2016.

Notwithstanding all the current rules (both General rules and Departmental Rules) that regulate this diploma, the last semester in which any student may register for each of the subjects is listed as follows:

Subject Name	Last Possible Semester of Registration
Communication Skills I	July 2016
Computer Skills I	July 2016
Programming I	July 2016
Electrical Engineering I	July 2016
Electronics I	July 2016
Mathematics I	July 2016
Digital Systems I	July 2016
Projects I	July 2017
Programming II	July 2017
Digital Communications II	July 2017
Electronics II	July 2017
Mathematics II	July 2017
Digital Systems II	July 2017
Operating Systems III	July 2018
Programming III	July 2018
Network Systems II	July 2018
Systems Analysis II	July 2018
Mathematics III	July 2018
Digital Systems III	July 2018
Design Project III	July 2019
Software Engineering III	July 2019
Network Systems III	July 2019
Database Principles III	July 2019
Logic Design III	July 2019
Microprocessors III	July 2019
Experiential Learning I (P1)	January 2020
Experiential Learning II (P2)	July 2020

New Rule
No student may register for Experiential Learning I or Experiential Learning II unless they have completed the following prerequisites. **Experiential Learning I (P1)** Pre-requisites: Complete ALL Diploma subjects BEFORE commencing Experiential Learning I **Experiential Learning II (P2)** Pre-requisites: Complete Experiential Learning I,

The dates stated in this rule are subject to change depending on the effective approval date for the new HEQF aligned programmes.

2. ***Phase-out rules for the National Diploma : Engineering : Electrical (Light Current)***
   Important information for current and prospective students (effective as of January 2016):

The current National Diploma: Engineering: Electrical (Light Current) will be phased out starting in 2016 to allow for the introduction of the new Bachelor of Engineering Technology in Electronic Engineering.
The last cohort of first-time entering students admitted to this National Diploma qualification will be in January 2016.
Notwithstanding all the current rules (both General rules and Departmental Rules) that regulate this diploma, the last semester in which any student may register for each of the subjects is listed as follows:

Subject Name	Last Possible semester of Registration
Communication Skills I	July 2016
Computer Skills I	July 2016
Electrical Engineering I	July 2016
Electronics I	July 2016
Mathematics I	July 2016
Digital Systems I	July 2016
Projects I	July 2017
Electrical Engineering II	July 2017
Electronics II	July 2017
Mathematics II	July 2017
Digital Systems II	July 2017
Projects II	July 2018
Electronic Communications II	July 2018
Electronics III	July 2018
Mathematics III	July 2018
Digital Systems III	July 2018
Process Instrumentation I	July 2018
Process Instrumentation II	July 2018
Control Systems II	July 2018
Design Project III	July 2019
Microwave Communication III	July 2019

Radio Engineering III	July 2019
Software Design II	July 2019
Network Systems II	July 2019
Process Instrumentation III	July 2019
Control Systems III	July 2019
Experiential Learning I (P1)	January 2020
Experiential Learning II (P2)	July 2020

New Rule

No student may register for Experiential Learning I or Experiential Learning II unless they have completed the following prerequisites.

Experiential Learning I (P1)

Pre-requisites: Complete ALL Diploma subjects BEFORE commencing Experiential Learning I

Experiential Learning II (P2)

Pre-requisites: Complete Experiential Learning I

The dates stated in this rule are subject to change depending on the effective approval date for the new HEQF aligned programmes.

ABBREVIATED SYLLABI:
NATIONAL DIPLOMA

A. **Contact Time**

For each subject, with the exception of Communication Skills 1, Computer Skills 1, Design Project 3 and Industrial Project 4, contact time per week is made up of four lecture periods and two periods devoted to either practical work or tutorials.

Computer Skills 1 and Communication Skills 1 each have one lecture period and two practical/tutorial periods per week.

Design Project 3 has two formal lecture periods per week. In addition to this the learner is expected to devote eight hours per week to unsupervised work on a design project.

