

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 proposing the course	Electrical Engineering
2.	Course Title (< 45 characters)	Electro-Mechanics
3.	L-T-P structure	3-1-0
4.	Credits	4
5.	Course number	EEL - 203
6.	Status (category for program)	B.Tech Core (EE1 & EE3)

7.	Pre-requisites (course no./title)	EEL - 100
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8.	Status vis-à-vis other courses (give course number/title)	
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	Supercedes 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, 1 st Sem.
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11.	Faculty who will teach the course Prof.Bhim Singh, Prof. K.R. Rajagopal, Prof. Bhuvaneswari, Prof. M.Veerachary, Dr. Amit Kumar Jain	
12.	Will the course require any visiting faculty?	No

13.	Course objective <i>(about 50 words):</i> To Introduce the Concepts of Electro-mechanical Energy Conversion through magnetic medium in Transformers, Direct Current and Alternating Current Electric Machines.
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> Review: AC Circuits, Complex representation and Power Measurement. Magnetic Circuits: Simple magnetic circuit, analogy between magnetic circuits and electrical circuits, linear and nonlinear magnetic circuits, hysteresis and eddy current losses, permanent magnet materials. Transformers: Single-phase and three-phase, analysis, equivalent circuit, Tests on transformers, phasor diagram regulation and efficiency, auto-transformer and instrument transformers (PT/CT) Electro-mechanical energy conversion principles: Force and EMF production in a rotating machine DC machines: Types, construction, working principle, characteristics and applications 3-phase induction machines: Types, construction, Introduction to windings and winding factor, production of revolving magnetic field, working principle on 3-phase induction machine, equivalent circuit, characteristics, phasor diagram and applications 3-phase synchronous machines: Types, construction, working principle, equivalent circuit, characteristics, phasor diagram and applications. Fractional-HP and Special Machines
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Review	3
2	Magnetic Circuits	4
3	Transformers	8
4	Electro-mechanical energy conversion principles	3
5	DC machines	8
6	3-phase induction machines	8
7	3-phase synchronous machines	5
8	Fractional-HP and Special Machines	3
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

No	Topic	No of tut hours
1	Review - circuits, complex representation, power	1
2	Magnetic Circuits	1
3	Transformers	2
4	Electro-mechanical energy conversion principles	1
5	DC machines	2
6	3-phase induction machines	2
7	3-phase synchronous machines	1
8	Introduction to Fractional-HP and Special Machines	1
9	Tut tests etc	2
	TOTAL	14

17. Brief description of laboratory activities

Module No.	Experiment description	No. of hours
1		
COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

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

- 1.Fitzgerald, Kingsley, Umans "*Electrical machinery*" Tata McGraw-Hill publishing company Limited, New Delhi, India, 2009.
- 2.P.C. Sen, "*Principles of Electric Machines and Power Electronics*," IInd edition, John Wiley & Sons, 1997
3. Hughes E., "Electrical Technology", Pearson Education Indian edition
- 4.A.S. Langsdorf, "*Theory of alternating current machinery*," TMH, new Delhi, 2001.
- 5.Stephen J. Chapman, "*Electric machinery fundamentals*" The McGraw-Hill Companies, New York 2005.
- 6.Say, M.G. "*Alternating Current Machines*" Fifth Edition. London: Pitman (1983).
- 7.Bhag Singh Guru, Hüseyin R. Hızıroğlu, "Electric Machinery and Transformers", Oxford University Press, Incorporated, 1995

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
2.	Course Title (<i>< 45 characters</i>)	Electro-Mechanics Laboratory
3.	L-T-P structure	0-0-3
4.	Credits	1.5
5.	Course number	EEP - 203
6.	Status (<i>category for program</i>)	B.Tech Core (EE1 & EE3)

7.	Pre-requisites (<i>course no./title</i>)	EEL100
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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	Supercedes any existing course	None

9.	Not allowed for (<i>indicate program names</i>)	-
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☒ 2 nd sem ☐ Either sem - 2nd Yr, 2nd Sem.
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11.	Faculty who will teach the course Prof. Bhim Singh, Prof. K.R. Rajagopal, Prof. Bhuvaneswari, Prof. M. Veerachary, Dr. Amit Kumar Jain, Prof. P.R. Bijwe, Prof. Sukumar Mishra, Dr. B.K. Panigrahi, Dr. N. Senroy, Dr. Abhijit Abhyankar	
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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 Electro-mechanical Energy Conversion through magnetic medium in Transformers, Direct Current and Alternating Current Electric Machines.	
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> 	
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1		
COURSE TOTAL (14 times 'L')		

