KURUKSHETRA UNIVERSITYKURUKSHETRA

Bachelor of Technology (Electrical Engineering)

Scheme of Studies/Examination Semester-IV (w.e.f. Session 2019-20 onwards)

Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)			
					Major Test	Minor Test	Practical	Total
EE-202A	Digital Electronics	3:1:0	4	4	75	25	0	100
EE-204A	Signals and Systems	3:1:0	4	4	75	25	0	100
***EE- 206A**	**Electrical Machines – II**	3:1:0	4	4	75	25	0	100
***EE-208A**	**Power Electronics**	3:1:0	4	4	75	25	0	100
EE-216A	Electromagnetic Fields	3:0:0	3	3	75	25	0	100
***EE-210A**	**Electrical Machines- II Lab**	0:0:2	2	1	-	40	60	100
***EE-212A**	**Power Electronics Lab**	0:0:2	2	1	-	40	60	100
EE-214A	Digital Electronics Laboratory	0:0:2	2	1	-	40	60	100
**MC-902A	Constitution of India	3:0:0	3	-	100	-	0	100
	Total		**28**	**22**	**375**	**245**	**180**	**800**

* Subjects Common with IV Semester. B.Tech. [Electrical & Electronics Engg.] Scheme, K.U.K.

**MC-902A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

Note: All the students have to undergo 4 to 6 weeks Industrial Training after 4thsemester which will be evaluated in 5thsemester.

EE-202A	Digital Electronics	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand working of logic families and logicgates.
- Design and implement Combinational and Sequentiallogic circuits.
- Understand the process of Analog to Digital conversion and Digital to Analog conversion.
- Be able to use PLDs to implement the given logicalproblem.

Unit-I

Fundamentals of Digital Techniques:

Digital signal, review of number systems, binary codes, BCD, Excess-3, Gray, EBCDIC, ASCII, logic gates-AND, OR, NOT, NAND, NOR, EX-OR, Boolean algebra, Error detection and correction, hamming code.

Unit-II

Combination Design using Gates:

Design using gates, K- map and Quine-Mccluskey methods of simplification.

Combinational design using MSI Devices

Multiplexers and Demultiplexers and their uses as logic elements, Decoders, Adders/Subtracters, BCD arithmetic circuits, Encoders, Decoders/Drivers for display devices.

Unit-III

Design of Sequential circuits:

Flip flops: S-R, J-K, T,D, master slave, edge triggered, shift registers, sequence generators, counters-asynchronous and synchronous, ring counters and Johnson Counter.

D/A &A/D Converters:

D/A converters- weighted resistor and R-2 R ladder, specifications for D/A converters, A/D converters: Sample and hold circuits, Quantization, Parallel-comparator, successive approximation, counting type, dual slope ADC.

Unit-IV

Digital logic families:

Bipolar logic families: RTL, DTL, DCTL, HTL, TTL, ECL, MOS, and CMOS logic families. Tristate logic, interfacing of CMOS and TTL families.

Programmable logic devices:

ROM, PLA, PAL, FPGA and CPLDS.

REFERENCES:

1. Modern Digital Electronics (Edition III) : R.P. Jain, TMH.
2. Digital Integrated Electronics: Taub& Schilling, MGH
3. Digital Principles and Applications: Malvino& Leach, MGH
4. Digital Fundamentals,Floyd,11thEd.,Pearson.

Note: The paper setter will set the paper as per the question paper templates provided.

Lesson Plan

Name of Faculty: - Rajiv Sharma
Discipline: - Electrical Engg.
Semester: - 4th
Subject: - Digital Electronics (EE-202A)
Lesson Plan Duration: - 15 week
Work Load (Lecture/Practical):- Lecture=03, Tutorial=01, Practical=02

Week	Theory		Practical	
	Lecture Day	Topic	Practical Day	Topic
1st	1.	Introduction of subject and review of basic terms	1	Study of TTL gates- AND, OR, NOR, NAND, NOT, EX-OR, EX-NOR.
	2.	Digital signal, logic gates, AND, OR, NOT, NAND, NOR, EX-OR		
	3.	Boolean algebra		
2nd	4.	Binary codes	2	esign & realize a given function using K-Map and verify its performance.
	5.	BCD		
	6.	Excess-3		
3rd	7.	Gray, EBCDIC, ASCII	3	To verify the operation of multiplexer & Demultiplexers.
	8.	Error detection, Error correction codes		
	9.	UNIT Test		
4th	10.	Design using gates	4	To verify the operation of comparator.
	11.	Karnaugh map		
	12.	Quine-McCluskey methods of simplification		
5th	13.	Quine-McCluskey methods of simplification	5	To verify the truth tables of S-R, J-K, T& D type flip flops
	14.	Multiplexers		
	15.	Demultiplexers, Encoders		
6th	16.	Decoders	6	To verify the operation of bi-directional shift register.
	17.	Design of Half and Full Adder		
	18.	Design of Half and Full Subtractor, BCD arithmetic circuits		
7th	19.	Drivers for display devices	7	Revision
	20.	Revision		
	21.	Unit Test		
8th	22.	Sequential circuits: Flip flops: S-R and J-K ,Flip flops: T and D	8	To design & verify the operation of 3-bit synchronous counter.
	23.	Flip flops: Master Slave and Edge triggered		
	24.	Sequence generators, Shift Registers		
9th	25.	Counters : Asynchronous counters	9	Design a 4-bit shift register and verify its operation of a ring counter and a Johnson counter.
	26.	Synchronous counters		
	27.	Ring counters, Johnson Counter		

10th	28.	D/A converters: weighted resistor, R-2 R ladder network	10	To design and verify the operation of asynchronous UP/DOWN decade counter using JK flip flop
	29.	specifications for D/A converters		
	30.	A/D converters : Sample and hold circuits		
11th	31.	Quantization, Parallel-comparator	11	Design Half Adder & Full adder
	32.	Successive approximation, counting type		
	33.	Dual Slope ADC, Specifications of ADCs		
12	34.	Revision	12	Design Half Subtractor & Full Subtractor
	35.	Unit Test		
	36.	Bipolar logic families RTL, DTL, DCTL logic families		
13	37.	HTL logic families	13	To Study 4-Bit Comparator
	38.	TTL, ECL, MOS logic families		
	39.	CMSO, Tristate logic families		
14	40.	interfacing of CMOS, TTL	14	Revision
	41.	ROM, PLA, PAL		
	42.	FPGA		
15	43.	CPLDS	15	Revision
	44.	Revision		
	45.	Unit Test		

Tutorial Sheets

Unit-I

1. Express the following number in Binary, Octal & Hexadecimal.
   i) $(1947)_{10}$ **(ii)** $(6725)_{10}$ **(iii)** $(2421)_{10}$ **(iv)** $(738)_8$ **(v)** $(A7.F3)_{16}$
2. Convert the following binary to gray
   (i) 10101 **(ii)** 110101 **(iii)** 1101011 **(iv)** 10110101
3. Reduce the following expressions using Boolean algebra:
   (i) AB+A+ABC(AB+C) **(ii)** $\overline{AB+ABC+A(B+AB)}$
   (iii) A(B+C(AB+AC)) **(iv)** AB+AB+AB+AB
4. What is parity generator? Explain its working.
5. What is use of code converter? Design a code converter for binary to gray and gray to binary.

Unit-II

1. What does SOP means? Implement the expression: AB+BCD+EFGH using logic gates.
2. Reduce and implement in NOR logic.
   $F=\sum m\ (0,2,3,5,7,9,11,12,13,14,15)$
3. Reduce $F=\sum m\ (0, 2, 3, 5, 7)$ using mapping.
4. What is POS method of Boolean expression?
5. Describe difference between half adder and full adder.
6. What is the function of comparator? How it works?

7. Describe function of decoder. Design a 4 to 16 line decoder.
8. Design an 8 to 3 encoder using binary inputs and outputs.
9. Discuss use of multiplexers in digital electronics.
10. Explain functioning of demultiplexers.