Industrial Project 4 requires the learner to devote 300 hours to the completion of an industry-based project. Most of this time will be unsupervised work on the project with regular report back meetings with a member of the academic staff in the department.

B. **Self-Study**

A learner should set aside four hours per day (weekends included) for self-study and revision of work covered in lectures. In addition to this time will be required to prepare for tests, exams and to complete assignments.

C. **Abbreviated syllabi**

Communications Skills 1: Communication theory, oral presentation, technical writing, group communication skills.

Computer Skills 1: Computer Hardware including CPU, RAM, ROM, ALU and peripheral devices; Overview of Networks covering LAN, WAN, Internet, Intranet ; File Management in the Windows environment ; Performing mathematical calculations including conditional branching in Excel Spreadsheet; Word processing using MS Word covering tables, templates, Headers, Footers, Paragraphs, editing, savings, printing. Formatting.

Control Systems 2: Introduction to control systems and MATLAB. Dynamic models of physical systems. Standard control systems inputs. Solutions to transfer function and state space models. Transient and steady state response of first and second order systems. Time domain specifications of systems. Routh-Hurwitz stability criterion.

Control Systems 3: Control system design tools. Root locus plots. Frequency domain specifications, Bode plots, polar plots, log-magnitude versus phase plots and Nichols chart plots. Relation between frequency and time domain for second order systems. Introduction to compensator design. Simple designs.

Database Principles 3: Introduction to file systems and database systems. Data models. The relational database model. Entity relationship (ER) modelling. Normalisation of database tables. Advanced data modelling. Introduction to Structured Query language (SQL). Database design. Database connectivity. (project)

Design Project 3: The design, construction, testing and documentation of a complete project.

Digital Communication 2: Data communications and networking basics: Overview; Applications and networking terminology; Digital communications basics; Protocol basics; Protocol stacks. Telephone networks and modems: Introduction;

Transmission systems; Access network signalling; Trunk network signalling; Broadband modems; Internet service providers. Multimedia data representation and compression. Error detection methods. Forward error control. The World Wide Web: Introduction; Overview; URLs and HTTP; HTML; Java and JavaScript; Audio and video; Wireless Web; Web operation.

Digital Systems 1: The decimal, binary and hexadecimal number systems. The BCD system. Conversion between systems. Alphanumeric binary codes. Parity. Gray code. Basic logic functions. The AND, OR and NOT. The NAND, NOR XOR and XNOR. The universality of NAND and NOR. Dual symbols. Simplification using Boolean algebra. Simplification using the Karnaugh map. Combinational logic circuits. Functions of combinational logic, Adders, Comparators, Decoders, Encoders, Code converters, Multiplexers and Demultiplexers. Sequential logic circuits. Latches and Flip-Flops. Shift registers. Counters.

Digital Systems 2: Sequential logic circuits. JK and D flip flops and latches, operation, applications, timing diagrams, counters, shift registers, serial/parallel data transfer, sequence tables, astable and monostable multivibrators. Interfacing and data converters. Interface busses, digital to analog and analog to digital converters, parameters and performance issues. Memory devices. Data and Program memory devices. Flash memories. Application in microcomputers. Integrated circuit technologies. Displays. Multiplexing.

Digital Systems 3: Introduction to microprocessors and microcontrollers. Concepts of program storage and program processing. Basic assembly language programming and machine coding. Function of the CPU, memory and ports. Microcontroller architecture. Steps in program development and testing. Microcontroller circuit design. Microcontroller interfacing. Software and hardware timing techniques. Interrupts. Display multiplexing. Analogue to Digital conversion. Keypad interfacing. Comparison of microcontrollers.

Electrical Engineering 1: Introduction to electrical and mechanical engineering quantities and the application thereof, batteries, direct current theory and network analysis, alternating current theory and measurements, electromagnetism, magnetic circuits, inductance and capacitance.

Electrical Engineering 2: Alternating current networks, parallel and series resonance, direct and alternating current circuit analysis, power factor correction, harmonics, three phase circuits.