16. Brief description of tutorial activities

No	Topic	No of tut hours
1		
	TOTAL	

17. Brief description of laboratory activities

Module No.	Experiment description	No. of hours
1	Introduction	3
2	Steady-state performance of a 1-phase transformer: (a) Obtain equivalent circuit parameters by conducting open-circuit, short circuit and resistance measurement tests, (b) Obtain voltage regulation and efficiency at different resistive loads.	3
3	Steady-state performance of a separately excited dc generator: By conducting suitable tests, obtain OCC and load characteristics	3
4	Steady-state performance of a dc motor: By conducting suitable tests (field circuit resistance control, armature terminal voltage control), obtain the speed control characteristics of a given dc motor	3
5	Steady-state performance of a 3-phase alternator: By conducting suitable tests (OCC, SCC, Load tests) obtain voltage regulation at different resistive loads	3
6	Steady-state performance of a 3-phase Induction motor: (a) Obtain equivalent circuit parameter by conducting open-circuit, short circuit and resistance measurement tests, (b) Conduct load test and draw various performance characteristics (i) speed –vs- output power, (ii) stator current –vs- output power, (iii) power factor –vs- output power, (iv) efficiency –vs- output power.	3

7	Steady-state performance of a 3-phase squirrel-cage Induction machine as a generator.	3
8	Steady-state performance of a 3-phase transformer: (a) By conducting different tests, verify the voltage and current transformation ratios of different 3-phase transformers (Star-Star; Star- Delta; Delta-Star; Delta-Delta), (b) Obtain voltage regulation and efficiency at different resistive loads.	3
9	Steady-state performance of a 1-phase squirrel-cage Induction motor: (a) Obtain equivalent circuit parameter by conducting open-circuit, short circuit and resistance measurement tests, (b)conduct load test and draw various performance characteristics: torque –vs- speed, current –vs speed, current -vs- output power etc	3
10	Steady-state performance of a 3-synchronous motor: By conducting suitable tests synchronize the given synchronous machine with utility and then obtain: “V” and inverted “V” curves.	3
11	Make Class (2 Nos) After Cycle-1 and Cycle-5 (each cycle 5 experiments)	6
12	Laboratory Exam	3
COURSE TOTAL (14 times 'P')		42

18. Suggested texts and reference materials

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

1. Fitzgerald, Kingsley, Umans “*Electrical machinery*” Tata McGraw-Hill publishing company Limited, New Delhi, India, 2009.
2. P.C. Sen, “*Principles of Electric Machines and Power Electronics,*” IInd edition, John Wiley & Sons, 1997
3. Hughes E., "Electrical Technology", Pearson Education Indian edition
4. A.S. Langsdorf, “*Theory of alternating current machinery,*” TMH, new Delhi, 2001.
5. Stephen J. Chapman, “*Electric machinery fundamentals*” The McGraw-Hill Companies, New York 2005.
6. Say, M.G. "Alternating Current Machines" Fifth Edition. London: Pitman (1983).
7. Bhag Singh Guru, Hüseyin R. Hızıroğlu, "Electric Machinery and Transformers", Oxford University Press, Incorporated, 1995.

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

19.1	Software	
19.2	Hardware	YES
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	YES
19.5	Equipment	YES
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	EE
2.	Course Title (<i>< 45 characters</i>)	Integrated Analog Circuits
3.	L-T-P structure	3-1-0
4.	Credits	4
5.	Course number	EEL204
6.	Status (<i>category for program</i>)	BTech Core for EE1 and EE3

7.	Pre-requisites (course no./title)	EEL100, EEL202, EEL218/PE&ED
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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	NO
8.2	Overlap with any UG/PG course of other Dept./Centre	NO
8.3	Supersedes any existing course	NO

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 Prof. G.S. Visweswaran, Prof. Basabi Bhaumik, Prof. Jagadesh Kumar, Dr. Shouribrata Chatterjee, Dr. Mukul Sarkar, Dr. Madhusudan Singh and Dr. Turbo Majumder
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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>): The motivation for the course is to make the students understands the basics of analog circuit design using BJTs and MOSFETs.	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Review of working of BJT and MOSFET, large signal and small signal models, biasing schemes, analysis and design of various single stage amplifier configuration, low and high frequency analysis of single stage amplifiers, frequency compensation, current mirrors, multistage amplifiers; differential and operational amplifiers, negative and positive feedback, oscillators and power amplifiers.	
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15. Lecture Outline(with topics and number of lectures)

Module no.	Topic	No. of hours
1	Review of working of BJT and MOSFET	3
2	Large signal and small signal models	2
3	Analysis and design of various single stage amplifier configuration	10
4	Low and high frequency analysis of single stage amplifiers	5
5	Current mirrors	3
6	Multistage amplifiers; differential and operational amplifiers	7
7	Negative and positive feedback	5
8	Frequency compensation	3
9	Oscillators basics, Power amplifiers	4
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

There will be 14 tutorials.

Week 1: 2-port network analysis and amplifier configurations

Week 2 and 3: BJT and MOSFET biasing

Week 4 and 5: BJT and MOSFET small signal model

Week 6, 7 and 8: current mirrors and single stage amplifiers

Week 8 and 10: multistage amplifiers and differential amplifiers

Week 11, 12 and 13: operational amplifiers, oscillators and power amplifiers.

