Department of Electrical Engineering

Minutes of meeting of the Departmental Faculty Board

The 10th of December, 2012

The Departmental Faculty board (DFB) was held in the EE Committee room at 15:30 hrs on the 10th of December 2012. The following members were present:

AJ, BL, BB, SA, NSR, SDJ, VKJ, SC, SDe, SB, SDR, BS, MVC, AD, SBC, MB, SK, RKM, JD, GB, SJ.

1. The DFB confirmed the minutes of its earlier meeting.

1. The DFB welcomed new faculty, Dr. Sumeet Agarwal into the department.

1. The DFB discussed the UG curriculum review. The following suggestions were given by the DFB.

i. i. The DFB suggested that the two UG programmes offered by the department be named as (a) B. Tech in Electrical Engineering and (b) B. Tech in Electrical Engineering (Power and Automation)

ii. ii. It was also suggested that the B. Tech student intake be distributed among the two programmes in 3:2 ratio,

iii. iii. It was strongly suggested by the DFB that the course 'Fundamentals of Electrical Engineering', which is a core course for all B. Tech students, be taught by two faculty, to cover the broad sub-topics of Electromagnetic, and Electronic Circuits and Networks respectively.

iv. iv. The DFB felt that the proposed contents of the 'Materials Science' course are too heavy to be covered as a single course. It was suggested that the content of the course be reduced. The updated course content can be directly approved by the HOD and need not be re-ratified by the DFB.

CC: All faculty members

(**S. Janardhanan**)
DFB Convenor

Details attached.

Consolidated Proposal for UG Curriculum of EE Dept. (version 1.0)

DUGC through a series of meetings and lengthy discussions have come up with a basic framework for undergraduate programmes of the department of Electrical Engg.. This proposal is being submitted to HOD for possible consideration in the next DFB.

I. FRAME WORK OF THE BASIC B.TECH Programmes

A. Objective

Today, electrical engineering as a discipline that encompasses a remarkably diverse and fertile set of technological areas, including analog and digital electronics, computer and embedded systems, design and fabrication of VLSI/ULSI, intelligent robotic systems, cognitive and bio-inspired technologies, control systems, telecommunications and computer networking, wireless communication systems, signal and information processing and multimedia systems, solid state physics and devices, micro and nano-electronics, micro-electromechanical systems (MEMS), electromagnetic and electromechanical systems, power engineering, renewable energy, electrical transportation systems, green technologies, etc. Unlike many other institutions in the country, this department has the expertise to offer education and research leadership in all of these diverse areas. An important factor for the growth of these diverse areas has been the inter-disciplinary integration of technology across different sub-areas of Electrical Engineering. Against this background, DUGC would like to define objective of the undergraduate academic programme of the department in the following way:

The undergraduate programmes of the department should enable a student to build a broad based academic background which would enable him/her to pursue any of these diverse areas of Electrical Engineering either in an industry-based or research-based career.

B. Framework

Taking into account departmental strength and trends in technology, DUGC proposed to offer two B.Tech programmes with different focus but having desired breadth and inter-disciplinarity within the field of Electrical Engineering. These programmes will address different applications requirements. Also, given the breadth of the field of Electrical Engineering, DUGC have found that it will not be possible to cover all aspects of

Electrical Engineering as core component of the curriculum. In order to provide coverage of reasonable depth of some areas in the core requirement to address application dependent requirements, focus areas were defined in terms of courses in the areas of

(i) Communication Engineering

(ii) Electromechanical Energy Conversion and Power Engineering

However, each of these programmes have been framed with the basic philosophy that core departmental requirement for the undergraduate degree will have approximately 50-50 split between focus area and other areas of Electrical Engineering so that a student can have option and flexibility to pursue any of the diverse and emerging areas of Electrical Engineering.

These two programmes will be referred to as

A. B.Tech in Electrical Engg.
B. B.Tech in Electrical Engg. (Power and Automation)

C. Proposed Credit Distribution

Department Linked EA/ES & BS Courses (same for both the programmes)

1. Probability and Stochastic Process (Maths)- 4cr
2. Material Science (from Physics) – 3cr
3. Data Structures (CSE) - 4cr
4. Thermodynamics (ME) - 4 cr

Total : 15 credits

Departmental Core

Areas / Strengths	Courses	L	T	P	Total Credits	Prog. A	Prog.B
Computers	Computer Architecture	3	0	0	3	3	3
	Digital Systems Lab (arch + emmbedded)	0	0	3		1.5	1.5
	Embedded Systems	3	0	0	3	0	3
Control	Control Engineering	3	1	3	5.5	5.5	5.5
Devices	Physical Electronics	3	0	0	3	3	0
	Power Electronics and Energy Devices	3	0	0	3	0	3
Electronics	Circuit Theory	3	1	0	4	4	4
	Analog Electronics	3	1	3	5.5	5.5	5.5

