

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 + embedded)	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: 55 (institute core) + 15 (dept. linked EA/ES, BS) + 60 (dept. core) + 10 (departmental elective) + 10 (open category, if not opted for departmental specialization) = 150 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 (Bravais Lattices, Primitive unit cell, Wigner-Seitz cell, Diamond and Zincblende 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 pyroelectricity. 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)

EE1

III	EEL202 Circuit Th 3-1-0	CSL201 3-0-4	EEL203 Electromech 3-1-0	EEL218 Phys. Elec 3-0-0	EEL205 Sig Sys 3-1-0	ENV 2-0-0			22
IV	EEL201 Dig Elec 3-0-3	EEL207 Electromagnetics 3-1-0	BIO 3-0-2	Prob&Stat 3-1-0	EEL301 Control Sys 3-1-0	EEP203 0-0-3			22
V	EEL204 Analog Elec 3-1-3	EEL306 Comm Engg 3-1-0	HUL1 3-1-0	EEL209 Power Elec 3-0-0	EEL308 Comp Arch 3-0-0	EEP207 0-0-3	EEP301 Control Lab 0-0-3		22.5
VI	Thermo 3-0-0	HUL2 3-1-0	Mat Sci 3-0-0	EEL303 Power Engg 3-1-0	DE1 3-0-2	EEP306 0-0-2	EEP308 Comp Arch Lab 0-0-3	EEP209 Power Elec Lab 0-0-3	22
VII	HUL3 3-1-0	HUL4 3-0-0	DE2 3-0-0	OC1 3-0-2	BTP1 0-0-6	EEP303 0-0-3			18.5
VIII	DE3 3-0-0	OC2 3-0-0	OC3 3-0-0						9

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III	EEL202 Circuit Th 3-1-0	CSL201 3-0-4	EEL203 Electromech 3-1-0	BIO 3-0-2	EEL205 Sig Sys 3-1-0				21
IV	EEL201 Dig Elec 3-0-3	PE&ED 3-0-0	ENV 2-0-0	Prob&Stat 3-1-0	EEL301 Control Sys 3-1-0	HUL1 3-1-0	EEP203 Electromech 0-0-3		23
V	EEL204 Analog Elec 3-1-3	DE1 3-0-2	EEL209 Power Elec 3-0-0	HUL2 3-1-0	EEL308 Comp Arch 3-0-0	EEP301 Control Lab 0-0-3			21
VI	Thermo 3-0-0	Emb Sys 3-0-0	Mat Sci 3-0-0	EEL303 Power Engg 3-1-0	EEL305 Elec Drives 3-0-0	EEP308 Comp Arch Lab 0-0-3	EEP209 Power Elec Lab 0-0-3		19
VII	HUL3 3-1-0	HUL4 3-0-0	Power Engg II 3-0-0	OC1 3-0-2	BTP1 0-0-6	EEP303 Power Lab 0-0-3	EEP305 Elec Drives Lab 0-0-3		20
VIII	DE2 3-0-0	DE3 3-0-0	OC2 3-0-0	OC3 3-0-0					12

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COURSE TEMPLATE

1.	Department/Centre proposing the course	Electrical Engineering
2.	Course Title (<i>< 45 characters</i>)	Digital Electronics Circuits
3.	L-T-P structure	3-0-3
4.	Credits	4.5
5.	Course number	EEL - 201
6.	Status (<i>category for program</i>)	B.Tech Core for EE1 and EE3

7.	Pre-requisites (<i>course no./title</i>)	EEL - 100
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	None
8.2	Overlap with any UG/PG course of other Dept./Centre	None
8.3	Supersedes any existing course	None