Week 14: student doubt clarification week.

17. Brief description of laboratory activities :

Moduleno.	Experiment description	No. of turns
1	Characterization of BJT	1
2	Study of bias, self-bias circuits for BJT	2
3	Current mirrors	2
4	Common Collector Amplifier	1
5	Multi-stage amplifier	2
6	Differential amplifier	2
7	Power amplifier	1
8	Exams and repeat classes	3
COURSE TOTAL (14 times 'P')		14

18. Suggested texts and reference materials

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

Sedra and Smith, Microelectronic Circuits, 6th edition, Oxford University Press.

Razavi, B, Design of Analog CMOS integrated Circuits, McGraw Hill.

Johns and Martin, Analog Integrated Circuit Design, 1st edition, Wiley, 2008.

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

19.1	Software	NGSPICE, LTSPICE,
19.2	Hardware	NIL
19.3	Teaching aides (videos, etc.)	NIL
19.4	Laboratory	Electronics Lab
19.5	Equipment	CRO, Power supply, function generator, bread-board and discrete electronic components.
19.6	Classroom infrastructure	A big classroom with a projector and large black board / whiteboard / visualiser.
19.7	Site visits	NA

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

20.1	Design-type problems	40%
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20.2	Open-ended problems	10%
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.

S1	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	1

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	Department of Electrical Engineering
2.	Course Title (< 45 characters)	Power Electronics
3.	L-T-P structure	(3-0-0)
4.	Credits	3-credits
5.	Course number	EEL-209
6.	Status (category for program)	Dept Core (EE1 & EE3)

7.	Pre-requisites (course no./title)	EEL218 (EE1)/ Power Electronics and Energy Devices (EE3)
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8.	Status vis-à-vis other courses (give course number/title)	
8.1	Overlap with any UG/PG course of the Dept./Centre	
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 3rd Year, First semester
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11.	Faculty who will teach the course Prof. Bhim Singh, Prof. K.R. Rajagopal, Prof. Bhuvaneswari, Prof. M.Veerachary, Dr. Amit Kumar Jain	
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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 power electronics circuits using operation of various power converters used for conversion of electrical power between AC-AC, DC-DC, AC-DC, DC-AC sources.
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> 1. Introduction to Power Electronics devices and protection: Thyristor family devices, principle of operation, IGBT operation, principles and ratings. Snubber designs, selection and protection, Firing circuits. 2. AC-DC converters: uncontrolled, semi-controlled, fully controlled and dual converters in single-phase and three-phase configurations, design, phase control, harmonic analysis, firing circuits and their designs. Improved power quality AC-DC converters. 3. Choppers: Introduction to dc-dc conversion, various topologies, buck, boost, buck-boost converters, High frequency isolated dc-dc converters: design problems, PWM control and operation. 4. Inverters: Basics of dc to ac conversion, inverter circuit configurations and principle of operation, VSI and CSI, single and three-phase configurations, Square wave and sinusoidal PWM control methods and harmonic control. Design problems. 5. AC voltage controllers: Introduction to ac to ac conversion, single-phase and three-phase ac voltage controller circuit configurations, applications, advantages, harmonic analysis, control, design problems. 6. Cyclo-converters: single-phase to single-phase, three-phase to single-phase, three-phase to three-phase and single-phase to three-phase circuit configurations thyristors and triacs.
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15. Lecture Outline(with topics and number of lectures)

Module no.	Topic	No. of hours
1	Power Electronics devices and Protection	5
2	AC –to- DC Converters	9
3	DC –to- DC Converters	9
4	Inverters	9
5	AC voltage controllers	6
6	Cyclo-converters	4
COURSE TOTAL (14 times ‘L’)		42

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

S no.	Experiment description	No. of hours
1	NA	
COURSE TOTAL (14 times ‘P’)		

18. Suggested texts and reference materials

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

1. N. Mohan, T. M. Undeland and W. P. Robbins, “Power Electronics, Converter, Application and Design”, Second Edition, John Wiley & Sons, 1995, New York, ISBN
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9971-51-177-0.

2. M. H. Rashid, "Power Electronics, circuits, Devices and Applications", Second Edition, Prentice-Hall, 1995, India, ISBN 81-203-0869-7.
3. Joseph Vithayathil, "Power electronics Principles and application" Third reprint 2011, TATA McGraw-Hill.
4. W. C. Lander, "Power Electronics", 3rd Edition, McGraw-Hill, 1993, New York, ISBN: 0077077148S.
5. Robert W. Erickson, "Fundamentals of Power Electronics", Springer; 2nd ed. 2001 edition

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
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	Department of Electrical Engineering
2.	Course Title (< 45 characters)	Power Electronics
3.	L-T-P structure	(0-0-3)
4.	Credits	1.5-credits
5.	Course number	EEP-209
6.	Status (category for program)	Dept Core (EE1 & EE3)