	Digital Electronics	3	0	3	4.5	4.5	4.5
Communications	Engineering Electromagnetics	3	1	3	5.5	5.5	0
	Communications Engineering	3	1	3	5.5	5	0
	Signals and Systems	3	1	0	4	4	4
Machines and Drives	Electromechanics I	3	1	3	5.5	5.5	5.5
	Electric Drives	3	0	3	4.5	0	4.5
	Power Electronics circuits	3	0	3	4.5	4.5	4.5
Power and Energy	Power Engineering I	3	1	3	5.5	5.5	5.5
	Power Engineering II	3	0	0	3	0	3
BTP					3	3	3
						60	**60**

Prog. A: B.Tech in Electrical Engg.

Prog. B: B.Tech in Electrical Engg. (power and Automation)

Departmental Electives: 10 credits (to be identified)

Total Credit Requirement: 60 (institute core) + 15 (dept. linked EA/ES, BS) + 60 (dept. core) + 10 (departmental elective) + 10 (open category, if not opted for departmental specialization) = 155 credits (graded) with 15 non-graded credits.

II. Proposed Departmental Specialisations

DUGC has proposed a set of departmental specialization taken into account departmental strength. These areas have been made interdisciplinary so that a student can understand the importance and significance of integration technology across different sub-disciplines of Electrical Engineering and have an integrated picture.

These areas will require students to do 20 credits. DUGC propose that as part of specialization students will do BTP part-2 of 8 credits. Remaining 12 credits will be earned through courses.

DUGC has proposed following Areas of specialization

- Systems and Control
- Appliance Engineering
- Smart Grid and Renewable Energy
- Energy efficient Technologies

- Electric Transportation
- VLSI and Embedded systems
- Nano-electronic and photonic systems
- Cognitive and Intelligent systems
- Communication Systems and Networking
- Information Processing

These areas will be available to the students of both the programmes provided they satisfy the pre-requisites of the courses. They may do additional credits to satisfy the requirements.

DUGC has also identified a set of possible courses to define the specialisations:

Systems and Control

- Linear system theory
- Non-linear control
- Digital control
- Robotics and Automation
- Random Processes in control and Estimation
- Systems Biology
- Special Topics in S&C – I
- Special Modules in S&C – I
- BTP part-II

Appliance Engineering

- Embedded Systems
- Digital Signal Processing
- Special motors
- Advanced motors
- Intelligent control
- Appliance system Design (from Design and Innovation Centre)
- Mechatronics
- Special Topics in AE – I (EEL, 3-0-0)
- Special Modules in AE – I (EEV, 1-0-0)
- BTP part-II (EED, 0-0-8)

Smart Grid and Renewable Energy

- Power system analysis
- Power system dynamics
- Smart Grids
- Distributed generation

- Renewable energy
- FACTS / HVDC
- Special Topics in SG&RE – I
- Special Modules in SG&RE – I
- BTP part-II

Energy efficient Technologies

- Energy efficient motors
- Advanced drives
- Energy efficient systems
- Low power devices and circuits
- Power efficient architecture
- Power aware communication
- Intelligent power systems
- Special Topics in EET – I
- Special Modules in EET – I
- BTP part-II

Electric Transportation

- Electric vehicles
- Advanced motors
- Electric transportation in industry
- Modeling and analysis of electrical machines
- Solid state control of drives
- Energy efficient systems
- Special Topics in ET – I
- Special Modules in ET – I
- BTP part-II

VLSI and Embedded systems

- Digital VLSI design
- Analog VLSI design
- Mixed signal circuit design
- Computer aided design
- Digital Signal Processing
- Embedded Systems
- Digital Hardware Design

- Special Topics in V&ES – I
- Special Modules in V&ES – I
- BTP part-II

Nano-electronic and photonic systems

- Principles of advanced transistors
- IC technology and fabrication
- Micro and Nano photonics
- Quantum Electronics
- Nano material properties and developments
- Special Topics in NE&PS – I
- Special Modules in NE&PS – I
- BTP part-II

Cognitive and Intelligent systems

- Machine Learning
- Neural Networks
- Soft computing
- Pattern recognition
- Intelligent power systems
- Cognitive systems
- Systems Biology
- Intelligent control
- Special Topics in C&IS – I
- Special Modules in C&IS – I
- BTP part-II

Communication Systems and Networking

- Signal Theory
- Digital Communications
- Computer Networks
- Broadband Communications
- Mobile Communications
- Telecom transmission and switching
- Information theory and coding
- Satellite communication
- Optical communication

- Microwave theory and techniques
- Special Topics in AT&NS – I
- Special Modules in AT&NS – I
- BTP part-II

Information Processing

- Signal theory
- Detection and estimation theory
- Pattern recognition
- Image processing
- Statistical signal processing
- Computer vision
- Multimedia systems
- Speech and Audio processing
- Information theory and coding
- Special Topics in IP – I
- Special Topics in IP – II
- Special Modules in IP – I
- BTP part-II

This structure and the set of areas are tentative. These will undergo changes with further discussions and feedback.