Electronic Communication 2: Introduction to communications engineering. Fourier series analysis. The spectrum. Frequency response of RLC circuits. The dB. Noise analysis, Noise Ratio and Noise Figure. Analogue modulation, AM, FM and PM. The radio receiver and the radio transmitter. Basic antennas and propagation. The radio link budget.

Electronics 1: Semiconductor basics. N type and P type materials, depletion region, and barrier potential. The diode. Ideal, practical and complete diode models. IV characteristics. Packages and terminal identification, data sheet and testing of diodes. Application and design as rectifier circuits in power supplies and as clippers and clampers. Troubleshooting power supplies and diode circuits. Zener diode characteristic. Basic zener regulator circuit. The Transistor. Structure, basic operation as an amplifier and as a switch,
Characteristic curves and parameters. DC load line and operating point. Package types and terminal identification. Testing of transistors. Transistor bias circuit analysis and design. Troubleshooting various faults in transistor circuits. Operational amplifiers, symbol, terminals and package types. The ideal and practical op-amp. Op-amp modes, single ended input and differential input operation. Bias current and offset voltage compensation. Negative feedback. Analysis of the non-inverting, inverting and voltage follower configurations.

Electronics 2: Power supply filters and regulators including series, shunt and integrated voltage regulators. Zener diodes and zener diode applications. Frequency response including basic concepts, the decibel, filters and plotting filter response. Op-Amps and Comparators- explanation of circuits, operation, derivations of relevant equations, sketch of circuit waveforms. Amplifiers (small signal analysis). Multistage amplifierss. Field Effect transistors including ac and dc analysis. Power Control devices including SCR, diac, triac and UJT. Use of characteristic curves to explain operation of the device and its applications. Power Amplifiers. The different classes (A, B, AB, C) including biasing of devices, efficiency and advantages or disadvantages.

Electronics 3: Amplifier theory and application: Direct coupled amplifiers; Direct-coupled differential amplifiers, differential and common mode signals and gains, CMRR; Current-source biasing, current mirrors, active loads. Integrated amplifiers: Op-amp applications; Performance limitations of real op amps; Oscillators: IC relaxation oscillators: Comparators and Schmitt triggers; astable circuits; Sinusoidal oscillators: Positive feedback, Barkhausen criterion Wein-bridge and phase-shift circuits. Voltage regulators: feedback voltage regulators; Switching regulators and IC regulators. Power transistors and heatsinking. Passive filter design: Passive RC filters; transfer characteristic analysis, limitations. Filter performance criteria. Filter types; Butterworth, Chebyshev, Bessel. Simple passive filter design. Noise: measurement and interference. Noise bandwidth limitation.

Logic Design 3: Introduction to PLDs. PLD types, uses and internal configurations. Performance issues. Implementation of a wide range of logic functions and logic devices using industry-standard PLDs. Programming, simulation and real-time prototype testing. Complete design of a digital project including background information, block diagrams, circuit design, testing and troubleshooting, recording resultant data and project presentation.

Mathematics 1: Determinants, logarithms, formulae, trigonometry, radian measure, complex numbers, statistics, differentiation, elementary integration.

Mathematics 2: Differentiation, integration and first order differential equations with applications, matrices.

Mathematics 3: The solution of ODEs by D-operators, Laplace transforms, numerical techniques. Eigenvalues and eigenvectors, Fourier series.

Microprocessors 3: Interpreting and understanding the architecture of a microprocessor system, programming a microprocessor system to perform small functions and applying microprocessor software design tools and techniques.

Microwave Communication 3: Mismatched transmission lines, VSWR, Reflection Coefficient and Return Loss, The Smith Chart, Microstrip. Lumped element components at high frequencies, Lumped and distributed element impedance matching networks. Network characterization using Y and S parameters, power gains associated with a 2 port network, the Vector Network Analyser. Narrowband amplifier design, stability, design for maximum available gain, design with potentially unstable active devices. Thermal noise, noise figure, cascaded noise figure, equivalent noise temperature, C/N and G/T ratio, measurement of noise figure, low noise amplifier design.