7.	Pre-requisites (course no./title)	EEL209
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8.	Status vis-à-vis other courses (give course number/title)	
8.1	Overlap with any UG/PG course of the Dept./Centre	
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 3rd Year, Second semester
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11.	Faculty who will teach the course Prof. Bhim Singh, Prof. K.R. Rajagopal, Prof. Bhuvaneswari, Prof. M.Veerachary, Dr. Amit Kumar Jain	
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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 power electronics circuits using operation of various power converters used for conversion of electrical power between AC-AC, DC-DC, AC-DC, DC-AC sources in laboratory.	
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> 	
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15. Lecture Outline(with topics and number of lectures)

Module no.	Topic	No. of hours
1		
COURSE TOTAL (14 times 'L')		

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Introduction	3
2	Study of I-V switching characteristics an SCR, Triac and MOSFET devices.	3
3	Study of the characteristics of a single phase controlled rectifier for different types of loads.	3
4	Study the characteristics of a single phase AC controller for different types of loads.	3
5	Study the characteristics of a single phase Voltage Source Inverter for different type of loads.	3
6	Performance characteristics of a buck dc-dc converter, PWM control, regulation.	3
7	Performance characteristics of a boost/buck-boost dc-dc converter, PWM control, regulation	6
8	Study of the characteristics of a three phase controlled rectifier for different types of loads.	3
9	Study of the characteristics of a cyclo-converter.	3
10	Study the characteristics of a three phase Voltage Source Inverter (VSI).	3

11	Make up Lab and Tests etc.	6
COURSE TOTAL (14 times 'P')		42

18. Suggested texts and reference materials

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

1. N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics, Converter, Application and Design", Second Edition, John Willey & Sons, 1995, New York, ISBN 9971-51-177-0.
2. M. H. Rashid, "Power Electronics, circuits, Devices and Applications", Second Edition, Prentice-Hall, 1995, India, ISBN 81-203-0869-7.
3. Joseph Vithayathil "Power electronics Principles and application" Third reprint 2011, TATA McGraw-Hill.
4. W. C. Lander, "Power Electronics", 3rd Edition, McGraw-Hill, 1993, New York, ISBN: 0077077148S.
5. Robert W. Erickson, "Fundamentals of Power Electronics", Springer; 2nd ed. 2001 edition

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

19.1	Software	PSIM/ MATLAB
19.2	Hardware	Power Electronics related instruments.
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	YES
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
2.	Course Title (<i>< 45 characters</i>)	Power Electronics and Energy Devices
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	EEL - 219
6.	Status (<i>category for program</i>)	B.Tech (Core for EE3)

7.	Pre-requisites (course no./title)	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	Supercedes 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
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11.	Faculty who will teach the course Madhusudhan Singh, Anuj Dhawan, Abhisek Dixit, B. Bhaumik, G. S. Visweswaran, M. Jagadesh Kumar	
12.	Will the course require any visiting faculty?	No

13.	Course objective <i>(about 50 words):</i> Introduce the fundamental and advanced concepts of modern power semiconductor devices used in the control of power and energy.
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> Introduction to semiconductor basics and PN Junctions. Short introduction to power device technology, PIN diodes, Schottky diodes, Power BJTs, Power MOSFETs, IGBTs, Thyristors, Wide bandgap power semiconductor devices, Packaging and Reliability of Power devices, Destructive mechanisms in power devices, Power device induced oscillations and Electromagnetic disturbances, Selection of power devices in power electronic systems, Smart power integrated circuits.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to semiconductor basics, material properties, PN Junction theory and modeling	5
2	Short introduction to power device technology	2
3	PIN diodes and Schottky diodes	5
4	Power BJTs	5
5	Power MOSFETs	4
6	IGBTs	4
7	Thyristors	5
8	Wide bandgap power semiconductor devices	3
9	Packaging and Reliability of Power devices	3
10	Destructive mechanisms in power devices, Power device induced oscillations and Electromagnetic disturbances	3
11	Selection of power devices in power electronic systems, Smart power integrated circuits.	3
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

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

18. Suggested texts and reference materials

1. J. Lutz, H. Schlangenotto, U. Scheuermann and R. D. Doncker, "Semiconductor Power Devices: Physics, Characteristics, Reliability ", Springer, 2011.
2. B.J. Baliga, "Modern Power Devices", Wiley, New York.
3. B.J. Baliga, "Power Semiconductor Devices", PWS, Boston, MA.
4. A. Grant and J. Gowar, "Power MOSFETs--Theory and applications", New York: John Wiley & Sons
5. Stefan Linder, "Power Semiconductors", CRC press, 2006

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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	40 %
20.2	Open-ended problems	20 %
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
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
2.	Course Title (< 45 characters)	Control Engineering Laboratory
3.	L-T-P structure	0-0-3
4.	Credits	1.5
5.	Course number	EEP301
6.	Status (category for program)	B Tech Core for EE1 and EE3

