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Sant Gajanan Maharaj College of Engineering, Mahagaon

Site- Chinchewadi, Tal- Gadhinglaj, Dist- Kolhapur

Department of Electrical Engineering

COURSE PLAN

Course Code	EE 311	**Course Name**	Digital Electronics and Microcontroller
Prepared by	Mr. P I Kanthi	**Date**	20/05/2018 (AY-2019-20)
Verified by	Mr. M B Patil (HOD EE)	**Approved by**	Academic Coordinator/ Principal
Objective	Provide an introduction and basic understanding of Logic Gates, K-Map, Adders, Substractors, FlipFlops, Counters, Shift Registers and Understand the operation & Design of Interfacing and Write ALP Programs.		

COURSE OUTCOMES

At the end of this course the students should be able to:

Sr. No.	CO	CO No.
1.	**Understand, Assess** and **solve** basic binary math operations Number System, Logic Gates, Theorems, Properties of Boolean Algebra.	EE311.1
2.	**Understand**, **Solve** and **Analyze** 2, 3 and 4 variable K-Map	EE311.2
3.	**Design** and **analyze** different types Adders, Substractors, FlipFlops and Counters.	EE311.3
4.	**Apply** Knowledge and Demonstrate various addressing modes and data transfer instructions.	EE311.4
5.	**Analyze** assembly language programs select appropriate assemble into machine a cross assembler utility of a microcontroller	EE311.5
6.	**Design** and **Analyze** different types of Interfacing.	EE311.6

EXAMINATION SCHEME

Examination Scheme	Theory	Term Work	#POE	Total
Maximum Marks	100	25	**	125

Contact Hours	4	2	**	6

MAPPING OF COs-Pos

POs / COs	a	b	c	d	e	f	g	h	i	j	k	l
ETC212.1	3	#	2	#	2	#	2	#	2	#	2	#
ETC212.2	3	3	#	2	2	#	#	#	#	#	#	#
ETC212.3	3	3	#	#	2	#	#	#	#	#	#	#
ETC212.4	2	1	2	#	2	3	#	1	3	#	1	#
ETC212.5	3	#	3	#	2	#	#	1	3	2	#	#
ETC212.6	2	3	#	#	2	#	#	#	#	#	#	1

Correlation Levels 1. Low 2. Medium 3. High and "#" if there is no relation

COURSE CONTENTS

Chapter No.	Contents	No. of Hours
I	**Boolean algebra & logic** Introduction to number system- binary, octal, hexadecimal. Logic gates and truth tables. Basic theorems and properties of Boolean algebra. Boolean functions. Canonical and standard forms. Digital logic gates. IC digital logic families.	**5 Hrs.**
II	**Simplification of Boolean functions** The map method. 2 and 3 variable maps. 4 variable maps. Product of sums and sum of products simplification. Don't Care Conditions.	**4 Hrs.**
III	**Combinational logic & Sequential logic** Introduction, Design procedure, adders, subtractors, code conversion. Analysis procedure. Ex-OR and equivalence functions. Binary parallel adder, decimal adder, magnitude comparator, decoders, multiplexers, ROM. Introduction, Flip Flops, Triggering of Flip Flops, Design of Counters, Shift Registers, Ripple Counters, Synchronous Counters	**10 Hrs.**
IV	**8051 Architecture and Instructions** 8051 architecture- features, pins and signals, program and data memory organization, system clock.SFR, PSW, registers, ports and addressing modes. Instructions. Interrupts, counter/ Timer, Serial Communication.	**7 Hrs.**
V	**Assembly Programming Examples** Copy block, shift block, count no. of nulls, find checksum, sum of natural numbers, sum of a series, Fibonacci series, generate a series. Count 1s in a byte,	**8 Hrs.**

	find largest / smallest integers of an array. Bubble sorting, find sum of factorials. Compare with external array, reverse an array. Sum of a series, generate prime numbers.	
VI	**Interfacing** Interfacing- external memory, keyboard, display devices, DAC/ADC, dc motor, stepper motor, servomotor. Introduction to power management.	**8 Hrs.**

EVALUATION SCHEME

Section	Maximum Marks	Question No.	Chapter No.
I	12-16 Marks	Question-1	Chapter-1
	12-16 Marks	Question-2	Chapter-2
	18-24 Marks	Question-3	Chapter-3
II	18-24 Marks	Question-4	Chapter-4
	12-18 Marks	Question-5	Chapter-5
	16-24 Marks	Question-6	Chapter-6

REFERENCES

Books	
1.	Digital Electronics: Principles & Integrated Circuits, A. K. Maini, Wiley Publications
2.	Digital Systems- Principles and Design, Rajkamal, Pearson Education
3.	The 8051 Microcontroller Architecture, Programming and Applications, Kenneth Ayala, Penram International, 2nd Edition
4.	8051 Microcontroller: Internals, Instructions, Programming and Interfacing, Subrata Ghoshal, Peasrson Publications
5.	The 8051 Microcontroller and Embedded Systems, "The 8051 Microcontroller and Embedded Systems.
6.	Microcontrollers: Architecture, Programming, Interfacing and System Design By Raj Kamal
7.	The 8051 Microcontroller by Kenneth J Ayala
Data Manuals	
1.	National Instruments Data Manual on Digital Electronics and Microcontroller
E-books/E-Links	
1.	Introduction to Microcontrollers by Guenther Gridling, Bettina Weiss
2.	K Map : https://www.youtube.com/watch?v=0LtAuuMYQME
3.	Introduction to Microcontroller: https://www.youtube.com/watch?v=CmvUY4S0UbI
NPTEL /Other Video Links	

1.	Introduction to Binary System: https://www.youtube.com/watch?v=bMuHZAvZAm0
2.	Boolean Algebra : https://www.youtube.com/watch?v=WW-NPtIzHwk
3.	SOP and POS : https://www.youtube.com/watch?v=K2cpJex0o_A
4.	Don't Care Conditions: https://nptel.ac.in/courses/117106114/10
5.	Combinational and Sequential Logic: https://nptel.ac.in/courses/117106086/3
6.	8051 Microcontroller : https://nptel.ac.in/courses/108105102/23
7.	8051 Introduction ALP Introduction : https://www.youtube.com/watch?v=xOCjCA3kNgc
8.	Assembly Language Programming in 8051: https://freevideolectures.com/course/3018/microprocessors-and-microcontrollers/25
9.	Interfacing Keyboard and Display : https://www.youtube.com/watch?v=Yz6UfvkNe5M
10.	Interfacing LCD: https://www.youtube.com/watch?v=YDJISiPUdA8

LIST OF EXPERIMENT

Exp. No.	Experiment Title	
A. Practical Exercise		**CO No.**
1.	Verification of Logic Gates	EE311.1
2.	Code Converter BCD to Excess 3 and Excess 3 to BCD Trainer Kit	EE311.3
3	Comparator using IC 7485 Trainer Kit	EE311.3
4.	Study of 7 Segment Decoder Driver (7447) Trainer Kit	EE311.3
5.	Study of Half and Full Adder, Half & Full Substractor Trainer Kit	EE311.3
6.	Finding CheckSum in Keil µVision	EE311.5
7.	Finding Natural Numbers in Keil µVision	EE311.5
8.	Finding Fibonacci Series in Keil µVision	EE311.5
9.	Stepper Motor Interface	EE311.6
10.	8 bit ADC Interface	EE311.6
C. Beyond Syllabus Activity		