Network Systems 2: The subject explores the key topics in the field of data and computer communications, pertaining to the Network Layer, in the following general categories: Local Area Networks and Intranets. Wireless Networks. The Internet Protocol. Security. Radio Propagation and Transmission Basics.

Network Systems 3: The subject explores the key topics in the field of data and computer communications in the following general categories:
Transport Layer: Address/Name resolution, Addressing methods, Segment development, Connection services, End-to-end flow control.
Application Layer: Dialog control, Session administration, Translation and Encryption, Service advertisement and Service use Methods.

Operating Systems 3: Introduction to Operating Systems. Discover the concepts, structure and mechanisms of Operating Systems. Beginning with the management of main memory and moving on to processors, devices, files and networks. Evaluate and research the nature and characteristics of modern operating systems. Compare key areas of Operating Systems design and relate contemporary issues to future directions in the Development of Operating Systems including Open Source Software and Open Standards.

Process Instrumentation 2a: Introduction to instrumentation engineering terminology and definitions. Introduction to radioactivity and radiation measuring devices. Basic pressure measurement terminology, units and references (types). Pressure measuring devices. Level measurement methods. Temperature measurements: Contact and non-contact methods. Introduction to flow measurements. Process instrumentation engineering documentation: Symbols / logic symbols / tag numbering and loop diagrams.

Process Instrumentation 2b: Process control basics (On/Off control and PID control), Flow introduction, Bernoulli's theorem. Flow measuring devices (restriction devices, velocity detectors, mass flow detectors and volume flow detectors), Flow calculations (liquid flow and steam flow), Valves, Actuators (pneumatic and electric), Positioners, Pumps, Telemetry (analogue and digital), Instrument documentation (P&ID and loop diagrams).

Process Instrumentation 3: Unit operations: Boilers, distillation columns, heat exchangers, refrigeration systems. Control Systems: Discrete hardware, interface considerations, PLC, DCS. Control Strategies: Feedback, feed forward, decoupling, cascade, ratio. Analysers: Sampling, chromatographs, oxygen, pH, conductivity. Machine Control: Encoders, proximity devices, current, shaft speed, drives. Instrumentation Engineering: Hazardous environments, air supplies, electrical supplies, signal wiring practice.

Programming 1: An introduction to basic programming techniques. Problem solving techniques eg algorithms, flowcharting, tracing. Introduction to g++ for Linux. Use of complex programming structures such as control structures, arrays and functions. Programming of hardware devices via the parallel port.

Programming 2: Application development in C/C++ using the Object-Oriented programming paradigm (composition, inheritance and polymorphism). Reading from and writing to text and binary files. String manipulation using character arrays and string objects. The use of pointers to enhance program efficiency. Reading data from and sending data to the parallel port. Introduction to STL (Standard Template Library) and the graphics library.

Programming 3: Internet Programming using JavaScript for interactive Web pages. Data and control structures using JavaScript. An introduction to Query language to implement database access through Web pages.

Projects 1: Planning and construction of a project. Computer aided drawing. Ergonomic and aesthetic design principles. Safety. Workshop tools and machines. Sheet metal work. Materials technology. Connections. Printed circuit boards. Soldering.

Projects 2: Design, planning, construction, and testing of a project. Design specifications and data sheets. Component failure and reliability. PCB silk screening, thru-hole plating and thick film technology. Single and double sided PCB track layout and board manufacture methods.

Radio Engineering 3: Phase-locked loops and RF applications, frequency synthesis, Fourier series and Fourier transform in the context of digital modulation, Shannon-Hartley theorem, Shannon limit, pulse shaping, typical pulse formats, power in digital signals, sampling, DACs, ADCs, multiplexed PCM, dynamic range, quantisation noise, companding, codecs, OOK, BPSK, quadrature modulator, quadrature demodulator, m-PSK, DQPSK, pi/4-DQPSK, BFSK, MSK, GMSK, m-QAM, ASCII, error detection and correction, convolutional codes, CRC, noise and error rate, serial interface standards.