Unit-III

1. What is latch circuit? Discuss the use of latch circuit in flip-flops.
2. Explain how RS and JK flip flop works? What is the drawback of RS flip-flop?
3. What is care-around condition? Why does it exist? How it can be over-come or minimized?
4. What are the advantages of MS and JK flip flops aver others? Draw their truth table also.
5. What is the use of shift register? Explain in detail.
6. State the difference between asynchronous and synchronous counter.
7. What is the use of counter in digital electronics? Explain the working of up-down counter.
8. What is the main disadvantage of an asynchronous counter?
9. Explain state-transition program.
10. Explain working of D/A converter.
11. Explain working of A/D converter.
12. How can we determine the accuracy and precision on converters?
13. Explain successive approximation method.
14. Discuss the applications of D/A and A/D converter in digital electronics.

Unit-IV

1. Explain the operation of ECL logic family. What parameters determine the noise margin of ECL gate?
2. Describe a major difference between bipolar and MOS integrated circuit.
3. If the frequency of operations of a CMOS device is increased, what happens to the dynamic power consumption?
4. What is the advantage of ECL over IC technology?
5. Explain TTL to CMOS interfacing. Give some necessary conditions to be satisfied.
6. Explain ROM & dynamic RAM. Differentiate these two.
7. Explain PROM and EPROM.
8. Explain why an open TTL input acts as HIGH.

Roll No. .....

Printed Pages : 3

Sample Paper

DIGITAL ELECTRONICS

Paper–EE–202A

Time allowed : 3 hours] *[Maximum marks : 75*

*Note :- The candidate is required attempt **five** questions in all, taking at least **one** question from each section. All questions carry equal marks i.e. 15 marks. Marks within a question are divided equally over its sub-questions e.g. if a question has two parts then each part is of 7.5 marks.*

Section–I

1. (a) Convert 1100101001010111 into Hexadecimal and Octal representation.

   (b) Carry out the BCD addition of the numbers 010001010000 + 010000010111

   (c) Explain the Grey Code and where it is used.

   (d) Explain the process of binary code to Grey Code conversion.

   (e) Realize an XOR gate using any combination of universal gates.

2. (a) Explain the method of parity check for error detection. Also explain what is CRC.

   (b) Simplify the Boolean relation (i) ABC (BD+CDE) (ii) (A+B) C + ABC

   (c) Explain in detail the Excess - 3 code and its uses.

   (d) Convert ABC_{16} and $ABCD_{16}$ into octal representation.

   (e) Perform the operations (i) $25_{16} + 33_{16}$ (ii) $145_8 - 26_8$

Section–II

3. (a) Discuss the procedure for digital relation simplification using K-Maps. Simplify the Boolean equation $Y = \overline{A}\,\overline{B}\,\overline{C}D + A\overline{B}\,\overline{C}D + AB\overline{C}D + ABC\overline{D}$ using K-maps. Also draw the logic circuit for the simplified relation.

   (b) Explain the process of Quine-Mccluskey method of simplification of Boolean relations and apply the same on above problem.

4. (a) What is an encoder? How will you design a 4×2 encoder. Discuss any application where encoders are used.

   (b) Give the schematics and explain a full adder circuit. Explain how can you make a full adder using a half adder circuit.

   (c) Explain the use of decoders as drivers for display devices.

Section–III

5. (a) What do you mean by a sequential circuit? Can you make sequential circuits using combinational circuits? Discuss the features of a flip-flop and explain how is it different from a latch.

   (b) Explain how will you convert a S-R flip flop into a J-K flip flop. Explain what are racing conditions and how they are avoided using master slave configurations.

   (c) Differentiate between asynchronous and syschronous sequential circuits.

EE-204A	Signals and Systems	2L:1T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the concepts of continuous time and discrete timesystems.
- Analyse systems in complex frequencydomain.
- Understand sampling theorem and itsimplications.

Unit-I

Introduction to Signals: Continuous and discrete time signals, deterministic and stochastic signals, periodic and aperiodic signals, even and odd signals, energy and power signals, exponential and sinusoidal signals and singular functions. Signal representation in terms of singular functions,

Introduction to Systems: Linear and non-linear systems, time invariant and time varying systems ,lumped and distributed systems, deterministic and stochastic systems, casual and non-causal systems, analog and discrete/digital memory and memory less systems.

Unit-II

Random Variables: Introduction to Random Variables, PDF, CDF

Linear Time Invariant Systems: Introduction to linear time invariant (LTI) systems, properties of LTI systems, convolution integral, convolution sum, causal LTI systems described by differential and difference equations. Concept of impulse response.

Unit-III

Discretization of Analog Signals: Introduction to sampling, sampling theorem and its proof. Effect of under sampling, reconstruction of a signal from sampled signal.

Fourier Series : Continuous time Fourier series (CTFS), Properties of CTFS, Convergence of Fourier series.

Unit-IV

Fourier Transform: Continuous Time Fourier Transform (CTFT), Properties of CTFT, Systems characterized by linear constant- coefficient differential equations.

Discrete time Fourier transform (DTFT), Properties of DTFT, Duality, Systems characterized by linear constant coefficient difference equations.

Laplace Transform: Introduction to Laplace transform, Region of convergence for laplace transform, Inverse Laplace transform, Properties of Laplace transform, Analysis and characterization of LTI systems using LaplaceTransform.

REFERENCES :

1. Oppenheim, Willsky, Nawab, Signals and Systems, Prentice Hall India, 2nd Edition, 2009
2. Simon Haykins – "Signal & Systems", Wiley Eastern
3. Tarun Kumar Rawat, Signals and Systems, Oxford University Press.

Note: The paper setter will set the paper as per the question paper templates provided.

Lesson Plan

Name of the teacher with designation: - Rishi Sarup Sharma (Assoc. Prof.)

Department- Electrical Engg.

Subject : Signals & Systems (4th Semester), Computer Methods in power System (8th Semester)

Lecture	Class	Topic/Chapter covered	Academic Activity	Test / Assignment
1.	4thsem	Introduction of subject and review of basic terms	Lect.	
2.	4thsem	Different types of signals	Lect.	
3.	4thsem	Periodic, impulse, singular functions	Lect.	
4.	4thsem	Continuous and discrete time signals, deterministic and stochastic signals	Lect.	
5.	4thsem	Periodic and aperiodic signals, even and odd signals,	Lect.	
6.	4thsem	energy and power signals	Lect.	
7.	4thsem	exponential and sinusoidal signals and singular functions.	Lect.	
8.	4thsem	Signal representation in terms of singular functions.	Lect.	
9.	4thsem	Linear and non-linear systems,	Lect.	
19.	4thsem	Time invariant and time varying systems	Lect.	Test
11.	4thsem	Lumped and distributed , deterministic and stochastic systems	Lect.	
12.	4thsem	Casual and non-causal systems	Lect.	
13.	4thsem	Analog and discrete/digital memory and memory less systems.	Lect.	
14.	4thsem	Introduction to Random Variables, PDF, CDF	Lect.	
15.	4thsem	Introduction to linear time invariant (LTI) systems	Lect.	
16.	4thsem	Properties of LTI systems	Lect.	
17.	4thsem	Convolution integral, , convolution sum	Lect.	
18.	4thsem	Causal LTI systems described by differential and difference equations.	Lect.	Test
19.	4thsem	Concept of impulse response.	Lect.	
20.	4thsem	Introduction to sampling, sampling theorem and its proof.	Lect.	
21.	4thsem	Effect of under sampling, reconstruction of a signal from sampled signal.	Lect.	
22.	4thsem	time Fourier series (CTFS)	Lect.	
23.	4thsem	Properties of CTFS	Lect.	
24.	4thsem	Convergence of Fourier series	Lect.	
25.	4thsem	Continuous Time Fourier Transform (CTFT),	Lect.	
26.	4thsem	Properties of CTFT	Lect.	
27.	4thsem	Systems characterized by linear constant- coefficient differential equations.	Lect.	
28.	4thsem	Discrete time Fourier transform (DTFT)	Lect.	Test
29.	4thsem	Properties of DTFT	Lect.	
30.	4thsem	Duality	Lect.	
31.	4thsem	Systems characterized by linear constant coefficient difference equations.	Lect.	
32.	4thsem	Continuous Time Fourier Transform (CTFT),	Lect.	
33.	4thsem	Introduction to Laplace transform, Properties of Laplace transform,	Lect.	
34.	4thsem	Analysis and characterization of LTI systems using Laplace Transform.	Lect.	
35.	4thsem	Region of convergence for Laplace transform, Inverse Laplace transform,	Lect.	
36.	4thsem	Solution of University paper (Unit-I and II)	Lect.	
37.	4thsem	Solution of University paper (Unit-III and IV)	Lect.	Test