7.	Pre-requisites (course no./title)	EEL301
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8.	Status vis-à-vis other courses (give course number/title)	
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	Supercedes 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 3 rd year 1 st semester
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11.	Faculty who will teach the course I.N. Kar, S. Janardhanan, M. Nabi, S. Sen , S. Bhasin	
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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 familiarize with the practical aspects of Control Engineering	
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> Basics of Sensors and Actuators, Study of AC and DC Motors, Linear Systems, Analog and Digital Motors, Synchros, Temperature Control.	
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
COURSE TOTAL (14 times 'L')		

16. Brief description of tutorial activities

NA

17. Brief description of laboratory activities

Moduleno.	Experiment description	No. of hours
1	Introduction	3

2	Study of AC and DC Motor Control Characteristics	3
3	Sensors and Transducers	3
4	Temperature Control of a Process	6
5	Study of Linear Systems through hardware	3
6	Analog Motor Control	3
7	Digital Control System	3
8	Modular Servo Systems and Control	3
9	Position Control System	3
10	Synchro-set : Study and Control	3
11	Make-up Turn	3
12	Lab Viva and Quiz	6
COURSE TOTAL (14 times 'P')		42

18. Suggested texts and reference materials

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

1. Control Engineering Laboratory manual (handouts) & references therein.
2. Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, Prentice-Hall.
3. 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	Needed
19.2	Hardware	Needed
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	Analog Control Laboratory, Digital Control Laboratory
19.5	Equipment	Needed
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
2.	Course Title (<i>< 45 characters</i>)	Power Engineering I
3.	L-T-P structure	3-1-0
4.	Credits	3
5.	Course number	EEL - 303
6.	Status (<i>category for program</i>)	B.Tech core for EE1 and EE3

7.	Pre-requisites (course no./title)	EEL – 100, EEL 203
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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	Supercedes 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 3 rd year second semester
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11.	Faculty who will teach the course Prof. PR Bijwe, Prof. S Mishra, Dr. BK Panigrahi, Dr. AR Abhyankar, Dr. N Senroy	
12.	Will the course require any visiting faculty?	No

13.	Course objective <i>(about 50 words):</i> Introduce the basic and fundamental concepts in modern power systems engineering, analysis and control. It covers the broad spectrum of Power System.
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> Introduction to the basic structure of power system along with various power generation technologies. Modeling of generators, transformers and transmission line for power system analysis. per unit system. Power flow analysis. Fault analysis in power systems. Power system stability studies. Transients in power system and travelling waves. Introduction to power system relaying and brief idea of over current, differential and impedance based protection. Basic concepts of Power system operation and control. Introduction to HVDC and FACTS.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to the structure of Power system. Brief introduction to different Power generation sources with an emphasis on wind and solar generation	3
2	Modeling of generator, transformer and transmission line	3
3	Per unit system. Power flow equation	4
4	Power flow solution	4
5	Fault Analysis	8
6	Stability studies	6
7	Transients in Power system	3
8	Basics of protection	4
9	Concepts of Power system operation and control	3
10	Introduction to HVDC and FACTS	2
COURSE TOTAL (14 times 'L')		

16. Brief description of tutorial activities

Per-unit system calculation, performance of transmission lines, load flow studies, fault studies, stability studies, power system transients, protection.

17. Brief description of laboratory activities

The laboratory will be of 10 experiments covering the above outlined syllabus

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

18. Suggested texts and reference materials

John J. Grainger and William D. Stevenson, Power Systems Analysis, Tata McGraw - Hill Education

Arthur R. Bergen and Vijay Vittal, Power Systems Analysis, Pearson , 2000

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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
2.	Course Title (<i>< 45 characters</i>)	Power Engineering I
3.	L-T-P structure	0-0-3
4.	Credits	3
5.	Course number	EEP - 303
6.	Status (<i>category for program</i>)	B.Tech core for EE1 and EE3

7.	Pre-requisites (course no./title)	EEL – 100, EEL 203, EEL303
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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	Supercedes 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 4 th year first semester
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11.	Faculty who will teach the course Prof. PR Bijwe, Prof. S Mishra, Dr. BK Panigrahi, Dr. AR Abhyankar, Dr. N Senroy	
12.	Will the course require any visiting faculty?	No

13.	Course objective <i>(about 50 words):</i> Experiments related to EEL303 Power Engineering - I.
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> Experiments will be conducted on 3-phase alternators and transformers for measuring their sequence impedance. Directional, overcurrent and differential protection relays will be studied. Computer simulation for power flow, short circuit and stability studies of interconnected power systems. Numerical relays and synchrophasors will be introduced. FACTS devices will be experimented.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
COURSE TOTAL <i>(14 times 'L')</i>		