1.	Study of Integration of various Components to design any circuit like Digital Gates.

ASSIGNMENT QUESTIONS/QUESTION BANK

Unit- I (Assignment 1)	Boolean algebra & logic		12 to 16 Marks
Que. No.	**Question**	**CO No.**	**Remark**
1.	a. $(10110)_2 = (?)_8 = (?)_{10} = (?)_{16}$ b. $(123.45)_8 = (?)_2 = (?)_{10} = (?)_{16}$	EE 311.1	Common for All
	c. $(467.52)_{10} = (?)_2 = (?)_8 = (?)_{16}$ d. $(DEF7)_{16} = (?)_2 = (?)_8 = (?)_{10}$		
a.	Write a note on Rules in Boolean Algebra	EE 311.1	
b.	Explain Associative, Commutative, Distributive Law and De-Morgan's Theorem.	EE 311.1	
c.	Write a note on Logic Gates and Draw the Truth Table.	EE 311.1	
d.	Briefly Explain IC Digital Logic Families.	EE 311.1	
e.	Apply reduction technique using Boolean Algebra by taking examples by your own.	EE 311.1	
f.	Draw a logic circuit for a. $\overline{(A + B)}(C + D)\overline{C}$. B. Draw a logic circuit for $AB + \overline{AC}$.	EE 311.1	Additional questions for Fast Learner
g.	Draw a truth table for $\overline{W}(X+Y)Z$ and $P\overline{T}(P+Z)$.	EE 311.1	
Unit-II: (Assignment 2)	**Simplification of Boolean functions**		**12 to 16 Marks**
1.	Explain SOP and POS with Examples.	EE 311.2	Common for All
2.	Solve $F(P,Q,R,S) = \sum(0,2,5,7,8,10,13,15)$	EE 311.2	
3.	Solve $F(A,B,C,D) = \pi(3,5,7,8,10,11,12,13)$	EE 311.2	
4.	Solve F = A`B`C`+A`BC` + ABC` d = A`B`C +A`BC + AB`C	EE 311.2	
5.	Solve F = (A`+B+C`) (A`+B+C) ( A'+B'+C`) d = (A+B`+C') (A`+B'+C) (A+B`+C)	EE 311.2	
6.	Solve $F(A,B,C,D) = \pi(3,7,8,10,11,13) + dc\ (0,2,9,15)$	EE 311.2	
7.	Write a Short note on Don't Care Condition	EE 311.2	
8.	Solve $F(P,Q,R,S) = \sum(0,1,4,8,10,12,13,15) + dc\ (2,5)$	EE 311.2	
9.	Solve F = (A`+B+C`+D) (A`+B+C+D') ( A'+B'+C`+D') (A+B+C+D) d = (A+B`+C'+D) (A`+B'+C+D) (A+B`+C+D) (A'+B+C+D')	EE 311.2	Additional question for Fast Learner

Unit- III:(Assignment 3) Combinational logic & Sequential logic			18 to 24 Marks
Que. No.	**Question**	**CO No.**	**Remark**
1.	Design Circuit for Binary to Gray and Gray to Binary Conversion	EE 311.3	Common for All
2.	Design Circuit for Binary to Excess-3 and Excess-3 to Binary	EE 311.3	
3.	Explain Half Adder and Full Adder	EE 311.3	
4.	Explain Half Substractor and Full Substractor	EE 311.3	
5.	Design Binary Parallel Adder and BCD Adder	EE 311.3	
6.	Explain 4:1 & 8:1 Multiplexer and 2 bit Comparator.	EE 311.3	
7.	Write a note on Decoder, Encoder & Ring Counter	EE 311.3	
8.	Explain SISO, SIPO, PISO, PIPO Shift Registers.	EE 311.3	
9.	Explain with the Truth Table i) SR ii) D iii) T iv) JK v) MS Flip Flop	EE 311.3	
10.	Design F1 (A,B,C) = π (2,3,5,7) and F2= π (A,B,C) = (0,1,4) using 74LS138	EE 311.3	Additional question for Fast Learner
11.	Design F (P,Q,R,S) = (1,2,5,8,10,13,15) using 4:1 Mux and 8:1 Mux	EE 311.3	
Unit- IV:(Assignment 4)	**8051 Architecture and Instructions**		**18 to 24 Marks**
1.	Draw and Explain 8051 Architecture, Pin Diagram of 8051	EE 311.4	Common for All
2.	Explain Memory Organization in 8051	EE 311.4	
3.	Explain Timers/Counters and Serial Communication in 8051	EE 311.4	
4.	Explain PSW, SFR and Register Addressing Modes	EE 311.4	
5.	Explain TMOD, TCON, SCON, PCON, SP, PC, DPTR, A & B	EE 311.4	Additional question for Fast Learner
Unit- V: (Assignment 5)	**Assembly Programming Examples**		**12 to 18 Marks**
1.	Write an ALP for Addition & Substraction of two 8 bit numbers.	EE 311.5	Common for All
2.	Write an ALP for Copy, Shift Block and To Count number of Nulls.	EE 311.5	

3.	Write an ALP for Fibonacci Series and Count 1's and 0's in byte.	EE 311.5	
4.	Write an ALP for Sum of Factorials and Addition of first 10 bytes.	EE 311.5	
5.	Write an ALP for Reversing an Array and Generation of Prime Numbers.	EE 311.5	
6.	Write an ALP for Largest and Smallest Number in a given Array. 02 AE 21 97 DC 16 84 07 72 CA		Additional question for Fast Learner
Unit- VI: (Assignment 6)	**Interfacing 16 to 24 Marks**		**16 to 24 Marks**
1.	Interface 8051 with Keyboard and LCD	EE 311.6	Common for All
2.	Interface 8051 with DAC/ADC and Stepper Motor	EE 311.6	
3.	Write a note on Power Management	EE 311.6	
4.	Interface 8051 wit Stepper Motor and Write a 'C' Program to Rotate Stepper Motor in Clockwise and Anticlockwise Direction.	EE 311.6	

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Department of Electrical Engineering

COURSE PLAN

Course Code	EE 312/66251	**Course Name**	A C Machine
Prepared by	Mrs. M. B. Patil	**Date**	15/06/2019 (AY-2019-20)
Verified by	Mr. M. B. Patil (HOD EE)	**Approved by**	Academic Coordinator/ Principal
Objective	Provide an introduction and basic understanding of AC Circuits. Understand the Construction, operation & analysis of Different AC machines.		

COURSE OUTCOMES

At the end of this course the students should be able to:

Sr. No.	CO	CO No.
1.	Acquire knowledge about various types, constructional details, working principle, starters and speed control of three phase induction motor.	EE 312.01
2.	Acquire knowledge about the performance and losses of three phase Induction motor.	EE 312.02
3.	To impart the knowledge on constructional details, principle of operation, type of 1 phase induction motor.	EE 312.03
4.	Acquire knowledge about the constructional details and principle of operation of three phase alternators.	EE 312.04
5.	Acquire knowledge about testing and applications of three phase alternator.	EE 312.05
6.	To impart the knowledge on constructional details, principle of operation, performance of three phases synchronous motor.	EE 312.06

EXAMINATION SCHEME

Examination Scheme	Theory	Term Work	#POE	Total
Maximum Marks	100	25	50	175

Contact Hours	4	2	**	6

MAPPING OF COs-Pos

POs / COs	a	b	c	d	e	f	g	h	i	j	k	l
EE 312.01	3	2	2	2	2	3	1	2	1		1	2
EE 312.02	3	1	2	1	2	1		1	1		1	1
EE 312.03	3	2	2	2	2	3	1	2	1	1	1	2
EE 312.04	3	2	2	2	2	3	1	2	1		1	2
EE 312.05	3	1	2	1	2	1		1	1	1	1	1
EE 312.06	3	2	2	2	2	3	1	2	1		1	2

Degree of Compliance of COs and POs 1: Low 2: Medium 3: High

COURSE CONTENTS

Chapter No.	Contents	No. of Hours
I	**Three Phase Induction Motor:** Construction & types of 3 ph. Induction motors, Rotor quantities (emf ,current, frequency, pf), torque equation, starting torque, running torque (numerical treatment) , Factors affecting torque, condition of maximum torque ,torque slip characteristics, Need of starters for 3 phase. Induction motors, types of starters (DOL, autotransformer, star-delta, rotor resistance starter, Speed control methods from stator side (Stator voltage control Stator Frequency control, Pole changing) & rotor side (rotor resistance control), Applications of 3 ph. Induction motors	**11 Hrs.**
II	**Three Phase Induction Motor:** Losses & efficiency of 3 phase induction motor, power flow diagram with numerical treatment, No load & blocked rotor test, equivalent circuit of 3 phase induction motor, Phasor diagram of 3 phase induction motor, performance of 3 phase induction motor using circle diagram, Concept of operation of 3 phase induction motor as induction generator, Double cage induction motor along with its characteristics, cogging & crawling of 3 phase induction motor.	**10 Hrs.**
III	**Single Phase Induction Motor :** Double field revolving theory, types of single phase induction motor (Split phase,	**5 Hrs.**

	capacitor start/run, shaded pole motors).	
IV	**Three Phase Alternator:** Construction, principle of operation of three phase alternator, emf equation, parameters of armature winding. (resistance & leakage reactance), armature reaction (at unity, lagging zero and leading zero power factor), concept of synchronous reactance and synchronous impedance. Equivalent circuit of 3 phase alternator, alternator on load (resistive, inductive & capacitive).	**6 Hrs.**
V	**Parallel Operation of Three Phase Alternator:** OC test & SC test on 3 Phase alternator, short circuit ratio, voltage regulation methods (emf, mmf, zero power factor and direct loading method) with numerical treatment, Losses and efficiency, power flow diagram, need of parallel operation, conditions for parallel operation, synchronizing procedures, hunting and oscillations in alternators (theoretical treatment).	**8 Hrs.**
VI	**Three Phase Synchronous Motor:** Principal of operation of three phase synchronous motor, staring methods of three phase synchronous motors (using prime mover and damper winding, Phasor Diagram of three phase synchronous motor at Unity, lagging and leading power factor, Effect of excitation on power factor and armature current, V & inverted V Curves, Operation of Synchronous motor as Synchronous Condenser, Application of three phase synchronous motor.	**8 Hrs.**