Tute Sheets

Unit-I

1. What are the basic operations on signals ? Discuss.
2. Examine whether following signals rae periodic or not?
   a. $X(t) = \sin \pi t\, u(t)$ b. je^{j6t} c. $3u(t) + 2 \sin 2t$ d. $3 \sin 200\pi t + 4 \cos 100t$
3. Determine the power and rms value of the signal $x(t) = A \sin (w_0 t + \Phi)$
4. Determine whether the following signals are time-invariant or not?
   a. $Y(t) = t^2 x(t)$ b. $y(n) = x^2(n-2)$ c. $y(t) = e^{2x(t)}$ d. $y(t) = x(t) \sin 10 \pi t$
5. Find whether the following systems are stable or not?
   a. $H(t) = (2+e^{-3t})\, u(t)$ b. $y(t) = (t+5)\, u(t)$ c. $h(t) = e^{2t}\, u(t)$ d. $h(t) = (1/RC)\, e^{-t/RC}\, u(t)$

UNIT-II

1. A box contains 3 red, 4 white and 5 black balls. One ball is drawn at random . Find the probability that it is

A. Red B. not Black and C. Black or white

2. In an experiment =, three coins are tossed simultaneously. If the number of heads is the random variable, find the probability function for this random variable.
3. What is meant by CDF? Give the properties of CDF.
4. The joint PDf of two random variables is expressed as $F_{XY}(x.y)$. If the random variable X and Y are statistically independent, then show that $f_{XY}(x,y) = F_X(x)\, F_Y(y)$
   Here $f_X(x)$ is the PDF of random variable X and $f_Y(y)$ is the PDF of random variable Y.
5. The joint probability density function of two random variables X and Y is given as
   $F_{XY}(x,y) = C(2x+y)$ for $0<x<2$, $O<y<3$
   $= 0$, elsewhere
   Determine the value of constant C.

UNIT-III

1. State and explain the sampling theorem?
2. Explain the trigonometric Fourier series. What are its symmetric conditions?
3. Discuss the following properties of CTFS;
   a. Time-shifting b. Frequency-shifting c . Convolution
4. Obtain the Fourier series representation of a periodic rectangular waveform.
5. Explain the concept of negative frequency.

Unit-IV

1. .Evaluate the fourier transform of a single-sided exponential function $e^{-at}\, u(t)$ .Draw its spectrum.
2. Find the Fourier transform of the Gate function.
3. State and prove the final value theorem.
4. Determine the Laplace transform of the square wave.
5. Evaluate the Laplace transform of the damped sine and cosine functions.

Roll No. 1218781

34106

Printed Pages : 4

BT-4/M–19

SIGNALS AND SYSTEMS

Paper–EE–206-N

Time allowed : 3 hours] *[Maximum marks : 75*

Note : *Attempt any **five** questions completely by selecting at least **one** from each unit.*

Unit–I

1. Determine whether the following signals are energy signals, power signals or neither : 15

(i) $x(t) = e^{-at}\, u(t) \quad \alpha > 1$

(ii) $x(t) = A\cos(\omega_0 t + \theta)$

(iii) $x(t) = tu(t)$

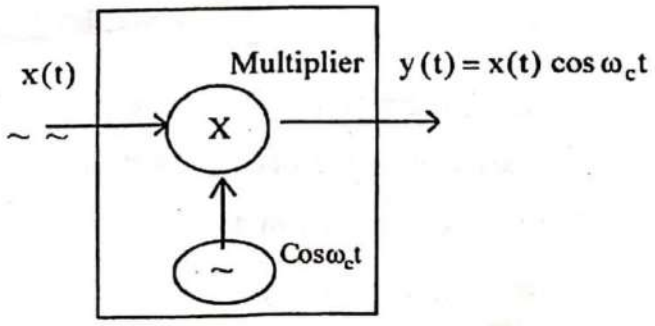
(iv) $x[n] = (-0.5)^n\, u[n]$

(v) $x[n] = u[n]$

(vi) $x[n] = 2\, e^{j3n}$

(vii) $x[n] = u[n]$

2. (a) Consider the system shown in the figure. Determine whether it is a (a) memoryless, (b) casual, (c) linear, (d) time-invariant or (e) stable. 10



(b) Determine whether or not each of the following signals is periodic. If signal is periodic, determine its fundamental period. 5

(i) $x(t) = \cos 2t + \left(\frac{\pi}{4}\right)$

(ii) $x(t) = \cos^2 t$

Unit–II

3. (a) Find the constant k for the density function $fx(x) = kx^2$ for $(0 < x < 2)$ also compute $P(1 << 2)$.

(b) Evaluate $y(t) = x(t) * h(t)$ by analytical technique given $x(t) = 1$ for $0 < t < 3$, otherwise $x(t) = 0$ and $h(t) = 1$ for $0 < t < 2$, otherwise $h(t) = 0$ 7+8

4. It the probability density function of a random variable X is given by $fx(x) = (1-x)^2$ for $0 \le x \le 1$. Then find the mean, variance and standard deviation. 15

Unit–III

5. (a) What is Shanon's sampling theorem ? Using an example also discuss aliasing. Find the minimum sampling interval to satisfy Shanon's rule for

$$x(t) = \cos(2\pi t)\frac{\sin(\pi t)}{\pi t} + \cos(2\pi t)\frac{\cos(\pi t)}{\pi t}$$ 10+5

(b) Determine the complex exponential Fourier series representation for the following signals :

(i) $x(t) = \cos \omega_0 t$

(ii) $x(t) = \sin \omega_0 t$

(iii) $x(t) = \cos\left(2t + \frac{\pi}{4}\right)$

(iv) $x(t) = \sin^2 t$

6. Determine the discrete Fourier series representation for each of the following sequence : 15

(i) $x[n] = \cos \pi n / 4$

(ii) $x[n] = \cos \pi n / 3 + \sin \pi n / 4$

(iii) $x[n] = \cos^2 (\pi n / 8)$

Unit–IV

7. (a) Using various Laplace transform properties derive the Laplace transforms of the following signals from the Laplace transform : 15

(a) $\delta(t)$;

(b) $\delta'(t)$;

(c) $tu(t)$;

(d) $e^{-\alpha t} u(t)$

(e) $te^{-\alpha t} u(t)$

(b) Find the Fourier Transform of

$x|n| = -a^n u|-n-1|$

$x|n| = a^{-n} u|-n-1|$

8. (a) Show that Laplace transform and Fourier transform of the unit impulse function is the same. 5+10

(b) What is Laplace transform ? Explain its importance in signal analysis. Also explain the region of convergence for Laplace transform.

EE-206A	Electrical Machines-II						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3h

Purpose	To familiarize the students with the basics of Electrical Machines
Course Outcomes	
CO1	Understand the concepts of rotating magnetic fields.
CO 2	Understand the operation of ac machines.
CO 3	Analyse performance characteristics of ac machines.
CO 4	Analyse synchronous machine

UNIT-I

Induction Machines:

Basic concept of Induction machines: winding factors, generated e.m.f. and m.m.f distribution, a.c. winding, rotating magnetic field.

3-phase Induction Motor: Construction, features, production of torque, phasor diagram, equivalent circuit, performance analysis, torque -slip characteristics, running, light and blocked rotor test, load test on 3-ph I.M.

UNIT-II

Single phase induction motors:-

Constructional features & double revolving field theory, equivalent circuit, determination of parameters. Split phase, starting methods, types& applications.

Starting of 3-ph I.M. Starting methods of squirrel cage and wound rotor induction motor.

Induction Generator-Operation, applications, advantages.

UNIT-III

Three Phase Synchronous Generators:

Principle, construction, EMF equation, armature winding, armature reaction, equivalent circuit, voltage regulation - synchronous reactance method , Rothert'sm.m.f method, Potier triangle method, Output power equation, power angle curve, two reactance theory, slip test, Transient and subtransient reactance, synchronization, parallel operation.

UNIT-IV

Three Phase Synchronous Motor: Construction, Principle of operation, Equivalent circuit, torque, power developed, starting, V-curve, Hunting-causes , effects & reduction , synchronous condenser applications. Comparison between induction motor and synchronous motor, high startig torque motors.