Software Design 2: General software design utilising the top-down design method. The VB6 IDE. Event-driven programming. Designing a GUI. Variables, arrays, and the scope of variables. Relational expressions. Control structures. Loop structures. Timers. Line drawing. Sequential file access. Serial communications. Data acquisition and analysis.

Electronic Communications option: EXCEL applications including Fourier series, Fourier transforms, FFT, Macros and VBA programming.
Process Instrumentation and Control option: General PLC operation. Inputs and outputs. Latching circuits. Timers. Counters. Ladder logic. Statement list. Function block.

Software Engineering 3: System development life cycle models. The five stages of software process. Testing, requirements phase, analysis phase, object orientated analysis, design phase, implementation. Post-delivery maintenance. Planning the software process.

Systems Analysis 2: Introduction to concepts, principles, and stages of computer-based information systems analysis. Systems development and the different methods, tools, and techniques used in systems analysis and design.
Feasibility study, requirements for definition design and development of documentation. The system development life cycle, prototyping, data modelling, and user involvement. The objective of the course is to learn and demonstrate an understanding of systems analysis principles, concepts, and evaluation and to gain an appreciation for the scope of systems analysis in a business organization context.

BACHELOR OF TECHNOLOGY

Computer Networks 4: Advanced top-down approach of the protocol stack featuring the Internet. Advanced application layer protocols (HTTP, SMTP, FTP, DNS). P2P file sharing. Building a simple Web server (TCP/UDP). Principles of reliable data transfer —Go-Back-N and Selective Repeat algorithms. Principles of Flow Control and Congestion Control. Forwarding and Routing (Distance-Vector/ Link-State algorithms) in the Internet (IPv4 & IPv6). Error-detection and Correction techniques including Parity, Check summing and CRC coding. Wireless and mobile networks including Wi-Fi and Bluetooth.

Control Systems 4: Analysis and design of control systems in the state space. Computational Intelligence. Artificial Neural Networks. Fuzzy Knowledge based systems. Evolutionary Algorithms. Swarm Algorithms.

Electronic Communications 4: Signal representation, Fourier transforms, transmission through linear systems, convolution, random signals and probability, histograms, probability density functions, Gaussian distribution and the error function. Baseband digital communication, source and channel coding. The effect of noise and inter symbol interference. Forward error correction, block and convolutional codes. Digital modulation, ASK, PSK, FSK, QAM, MSK. Error performance of digital modulated signals, measurements on digital communication systems.

Electronic Communication Systems 4: Introduction to teletraffic. The Erlang B and C formulas and their use. The public switched telephone network. The local loop. The transmission system, PCM and the PCM frame hierarchy. Signaling. Switching systems, time and space switches. The GSM cellular system. The cellular concept, the air interface, TDMA, FDM and the frame structure. Data communications. The OSI model. LANs, WANs and the internet. Radio wave propagation in the troposphere. Radio refractive index. Link budget calculations for analogue and digital radio links.

Engineering Mathematics 4: Linear differential equations, complex analysis, difference equations, linear algebra, z transforms.

Digital Signal Processing 4: Discrete time DAC Synthesis techniques Elaborate signals complex exponentials ADC and sampling aliasing filtering time invariance, linearity system difference equation impulse response FIR, IIR testing method stability convolution causality DFT programming the DFT FFT LTI systems DTFT use of equaliser reconstruction filters Z-transform poles and zeros pure real system design stability oscillator design gain response phase response linear phase direct form I and II cascade structure.

Engineering Management 4: General management, Strategic Management, Market Management, Creativity and Teamwork, Quality, Production, Process Redesign, Change Management, Motivation, Labour Procedures, Project Management, Time Value of Money, Entrepreneurship, Financial Accounts.

Industrial Project 4: 300 hour industrial design project involving application of advanced principles related to the field of study.