EVALUATION SCHEME

Section	Maximum Marks	Question No.	Chapter No.
I	18 Marks	Question-1	Chapter-1
	16 Marks	Question-2	Chapter-1
	16 Marks	Question-3	Chapter-2
	16 Marks	Question-4	Chapter-3
II	16 Marks	Question-5	Chapter-4
	16 Marks	Question-6	Chapter-5
	16 Marks	Question-7	Chapter-6
	18 Marks	Question-8	Chapter-6 & 5

REFERENCES

Books

1.	Electical Machines, S. K. Bhattacharya, Tata Mc-Graw-Hill publication III edition

2	Electrical Technology Vol.II, B. L. Theraja, S. Chand Publications
3	Electrical Machines, I. J. Nagrath, D. P. Kothari, Tata Mc-Graw-Hill publication IV Edition.
4	Electric Machinery, A. E. Fitzgerald, Mc-Graw Hill publications VI edition
5	Electrical Machinery, P S Bhimbhra, Khanna Publications
6	Electrical Machines, Ashfaq Hussain, Dhanpat Rai & Sons
Data Manuals	
1	
E-books/E-Links	
1	Electrical Machines II: https://www.pdfdrive.com/electrical-machines-books.html
2	Alternator : http://www.engineersedge.com/motors/alternators_types.htm
3	Three Phase Alternator : http://www.learn-about-electronics.com/Three-Phase_alternator.html
4	Synchronous Motor: http://www.engineersedge.com/motors/synchronous_motor.htm
5	Single phase Induction Motor: http://dcacmotors.blogspot.in/2009/04/capacitor-start-single-phase-induction.html
6	AC Motor : http://en.wikipedia.org/wiki/AC_motor
7	Linear induction motor: http://en.wikipedia.org/wiki/Linear_induction_motor
8	Electrical Machines I : https://nptel.ac.in/courses/108105017/
NPTEL /Other Video Links	
1.	Induction Machine : https://nptel.ac.in/courses/108106072/

LIST OF EXPERIMENT

Exp. No.	**Experiment Title**	
B. Practical Exercise		**CO No.**
1.	Conducting No Load & Blocked Rotor Test on 3-phase Induction motor.	EE 312.02
2.	Conducting No Load & Blocked Rotor Test on 1-phase Induction motor.	EE 312.03
3	Parallel operation of alternator with control panels.	EE 312.05
4.	Synchronization of 3-phase alternator with bus bar with the help of a) Three lamp method. b) By using synchroscope.	EE 312.05

5.	Speed control methods of 3-phase Induction motor.	EE 312.01
6.	Study of starters for 3-phase Induction motor.	EE 312.01
7.	Determination of efficiency of alternator by direct loading method.	EE 312.04
8.	Speed control of 3-phase Induction motor by using V/F method.	EE 312.01
9.	Determination of Voltage regulation of an alternator by EMF method.	EE 312.04
10.	Determination of Voltage regulation of an alternator by MMF method.	EE 312.04
11.	Determination of Voltage regulation of an alternator by ZPF method.	EE 312.04
B. Beyond Syllabus Activity		
1.	Design of Electrical machines.	

ASSIGNMENT QUESTIONS/QUESTION BANK

Unit- I (Assignment 1) Three phase Induction Motor 16 to 24 Marks

Que. No.	Question	CO No.	Remark
1	A 24 pole, 50 Hz, star connected induction motor has rotor resistance of 0.016 Ω per phase and rotor reactance of 0.265 Ω per phase at standstill. It is achieving its full load torque at a speed of 247 r.p.m. Calculate the ratio of: i) Full load torque to maximum torque ii) starling torque to maximum torque	EE 312.01	Common for All
2.	State the necessjty ofstarterin three phass induction motor. Explain star delta stater with the help of neat connection diagram.	EE 312.01	
3.	What are various methods of speed control of 3 phase Induction Motor, explain any one.	EE 312.01	
4.	Describe with neat sketches the construction of 3 phase wound Induction motor.	EE 312.01	

5.	State & explain the different methods of speed control of three phase induction motor.	EE 312.01	
6.	A 4 pole, 3 phase induction motor operates from a supply whose frequency is 50Hz. Calculate a) the speed at which RMF rotates b) the speed of rotor when slip is 0.04.	EE 312.01	
7.	Derive the Torque equation of the three phase induction motor. Draw and explain the torque and speed characteristics for various values of R_2.	EE 312.01	Additional questions for Fast Learner
8.	Explain the factors affecting the torque.	EE 312.01	
Unit-II: (Assignment 2)	**Three phase Induction Motor**		**16 to 18 Marks**
1	What are the various losses in an induction motor? On what factors do they depend?	EE 312.02	Common for All
2	Explain with neat diagram, construction and working of double cage induction motor.	EE 312.02	
3	Explain the cogging & crawling of 3 phase induction motor.	EE 312.02	
4	Explain concept of operation of 3 phase induction motor as induction generator.	EE 312.02	
5	Draw the circle diagram of a from no-load and short-circuit test of a 3 phase, 14.92 KW, 400V, 6 pole Induction motor from the following (line values): Noloadtest: 400V llA p.f=0.2 Block rotor test: 100V 25A p.f=0.4 Rotor Cu loss at standstill is half the total Cu loss. From the diagram find full load values of : i) Line current n) p.f iii) Efficiency	EE 312.02	
6	The power input to the rotor ofa440V,50tI4 6 Pole three phase induction motor is l00KW. The rotor emfmakes 120 cycles per minute. Calculate the slip, rotor speed, mechanical power developed, rotor Cu loss per sphase.	EE 312.02	
7	Explain the tests conducted to draw circle diagram of three phase induction motor. Explain how max. torque, max. power-output is obtained from circle diagram.	EE 312.02	
8	A 440V, 3 phase 50Hz, 4 pole, star connected induction motor has a full load speed of 1425 rpm. The rotor has an impedance of (0.4+j4)Ω/phase and rotor/stator turns ratio is 0.8. calculate a) Full load torque b) Rotor current and c) Full load rotor cu loss.	EE 312.02	
9	A 440V, 50Hz, 6 poles, 3 phase induction motor draws an input power of 76KW from the mains. The rotor emf makes 120 complete cycles per minute. Its stator losses are 1KW and rotor current per phase is 62A. Calculate a) Rotor copper losses per phase b) Rotor resistance per phase c) Torque developed.	EE 312.02	Additional question for Fast Learner

Unit- III:(Assignment 3)	Single phase Induction motor		16 to 18 Marks
Que. No.	**Question**	**CO No.**	**Remark**
1	Explain with the help of the neat construction diagram explain working of shaded pole induction motor.	EE 312.03	Common for All
2	Explain double field revolving theory of single phase induction motor.	EE 312.03	
3	Why single phase induction motor is not self starting?	EE 312.03	
4	Draw the circuit diagram of a capacitor star capacitor run single phase induction motor and explain its working.	EE 312.03	
5	Explain various methods used to start single phase induction motor.	EE 312.03	Additional question for Fast Learner
Unit- IV:(Assignment 4)	**Three phase Alternator**		**12 to 16 Marks**
1	What is Distribution factor and Pitch factor?	EE 312.04	Common for All
2	Calculate the RMS value of the induced emf per phase of three phase, 10 poles, 50Hz, alternator with 2 slots per pole per phase and 4 conductors per slot. The coil span is 150^0 and the flux per pole is 0.12wb.	EE 312.04	
3	What is armature reaction? Explain the effect of armature reaction on the terminal voltage of an Alternator at i) Unity p.f. ii) Zero lagging p.f. iii) Zero leading p.f. of the load. Draw the relevant Phasor diagram.	EE 312.04	
4	A 3 phase ,50tlz, 4 Pole, star connected turbo altemator has 60 slots with 4 conductors per slot. The pitch of the coil is 3 slots less than the pole pitch. Ifphase spread is 60', find the line voltage induced for a flux per pole of0.943wb.	EE 312.04	
5	Derive emf equation of an alternator.	EE 312.04	Additional question for Fast Learner
Unit- V: (Assignment 5) Three phase Alternator			**16 to 24 Marks**
1	What is regulation in altemator? Explain Potier triangle method to determine voltage regulation.	EE 312.05	Common for All
2	A 1200 KVA, 3300Y 50H2, three phase star connected altemator has armature resistance of0.25 ohm per phase. A field current of 40A produces short circuit cunent of 200A, and an open circuit emf of ll00V line to line. Find the voltage regulation on full load 0.8 p.f. lagging and 0.8 p.f. leading	EE 312.05	
3	What is synchronizing of altemators? Explain any one method of Synchronizing.	EE 312.05	
4	Explain the MMF method of determining voltage regulation of alternator.	EE 312.05	
5	The eff'ective resistance of a 2200V, 50Hz, 440KVA, I phase, alternator is 0.5ohm. on short circuit, a field current of 40 A gives the	EE 312.05	Additional question for Fast Learner

	full load cunent of 200A. The electromotive force on open circuits with same fleld excitation is 1160 V. Calculate the synchronous impedance and reactance.		
6	A 3-phase star-connected alternator supplies a load of 1OMW at pf 0.85 lagging and at 11 KV (terminal voltage). Its resistance is 0.1 ohm per phase and synchronous reactance 0.66 ohm per phase Calculate the line value of e.m.f. generated.	EE 312.05	
Unit- VI: (Assignment 6)	**Three phase Synchronous motor**		**16 to 18 Marks**
1	Explain the working principle of synchronous motor. State the methods used to start the synchronous motor.	EE 312.06	Common for All
2	Explain V and inverted V curves of synchronous motor.	EE 312.06	
3	Why synchronous motor is called as synchronous condenser? Explain operation of Synchronous motor as synchronous condenser.	EE 312.06	