Suggested Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.

Note: The paper setter will set the paper as per the question paper templates provided.

LECTURE PLAN

LECTURES	TOPICS
L1	Winding factor, generated e.m.f. and m.m.f. of distributed ac winding.
L2	Rotating magnetic field
L3	Effects of rotatings magnetic field
L4	Induction Machines : Constructional feature
L5	Production of torque, phasor diagram
L6	Equivalent circuit, performance analysis
L7	Torque slip characteristics.
L8	Testing - Light running, blocked rotor
L9	Load Test
L10	Effect of rotor resistance, deep bar induction motor
L11	Double cage Induction motor
L12	Generator operation
L13	Wound rotor induction motor
L14	Starting methods of squirrel cage
L15	Wound motor induction motor
L16	Introduction of space harmonics
L17	Effects of space harmonics
L18	Single phase induction motors : Constructional features
L19	Double field revolving theory
L20	Equivalent circuit.
L21	Determination of parameters
L22	Split phase starting methods
L23	Applications
L24	Synchronous Machine; - Construction
L25	Cylindrical rotor machine
L26	Alternator - e.m.f., circuit. model, phasor diagram
L27	Armature reaction, synchronous impedance
L28	Voltage regulation & different methods
L29	Synchronous motors- principle, circuit model, phase or diagram
L30	Effect of load
L31	Operating characteristics of machines, V-curves
L32	Starting methods of motor
L33	Salient pot machine - two reaction theory
L34	Phasor diagram/power angle characteristics
L35	X_d&X_q
L36	Parallel operation of alternator - Synchronization
L37	Load division

Tute Sheets

UNIT -1

1. Explain generated EMF of distributed winding.
2. Explain MMF of distributed winding.
3. Explain the construction and working principle of 3 phase induction motor.
4. Draw and explain the Torque-speed charteristics of three phase induction motor.
5. On short circuit test, a 6 pole 50, HZ, 3 phase induction motor with stator resistance equal to equivalent stand still rotor resistance, took 200A and 80Kw. Calculate the starting torque.
6. Discuss the points of similarities between a transformer and induction motor. Hence explain why an induction machine, is a generalized transformer.

UNIT 2

1. Explain various methods of starting of squirrel cage and wound rotor Induction motor.
2. Write short notes on –
   i. Generator operation
   ii. Deep bar Induction motor
   iii. Double cage Induction motor
3. Explain the Double field revolving theory of Single phase induction motor.
4. Explain the construction of Single phase Induction motor.

UNIT - 3

1. Explain the constructional feature of Synchronous generator.
2. Explain the parallel operation of Alternator.
3. Explain the MMF method or Potier Triangle method of voltage regulation.
4. Explain synchronizing the Alternator.

UNIT – 4

1. Explain why synchronous motor is not self-starting.
2. Explain the principle of operation of synchronous motor and effect of load on it.
3. Draw and explain the V-curves for synchronous motor. Compare the induction motor and synchronous motor.

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BT-4 / M-19

ELECTRICAL MACHINES-II

Paper–EE-208 N, Opt. (I)

Time allowed : 3 hours] *[Maximum marks : 75*

Note : *Attempt any five questions, selecting at least one question from each unit.*

Unit–I

1. (a) Draw and explain the equivalent circuit of Induction machine (3-phase). 8

   (b) A 3-phase star connected, 400 V, 50 Hz 4 pole induction motor has the following per phase constants in ohms referred to stator :

   $r_1 = 0.15$, $x_1 = 0.45$, $r_2 = 0.12$, $x_2 = 0.45$, $Xm = 28.5$

   Fixed losses (core, friction and windage losses) = 400 watts compute the stator current, rotor speed, output torque and efficiency when the motor is operated at rated voltage and frequency at a slip of 4%. 7

2. (a) Draw the phasor diagram of three phase induction machine at full load. 8

   (b) Explain the torque-slip characteristics of three induction machine. 7

Unit–II

3. (a) Explain the effect of space harmonics in three phase induction motor. 7

   (b) A three phase induction motor with $r_2/x_2 = 0.5$ has a starting torque of 25.0 N-m. For negligible stator impedance and no load current, determine the starting torque in case the rotor-circuit resistance per phase is doubled. 8

4. (a) Explain the operation of Induction Generator. 8

(b) Explain the starting of split phase induction motor. 7

Unit–III

5. (a) Explain the mmf method of regulation of synchronous generator. 5

(b) A-three phase star connected, 50Hz Synchronous Generator has direct axis Synchronous reactance of 0.45p.u. The generator delivers rated KVA at rated voltage. Draw phasor diagram at full load 0.8 p.f. lagging and hence calculate the open circuit voltage and regulation. Resistive drop at full load is 0.015.p.u. 10

6. (a) Explain the two reaction theory of salient pole synchronous generator. Also draw the phasor diagram. 7

(b) Explain the synchronization and parallel operation of synchronous generator. 8

Unit–IV

7. (a) Explain the effect of Excitation on V Curves of synchronous motor. 5

(b) Derive the expression of torque and power developed in synchronous motor. 10

8. (a) Explain the operation of synchronous condenser. 7

(b) Explain in brief the high starting torque motors. 8

EE-208A	Power Electronics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3h

Purpose	To familiarize the students with the Converter and Power switching device

Course Outcomes	
CO1	Understand the differences between signal level and power level devices.
CO 2	Analyse controlled rectifier circuits.
CO 3	Analyse the operation of DC-DC choppers.
CO 4	Analyse the operation of voltage source inverters.

UNIT-I

Power switching devices :

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

UNIT-II

Thyristor rectifiers

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with Rload and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

UNIT-III

DC-DC buck converter:

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.

DC-DC boost converter:

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

UNIT-IV

Single-phase voltage source:

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage.

Suggested Books:

1. M. H. Rashid, "*Power electronics: circuits, devices, and applications*", Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
4. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

Note: The paper setter will set the paper as per the question paper templates provided.

Lesson Plan

Lecture Day	Topic
1.	Introduction
2.	Diode
3.	Thyristor
4.	Numerical Practice
5.	MOSFET
6.	IGBT: I-V Characteristics
7.	Firing circuit for thyristor
8.	Numerical Practice
9.	Voltage and current commutation of a thyristor
10.	Voltage and current commutation of a thyristor
11.	Gate drive circuits for MOSFET and IGBT
12.	Numerical Practice
13.	Gate drive circuits for MOSFET and IGBT
14.	Revision
15.	Test
16.	Numerical Practice
17.	Single-phase half-wave and full-wave rectifiers
18.	Single-phase half-wave and full-wave rectifiers
19.	Single-phase half-wave and full-wave rectifiers
20.	Numerical Practice
21.	Single-phase full-bridge thyristor rectifier with Rload and highly inductive load
22.	Single-phase full-bridge thyristor rectifier with Rload and highly inductive load
23.	Single-phase full-bridge thyristor rectifier with Rload and highly inductive load
24.	Numerical Practice
25.	Three-phase full-bridge thyristor rectifier with R-load and highly inductive load
26.	Three-phase full-bridge thyristor rectifier with R-load and highly inductive load
27.	Input current wave shape and power factor.
28.	Numerical Practice
29.	Revision
30.	Test
31.	Elementary chopper with an active switch and diode
32.	Numerical Practice
33.	Concepts of duty ratio and average voltage
34.	Power circuit of a buck converter
35.	Analysis and waveforms at steady state, duty ratio control of output voltage
36.	Numerical Practice
37.	Analysis and waveforms at steady state, duty ratio control of output voltage
38.	Power circuit of a boost converter
39.	Analysis and waveforms at steady state
40.	Numerical Practice
41.	Relation between duty ratio and average output voltage
42.	Revision
43.	Test
44.	Numerical Practice
45.	Power circuit of single-phase voltage source inverter
46.	Switch states and instantaneous output voltage, square wave operation of the inverter
47.	Switch states and instantaneous output voltage, square wave operation of the inverter
48.	Numerical Practice
49.	Concept of average voltage over a switching cycle
50.	Bipolar sinusoidal modulation and unipolar sinusoidal modulation

51.	Bipolar sinusoidal modulation and unipolar sinusoidal modulation
52.	Numerical Practice
53.	Modulation index and output voltage
54.	Revision
55.	Test
56.	Numerical Practice
57.	Revision
58.	Revision
59.	Revision
60.	Test

Tutorial Sheet-1

Q1. Which is the Power semiconductor device having
a) Highest switching speed;
b) Highest voltage / current ratings;
c) Easy drive features;
d) Can be most effectively paralleled;
e) Can be protected against over-currents with a fuse;
f) Gate-turn off capability with regenerative features;
g) Easy drive and High power handling capability

Q2. An SCR requires 50 mA gate current to switch it on. It has a resistive load and is supplied from a 100 V DC supply. Specify the Pulse transformer details and the circuit following it, if the driver circuit supply voltage is 10 V and the gate-cathode drop is about 1 V.