Microcontroller Systems 4: Embedded system, microprocessor, microcontroller, RAM, EPROM, EEPROM, flash memory, ADC, DAC, C programming language, C syntax, compiler, cross-compiler, preprocessor, C preprocessor, in-circuit emulator, debugger, debugging, revision control, SPI, I2C, RS-232, CAN, USB, Ethernet, real-time computing, real-time operating system, embedded Linux, Contiki, semaphore programming, message passing, interrupt, interrupt latency, system-on-a-chip, ASIC, PLD, FPGA, surface-mount technology, RoHS Directive, lead-free solder, electromagnetic interference, practical construction project, practical design, high-level programming and debugging of embedded system.

Microwave Engineering 4: Principles of oscillator design using the loop method and the negative resistance method. LC oscillators, resonator Q factor, augmented resonators. Transmission line resonators, quartz crystal resonators and SAW resonators. Flicker and phase noise, measurement of phase noise. Negative resistance oscillators. An introduction to RF power amplifier design, Linear and non-linear networks, transmission distortion, gain compression, harmonic and intermodulation distortion, cascaded 3rd order intercept. An introduction to class A power amplifier design. Stability, the design of a class A power amplifier.

Process Control 4: PLC Systems: Scan time, power supplies, marshalling, grounding and noise, project management and documentation, software, commissioning, communications, bus systems, IEC 61131. DCS: layout and functions, dependability issues, design. Single loop controllers: Structure, configuration, application. SCADA systems: Structure, implementation, communications issues.

Process Instrumentation 4: Analysers: Selection, application, sampling systems, Stack gas, water quality. Final Control Elements: Control valve sizing and selection, variable speed drive sizing and selection. Control rooms: Lighting, air conditioning, pressurization, fire protection, noise, ergonomics. Unit operations: pH control, reactor control.

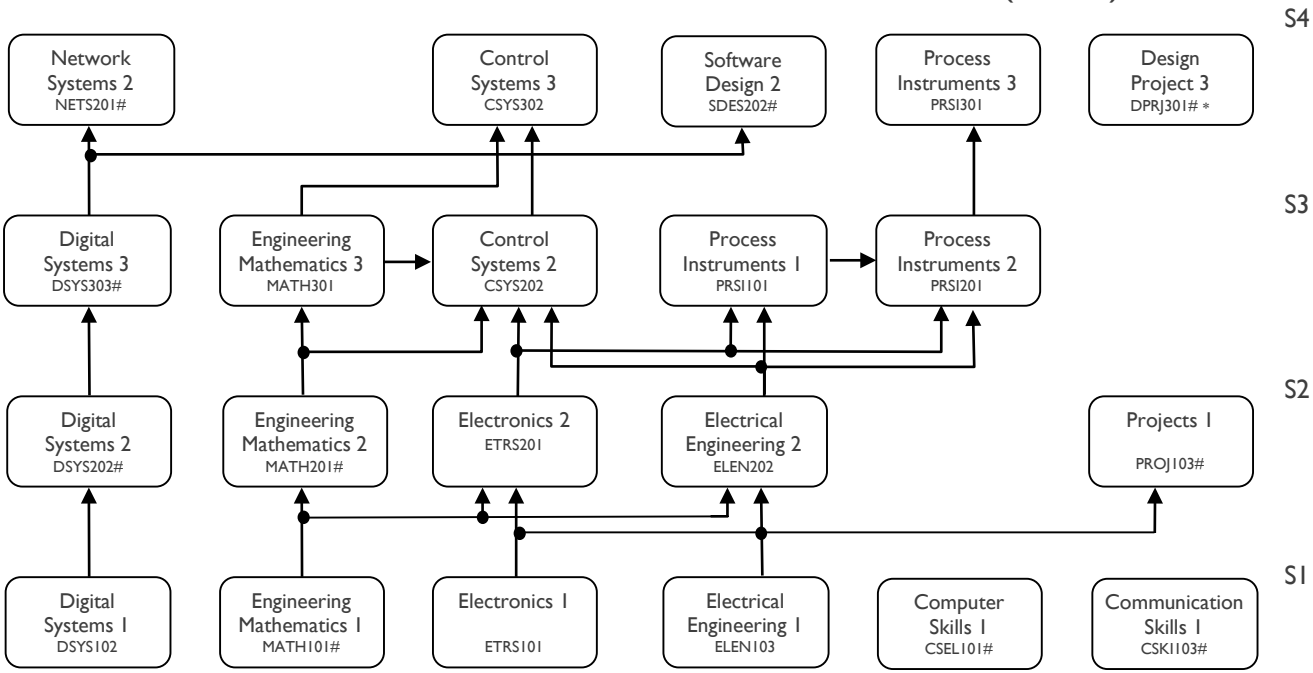
Software Systems 4: Graphical applications software as applied to microprocessor systems.