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Sant Gajanan Maharaj College of Engineering, Mahagaon

Site- Chinchewadi, Tal- Gadhinglaj, Dist- Kolhapur

Department of Electrical Engineering

COURSE PLAN

Course Code	ELE303	Course Name	Power System II
Prepared by	Ms. N H M Netravati	Date	03/06/2019 (AY-2019-20)
Verified by	Mr. M.B.Patil (HOD E&E)	Approved by	Academic Coordinator/ Principal
Prerequisites	This course requires the student to know about the basic concepts of power system, elements of power system, power flow and types of faults		
Objective	The objective of Power system analysis is for designing entire power systems. Power system analysis makes sure the equipment work together so that the required power is delivered to the load centers at the prescribed voltage and frequency, and no component in the network is overloaded and no fault condition jeopardizes the system.		

COURSE OUTCOMES

At the end of this course the students should be able to:

Sr. No.	CO	CO No.
1.	Empathize[2] with Representation of Power System in P.U.	ELE 303.1
2.	Evaluate[5] Symmetrical Fault Analysis.	ELE 303.2
3.	Investigate[6] Sequence Components and To Draw Sequence Network of Different Power System Components.	ELE 303.3
4.	Evaluate[5] Unsymmetrical Fault Analysis.	ELE 303.4
5.	Recognize[1] Power flow and Network Model Formulation	ELE 303.5
6.	Explicate[2] Need of Substation and Substation Layout	ELE 303.6

EXAMINATION SCHEME

Examination Scheme	Theory	Term Work	#POE	Total
Maximum Marks	100	25	50	175

Contact Hours	4		2	6

MAPPING OF COs-Pos

POs / COs	a	b	c	d	e	f	g	h	i	j	k	l
ETC212.1		2	1	3								
ETC212.2				1								
ETC212.3		1	2	3								
ETC212.4		3	1	2				1		1		
ETC212.5		2	3	1						1		
ETC212.6			2	3								

Degree of Compliance of COs and POs 1: Low 2: Medium 3: High

COURSE CONTENTS

Chapter No.	Contents	No. of Hours
I	**Representation of Power system Components:** Single phase representation of Balanced 3 phase Networks, OLD & Impedance & Reactance Diagram, Per Unit System- P.U. Representation of Transformer, P.U. Impedance Diagram of Power system, Steady State Model of Synchronous Machine, Representation of Loads, NUMERICALS EXPECTED	**4 Hrs.**
II	**Symmetrical Fault Analysis:** Short circuit transients on transmission line Short Circuit on Unloaded Synchronous machine, Short Circuit on loaded Synchronous machine Selection Checklist for circuit breaker, Short circuit MVA, Algorithm for Short circuit studies , Z- Bus Formulation, NUMERICALS EXPECTED	**8 Hrs.**
III	**Symmetrical Components:** Phase Shift In Transformers, Sequence Impedances of Transmission line, Sequence Impedances Synchronous machine. Sequence Impedances Transformer, Construction of Sequence N/W of Power Systems, NUMERICALS EXPECTED.	**8 Hrs.**
IV	**Unsymmetrical Fault Analysis:** Symmetrical component analysis of Unsymmetrical Faults, Analysis of Single Line to Ground (LG) fault, Line-To-Line (LL) fault, Double-Line-To-Ground (LLG) fault, One conductor open fault, Bus Impedance Matrix for analysis of Unsymmetrical shunt faults. NUMERICALS EXPECTED	**10 Hrs.**

V	**Load Flow Analysis:** Network Model Formulation, Formation of Y- Bus by singular Transformation, Load flow problem, Gauss-Seidel Method, Newton-Raphson Method, Decoupled Load Flow studies, Fast Decoupled Load Flow studies. Comparison of Load Flow methods, NUMERICALS EXPECTED	**12 Hrs.**
VI	**Substation Engineering:** How Substation Happens, Gas Insulated Sub-stations, Air Insulated Sub-stations, H.V. Switching Equipments, H.V. Power electronics sub-stations, Substation Grounding, Direct Lightning stroke shielding of substations, Role of Substations in Smart Grids.	**6 Hrs.**

EVALUATION SCHEME

Section	Maximum Marks	Question No.	Chapter No.
I	16	Question-1	Chapter-1
	18	Question-2	Chapter-2
	16	Question-3	Chapter-3
II	16	Question-4	Chapter-4
	18	Question-5	Chapter-5
	16	Question-6	Chapter-6

REFERENCES

Books

1.	Modern Power System Analysis by I. J. Nagrath, D. P. Kothari,, Tata McGraw Hill Publishing Co. Ltd., 2003
2.	Electrical power System by Ashfaq Husain, CBS Publishers and Distributors, Fifth Edition 2007
3.	Power System Analysis by Grainger John J and W D Stevenson, McGraw,Hill, 1994
4.	Electric Power substations Engineering by John D. McDonald, CRC Press , Third Editions

E-books/E-Links

1.	power system analysis by hadi saadat: http://www.engineeringbookspdf.com/power-systems-analysis-2nd-edition-hadi-saadat/
2.	Power System Analysis: https://books.google.co.in/books/about/Power_System_Analysis.html?id=zp7ZnQEACAAJ&redir_esc=y
3.	Power System Stability and Control: https://books.google.co.in/books/about/Power_System_Stability_and_Control.html?id=2cbvyf8Ly4AC

NPTEL /Other Video Links

1.	per unit system : https://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/power-system/chapter_1/1_20.html
2.	Single phase solution of balanced three phase networks: https://www.slideshare.net/akbarrazashaikh/single-phase-solution-of-balanced-three-phase-network
3.	impedance and reactance diagram of power system: http://www.srmuniv.ac.in/sites/default/files/files/Chapter1.pdf
4.	Formation of Bus Impedance matrix by Z – bus building algorithm: https://nptel.ac.in/courses/108107028/module4/lecture3/lecture3.pdf
5.	Short circuit capacity: https://unacademy.com/lesson/short-circuit-capacity/MDH12V7I
6.	Analysis of Single Line to Ground (LG) fault: http://www.eeeguide.com/single-line-to-ground-fault/
7.	Gauss-Seidel Method: https://www.researchgate.net/publication/322024284_Load_Flow_Analysis_by_Gauss-Seidel_Method_A_Survey
8.	Formation of Y- Bus by singular Transformation:https://www.slideshare.net/shwetayadav58958/exp-3-1
9.	Gas Insulated Sub-stations: https://electrical-engineering-portal.com/gas-insulated-substations-gis
10.	Direct Lightning stroke shielding of substations: https://ieeexplore.ieee.org/document/277702/