Q3. A Power BJT is used to switch an inductive load carrying 20 A. The supply voltage is 200V, switching frequency and duty cycle are 1 KHZ and 0.5 respectively. Switching times are as follows. t_d = 1μs, $t_{ri} = t_{fv1}$ = 8 μs, t_{fv2} = 0, t_s = 12 μs, $t_{fi} = t_{rv2}$ = 8 μs, t_{rv1} = 0. V_{CEsatc} = 1.0V at i = 20 A
Calculate switching and conduction losses in the transistor.

Q4. A thyristor has a maximum average current rating 1200 Amps for a conduction angle of 180°. Find the corresponding rating for Φ = 60°. Assume the current waveforms to be half cycle sine wave.

Q5. Explain the effect of increasing the magnitude of the gate current and junction temperature on (i) forward and reverse break down voltages, (ii) forward and reverse leakage currents.

Q6.
A MOSFET has the following parameters
V_{GS}(th) = 3V, g_{fs} = 3, C_{GS} = 800 PF, C_{GD} = 250 PF. The MOSFET is used to switch an inductive load of 15 Amps from 150V supply. The switching frequency is 50 kHz. The gate drive circuit has a driving voltage of 15V and output resistance of 50Ω. Find out the switching loss in the MOSFET.

Q7. An IGBT is used to switch a resistive load of 5Ω from a DC supply of 350 volts as shown in the inset of Fig 7.4 (a). The ON state gate voltage is v_{gE} = 15v. For the IGBT, v_{gE} (th) = 4 volts and g_{ts} = 25. Find out the maximum current flowing through the IGBT in the event of a short circuit fault across the load. Also find out the power dissipation inside the device.

Q8. What is the role of dv/dt in operation of a thyristor? How can a high dv/dt cause an unwanted trigerring? Discuss.

Q9. Draw and explain the trigerring circuits of a thyristor.

Q10. What is meant by commutation of SCR? Draw circuits and explain the methods for it.

Tutorial Sheet 2

Q1. Derive expressions for various performance indices of a controlled rectifier circuit.

Q2. A single phase fully controlled bridge converter operates in the continuous conduction mode from a 230V, 50HZ single phase supply with a firing angle α = 30°. The load resistance and inductances are 10Ω and 50mH respectively. Find out the 6th harmonic load current as a percentage of the average load current.

Q3. A 220 V, 20A, 1500 RPM separately excited dc motor has an armature resistance of 0.75Ω and inductance of 50mH. The motor is supplied from a 230V, 50Hz, single phase supply through a fully controlled bridge converter. Find the no load speed of the motor and the speed of the motor at the boundary between continuous and discontinuous modes when $\alpha = 25°$.

Q4. Is it possible to operate a single phase fully controlled half wave converter in the inverting mode? Explain.

Q5. A single phase half controlled converter is used to supply the field winding of a separately excited dc machine. With the rated armature voltage the motor operates at the rated no load speed for a fining angle $\alpha = 0°$. Find the value of α which will increase the motor no load speed by 30%. Neglect lasses and saturation. Assume continuous conduction.

Q6.A single phase half controlled converter is used to boost the no load speed of a separately excited dc machine by weakening its field supply. At $\alpha = 0°$ the half controlled converter produces the rated field voltage. If the field inductance is large enough to make the field current almost ripple face what will be the input power factor when the dc motor no load speed is bossed to 150%?

Q7. A three phase fully controlled bridge converter operating from a 3 phase 220 V, 50 Hz supply is used to charge a battery bank with nominal voltage of 240 V. The battery bank has an internal resistance of 0.01 Ω and the battery bank voltage varies by ± 10% around its nominal value between fully charged and uncharged condition. Assuming continuous conduction find out. (i) The range of firing angle of the converter. (ii) The range of ac input power factor. (iii) The range of charging efficiency. When the battery bank is charged with a constant average charging current of 100 Amps through a 250 mH lossless inductor.

Q8. A 220V, 750 RPM, 200A separately excited dc motor has an armature resistance of 0.05 Ω. The armature is fed from a three phase non circulating current dual converter. If the forward converter operates at a firing angle of 70º i) At what speed will the motor deliver rated torque. ii) What should be the firing angle in the regenerative braking mode when the motor delivers half the rated torque at 600 rpm. Assume continuous conduction. Supply voltage is 400 V.

Q9. If a free wheeling diode is connected across the output terminals of a three phase fully controlled converter will the performance of converter will be similar to a half controlled converter? Justify your answer.

Q10. A battery with a nominal voltage of 200V and internal resistance of 10mΩ has to be charged at a constant current of 20 amps from a 3 phase 220V 50 Hz power supply. Which of the following converters will give better performance with respect to input current displacement factor, distortion factor and power factor? (i) 3 phase fully controlled converter; (ii) 3 phase half controlled converter.

Tutorial Sheet – 3

Q1. A Chopper circuit is operating on TRC at a frequency of 2 kHz on a 460 V supply. If the load voltage is 350 volts, calculate the conduction period of the thyristor in each cycle.

Q2. Input to the step up chopper is 200 V. The output required is 600 V. If the conducting time of thyristor is 200 μssec. Compute Chopping frequency, If the pulse width is halved for constant frequency of operation, find the new output voltage.

Q3. A dc chopper has a resistive load of and input voltage. When chopper is ON, its voltage drop is 1.5 volts and chopping frequency is 10 kHz. If the duty cycle is 80%, determine the average output voltage and the chopper on time.

Q4. In a dc chopper, the average load current is 30 Amps, chopping frequency is 250 Hz. Supply voltage is 110 volts. Calculate the ON and OFF periods of the chopper if the load resistance is 2 ohms.

Q5. Discuss the main classification of dc to dc thyristor converters. Which of these is more commonly employed and why?

Q6. Describe the principle of step-up chopper. Derive an expression for the average output voltage in terms of input dc voltage and duty cycle. State the assumptions made.

Tutorial Sheet – 4

Q1. A single phase half bridge inverter has a resistance of 2.5Ω and input DC voltage of 50V. Calculate the following −RMS voltage occurring at the fundamental frequency, power Output, Peak current and average current, Harmonic RMS voltage and Total harmonic distortion.

Q2. What are line-commutated inverters? How do they operate? Explain the difference between line-commutated and force-commutated inverters.

Q3. What is the purpose of connecting diodesin antiparallel with thyristors in inverter circuits? Explain how these diodes come into play.

Q4. Write Fourier series expression for the output voltages and currents obtained from single-phase half-bridge and full-bridge inverters.

Q5. A single phase full bridge inverter is connected to an RL load. For a dc source voltage V_s and output frequency f = 1/T, obtain expressions for load current and steady state current as a function of time for the first two half cycles of the output voltage. For R = 20Ω and L = 0.1H, obtain the expression for load current and steady state current, with source voltage 240V dc and frequency of output voltage as 50 Hz.

Q6. A Single-phase bridge inverter is fed from 230Vdc. In the output voltage wave, only fundamental component of voltage is considered. Determine the rms current ratings of an SCR and a diode of bridge type loads: (i) R=2Ω and (ii) wL = 2Ω. Also, find the repetitive peak voltage that may appear across the thyristor in part (i) and (ii).

Sample Paper

Power Electronics (EE-208A)

MM. 75 **Time: 3 Hours**

Note: Q1 and Q2 are compulsory. Attempt one question from each unit.