9.	Not allowed for (<i>indicate program names</i>)	-
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10.	Frequency of offering	☐ Every sem ☒ 1stsem ☐ 2ndsem ☐ Either sem - 2 nd Yr, 1 st Sem.
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11.	Faculty who will teach the course Dr. Shouri Chatterjee, Dr. Anuj Dhawan, Dr. Turbo Majumder, Prof G.S. Visweswaran, Prof. Basabi Bhaumik and Prof. Jayadeva.
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12.	Will the course require any visiting faculty?	No
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13.	Course objectives (<i>about 50 words</i>): To equip students with understanding of Digital Logic and applications: Combinational and Sequential Circuit Design, Pipelining, Memories and Asynchronous circuit Design. Familiarity with VHDL.
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14.	Course contents (about 100 words) (Include laboratory/design activities): Gates, binary number systems, arithmetic operations. Minimization using K-maps, reduced K-maps, tabular methods; design using multiplexers, decoders, and ROMs. Latches, flip-flops, registers and counters. Asynchronous, synchronous counters. Finite state machines, implementations thereof. Mealy, Moore machines. Clock period computation. Memories. Partitioning and pipelining. VHDL/Verilog, the register-transfer-level description style. Switch level introduction to logic families, CMOS logic, static, pre-charge and clocked logic. Asynchronous circuits and design styles.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction: Gates, Binary number systems and arithmetic operations.	4
2	Minimization- K-Map and Tabular methods, Design using decoders, MUX, ROMs, etc.	8
3	Latches, FF, registers and counters, clock period computation, Memories,	8
4	FSM and its implementations	5
5	Partitioning and pipelining	5
6	VHDL / Verilog, Description styles and examples.	3
7	Switch level introduction to Logic families, CMOS Logic: Static, precharge and clocked logic.	5
8	Introduction to asynchronous circuits and design styles.	4
COURSE TOTAL (14 times 'L')		42
16.	Brief description of tutorial activities: Tutorials are embedded in the Lectures.	

17. Brief description of laboratory activities

The laboratory will involve experiments on the breadboard and on CPLD kits, along with the corresponding subject in the lectures. A brief outline of the experiments to be done are as follows:

1	Introduction to the laboratory	1
2	Combinational circuit design	1
3	Exercise with adders	1
4	Exercise with multiplexers	1
5	Design of flip-flops	2
6	FPGA / CPLD programming : Sequential Circuits and system design.	8
	Total laboratory sessions	14

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

M. Morris Mano, Michael D. Ciletti, "Digital Design", Prentice Hall of India Pvt. Ltd., 2008.
Brian Holdsworth, Clive Woods, "Digital Logic Design", Elsevier India Pvt. Ltd., 2005.
Samir Palnitkar, "Verilog HDL, A Guide to Digital Design and Synthesis", Prentice Hall of India Pvt. Ltd., 2005.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Xilinx and Altera software (free) will be provided to the students for use with CPLD kits.
19.2	Hardware	CPLD kits/ FPGA kits and PCs will be provided in the laboratory
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	The electronics laboratory will be used for the course.
19.5	Equipment	Power supplies, multimeters, oscilloscopes, function generators will be provided to the students. Consumables including breadboards, wires, various ICs will be required for the course.
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	A course project on the CPLD kits will be given to the students.
20.4	Open-ended laboratory work	A course project on the CPLD kits will be given to the students.
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the course	Electrical Engineering
2.	Course Title (<i>< 45 characters</i>)	Circuit Theory
3.	L-T-P structure	3-1-0
4.	Credits	4
5.	Course number	EEL - 202
6.	Status (<i>category for program</i>)	B.Tech Core for EE1 and EE3

7.	Pre-requisites (<i>course no./title</i>)	EEL - 100
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	None
8.2	Overlap with any UG/PG course of other Dept./Centre	None
8.3	Supersedes any existing course	None

9.	Not allowed for (<i>indicate program names</i>)	-
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10.	Frequency of offering	☐ Every sem ☒ 1stsem ☐ 2ndsem ☐ Either sem - 2 nd Yr, 1 st Sem.
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11.	Faculty who will teach the course Prof. I.N. Kar, Prof Shouri Chatterjee, Prof G.S. Visweswaran, Prof Shaunak Sen, Prof Jayadeva, Prof Shankar Prakriya, Prof Mukul Sarkar	
12.	Will the course require any visiting faculty?	No

13.	Course objectives (<i>about 50 words</i>): To equip students with circuit analysis techniques, in time and frequency domain; further, to introduce students to circuit synthesis.
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14.	Course contents (about 100 words) (Include laboratory/design
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	activities): Overview of network analysis techniques, network theorems, transient and steady-state sinusoidal response. Network graphs and their applications in network analysis. Tellegen's theorem, two-port networks, Z, Y, h, g, and transmission matrices. Combining two ports in various configurations. Analysis of transmission lines to motivate the scattering matrix. Scattering matrix and its applications in network analysis. Network functions, positive real functions, and network synthesis. Butterworth and Chebyshev approximations. Synthesis of lossless two-port networks. Synthesis of lattice all-pass filters.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Review of network analysis	2
2	Graph theoretic approach to prove mesh and node-voltage methods	5
3	Network theorems including Tellegen's theorem	3
4	Transient and steady-state sinusoidal response	4
5	Two-port networks and combining them in various configurations (Z, Y, h, g, transmission matrix)	6
6	Analysis of transmission lines and the scattering matrix	6
7	Network functions, positive real functions, and network synthesis	7
8	Synthesis of lossless two-port networks, and all-pass lattice filters	6
9	Butterworth, Chebyshev approximations	3
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