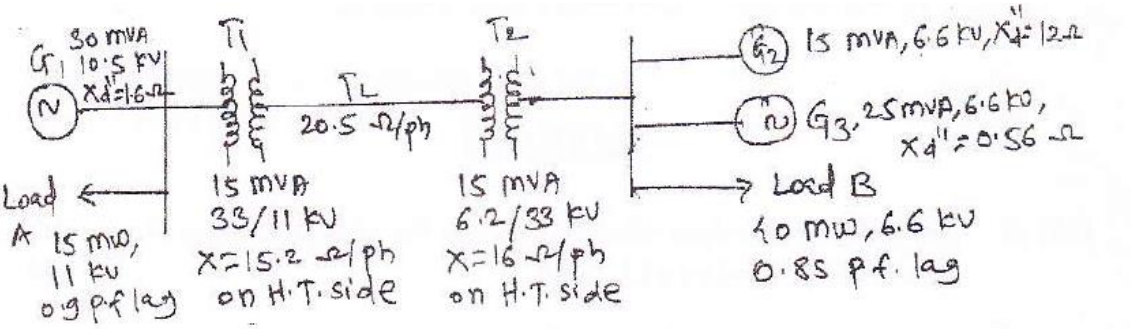
LIST OF EXPERIMENT

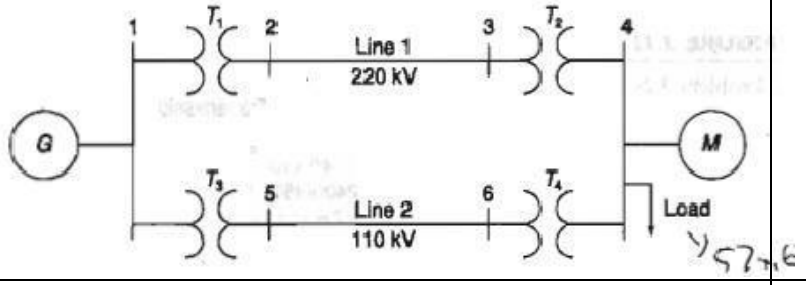
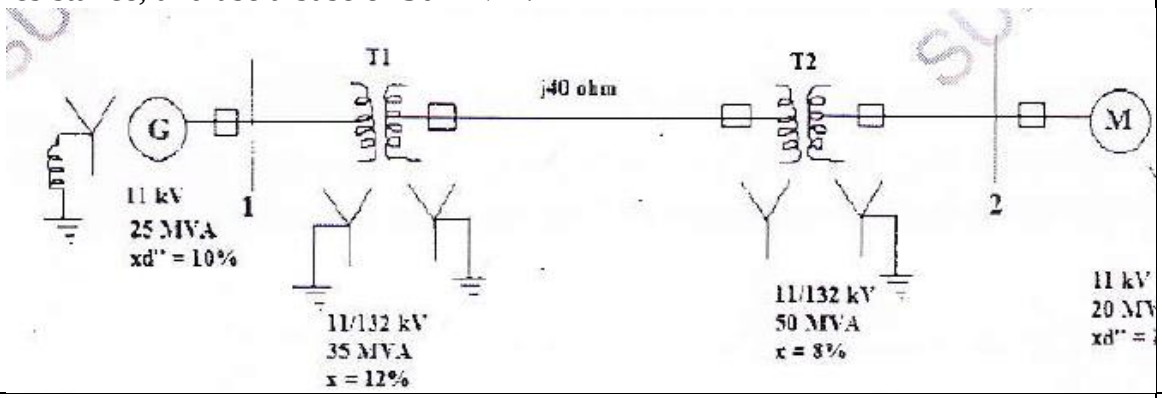
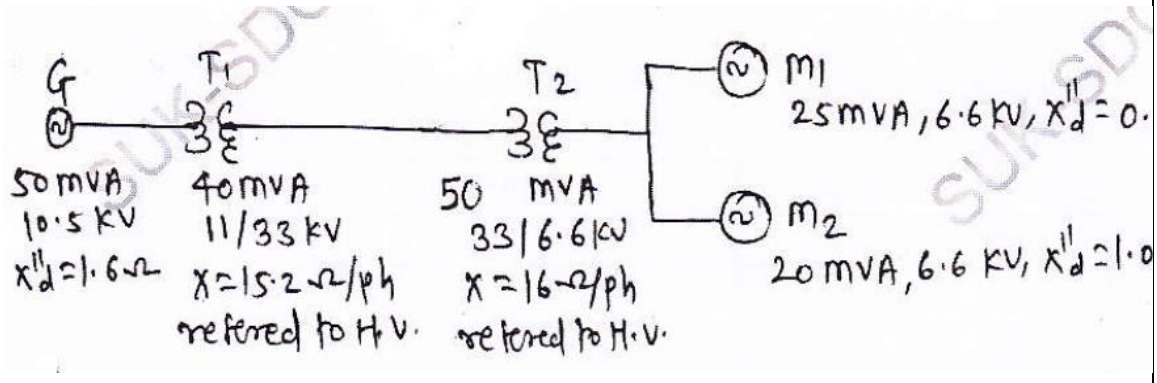
Exp. No.	Experiment Title	
C. Practical Exercise		**CO No.**
1.	Per Unit Calculation	ELE 303.1
2.	Symmetrical Fault Analysis using Thevenin's theory	ELE 303.2
3	Symmetrical fault analysis for large power system using Z-bus	ELE 303.2
4.	Calculation of symmetrical components	ELE 303.3
5.	Analysis of unsymmetrical faults	ELE 303.4
6.	Calculation of complex power	ELE 303.3
7.	Symmetrical fault analysis using kirchoff's law	ELE 303.2
8.	Load flow analysis	ELE 303.5
B. Field Visit		

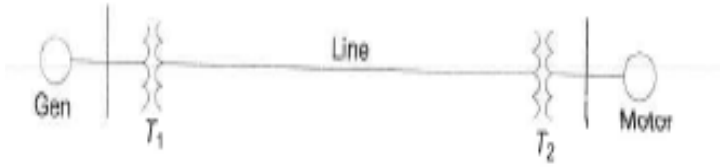
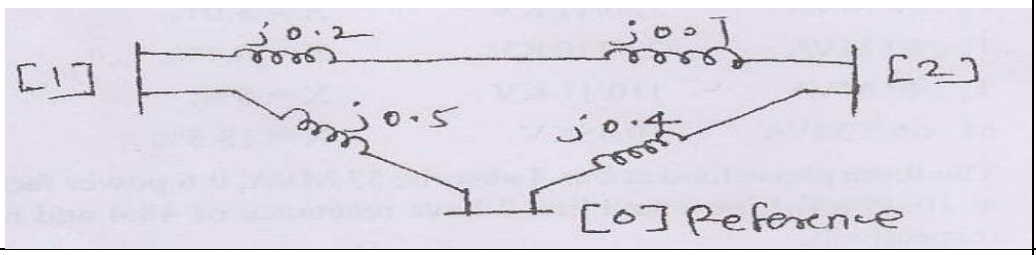
1.	Filed visit to Electrical Substation

ASSIGNMENT QUESTIONS/QUESTION BANK

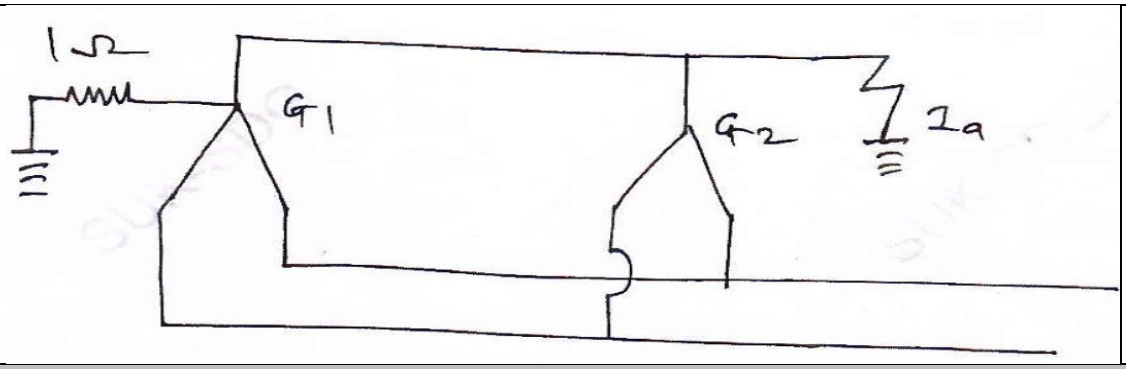
Unit- I (Assignment 1) Representation of Power system Components: 16 Marks

Q No.	Question	CO No.	Remark
1.	Explain with suitable example OLD, impedance & Reactance Diagram	ELE 303.1	Common for All
2.	Write a note on. i. Representation of loads ii. Per unit representation of transformer.	ELE 303.1	
3.	Explain the steady state representation of synchronous machine.	ELE 303.1	
4.	What is mean-by one line diagram (OLD) of power system? Discuss the OLD of a typical electrical substation.	ELE 303.1	
5.	What is Per Unit (PU) System? Explain the advantages of Per Unit System?	ELE 303.1	
6.	Explain the per unit representation of a three phase transformer.	ELE 303.1	
7.	Draw a per unit reactance diagram for given power systems and choose a common 3 phase, 30 MVA and voltage base of 33 kV line to line on transmission line. 	ELE 303.1	
8.	The one line diagram of 3 phase power system is shown in fig. select a common base of 100 MVA and 22 KV on the generator side. Draw an impedance diagram with all impedances including load impedance in per unit. The manufacturer data is as below	ELE 303.1	