Micro Systems Design 4: Microprocessors types up to Pentium 4. Addressing modes, instruction sets, assembly language. C/C++. I/O interface, DMA, interrupts.

Software Engineering 4: Outline of software development, software development life cycle, planning and estimating, test plan, requirements, properties of good requirements, specifications, software design, coding, wrapping up design and coding, software testing, coverage and systematic testing.

Database Programming 4: Basic concepts of database systems and advanced database systems. An overview of various theoretical approaches to database management systems and structures. Implementation and use of database systems, setting up of a database using fourth generation languages and database programming. A study of one database system implementation. Database planning, data models, R-R diagrams, database models, code generation packages.

APPENDIX 1: FIELD OF STUDY 1 - PROCESS INSTRUMENTATION AND CONTROL (NDEIN1)



NOTES:

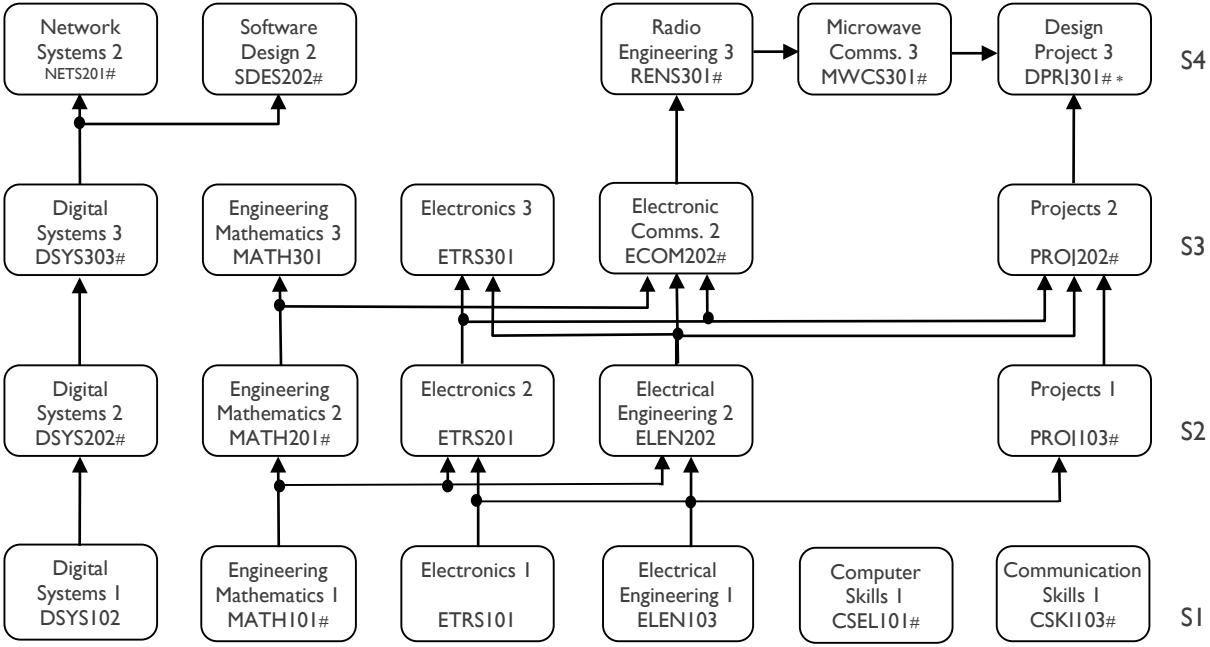
↑ Denotes prerequisites, that is, lower level subject must be completed first.