III. Dual Degree

DUGC recommends that there will be no intake for Dual Degree programme through JEE.

B.Tech students will have the opportunity to switch to dual degree programme at the end of the third year. If they opt for dual degree programme, they will be doing additional course work instead of BTP-II. In the fifth year they will do M.Tech project.

Dual Degrees should be aligned to the departmental M.Tech/M.S programmes and built upon departmental specialisations. It is expected that courses listed under departmental specialization will be common with first year courses of two-year M.Tech/M.S programmes.

IV. Proposed Course Content of Fundamentals of Electrical Engg. (part of Institute core)

DUGC proposed following content of the course

The structure will be 3-0-2

Lecture component

1. Elements in an Electrical circuit: R, L, C, Diode, Voltage and current sources (independent and dependent / controlled sources with examples)
2. DC circuits, KCL, KVL, Network theorems, Mesh and nodal analysis
3. Step response in RL, RC, RLC circuits
4. Phasor analysis of AC circuits
5. Single-phase and 3-phase circuits
6. Two port networks, BJT: CE and small signal model, Operational amplifiers: Model and applications
7. Introduction to Digital circuits
8. Magnetic circuits, Transformers: Modeling and analysis; parameter determination
9. Energy in magnetic field
10. Electromechanical energy conversion principles with examples
11. Principles of measurement of voltage, current and power

Laboratory component and the List of experiments

1. CRO (mechanism and usage)
2. KCL, KVL, Network theorem verification
3. Step / transient response of RL, RC, RLC circuits
4. Steady state response of RLC circuits for sinusoidal excitation
5. Diode experiment (clipping, clamping and rectification)
6. Basic circuits using opamp
7. Transformer OC and SC tests
8. BH loop in an iron core, DC and AC motor – for observation only
9. A small mini-project component has to be included for the students to explore something new in terms of control of a small toy motor or construction of a simple digital circuit, relay or an amplifier or an antenna etc. (should start at the beginning of the semester)

V. Proposed Material Science Course

DUGC agreed upon the requirement of a EE Dept. specific Materials Science course. Dept. of Physics has been requested to offer a course with following tentative course content:

Course: Material Science for EE Students

Suggested Course content for consideration by the Physics Department

Crystal Structure, Bonding, Defects (19 Lectures - 5 lectures for the quantum mechanics revision section, and 14 for the other sections)

Basic revision of quantum mechanics* (Schrödinger's Equation and Discrete Energy States of a confined electron, Free electrons, Electrons in a metal, The hydrogen atom, Molecules from atoms: energy minimization, Hybridization of atomic orbitals), Crystal structure (Bravis Lattices, Primitive unit cell, Wigner-Seitz cell, Diamond and Zincblend lattice, Perovskites), glasses and quasi crystals, Diffraction by a discrete lattice, X-rays at Work - Laue Condition, Ewald Construction, Bragg's Law, X-ray diffraction, Electron and neutron diffraction, Defects, Lattice vibration - concepts of Debye and Einstein temperatures, thermal conductivity.

Dielectric properties of materials (11 Lectures)

Conductors and Resistors, Types of polarizations, local field and Clausius-Mossotti equation, dielectric constants and dielectric loss, dielectric strength and insulation breakdown, capacitor dielectric materials, piezo, ferro, and pyro electricity. Quartz oscillators and filters, piezo-spark generators, uni- and multi-axial ferroelectrics, pyroelectric detectors and devices.

Magnetic properties of materials (12 Lectures)

Unpaired d electrons in solids, Microscopic Source of Magnetization, classification of magnetic materials: diamagnetism, paramagnetism (Temperature Dependence of Paramagnetism, Pauli Paramagnetism, Landau paramagnetism), ferromagnetism, antiferromagnetism, magnetic domains, soft and hard magnetic materials, Meissner effect, flux quantization, field penetration and high frequency effects, Johnson junctions, SQUID, soft and hard superconductors, superconducting magnets.

*Basic revision of quantum mechanics - As the EE students would have covered quantum mechanics in the first year physics course, this course would cover this material in only 5 lectures as a revision and as a set-up for the materials course)