	G: 90 MVA, 22 KV, X = 0.18 pu T1: 50 MVA, 22/220 KV, X = 0.1 pu T2: 40 MVA, 220/11 KV, X = 0.06 pu T3: 40 MVA, 22/110 KV, X = 0.064 pu T4: 40 MVA, 110/11 KV, X = 0.08 pu M: 66.5 MVA, 10.45 KV, X = 0.185 pu Lines 1 and 2 have series reactances of 48.4 and 65.43 Ω, respectively. At bus 4, the 3-ϕ load absorbs 57 MVA at 10.45 KV and 0.6 *pf* lagging .  		
9.	Draw the pu impedance diagram for the power system as shown in fig. Neglect resistance, and use a base of 50 MVA.  	ELE 303.1	
10.	Draw per unit reactance diagram. Assume base MVA as 100 MVA and KV base as 33 KV in the line circuit.  	ELE 303.1	Additional questions for Fast Learner
Unit-II: (Assignment 2)	**Symmetrical Fault Analysis**		**18 Marks**
1.	Explain Short circuit transients on transmission line.	ELE 303.2	Common for

2.	Explain short circuit currents and reactance of a Synchronous Machine.	ELE 303.2	All
3.	Find the DC component of current upon closing switch ,if the instantaneous voltage is 50V at that time i. What is the instantaneous value of the voltage which will produce the maximum DC component of current upon closing the switch? ii. What is the instantaneous value of the voltage which will result in the absence of any DC component of current upon closing the switch? iii. If the switch is closed at the instant voltage is zero, find the current after 1.5 cycles?	ELE 303.2	
4.	A synchronous generator and a synchronous motor each rated 25 MVA, 11 kV having l5 % sub transient reactance are connected through transformers and a line as shown in Fig. The transformers are rated 25 MVA.11/66kV and 66/11kV with leakage reactance of l0% each. The line has a reactance of 10% on a base of 25 MVA, 66 kV. The motor is drawing 15 MW at 0.8 power factor leading and a terminal voltage of 10.6 kV when a symmetrical three-phase fault occurs at the motor terminals. Find the sub transient current in the generator, motor and fault. 	ELE 303.2	
5.	Explain the sequence networks and impedances of Synchronous Machine.	ELE 303.2	
6.	Explain Transients in a series R-L Circuit	ELE 303.2	
7.	For 4 bus system shown in fig. Find Z_{Bus} 	ELE 303.2	
8.	Describe selection criterion for circuit breakers	ELE 303.2	
9.	What are the causes and effect of faults? What is the need of Short circuit studies? Derive the expression for Short Circuit Capacity (SCC).	ELE 303.2	Additional question for Fast Learner
Unit- III:(Assignment 3)	**Symmetrical Components**		**16 Marks**

Que. No.	Question	CO No.	Remark
1.	Define symmetrical components. Resolve an unbalanced three phase voltages of a power system into the symmetrical components and also in vice versa.	ELE 303.3	Common for All
2.	Show that the zero sequence impedance of the neutral impedance is equal to thrice that of the neutral impedance.	ELE 303.3	
3.	Following data given the series impedance and line charging admittance in p.u. on a common base for each line of a four bus power system. Obtain Y-bus of the system	ELE 303.3	
4.	Draw the single phase zero sequence equivalent circuit of 3-phase transformer bank along with connection diagrams and symbols for the following types of connections.	ELE 303.3	
5.	Prove that the only in power systems having balanced impedances, currents of a given sequence produce voltage drops of the same sequence.	ELE 303.3	Additional questions for Fast Learner
6.	Explain the phase shift of symmetrical components in star-delta transformer bank with respect to voltage relations and current relations.	ELE 303.3	
Unit- IV:(Assignment 4)	**Unsymmetrical Fault Analysis:**		**16 Marks**
1.	What is a three unsymmetrical fault? Discuss the different types of unsymmetrical faults that can occur on a three phase system.	ELE 303.4	Common for All
2.	Derive the expression for fault current in single line to ground fault on unloaded generator. Draw an equivalent network showing the inter connection of networks to simulate single line to ground fault	ELE 303.4	
3.	A LL-G fault occurs at the terminals of an unloaded generator. Derive the expression for the fault currents. Draw the connection of sequence network.	ELE 303.4	
4.	Derive the expression for fault current in double line to ground fault on unloaded generator. Draw an equivalent network showing the inter connection of networks to simulate double line to ground fault	ELE 303.4	
5.	Develop the sequence network for a double line to ground (LLG) fault.	ELE 303.4	
6.	Derive the expression for the fault current in terms of the sequence impedances and hence obtain the connection diagram of the sequence networks for a LL fault through the fault impedance at the terminals of star connected alternator.	ELE 303.4	Additional question for Fast Learner
7.	Two 11 KV, 12 MVA, 3 phase, star connected generators operate in para11el. The positive, negative and zero sequence reactance's of each being j0.09, j0.05 and j0.04 pu respectively. A SLG fault occurs at the terminals of one of the generators. Estimate i. The fault current ii. Current in grounding resistor iii. Voltage across grounding resistor.		



Unit- V: (Assignment 5)	**Load Flow Analysis:**	**18 Marks**	
1.	Explain the significance of load flow analysis in a power system also give the classification of various types of buses in power system for load f1ow studies.	ELE 303.5	
2.	Explain Newton-Raphson Method of load flow studies.	ELE 303.5	Common for All
3.	Describe the procedure of load flow problem formulation with the help of necessary equations.	ELE 303.5	
4.	Discuss the flow chart for load flow solution by Gauss-Seidel iterative method using Y_{Bus}.	ELE 303.5	
5.	Compare methods of load flow Study	ELE 303.5	
6.	In a two bus system, the following table gives data of the operating parameters parameters / Bus 1 (pu values) / Bus 2 (pu values) Voltage / $V_1=1+j0$ / - Complex power Generated / $S_{D1=1+j1}$ / $S_{D2=0+j1}$ Complex power Demand / $S_{D1=0.5+j1}$ / $S_{D1=0.5+j1}$ Find V_2 by G-S Method. (Up to 1st iteration), Assume the Line connecting the buses have Z= j0.5 pu and shunt susceptance neglected	ELE 303.5	Additional question for Fast Learner
Unit- VI: (Assignment 6) Marks	**Substation Engineering:**		**16**
1.	Explain Gas Insulated Sub-stations	ELE 303.6	Common for All
2.	Role of Substations in Smart Grids.	ELE 303.6	
3.	Explain in detail Direct Lightning stroke shielding of substations	ELE 303.6	
4.	Explain the process of shielding of substations and reasons of substation grounding	ELE 303.6	

COURSE PLAN

Course Code	EE314	**Course Name**	Control System-II
Prepared by	Mr. Y. S. Bhajantri	**Date**	17/06/2019(AY-2019-20)
Verified by	Mr. M. B. Patil (**HOD EE**)	**Approved by**	Academic Coordinator/ Principal
Objective	A Basics of Control System consisting of interconnected components is designed &Analysis by Root Locus, Bode Plot method,State Space Design using pole placement,State Space Design using State Observer, Digital and Advanced Control Systems to achieve a desired purpose. To understand the purpose of a control system, it is useful to examine examples of control systems through the course of history. These early systems incorporated many of the same ideas of feedback control system characteristics that are in use today.		

COURSE OUTCOMES

At the end of this course the students should be able to:

Sr. No.	CO	CO No.
1.	Outline of Basics of Control System	EE314.01
2.	Design and Analysis of Control System by Root Locus method	EE314.02
3.	Design and Analysis of Control System by Bode Plot method	EE314.03
4.	Design of State Space using pole placement	EE314.04
5.	Design of State Space using State Observer	EE314.05
6.	Define Digital and Advanced Control Systems	EE314.06

EXAMINATION SCHEME

Examination Scheme	Theory	Term Work	#POE	Total
Maximum Marks	100	25	50	175
Contact Hours	4	0	2	6

MAPPING OF COs-POs												
POs / COs	a	b	c	d	e	f	g	h	i	j	k	l
EE314.01	3	3	2	1				1		1		1
EE314.02	3	3	2	1							1	
EE314.03	3	3	2					1	1	1		
EE314.04	3	3	1								1	1
EE314.05	3	3	1	1	1							
EE314.06	3	3	1	1							1	