16. Brief description of tutorial activities

17. Brief description of laboratory activities

The laboratory will be of 10 experiments covering the above outlined syllabus

Module No.	Experiment description	No of hours
1	Experiment to measure the sequence impedance of an alternator	3
2	Experiment to measure the sequence impedance of a 3-phase, 3-winding transformer	3
3	Study the characteristics of an overcurrent relay and a directional relay	3
4	Study of percentage biased differential protection scheme	3
5	Complete power flow analysis of a multi-bus power system	3
6	Complete fault study of a multi-bus power system	3
7	Stability analysis of a power system	3
8	Parallel operation of two alternators – active and reactive power sharing	3
9	Study of a static VAR compensator for voltage control (SVC)	3
10	Study of a thyristor controlled series capacitor (TCSC) for power flow control	3
11	Numerical relay simulation in Lab-VIEW	6
12	Study of synchrophasor measurements	3
13	Makeup turn / Exam	3
COURSE TOTAL 42 hours		

18. Suggested texts and reference materials

John J. Grainger and William D. Stevenson, Power Systems Analysis, Tata McGraw - Hill Education

Arthur R. Bergen and Vijay Vittal, Power Systems Analysis, Pearson , 2000

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

19.1	Software	Yes
19.2	Hardware	Yes
19.3	Teaching aides (videos, etc.)	No
19.4	Laboratory	Yes
19.5	Equipment	Yes
19.6	Classroom infrastructure	
19.7	Site visits	No

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
2.	Course Title (<i>< 45 characters</i>)	Electric Drives
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	EEL - 305
6.	Status (<i>category for program</i>)	Dept. Core for EE3

7.	Pre-requisites (course no./title)	EEL - 203
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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	Supercedes 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 - 4 th Yr, 1 st Sem.
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11.	Faculty who will teach the course Prof. Bhim Singh, Prof. K.R. Rajagopal, Prof. Bhuvaneswari, Prof. M.Veerachary, Dr. Amit Kumar Jain	
12.	Will the course require any visiting faculty?	No

13.	Course objective <i>(about 50 words):</i> To introduce the students to basic concepts of control of electrical drives systems, dynamics of load systems and various speed control methodologies for electric motors
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> Basic Concepts: Characteristics and operating modes of drive motors. Starting, braking and speed control of motors. 4 quadrant drives. Types of loads. Torque and associated controls used in process industries. DC Motor Drives: Characteristics, Starting Methods, Braking Methods, Speed Control Using Converters and Choppers. Three phase Induction Motor Drives: Characteristics and Equivalent Circuits, Starting Methods, Braking Methods, Speed Control of Cage Rotor Induction Machines using as AC voltage controllers, Voltage-Source and Current-Source Inverters. V-by-F Control and other Control Techniques. Speed Control of Wound-Rotor Induction Machines using Rotor Resistance Variation; Slip-Power Recovery Scheme. Three phase Synchronous Motor Drives: Characteristics and Equivalent Circuits, Starting Methods, Braking Methods, Speed Control in True Synchronous and Self Control Modes. Special Machines: Permanent Magnet Brush-Less Motor Drives, Permanent Magnet Synchronous Motor Drives, Stepper and Reluctance Motor Drives.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Basic Concepts and Dynamics of load systems	6
2	DC Motor Drives	12
3	Three phase Induction Motor Drives	14
4	Three phase Synchronous Motor Drives	7
5	Special Machines	3
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

Module No	Topic	No of Tutorials
1		
	TOTAL	

17. Brief description of laboratory activities

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

18. Suggested texts and reference materials

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

1. G. K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House.
2. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall, New Jersey.
3. S. B. Dewan, G. R. Slemon and A. Straughen, "Power Semiconductor Drives", John Wiley & Sons.
4. N. K. De and P. K. Sen, "Electric Drives", Prentice-Hall of India Pvt. Ltd.
5. S. K. Pillai, "A First Course on Electrical Drives", New Age International Pvt. Ltd.

6. W. Leonard, "Control of Electric Drives", Springer; 2001 edition
7. Ramu Krishnan, "Electric motor drives: modeling, analysis, and control", Prentice Hall PTR, 2001
8. Ion Boldea and S. A. Nasar, "Electric Drives", CRC Press
9. J. M. D. Murphy and F. G. Turnbull, "Power Electronic Control of AC Motors", Pergamon Press
10. N. Mohan, "Electric Drives", MNRPE 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
2.	Course Title (<i>< 45 characters</i>)	Electric Drives Laboratory
3.	L-T-P structure	0-0-3
4.	Credits	1.5
5.	Course number	EEP - 305
6.	Status (<i>category for program</i>)	Dept Core - EE3

7.	Pre-requisites (course no./title)	EEL - 305
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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	Supercedes 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 - 3 rd Yr, 2nd Sem.
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11.	Faculty who will teach the course Prof. Bhim Singh, Prof. K.R. Rajagopal, Prof. Bhuvaneswari, Prof. M.Veerachary, Dr. Amit Kumar Jain	
12.	Will the course require any visiting faculty?	No

13.	Course objective <i>(about 50 words):</i> To introduce the students to basic concepts of control of electrical drives systems, dynamics of load systems and various speed control methodologies for electric motors in the laboratory.
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i>
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
COURSE TOTAL (14 times 'L')		