Q1 (a). Define holding and latching current of a thyristor.
(b). What are the effects of firing angle on a converter?
(c). What are the types of commutation? Define them also.
(d). Explain the meaning of commutation and its types in regard to dc-dc choppers.
(e). What is an inverter and its types? (3x5)

Q2 (a). Explain the difference between power diode and signal diode.
(b). What are the advantages of freewheeling diodes in a controlled in a controlled rectifier?
(c). Discuss the advantages and disadvantages of Load Commutated Choppers.
(d). Compare the methods of commutation used in bridge inverters. (5x4)

Unit 1

Q3. What is a thyristor? Give its constructional details. Describe different modes of operation of a thyristor with the help of its static V-I characteristics.Explain the need of commutation in thyristor circuits. What are the different methods of commutation schemes? (10)

Q4. For an SCR, gate-cathode characteristic is given by Vg = 1 + 10Ig. Gate source voltage is a rectangular pulse of 15V with 20 μ sec duration. For an average gate power dissipation of 0.3W and peak gate drive power of 5W, compute (i) the resistance to be connected in series with SCR gate, (ii) the trigerring frequency, and, (iii) the duty cycle of the triggering pulse.(10)

Unit 2

Q5. A single-phase half-wave SCR circuit feeds power to a resistive load. Draw waveforms for source voltage, load voltage, load current and voltage across the SCR for a given firing angle of α. Hence obtain the expression for average and rms load voltages in terms of source voltage and firing angle. (10)

Q6. Draw the circuit for a three-phase full convertor bridge with resistive load. Sketch the waveform for output voltage for a firing angle of 0^o and overlap angle of 30^o. Also, sketch thewaveform for output voltage for a firing angle of 30^o and overlap angle of 30^o. Indicate the conduction of various SCRs in these waveforms. (10)

Unit 3

Q7. Describe the operation of a dc chopper operation. Derive an expression for its average dc output voltage. Explain with appropriate waveforms, the different control strategies used for obtaining variable output voltage from a dc chopper. Which one of these is preferred over the other and why? (10)

Q8. A chopper has the following data: T = 1000μs, R = 2Ω, L = 5mH. Find the duty cycle α, so that per unit value of minimum load current does not fall below, (i) 0.1 and (ii) 0.3 of V_s/R.(10)

Unit 4

Q9. Describe the working of a single phase half bridge inverter. What is its main drawback and how can it be overcome. (10)

Q10. A single phase full bridge inverter is connected to an RL load. For a dc source voltage V_s and output frequency f = 1/T, obtain expressions for load current and steady state current as a function of time for the first two half cycles of the output voltage. For R = 20Ω and L = 0.1H, obtain the expression for load current and steady state current, with source voltage 240V dc and frequency of output voltage as 50 Hz. (10)

EE-216A	Electromagnetic Fields	3L:1T:0P	4 credits
Course Outcomes	At the end of the course, students will demonstrate the ability • To understand the basic laws ofelectromagnetism. • To obtain the electric and magnetic fields for simple configurations under static conditions. • To analyse time varying electric and magneticfields. • To understand Maxwell's equation in different forms and differentmedia. • To understand the propagation of EMwaves. This course shall have Lectures and Tutorials. Most of the students find difficult to visualize electric and magnetic fields. Instructors may demonstrate various simulation tools to visualize electric and magnetic fields in practical devices like transformers, transmission lines and machines.		

Unit-I

Review of Vector Calculus

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus- differentiation, partial differentiation , integration, vector operat ordel, gradient, divergence and curl; integral theorems of vectors. Conversionofavectorfromonecoordinatesystemtoanother.

Unit-II

Static Electric Field

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energydensity.

Unit-III

Conductors, Dielectrics and Capacitance

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Unit-IV

Static Magnetic Fields and Maxwell's Equations:

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors. Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions.

Maxwell's equations in differential and integral forms and their physical significances in circuit and field theory.

***Text / References**:*

1. M.N.O.Sadiku,"ElementsofElectromagnetics",OxfordUniversityPublication,2014.
2. A.Pramanik,"Electromagnetism-Theoryandapplications",PHILearningPvt.Ltd,New Delhi,2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India,2012.

4. G. W. Carter, “The electromagnetic field in its engineering aspects”, Longmans,1954.
5. W.J.Duffin,“ElectricityandMagnetism”,McGrawHillPublication,1980.
6. W.J.Duffin,“AdvancedElectricityandMagnetism”,McGrawHill,1968.
7. E. G. Cullwick, “The Fundamentals of Electromagnetism” , Cambridge University Press, 1966.
8. B. D. Popovic, “Introductory Engineering Electromagnetics”, Addison-Wesley Educational Publishers, International Edition,1971.
9. W. Hayt, “Engineering Electromagnetics”, McGraw Hill Education,2012.

Note: The paper setter will set the paper as per the question paper templates provided.

EE -210A	Electrical Machines Lab-II						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	60	40	100	3h

LIST OF EXPERIMENTS:

1) To perform load test on a 3-phase induction motor & DC generator set and to determine the efficiency of induction motor.
2) Determine mechanical losses by light running of a 3-phase induction motor.
3) Study and starting of 1-phase induction motor. To perform light running and block rotor test and to determine the parameters of the equivalent circuit.
4) To perform the open circuit test and block rotor test on 3-phase induction motor and draw the circle diagram.
5) To perform & study effect of rotor resistance on a poly phase slip ring induction motor.
6)To calculate regulation by synchronous impedance method:-
a) Conduct open and short circuit test on a three phase alternator.
b) Determine and plot variation of synchronous impedance with If
c) Determine SCR
d) Determine regulations for 0.8 lagging power factor, 0.8 leading power factor and unity PF.
7) To plot V curves of a synchronous machine.
a) Determination of Xo of a synchronous machine.
b) Measurement Xd&Xq (Direct axis and Quardrature axis reactance) by slip test
8) To measure Xq of synchronous machine (negative sequence reactance).
9) To calculate regulation by ZPF method.
10) To perform and study parallel operation of synchronous generators.

Note: At least eight experiments should be performed from above list.

EE -212A	Power Electronics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	60	40	100	3h

LIST OF EXPERIMENTS:

1. To Plot the firing characteristics of given silicon control rectifier.
a. By varying the gate current Ig keeping forward voltage Vak fixed.
b. By varying forward voltage Vak keeping gate current fixed.
2. To study the V-I characteristics of given UJT. To plot graph between Ve and Ie . To find negative resistance from the graph.
3. To plot V-I characteristics of given Triac in I and III quadrant.
4. To plot the drain characteristics of given F.E.T & to evaluate the parameter rd, Idss.
5. To study the UJT based relaxation oscillator & to evaluate the dynamic resistance.
6. To study & draw the characteristics of DC-DC chopper power circuit
7. To study the characteristics of single phase fully controlled converter circuit.
8. To study the characteristics of 3-phase fully controlled converter power circuit.
9. To study single phase Mc Murray Inverter power circuit.
10. To study single phase cyclo-converter circuit.

Note: At least eight experiments should be performed from above list.

EEN -214A	Digital Electronics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	60	40	100	3h

LIST OF EXPERIMENTS:

1) Study of TTL gates- AND, OR, NOR, NAND, NOT, EX-OR, EX-NOR.
2) Design & realize a given function using K-Map and verify its performance.
3) To verify the operation of multiplexer & Demultiplexers.
4) To verify the operation of comparator.
5) To verify the truth tables of S-R, J-K, T& D type flip flops
6) To verify the operation of bi-directional shift register.
7) To design & verify the operation of 3-bit synchronous counter.
8) To design and verify the operation of synchronous UP/DOWN decade counter using JK flip flop & drive a seven segment display using the same.
9) To design and verify the operation of asynchronous UP/DOWN decade counter using JK flip flop & drive a seven segment display using the same.
10) To design and realize sequence generator for a given sequence using JK Flip flop.
11) Study of CMOS NAND & NOR gates and interfacing between TTL and CMOS gates.
12) Design a 4-bit shift register and verify its operation of a ring counter and a Johnson counter.

Note: At least ten experiments should be performed from above list.

MC-902A	Constitution of India					
Lecture	Tutorial	Practical	Major Test	Minor Test	Total	Time
3	-	-	75	25	100	3 Hrs.
Purpose	To know the basic features of Constitution of India					
Course Outcomes						
CO1	The students will be able to know about salient features of the Constitution of India.					
CO2	To know about fundamental duties and federal structure of Constitution of India.					
CO3	To know about emergency provisions in Constitution of India.					
CO4	To know about fundamental rights under constitution of India.					