Degree of Compliance of COs and POs 1:Low 2: Medium 3: High

COURSE CONTENTS		
Chapter No.	**Contents**	**No. of Hours**
I	***Unit 1: Basics of Control Systems*** Feedback control system characteristics, Objectives, Different types of controllers, P,I,D, PI, PDand PID Controllers, Effects of these controllers on system performance, Tuning of controllers,Ziegler-Nichols methods for controller tuning, Modifications of PID control scheme.	**6 Hrs.**
II	***Unit 2: Control System Design & Analysis by Root Locus method*** Review of Root Locus, Cascade Lead compensation, cascade Lag compensation, cascade Lead-Lag compensation, Series and parallel compensation, Effect of addition of poles and zeros, Design of Lead compensation based on Root Locus approach, Design of Lag compensation based on Root Locus approach, Design of Lead-Lag compensation based on Root Locus approach, Root Locus of system with dead time.	**10 Hrs.**
III	***Unit 3: Control System Design & Analysis by Bode Plot method*** Review of Bode Plot, Stability of system from Bode Plot, Cascade Lead compensation, cascade Lag compensation, cascade Lead-Lag compensation, Design of Lead compensation based on Bode Plot, Design of Lag compensation based on Bode Plot, Design of Lead-Lag compensation based on Bode Plot.	**8 Hrs.**
IV	***Unit 4: State Space Design using pole placement*** Review of State Space, Controllability, Observability (Kalmans's test & Gilbert's test), Pole placement technique for controller design, State Feedback Law, Pole placement technique by Transformation method, Direct Substitution Method and by Ackermann's formula.	**8 Hrs.**
V	***Unit 5: State Space Design using State***	**8Hrs.**

	State Observers, Full Order State Observer, Transformation Approach to Obtain Observer gain Matrix, Direct Substitution Approach to Obtain Observer gain Matrix, Ackermann's formula to Obtain Observer gain Matrix, Effect of addition of Observer on a Closed Loop System, transfer function of Observer based Controller, Design of Control System with Observer	
VI	**Unit 6: *Digital and Advanced Control Systems*** Introduction, Spectrum Analysis of Sampling Process, Signal Reconstruction, Difference Equation, The Z-transform, The Z- Transfer Function, The Z-transform Analysis of Sampled Data Control System, Z and S domain Relationship.	**8 Hrs.**

EVALUATION SCHEME

Section	Maximum Marks	Question No.	Chapter No.
I	16-24 Marks	Question-1	Chapter-1
	16-24 Marks	Question-2	Chapter-2
	16-24 Marks	Question-3	Chapter-3
II	12-18 Marks	Question-4	Chapter-4
	16-24 Marks	Question-5	Chapter-5
	16-24 Marks	Question-6	Chapter-6

REFERENCES

Text Books	
1.	Control system: Principles and Design, M. Gopal, Tata McGraw-Hill Publication
2.	Modern Control Engineering, K. Ogata, Eastern Economy, 5th edition 2011
3.	Control System Engineering, I. J. Nagrath and M. Gopal, New Age publication, 5th edition, 2008
Reference Books	
1.	Automatic Control System, B. C.Kuo, Wiley Publication 8th edition.
2.	Control System Engineering, Norman S. Nise, John wiley and Sons, 6th edition, 2014.
3.	Digital Control and State Variable Methods, M.Gopal, Tata McGraw Hill, 3rd edition
4.	Control System Engineering, Gupta, Wiley Publications
5.	Control Engineering, K. P. Ramchandran, Wiley Publications
6.	Automatic Control Systems, Shridhar, Wiley Publications
Data Manuals	
1.	*
E-books/E-Links	
1.	https://electronicsforu.com/resources/35-free-control-system-ebooks
2.	https://upload.wikimedia.org/wikipedia/commons/e/e4/Control_Systems.pdf
3.	https://en.wikibooks.org/wiki/Control_Systems

4.	http://homes.esat.kuleuven.be/~maapc/static/files/SYSTHEORY/Slides/Lecture17/extra_info%20Lecture%2017%20-%20LeadLagCompensator_rootlocus.pdf
5.	https://nptel.ac.in/courses/108103008/19
6.	https://nptel.ac.in/courses/108103008/21
NPTEL /Other Video Links	
1.	https://nptel.ac.in/courses/108106098/35
2.	https://nptel.ac.in/courses/108106098/34
3.	https://www.mathworks.com/videos/using-bode-plots-lead-lag-pid-controllers-4-of-5-77061.html
4.	http://nptel.ac.in/courses/108106098/38
5.	https://nptel.ac.in/courses/108106098/39
6.	https://nptel.ac.in/courses/108106098/37

LIST OF EXPERIMENT

Exp. No.	Experiment Title	
D. Practical Exercise		**CO No.**
1.	Obtain Step response of Given Transfer Function	EE314.01
2.	To Design a Lead Compensator by using Root Locus Method by a given Control System and a) Obtain Unit-Step Responses of Compensated Systems and Uncompensated System b) Obtain Unit-Ramp Responses of Compensated Systems	EE314.01
3.	To Design a Lag Compensator by using Root Locus Method a) Obtain Unit-Step Responses of Compensated Systems and Uncompensated System b) Obtain Unit-Ramp Responses of Compensated Systems	EE314.01
4.	To design a Lead Compensator Using Bode Plot and also obtain a) Unit Step Response for Compensated and Uncompensated System b) Unit Ramp Response for Compensated and Uncompensated System	EE314.03
5.	To design a Lag Compensator Using Bode Plot and also obtain a) Unit Step Response for Compensated and Uncompensated System b) Unit Ramp Response for Compensated and Uncompensated System	EE314.03
6.	Software program for Transfer Function to state space conversion	EE314.04
7.	Software program to obtain controllability of system.	EE314.05
8.	To find state feedback gain matrix using ACKERMANS Formula	EE314.05
B. Field Visit		
1.	There is no field visit for this elective subject.	
C. Beyond Syllabus Activity		
1.	*	

ASSIGNMENT QUESTIONS/QUESTION BANK
(Assignment 1)

Unit- 1. *Basics of Control Systems*16 to 24 Marks

Que. No.	Question	CO No.	Remark
1.	Define i) Control systems ii) Input iii) Output iv) Control v) Control Action vi) Disturbance vii) Feedback	EE314.1	Common for All
2.	Explain characteristics of feedback control system	EE314.1	
3.	Explain in brief P, PI,PD and PID controller.	EE314.1	
4.	For the closed loop system with feedback in which PID controller is used to control the system. For the open loop transfer function $G(s) = \frac{1}{s(s+1)(s+2)}$	EE314.1	Additional questions for Fast Learner
5.	With the help of suitable diagram explain modifications of PID controller.	EE314.1	

ASSIGNMENT QUESTIONS/QUESTION BANK
(Assignment 2)

Unit- 2. *Control System Design & Analysis by Root Locus method*16 to 24 Marks

Que. No.	Question	CO No.	Remark
1.	What is compensation explain in brief Lead Compensation.	EE314.1	Common for All
2.	Write a short note on Lag Compensation.	EE314.1	
3.	Explain different types of compensators in details.	EE314.1	
4.	Design suitable compensator such that the maximum overshoot of 25% and settling time 5sec. For the open loop systems$G(S) = \frac{1}{S^2(S+4)}$	EE314.1	
5.	Design a suitable lag-lead compensator for the system given below whose open loop transfer function is $G(S) = \frac{4}{S(S+0.5)}$ So that, i) Damping Ratio,ξ=0.5 ii) Undamped natural frequency,ω_n=5rad/sec iii) Velocity error constant Kv = 80sec^{-1}	EE314.1	
6.	For the lead compensator show that maximum phase lead angle is given by,$Sin\emptyset_m = \frac{1-\alpha}{1+\alpha}$	EE314.1	
7.	Consider unity feedback system with open loop transfer function $G(S) = \frac{K}{S(S+2)}$So that, i) Damping Ratio ξ=0.5 ii) Undamped natural frequencyω_n= 4rad/sec	EE314.1	
8.	Explain the effect of addition of poles and zeros on performance of control system.	EE314.1	Additional questions for Fast Learner
9.	For the lead compensator show that maximum phase lead angle is given by,$Sin\emptyset_m = \frac{1-\alpha}{1+\alpha}$	EE314.1	

ASSIGNMENT QUESTIONS/QUESTION BANK
(Assignment 3)

Unit-3. *Control System Design & Analysis by Bode Plot method*16 to 24 Marks

Que. No.	Question	CO No.	Remark
1.	What is bode plot? How stability of system is checked by bode plot?	EE314.1	Common for All
2.	Write down steps for designing of bode plot by lead and lag method.	EE314.1	
3.	Design a lead- lag compensator for the system $G(S) = \frac{k}{S(S+5)(S+1)}$So that i) Kv=20 ii) Gain Margin GM= 8dB iii) Phase Margin PM= 60	EE314.1	
4.	Derive the transfer function of cascade lag compensator from Electrical network	EE314.1	
5.	For cascade lead compensator having transfer function,$K_c\alpha\frac{T_s+1}{\alpha T_s+1}\ 0<\alpha<1$ Where α is called as attenuation factor. Show that the maximum phase lead angle is given by $Sin\emptyset_m = \frac{1-\alpha}{1+\alpha}$	EE314.1	
6.	Discuss correlation between frequency domain and time domain specifications.	EE314.1	Additional questions for Fast Learner
7.	Consider a unity feedback system has an open loop transfer function is, $G(S) = \frac{1}{S(S+1)(S+2)}$ Design suitable compensator so that, i) Phase margin=50 ii) Gain margin=10dB iii) Static velocity error constant is 10 sec^{-1}	EE314.1	