16. Brief description of tutorial activities

Module No	Topic	No of Tutorials
	TOTAL	

17. Brief description of laboratory activities

Module No.	Experiment description	No. of sessions
1	Introductory class	1
2	DC shunt motor braking – Dynamic braking and low voltage plugging. Get the parameters of the DC machine and also simulate the braking performance in a digital computer	1
3	Three-phase Induction motor starting- Record the starting current and speed transients for Y- Δ , auto transformer and DOL starting. Simulate the performance of DOL starting in a digital computer	1
4	Three-phase Induction motor braking (a) low voltage plugging (b) low voltage DC dynamic braking (c) Diode braking (d) capacitor braking. Simulate the plugging performance with a large rotor resistance in a digital computer.	1
5	Rectifier fed DC motor Drive. Observing Current and Voltage waveforms in the AC as well as DC side through current and voltage sensors for two different load conditions. Also study the harmonic spectrum in the current in the AC side for these load conditions	1
6	Rotor resistance control of 3-phase slip ring induction motor – simulation experiment	1
7	VSI fed 3-phase induction motor drive. Study the speed regulation at different load conditions for a given frequency setting. Observe input and	1

	output voltage and current waveforms. Simulate the same in SIMULINK	
8	Pole changing of 3-phase induction motors – Experimentally study the pole changing configurations of the motor in the laboratory and simulation of speed-torque characteristics	1
9	Chopper fed DC motor drive	1
10	Performance characteristics of PMSM drive	1
11	Performance characteristics of PMBLDC motor drive	1
12	Repeat Turns / viva-voce and final lab test	3
COURSE TOTAL (14 times 'P')		14 x3 hrs

18. Suggested texts and reference materials

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

1. G. K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House.
2. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall, New Jersey.
3. S. B. Dewan, G. R. Slemon and A. Straughen, "Power Semiconductor Drives", John Wiley & Sons.
4. N. K. De and P. K. Sen, "Electric Drives", Prentice-Hall of India Pvt. Ltd.
5. S. K. Pillai, "A First Course on Electrical Drives", New Age International Pvt. Ltd.
6. W. Leonard, "Control of Electric Drives", Springer; 2001 edition
7. Ramu Krishnan, "Electric motor drives: modeling, analysis, and control", Prentice Hall PTR, 2001
8. Ion Boldea and S. A. Nasar, "Electric Drives", CRC Press
9. J. M. D. Murphy and F. G. Turnbull, "Power Electronic Control of AC Motors", Pergamon Press
10. N. Mohan, "Electric Drives", MNRPE Press

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

19.1	Software	Simulink /MATLAB, PSIM
19.2	Hardware	Personal Computer
19.3	Teaching aides (videos, etc.)	NA
19.4	Laboratory	Electric Drives lab

19.5	Equipment	Different kinds of DC and AC motor drives and special machines
19.6	Classroom infrastructure	PC With LCD projector to show simulations
19.7	Site visits	Possibly to motor manufacturing facility / Power stations

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

20.1	Design-type problems	Design problems (numerical) 20%
20.2	Open-ended problems	Simulation exercises 10%
20.3	Project-type activity	mini-projects 10%
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 (< 45 characters)	Communication Engineering
3.	L-T-P structure	3-1-0
4.	Credits	4
5.	Course number	EEL306
6.	Status (category for program)	Department Core for EE1

7.	Pre-requisites (course no./title)	EEL205 / Signals and Systems
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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	Supersedes any existing course	No

9.	Not allowed for (indicate program names)	None
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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: SDJ, RKM, RB, PS, MB, BL, SM	
12.	Will the course require any visiting faculty?	No

13.	Course objective <i>(about 50 words)</i> :Details of analog communication followed by introduction of concepts for digital communication.
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> Review of Fourier Series and Transforms. Hilbert Transforms, BandpassSignal and System Representation. Random Processes, Stationarity, Power Spectral Density, Gaussian Process, Noise. Amplitude Modulation, DSBSC, SSB, VSB: Signal Representation, Generation and Demodulation.Frequency Modulation: Signal Representation, Generation and Demodulation. Mixing, Superheterodyne Receiver, Phase Recovery with PLLs. Noise: in AM Receivers using Coherent Detection, in AM Receiversusing Envelope Detection, in FM Receivers. Sampling, Pulse-AmplitudeModulation. Quantization, Pulse-Code Modulation. Noise considerations in PCM, Time Division Multiplexing, Delta Modulation. Intersymbol Interference, Introduction to Information Theory: concepts of Entropy and Source-Coding
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Review of Fourier Series and Transforms	3
2	Hilbert Transforms, BandpassSignal and System Representation	4
3	Random Processes, Stationarity, Power Spectral Density, Gaussian Process, Noise	3
4	Amplitude Modulation, DSBSC, SSB, VSB: Signal Representation, Generation and Demodulation	6
5	Frequency Modulation: Signal Representation, Generation andDemodulation. Mixing, Superheterodyne Receiver, Phase Recovery withPLLs	6
6	Noise: in AM Receivers using Coherent Detection, in AM Receiversusing Envelope Detection, in FM Receivers	7
7	Sampling, Pulse-AmplitudeModulation. Quantization, Pulse-Code Modulation	3
8	Noise considerations in PCM, Time Division Multiplexing, Delta Modulation	2
9	Intersymbol Interference	2
10	Geometric Representation of Signals	2
11	Information Theory,Entropy, and Source-Coding	4
12		
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

Practice problems in the areas listed in the lecture outline
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17. Brief description of laboratory activities

N.A.