→ Denotes complementary, that is, must register for prior to or simultaneously with.

\# Denotes continuous assessment.

* All S4 level subjects are complementary to Design Project 3.

APPENDIX 2: FIELD OF STUDY 2 - ELECTRONIC COMMUNICATIONS (NDECM1)



NOTES:

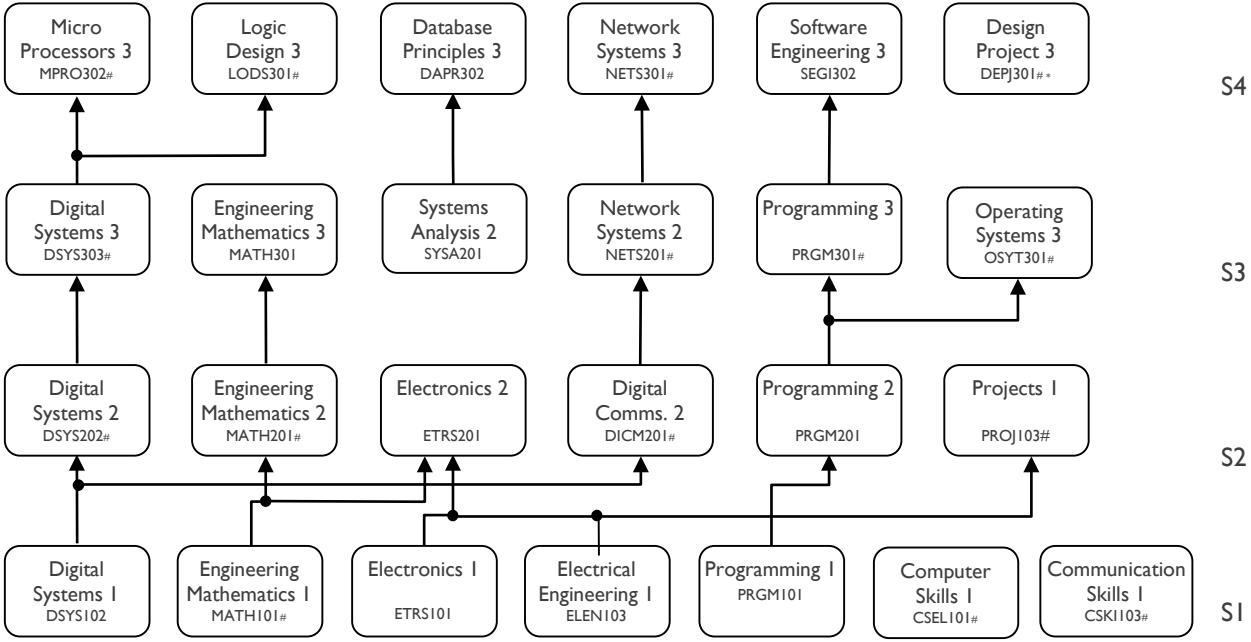
↑ Denotes prerequisites, that is, lower level subject must be completed first.

→ Denotes complementary, that is, must register for prior to or simultaneously with.

\# Denotes continuous assessment.

* Radio Engineering 3 and Microwave Communication 3 are complementary to Design Project 3.

APPENDIX 3: FIELD OF STUDY 3 - COMPUTER SYSTEMS (NDCSY2)



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↑ Denotes prerequisites, that is, lower level subject must be completed first.

→ Denotes complementary, that is, must register for prior to or simultaneously with.

\# Denotes continuous assessment.

* All S4 level subjects are complementary to Design Project 3.