No	Topic	No of tut hours
1	Graph theory, mesh and node-voltage methods	2
2	Network theorems	1
3	Transient and steady-state sinusoidal response	2
4	Two-port networks	2
5	Transmission lines, S parameters	2
6	Positive real functions, network synthesis	2
7	Synthesis of lossless two-port networks	1
8	All-pass lattice filters	1
9	Butterworth, Chebyshev approximations	1
	TOTAL	14

17. Brief description of laboratory activities

Not applicable.

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. Franklin F. Kuo, Network Analysis and Synthesis, Second edition, Wiley, 1966.
2. [William H. Hayt & Jack E. Kemmerly](#), Engineering Circuit Analysis, McGraw Hill, 1971.
3. Brian D.O. Anderson, Sumeth Vongpanitlerd, Network Analysis and Synthesis, Dover Publications, 1973.
4. M.E. Van Valkenburg, Network Analysis, Second edition, Prentice-Hall, 1964.
5. L.A. Zadeh, C.A. Desoer, Linear Systems Theory, McGraw Hill, 1963.
6. E.A. Guillemin, Introductory Circuit Theory, John Wiley and Sons, 1953.

19. Resources required for the course (*itemized & student access requirements, if any*)

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course (*Percent of student time with examples, if possible*)

20.1	Design-type problems	Lossless two-port network synthesis (academic problems) can be given as homework for the students. The students may spend upto 6 hours on these problems.
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre	ELECTRICAL ENGINEERING	
2.	Course Title (<45 characters)	ENGINEERING ELECTROMAGNETICS	
3.	L-T-P structure	3-1-0	
4.	Credits	4	
5.	Course number	EEL207	
6.	Status (category for program)	CORE for EE1	
7.	Pre-requisites	PHL100 - Fields and Waves	
8.	Status vis-à-vis other courses (give course number/title)		
8.1	Overlap with any UG/PG course of the Dept./Centre	NO	
8.2	Overlap with any UG/PG course of other Dept./Centre	NO	
8.3	Supercedes any existing course	NO	
9.	Not allowed for (indicate program names)		NIL
10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☒ 2 nd sem ☐ Either sem	
11.	Faculty who will teach the course	Dr. KUSHAL KUMAR SHAH Dr. UDAY KHANKHOJE	
12.	Will the course require any visiting faculty?		NO
13.	Course objective (about 50 words): This course is meant to introduce the fundamental concepts of electromagnetic waves, waveguides, transmission lines and antennas.		
14.	Course contents (about 100 words) (Include laboratory/design activities): Review of Maxwell's equations, wave propagations in unbounded medium. Boundary conditions, reflection and refraction of plane waves. Evanescent waves and surface plasmons. Waveguides: parallel-plane guide, TE, TM and TEM waves, rectangular and cylindrical waveguides, resonators. Dielectric guides and optical fibres. Transmission Lines: distributed parameter circuits, traveling and standing waves, impedance matching, Smith chart, analogy with plane waves. Planar transmission lines: stripline, micro stripline. Radiation: retarded potentials, Hertzian dipole, short loop, antenna parameters. Numerical techniques in electromagnetics.		

15. Lecture Outline (with topics and number of lectures)

Module no.	Topic	No. of hours
1	Review of Maxwell's equations	2
2	Origin of dielectric constant and dispersion	2
3	Electromagnetic waves in dielectrics and conductors	2
4	Reflection and refraction at normal and oblique incidence for TE and TM polarizations	4
5	Evanescent waves, surface plasmons	4
6	Waveguides	8
7	Transmission Lines	8
8	Electromagnetic radiation and antennas	8
9	Numerical techniques in electromagnetics	4

COURSE TOTAL (14 times 'L')	42
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16. Brief description of tutorial activities:

The tutorials will primarily be meant for clarification of doubts regarding individual problems or the basic concepts. No new material will be covered during these sessions.