UNIT-I

Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India. Salient features and characteristics of the Constitution ofIndia.
Scheme of the fundamentalrights

UNIT -II

The scheme of the Fundamental Duties and its legal status. The Directive Principles of State Policy – Its importance and implementation. Federal structure and distribution of legislative and financial powers between the Union and theStates.
Parliamentary Form of Government in India – The constitution powers and status of the President ofIndia

UNIT - III

Amendment of the Constitutional Powers and Procedure. The historical perspectives of the constitutional amendments inIndia.
Emergency Provisions: National Emergency, President Rule, Financial Emergency. Local Self Government – Constitutional Scheme inIndia.

UNIT-IV

Scheme of the Fundamental Right to Equality. Scheme of the Fundamental Right to certain Freedom under Article19.Scope of the Right to Life and Personal Liberty under Article21.

Text Books

1. Constitution of India. Prof.Narender Kumar (2008) 8th edition. Allahabad LawAgency.

ReferenceBooks:

1. The constitution of India. P.M. Bakshi (2016) 15th Edition. Universal lawPublishing.

Note: The paper setter will set the paper as per the question paper templates provided.

Week	Lecture Day	Class	Topic/Chapter Covered	Academic Activity	Test/ Assignment
1st	L1	B.Tech ELE- 4th Semester	eaning of the constitution law and constitutionalism	Lecture	
	L2	B.Tech ELE- 4th Semester	Do	Lecture	
	L3	B.Tech ELE- 4th Semester	Do	Lecture	
2nd	L4	B.Tech ELE- 4th Semester	storical perspective of the Constitution of India.	Lecture	
	L5	B.Tech ELE- 4th Semester	Do	Lecture	
	L6	B.Tech ELE- 4th Semester	Do	Lecture	
3rd	L7	B.Tech ELE- 4th Semester	lient features and characteristics of the Constitution of India.	Lecture	
	L8	B.Tech ELE- 4th Semester	Do	Lecture	
	L9	B.Tech ELE- 4th Semester	Do	Lecture	
4th	L10	B.Tech ELE- 4th Semester	Scheme of the fundamental rights	Lecture	
	L11	B.Tech ELE- 4th Semester	Do	Lecture	
	L12	B.Tech ELE- 4th Semester	Do	Lecture	Assignment from 1st Unit
5th	L13	B.Tech ELE- 4th Semester	The scheme of the Fundamental Duties and its legal status.	Lecture	
	L14	B.Tech ELE- 4th Semester	Do	Lecture	
	L15	B.Tech ELE- 4th Semester	Do	Lecture	
6th	L16	B.Tech ELE- 4th Semester	The Directive Principles of State Policy – Its importance and implementation.	Lecture	
	L17	B.Tech ELE- 4th Semester	Do	Lecture	
	L18	B.Tech ELE- 4th Semester	Do	Lecture	
7th	L19	B.Tech ELE- 4th Semester	Federal structure and distribution of legislative and financial powers between the Union and the States.	Lecture	
	L20	B.Tech ELE- 4th Semester	Do	Lecture	
	L21	B.Tech ELE- 4th Semester	Do	Lecture	
8th	L2	B.Tech ELE- 4th Semester	Do	Lecture	

	L22	B.Tech ELE- 4th Semester	Parliamentary Form of Government in India – The constitution powers and status of the President of India	Lecture	
	L23	B.Tech ELE- 4th Semester	Do	Lecture	
9th	L24	B.Tech ELE- 4th Semester	Do	Lecture	
	L25	B.Tech ELE- 4th Semester	Do	Lecture	Assignment from 2nd unit
	L26	B.Tech ELE- 4th Semester	nendment of the Constitutional Powers and Procedure.	Lecture	
10th	L27	B.Tech ELE- 4th Semester	Do	Lecture	
	L28	B.Tech ELE- 4th Semester	Do	Lecture	
	L29	B.Tech ELE- 4th Semester	The historical perspectives of the constitutional amendments in India.	Lecture	
11th	L30	B.Tech ELE- 4th Semester	Do	Lecture	
	L31	B.Tech ELE- 4th Semester	Do	Lecture	
	L32	B.Tech ELE- 4th Semester	Emergency Provisions: National Emergency	Lecture	
12th	L33	B.Tech ELE- 4th Semester	Do	Lecture	
	L34	B.Tech ELE- 4th Semester	President Rule	Lecture	
	L35	B.Tech ELE- 4th Semester	Do	Lecture	
13th	L36	B.Tech ELE- 4th Semester	Financial Emergency.	Lecture	
	L37 Add On's	B.Tech ELE- 4th Semester	Do	Lecture	
	L38 Add On's	B.Tech ELE- 4th Semester	Do	Lecture	
14th	L39 Add On's	B.Tech ELE- 4th Semester	Local Self Government – Constitutional Scheme in India.	Lecture	
	L40 Add On's	B.Tech ELE- 4th Semester	Do	Lecture	
	L41 Add On's	B.Tech ELE- 4th Semester	Do	Lecture	Assignment from 3rdUnit

15th	L42	B.Tech ELE- 4th Semester	Scheme of the Fundamental Right to Equality.	Lecture	
	L43	B.Tech ELE- 4th Semester	Do	Lecture	
	L44	B.Tech ELE- 4th Semester	Do	Lecture	
16th	L45	B.Tech ELE- 4th Semester	Scheme of the Fundamental Right to certain Freedom under Article 19.	Lecture	
	L46	B.Tech ELE- 4th Semester	Do	Lecture	
	L47	B.Tech ELE- 4th Semester	Do	Lecture	
	L48	B.Tech ELE- 4th Semester	Scope of the Right to Life and Personal Liberty under Article 21.	Lecture	
	L49	B.Tech ELE- 4th Semester	Do	Lecture	
	L50	B.Tech ELE- 4th Semester	Do	Lecture	
	L51	B.Tech ELE- 4th Semester	Do	Lecture	Assignment from 4th Unit

Tutorial Sheet 1

1. Define constitution law.

2. What is constitutionalism?

3. Analyse the historical perspective of constitution of India in detail.

4. Discuss the salient features and characteristics of constitution of India.

5. Discuss the scheme of fundamental rights in constitution of India.

Tutorial Sheet 2

1. Discuss the scheme of fundamental duties and their legal status.

2. Explain the directive principles of state policy.

3. Discuss the importance and implementation of the directive principles of state policy.

4. Analyse the Federal structure and distribution of legislative power between union and the states.

5. Analyse the Federal structure and distribution of financial powers between the union and states.

6. Discuss the constitutional powers and status of president of India.

Tutorial Sheet 3

1. Analyse the amendment of constitutional power and procedure.

2. Discuss the historical perspectives of the constitutional amendment in India.

3. Examine the emergency provision in the constitutional scheme of India.

Tutorial Sheet 4

1. Discuss the scheme of fundamental rights to equality.

2. Elaborate the scheme of fundamental right to certain freedom under article 19.

3. Discuss the scope of right to life and personal liberty under article 21.

Sample Paper
Constitution of India
MC-902

Time allowed: 3 Hours Maximum marks: 75

Note: The question paper carrys III parts, Part A & B is compulsory. Which is of 15 and 20 marks respectively. Part C is of 40 marks,attempt four questions by selecting at least one question from each unit.

Part A (5*3) = 15

Answer the following questions:

1. Define Constitutionalism.
2. Define characteristics of constitution of India.
3. List the scheme of fundamental rights.
4. List the fundamental duties.
5. Define president rule.

Part B (4*5) = 20

1. Discuss the historical perspective of constitution of India.

2. Discuss the federal structure and distribution of legislative and financial power between the union and the states.

3. Discuss the amendment of constitutional powers and procedures.

4. Analyse the scope of right to life and personal liberty under article 21.

Part C (4*10) = 40

Unit I

1. Discuss the salient features and characteristics of constitution of India.
2. Explain the scheme of fundamental rights in the constitution of India.

Unit II

1. Discuss the importance and implementations of directive principles of state policy.
2. Explain the parliamentary form of Govt. In India.

Unit III

1. Examine the amendments of constitutional powers and procedures in detail.
2. Discuss the emergency provisions: National , financial and presidential in detail.