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.

Proakis John G., and Salehi M, Communication Systems Engineering, Prentice Hall, 2nd Edition.
Haykin Simon, Communication Systems, Wiley, 3rd Edition

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

19.1	Software	None
19.2	Hardware	None
19.3	Teaching aides (videos, etc.)	None
19.4	Laboratory	None
19.5	Equipment	None
19.6	Classroom infrastructure	None
19.7	Site visits	None

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	
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 (< 45 characters)	Communication Engineering Laboratory
3.	L-T-P structure	0-0-2
4.	Credits	1
5.	Course number	EEP306
6.	Status (category for program)	Department Core for EE1

7.	Pre-requisites (course no./title)	EEL306 / Communication Engineering
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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)	None
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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: SDJ, RKM, RB, PS, MB, BL, SM	
12.	Will the course require any visiting faculty?	No

13.	Course objective <i>(about 50 words)</i> :Laboratory part of the communication Engineering course.
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities)</i> :Laboratory experiments on analog, pulse, and basic digital modulation and demodulation techniques
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15. Lecture Outline *(with topics and number of lectures)*

N.A.

Module no.	Topic	No. of hours
COURSE TOTAL <i>(14 times 'L')</i>		

16. Brief description of tutorial activities

N.A.

17. Brief description of laboratory activities

Moduleno.	Experiment description	No. of hours
1	Frequency Modulation and demodulation	2
2	Amplitude Modulation and demodulation	2
3	PLL – Capture range and lock range	2
4	Line Coding	2
5	Delta Modulation and demodulation	2
6	Pulse width modulation	2
7	Bit error rate measurement in noisy channel	2
8	Binary phase shift keying	2
9	Quadrature amplitude modulation	2
10	Project	10
COURSE TOTAL (14 times 'P')		28

18. Suggested texts and reference materials

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

Proakis John G., and Salehi M, Communication Systems Engineering, Prentice Hall, 2nd Edition.
Haykin Simon, Communication Systems, Wiley, 3rd Edition

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

19.1	Software	Needed
19.2	Hardware	Needed
19.3	Teaching aides (videos, etc.)	None
19.4	Laboratory	Needed
19.5	Equipment	Needed
19.6	Classroom infrastructure	None
19.7	Site visits	None

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	30%
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)

COURSE TEMPLATE

1.	Department / Centre proposing the course	Electrical Engineering
2.	Course Title (<i>< 45 characters</i>)	Power Engineering II
3.	L-T-P structure	3-0-0
4.	Credits	3
5.	Course number	EEL - 401
6.	Status (<i>category for program</i>)	B.Tech core for EE3

7.	Pre-requisites (course no./title)	EEL - 303
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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	Supercedes any existing course	None

9.	Not allowed for (<i>indicate program names</i>)	-
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10.	Frequency of offering	☐ Every sem ☒ 1 st sem ☐ 2 nd sem ☐ Either sem 4 th year first semester
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11.	Faculty who will teach the course Prof. PR Bijwe, Prof. S Mishra, Dr. BK Panigrahi, Dr. AR Abhyankar, Dr. N Senroy	
12.	Will the course require any visiting faculty?	No

13.	Course objective <i>(about 50 words):</i> Introduce advanced concepts in modern power systems engineering, analysis and control, and highlight the importance of renewable energy technologies and smart grid concepts.
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> Advanced concepts in power flow analysis, security analysis and state estimation. Economic load dispatch and unit commitment problem. Voltage and frequency control in power systems. Advanced concepts in multi-machine dynamics and stability. Electrical transients in power systems. Wind and solar generation technologies and their integration into the grid. Issues in restructured power systems. Modern numerical protection.
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5. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Power flow analysis techniques	4
2	Security analysis	2
3	State estimation	3
4	Optimal power flow and unit commitment	5
5	Voltage and frequency control	6
6	Multi-machine stability	5
7	Electrical transients	2
8	Wind and solar generation	4
9	Smart grids	3
10	Restructured power systems	3
11	Numerical protection	5
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

17. Brief description of laboratory activities

18. Suggested texts and reference materials

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

1. Power System Dynamics: Stability and Control, Jan Machowski, Janusz Bialek, and Jim Bumby
2. Power Generation Operation and Control, Allen J. Wood, Bruce F. Wollenberg
3. Power System Analysis, John J. Grainger and William Stevenson Jr.

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)