Module no.	Topic	No. of hours
1	Review of Maxwell's equations	1
2	Origin of dielectric constant and dispersion	1
3	Electromagnetic waves in dielectrics and conductors	1
4	Reflection and refraction at normal and oblique incidence	1
5	Evanescent waves and surface plasmons	1
6	Waveguides	3
7	Transmission Lines	3
8	Electromagnetic radiation and antennas	2
9	Numerical techniques in electromagnetics	1
	COURSE TOTAL (14 times 'T')	14

17. Brief description of laboratory activities :

The laboratory component of this course will be separately offered as EEP207 in the subsequent semester.

18. Suggested texts and reference materials

- M. Sadiku, *Principles of Electromagnetics*, 4th Ed, Oxford
- D. J. Griffiths, *Introduction to Electrodynamics*, 3rd Ed, PHI
- Ramo, Whinnery and Duzer, *Fields and Waves in Communication Electronics*, 3rd Ed, Wiley
- J. D. Jackson, *Classical Electromagnetics*, 3rd Ed, Wiley

19. Resources required for the course (itemized & student access requirements, if any)

Only basic classroom facilities required.

20. Design content of the course (Percent of student time with examples, if possible)

NIL

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre	ELECTRICAL ENGINEERING	
2.	Course Title (<45 characters)	ELECTROMAGNETICS LABORATORY	
3.	L-T-P structure	0-0-3	
4.	Credits	1.5	
5.	Course number	EEP207	
6.	Status (category for program)	CORE for EE1	
7.	Pre-requisites	EEL207 – Engineering Electromagnetics	
8.	Status vis-à-vis other courses (give course number/title)		
	8.1 Overlap with any UG/PG course of the Dept./Centre	NO	
	8.2 Overlap with any UG/PG course of other Dept./Centre	NO	
	8.3 Supercedes any existing course	NO	
9.	Not allowed for (indicate program names)		NIL
10.	Frequency of offering	☐ Every sem ☒ 1 st sem ☐ 2 nd sem ☐ Either sem	
11.	Faculty who will teach the course	Dr. KUSHAL KUMAR SHAH Dr. UDAY KHANKHOJE	
12.	Will the course require any visiting faculty?		NO
13.	Course objective (about 50 words): N/A		
14.	Course contents (about 100 words) (Include laboratory/design activities): N/A		

15. Lecture Outline (with topics and number of lectures) : N/A

16. Brief description of tutorial activities: N/A

17. Brief description of laboratory activities :

In this lab, the students will do experiments for half the semester and electromagnetic simulations for the other half. This will help in giving a much broader understanding of the area of electromagnetics to the student.

Sl.	Experiment	# turns
1	Introduction	1
2	Comparison of wavelength inside and outside a rectangular waveguide	1
3	Standing wave and VSWR measurement of a given load	1
4	Measurement of unknown impedance	1
5	Dispersion in optical link	1
6	Make a patch antenna and study its radiation pattern	2
7	Learn to mount RF components on pre-fabricated boards	1
8	Analysis of various Frequency Selective Surface (FSS) structures	1
9	Computational Electromagnetics	4
10	Make-up turn	1
	Total number of turns	14

18. Suggested texts and reference materials

- D. J. Griffiths, *Introduction to Electrodynamics*, 3rd Ed, PHI
- M. Sadiku, *Principles of Electromagnetics*, 4th Ed, Oxford
- Ramo, Whinnery and Duzer, *Fields and Waves in Communication Electronics*, 3rd Ed, Wiley
- Jordan and Balmain, *Electromagnetic Waves and Radiating Systems*, PHI Learning
- J. D. Jackson, *Classical Electromagnetics*, 3rd Ed, Wiley

19. Resources required for the course (*itemized & student access requirements, if any*)

19.1	Software	MPB and MEEP software (freely available)
19.2	Hardware	PCs
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	The microwave laboratory will be used for the course.
19.5	Equipment	Power supplies, signal generator, oscilloscope, horn antennas, optical receiver+Transmitter+Fiber, Consumables including breadboards, wires, various ICs will be required for the course.
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course (*Percent of student time with examples, if possible*)

In experiment no. 6, students will be asked to design the appropriate patch antenna for a given resonant frequency.

In experiment no. 10, students will be asked to design the appropriate Frequency Selective Surface (FSS) structure for a given resonant frequency.