Unit IV

1. Discuss the fundamental rights to equality.
2. Explain the scheme of fundamental rights to certain freedom under article 19.

EE-216A	Electromagnetic Fields	3L:1T:0P	4 credits
Course Outcomes	At the end of the course, students will demonstrate the ability • To understand the basic laws ofelectromagnetism. • To obtain the electric and magnetic fields for simple configurations under static conditions. • To analyse time varying electric and magneticfields. • To understand Maxwell's equation in different forms and differentmedia. • To understand the propagation of EMwaves. This course shall have Lectures and Tutorials. Most of the students find difficult to visualize electric and magnetic fields. Instructors may demonstrate various simulation tools to visualize electric and magnetic fields in practical devices like transformers, transmission lines and machines.		

Unit-I

Review of Vector Calculus

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus- differentiation, partial differentiation , integration, vector operat ordel, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

Unit-II

Static Electric Field

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energydensity.

Unit-III

Conductors, Dielectrics and Capacitance

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Unit-IV

Static Magnetic Fields and Maxwell's Equations:

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors. Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions.

Maxwell's equations in differential and integral forms and their physical significances in circuit and field theory.

***Text / References**:*

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11. A.Pramanik,"Electromagnetism-Theoryandapplications",PHILearningPvt.Ltd,New Delhi,2009.
12. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India,2012.
13. G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans,1954.
14. W.J.Duffin,"ElectricityandMagnetism",McGrawHillPublication,1980.
15. W.J.Duffin,"AdvancedElectricityandMagnetism",McGrawHill,1968.
16. E. G. Cullwick, "The Fundamentals of Electromagnetism" , Cambridge University Press, 1966.
17. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition,1971.
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Note: The paper setter will set the paper as per the question paper templates provided.

Lesson Plan

Name of Faculty: - Maan Singh
Discipline: - Electrical Engg.
Semester: - 4th
Subject: - Electromagnetic Fields (EE-216A)
Lesson Plan Duration: - 15 week
Work Load (Lecture/Practical):- Lecture=03, Tutorial=00, Practical=00

Week	Theory	
	Lecture Day	
1st	1.	Review of vector analysis
	2.	Vector Algera
	3.	Orthogonal co-ordinate systems(Rectangular co-ordinate system)
2nd	4.	Cylindrical co-ordinate system
	5.	Spherical co-ordinate system
	6.	Review of vector calculus in all the three coordinate systems: Line, surface & volume integrals
3rd	7.	Conversion of a vector from one coordinate system to another
	8.	Vector calculus- differentiation,
	9.	Partial differentiation , integration
4th	10.	DEL operators(Gradient, divergence & their physical significance)
	11.	Curl of vector, Laplacian & their physical significance
	12.	Divergence theorem, stokes theorem
5th	13.	Vector calculus- differentiation, partial differentiation , integration
	14.	Coulomb's law
	15.	Electric field intensity
6th	16.	Electrical field due to point charges
	17.	Line, Surface and Volume charge distributions
	18.	Gauss law and its applications
7th	19.	Absolute Electric potential
	20.	Potential difference
	21.	Calculation of potential differences for different configurations.
8th	22.	Electric dipole
	23.	Electrostatic Energy and Energy density
	24.	Current and current density
9th	25.	Ohms Law in Point form
	26.	Continuity of current
	27.	Boundary conditions of perfect dielectric materials.
10th	28.	Permittivity of dielectric materials
	29.	Capacitance, Capacitance of a two wire line
	30.	Poisson's equation
11th	31.	Laplace's equation
	32.	Solution of Laplace and Poisson's equation
	33.	Application of Laplace's and Poisson's equations
12	34.	Biot-Savart Law
	35.	Ampere Law
	36.	Magnetic flux and magnetic flux density
13	37.	Scalar and Vector Magnetic potentials
	38.	Steady magnetic fields produced by current carrying conductors

	39.	Nature of magnetic materials
14	40.	Magnetization and permeability
	41.	Magnetic boundary conditions
	42.	Maxwell's equations in differential forms and their physical significances in circuit and field theory
15	43.	Maxwell's equations in integral forms and their physical significances in circuit and field theory
	44.	Revision
	45.	Revision

TUTORIAL SHEET-1

1. State and prove Stoke's theorem and also state significance of theorem.
2. State and explain Gauss law in electrostatics with applications.
3. Find the angle between A=101x + 21z and B=41x + 0.51z using both, dot and cross product.
4. Find the unit vector directed from (2,-5,2) toward (15,-5,3).
5. Discuss Gradient, divergence and curl and their physical significance.

TUTORIAL SHEET-2

1. State and proof gauss law .and explain applications of gauss law.
2. Drive an expression for the electric field due to a straight and infinite Uniformly charged wire of length 'L' meters and with a charge density of + c/m at a point P which lies along the perpendicular bisector of wire.
3. Derive the boundary conditions of the normal and tangential components of electric field at the inter face of two media with different dielectrics.
4. Derive the boundary conditions of the normal and tangential components of electric field at the inter face of two media with different dielectrics.
5. A uniform line charge L =25Nc/m lies on the x=3m and y=4m in free space . Find the electric field intensity at a point (2,3,15)m.

TUTORIAL SHEET-3

1. The resistance of round long wire of diameter 3mm is 4.04 ohm/km.If current of 40 A flow through the wire, find
   (a) The conductivity of the wire and identify the material of the wire.
   (b) The electric current density of the wire.
2. Determine the total current in the wire of radius 1.6mm if $J=500a_z/\dot{\rho}$ A/m^2.
3. Drive and Explain the Poisson's Equation.
4. Drive and Explain the Laplace's Equation.
5. Determine the capacitance of a conducting sphare of radius 5cm deeply immersed in sea water (ε_r=80).

TUTORIAL SHEET-4

1. Explain Biot Savart's Law.
2. Derive the expressions for boundary conditions in magnetic fields.
3. Derive the expression for torque developed in a rectangular closed circuit carrying current I a uniform field.
4. Derive the expressions for magnetic flux intensity due to solenoid of the coil.
5. Write Maxwell's equations in differential and integral form for free space.

Sample Paper

Power Electronics (EE-216A)

MM. 75 **Time: 3 Hours**

Note: Q1 and Q2 are compulsory. Attempt one question from each unit.

Q1.

a) Write expression for differential length in cylindrical and spherical co- ordinates.
b) State divergence theorem.
c) State coulombs law.
d) Define electric field intensity.
e) Define current density. (3x5)

Q2.

a. Explain State and proof divergence theorem.
b. The electric field in a spherical co-ordinate is given by E=(r/5)ar. Show that closedE.dS=(.E)dv.
c. State and proof gauss law .and explain applications of gauss law.
d. A circular disc of radius'a' m is charged uniformly with a charge density of c/ m2.find the electric field at a point 'h' m from the disc along its axis.
e. Derive an expression for the capacitance of two wire transmission line. (5x4)

Unit 1

Q3. A vector field D=[5r2/4]Ir is given in spherical co-ordinates. Evaluate both sides of divergence theorem for the volume enclosed between r=1&r=2. (10)

Q4.Define divergence, gradient, curl in spherical co-ordinate system with mathematical expression (10)

Unit 2

Q5. Drive an expression for the electric field due to a straight and infinite Uniformly charged wire of length 'L' meters and with a charge density of + c/m at a point P which lies along the perpendicular bisector of wire. (10)

Q6. The capacitance of the conductor formed by the two parallel metal sheets, each 100cm2,in area separated by a dielectric 2mm thick is , 2×10-10 micro farad .a potential of 20KV is applied to it .
find
(i) Electric flux
(ii) Potential gradient in kV/m
(iii) The relative permittivity of materials
(iv) Electric flux density. (10)

Unit 3

Q7 Derive an expression for the capacitance of a parallel plate capacitor having two dielectric media. (10)

Q8. . Derive the boundary conditions of the normal and tangential components of electric field at the inter face of two media with different dielectrics. (10)

Unit 4

Q9. Derive the expressions for magnetic field intensity due to toroidal coil and circular coil.

(10)

Q10. An iron ring with a cross sectional area of 3cm square and mean circumference of 15 cm is wound with 250 turns wire carrying a current of 0.3A.The relative permeability of ring is 1500 . calculate the flux established in the ring. (10)