Date: (Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Electrical Engineering
2.	Course Title (<i>< 45 characters</i>)	Physical Electronics
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	EEL218
6.	Status (<i>category for program</i>)	B Tech Core course EE1

7.	Pre-requisites (<i>course no./title</i>)	EEL100 & PHL100
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8.	Status vis-à-vis other courses <i>(give course number/title)</i> <u>Overlap assessment is based on the provided listing of course names and topics. In PG courses identified below, material taught may well be at a much higher level than proposed in this course.</u>	
8.1	Overlap with any UG/PG course of the Dept./Centre	EEL732, Power Electronics and devices
8.2	Overlap with any UG/PG course of other Dept./Centre	EPL336 EPL439 PHL653 PHL704 PHL705 PHL727 PHL793
8.3	Supersedes any existing course	N/A

9.	Not allowed for (indicate program names)	N/A
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10.	Frequency of offering	☐ Every sem ☒ 1 st sem ☐ 2 nd sem ☐ Either sem 2 nd year, 1 st semester
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11.	Faculty who will teach the course Jagadesh Kumar, Madhusudan Singh, Abhisek Dixit, Anuj Dhawan, Basabi Bhaumik, G. S. Visweswaran	
12.	Will the course require any visiting faculty?	No

13.	Course objective (<i>about 50 words</i>): Provide students a basic working knowledge of semiconductor physics, materials and devices and prepare them for senior level courses in semiconductor physics, materials processing, device electronics, circuit design / layout / VLSI, power devices, optoelectronics.	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Semiconductor materials , crystal structure, carriers in semiconductors, band structure, density of states, excitons, doping and carrier statistics, carrier transport, recombination and generation, p-n junction physics: built-in potential, forward and reverse bias, capacitance, diode currents, breakdown, tunnel effects; metal-semiconductor junctions; BJTs: current gain/Gummel plots, transistor models, breakdown; MOSFET physics: MOS capacitors, inversion, depletion, accumulation, flatband, threshold voltage, long-channel model, saturation, short-channel models, sub-threshold conduction, SPICE models for MOSFETs; optoelectronic device physics, LEDs/OLEDs, lasers, photodetectors, solar cells.	
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Semiconductor materials, crystal structure.	3
2	Carriers in semiconductors, band structure, density of states, excitons, doping and carrier statistics, carrier transport, recombination and generation.	8
3	p-n junction physics: built-in potential, forward and reverse bias, capacitance, diode currents, breakdown, tunnel effects; metal-semiconductor junctions;	8
4	BJTs: current gain/Gummel plots, transistor models, breakdown	5
5	MOSFET physics: MOS capacitors, inversion, depletion, accumulation, flatband, threshold voltage, long-channel model, saturation, short-channel models, sub-threshold conduction, SPICE models for MOSFETs;	10
6	Optoelectronic device physics, LEDs/OLEDs, lasers	5
7	Photodetectors and solar cells.	3
8		
9	###	
10		
11	##	
12		
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

Lectures may involve discussions, presentations and solution of sample problems/HW.

17. Brief description of laboratory activities

None

Moduleno.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL (14 times 'P')		####

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

1. J. Singh, Physics of Semiconductors and their Heterostructures, John Wiley & Sons.
2. Ben Streetman and Sanjay Bannerjee, Solid State Electronic Devices, Prentice-Hall.
3. Donald Neamen, Semiconductor Physics and Devices, Irwin.
4. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice-Hall.
5. R. S. Muller, T. I. Kamins, and M. Chan, Device Electronics for Integrated Circuits, Wiley.
6. M. Shur, Physics of Semiconductor Devices, Prentice-Hall.

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19. Resources required for the course (*itemized & student access requirements, if any*)

19.1	Software	Matlab, Mathematica (optional)
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	None
19.5	Equipment	None
19.6	Classroom infrastructure	Video projector and screen
19.7	Site visits	

20. Design content of the course (*Percent of student time with examples, if possible*)

20.1	Design-type problems	10%
20.2	Open-ended problems	10%
20.3	Project-type activity	0%
20.4	Open-ended laboratory work	0%
20.5	Others (please specify)	0%

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department / Centre proposing the course	Electrical Engineering
2.	Course Title (<i>< 45 characters</i>)	Control Engineering - I
3.	L-T-P structure	3-1-0
4.	Credits	4
5.	Course number	EEL 301
6.	Status (<i>category for program</i>)	B.Tech Core for EE1 and EE3

7.	Pre-requisites (course no./title)	EEL 205
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	None
8.2	Overlap with any UG/PG course of other Dept./Centre	MEL312, CHL261
8.3	Supersedes any existing course	None

9.	Not allowed for (indicate program names)	-
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☒ 2 nd sem ☐ Either sem - 2 nd Yr, 2 nd Sem.
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11.	Faculty who will teach the course Prof. I. N. Kar, Dr. Shaunak Sen, Dr. Shubendu Bhasin, Dr. Mashuq un Nabi, Dr. S. Janardhanan	
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12.	Will the course require any visiting faculty?	No
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13.	Course objective <i>(about 50 words):</i> To Introduce the Concepts of Control Engineering
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> Introduction to the control problem, Control System Components: Sensors, Actuators, Computational blocks. Mathematical representation of systems, state variable model, linearization, transfer function model. Transfer function and state variable models of suitable mechanical, electrical, thermal and pneumatic systems. Closed loop systems, Block diagram and signal flow analysis, Basic Characteristics of feedback control systems: stability, steady-state accuracy, transient accuracy, disturbance rejection, sensitivity analysis and robustness. Basic modes of feedback control: Proportional, Integral, Derivative. Concept of stability, Stability criteria: Routh stability criterion, Mikhailov's criterion, Kharitonov theorem. Time response of 2nd order system, steady state error analysis. Performance specifications in the time domain. Root locus method of design. Nyquist stability criterion. Frequency response analysis: Nyquist plots, Bode plots, Nichols Charts, Performance specifications in frequency domain, Frequency domain methods of design. Lead lag compensation.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Control System Components	2
2	Mathematical Models	5
3	System Characteristics	3
4	Basic Modes of Feedback	4
5	Stability Concepts	4
6	Performance Specifications	3
7	Frequency Domain Analysis	6
8	Frequency Domain based Compensator Design	7
9	Time Domain Analysis	5
10	Time Domain based Compensator Design	3
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

No	Topic	No of tut hours
1	Control System Components	1
2	Mathematical Models	2
3	System Characteristics	1
4	Basic Modes of Feedback	1
5	Stability Concepts	1
6	Performance Specifications	1
7	Frequency Domain Analysis	2
8	Frequency Domain based Compensator Design	1

9	Time Domain Analysis	2
10	Time Domain based Compensator Design	1
	TOTAL	14

17. Brief description of laboratory activities

Module No.	Experiment description	No. of hours
COURSE TOTAL (14 times 'P')		####

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, Prentice-Hall.

F. Golnaraghi and B. C. Kuo, "Automatic Control Systems", Wiley Press.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Electrical Engineering Department
2.	Course Title (<i>< 45 characters</i>)	COMPUTER ARCHITECTURE
3.	L-T-P structure	3 - 0 - 0
4.	Credits	3
5.	Course number	EEL308
6.	Status (<i>category for program</i>)	Department core for EE1 and EE3

7.	Pre-requisites (course no./title)	Digital Electronics
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	CSL211
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	

9.	Not allowed for (indicate program names)	
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☒ 2 nd sem ☒ Either sem
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11.	Faculty who will teach the course SC, TM, SDR, SA, SK	
12.	Will the course require any visiting faculty?	NO

13.	Course objective (<i>about 50 words</i>): To introduce the students to the organisation and architecture of computer systems	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): 1. Introduction: Performance measurement 2. Instruction Set Architecture 3. Computer Arithmetic 4. Processor: ALU design, Control design, Pipelining 5. Memory Hierarchy 6. I/O management 7. Multicores, Multiprocessors, Clusters, GPU	
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction: Performance Measures	2
2	Instruction Set Architecture	8
3	Computer Arithmetic	5
4	Processor: ALU Design, Control Design, Pipelining	12
5	Memory Hierarchy	4
6	I/O Management	3
7	Multicore, Multiprocessors, Clusters, GPU	8
8		
9		
10		
11		
12		
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

6 hours of problem solving sessions

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL (14 times 'P')		####

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Computer Organization and Design, David A. Patterson, John. L. Hennessy, 4 th (ARM) edition, Morgan Kaufmann

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	MIPS Simulator (SPIM) or any other architecture simulator, MIPS/ARM soft-core IPs
19.2	Hardware	FPGA boards
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	

19.6	Classroom infrastructure	Dual screen projector, visualiser
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	
20.2	Open-ended problems	
20.3	Project-type activity	
20.4	Open-ended laboratory work	
20.5	Others (please specify)	

Date:

(Signature of the Head of the Department)