ASSIGNMENT QUESTIONS/QUESTION BANK
(Assignment 4)

Unit- 4. *State Space Design using pole placement*16 to 24 Marks

Que. No.	Question	CO No.	Remark
1.	Write a short note on Controllability and Observability	EE314.1	Common for All
2.	Explain Kalmans test for controllability and observability.	EE314.1	
3.	Design a pole placement controller so that eigen values are at, -4, -3+j1, -3-j1A controller system is described as,$\dot{x} = \begin{bmatrix}1 & 2 & 0\\ 3 & -1 & 1\\ 0 & 2 & 0\end{bmatrix}x + \begin{bmatrix}2\\1\\1\end{bmatrix}u$ $y = [0 \quad 0 \quad 1]x$	EE314.1	
4.	Evaluate the Controllability of the system with Gilberts test $A =$	EE314.1	

	$\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ and $C = [3 \quad 4 \quad 1]$		
5.	A system is given by $\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$ By using state feedback control u= -Kx, it is desired to have closed loop poles at -1+j2,-1-j2,-10. Determine state feedback gain matrix K using Direct substitution method.	EE314.1	
6.	Derive necessary and sufficient condition for arbitrary pole placement	EE314.1	Additional questions for Fast Learner
7.	Explain determination of matrix K using Transformation T matrix, Direct substitution method and Ackermann's formula.	EE314.1	

ASSIGNMENT QUESTIONS/QUESTION BANK
(Assignment 5)

Unit- 5. *State Space Design using State*16 to 24 Marks

Que. No.	Question	CO No.	Remark
1.	Write a short note on full order state observaer	EE314.1	Common for All
2.	1. Determine gain matrix 'm' for observer designing of the system $\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$ $y = [1 \quad 0 \quad 0]x$ By using, i) Direct substitution ii) Transformation matrix iii) Ackermanns formula Given pole locations are, -1+j2,-1-j2,-10. Also write MATLAB program for the same.	EE314.1	
3.	Design an observer for given plant by direct substitution method so that designed eigen values are at, -4+j6, -4-j6, -3 where, $\dot{x} = \begin{bmatrix} 7 & 4 & 0 \\ 3 & -5 & 1 \\ 0 & 2 & 0 \end{bmatrix} x + \begin{bmatrix} 3 \\ 3 \\ 1 \end{bmatrix} u, \; y = [0 \quad 0 \quad 1]x$	EE314.1	
4.	Derive the transfer function for observer based controller.	EE314.1	
5.	Explain the different steps for evaluation of state observer gain matrix 'Ke' using transformation 'T' method.	EE314.1	
6.	Consider the system where, $\dot{x} = \begin{bmatrix} 0 & 20.6 \\ 1 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \;\; , y = [0 \quad 1]x$ Determine the full order state observer so that desired eigen values of	EE314.1	Additional questions for Fast Learner

	observer matrix are, -10,-10 by using Ackermann's formula.		
7.	Design an observer for the plant by direct substitution method, to yield 17.1% overshoot and settling time of 1.6 sec. Take third closed loop poles at S= -6. $$G(S) = \frac{(S+6)}{(S+7)(S+8)(S+9)}$$	EE314.1	

ASSIGNMENT QUESTIONS/QUESTION BANK **(Assignment 6)**			
Unit- 6. *Digital and Advanced Control Systems*16 to 24 Marks			
Que. No.	**Question**	**CO No.**	**Remark**
1.	Explain digital control system with block diagram.	EE314.1	Common for All
2.	Explain advantages and implementation problems in digital control system. Also draw its block diagram	EE314.1	
3.	Solve the following difference equation by use if Z transform method $$x(k+2) + 3x(k+1) + 2x(k) = 0, x(0) = 0, x(1) = 1$$	EE314.1	
4.	Find the Z transform for following functions. i) $F(S) = \frac{2}{S^2+2S+2}$ ii) $F(S) = \frac{2}{S^2+1}$	EE314.1	
5.	Write a short note on Z and S domain relationship	EE314.1	Additional questions for Fast Learner

An ISO 9001-2015 Certified Institute

Sant Gajanan Maharaj College of Engineering, Mahagaon

Site- Chinchewadi, Tal- Gadhinglaj, Dist- Kolhapur

Department of Electrical Engineering

COURSE PLAN

Course Code	EE 315/66254	**Course Name**	Signals and Systems
Prepared by	Mr. Nitin kumar	**Date**	01/07/2019 (AY-2019-20)
Verified by	Mr. M. B. Patil (HOD EE)	**Approved by**	Academic Coordinator/ Principal
Objective	Provide an introduction and basic understanding of Signals and systems, Description and analysis of system, system analysis using laplace transform, Z-transform, Fourier transform and Sampling.		

COURSE OUTCOMES

At the end of this course the students should be able to:

Sr. No.	CO	CO No.
1.	Identify the different types of the signals and system.	EE315.1
2.	Design Continuous and discrete systems using zero state response and zero input response.	EE315.2
3.	Analyze system using Laplace Transform ,its properties and inverse Laplace Transform.	EE315.3
4.	Analyze System using Z- Transform, its properties and inverse z-transform.	EE315.4
5.	Discuss fourier analysis of continuous time signal.	EE315.5
6.	Discuss fourier analysis of discrete time signal.	EE315.6
7.	Illustrate sampling, correlation and spectral density.	EE315.7

EXAMINATION SCHEME

Examination Scheme	Theory	Term Work	#POE	Total

Maximum Marks	100	25	**	125
Contact Hours	4	1	**	5

MAPPING OF COs-Pos

POs / COs	a	b	c	d	e	f	g	h	i	j	k	l
EE315.1	2											
EE315.2	3											
EE315.3		2										
EE315.4			3		1							
EE315.5												
EE315.6		3									1	
EE315.7								2				

Degree of Compliance of COs and POs 1: Low 2: Medium 3: High

COURSE CONTENTS

Chapter No.	Contents	No. of Hours
I	**Introduction to signals & systems**: Continuous & discrete signal: size of signal, signal operations, classification of signals, standard test signals, singularity functions. Continuous & discrete systems: Classification of systems, system models of Electrical systems	**6 Hrs.**
II	**Description and analysis of system** Continuous & discrete systems: zero state response, zero input response, convolution sum and convolution integral, graphical representation of convolution, block diagram representation of differential and difference equation, FIR and IIR systems	**6 Hrs.**
III	**System Analysis using Laplace transform** Laplace transform: A brief introduction to Laplace transforms its properties and inverse Laplace transform, transfer function analysis, solution of LTI differential equation.	**4 Hrs.**
IV	**System analysis using Z-transform** A brief introduction to Z–transform, its properties & inverse – Z transform, connection between Laplace transform and Z–transform, transfer function analysis, solution of LTI difference equation, and stability in Z-domain.	**4 Hrs.**
V	**Fourier analysis of continuous signals**	**5 Hrs.**

	Periodic representation by trigonometric Fourier series, Fourier spectrum, Dirichlet's condition, exponential Fourier series, exponential Fourier spectra, Parseval's theorem, Fourier transform and its properties, Relation between Fourier and Laplace Transform, Fourier spectrum.	
VI	**Fourier analysis of discrete signal** A brief introduction to discrete Fourier series, D.T.F.T., properties of D.T. F. T., relation between DTFT & Z-transform, DTFT spectrum.	**6 Hrs.**
VII	**Sampling, correlation and spectral density** Sampling methods, representing CT signals by samples, sampling DT signals, correlation and Fourier series, energy and power spectral density of signals	**5 Hrs.**

EVALUATION SCHEME

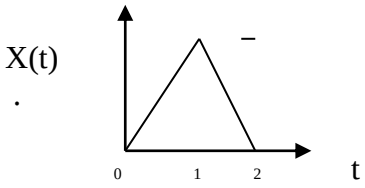
Section	Maximum Marks	Question No.	Chapter No.
I	16-24 Marks	Question-1	Chapter-1
	16-24 Marks	Question-2	Chapter-2
	16-24 Marks	Question-3	Chapter-3
II	16-18 Marks	Question-4	Chapter-4
	16-24 Marks	Question-5	Chapter-5
	08-18 Marks	Question-6	Chapter-6

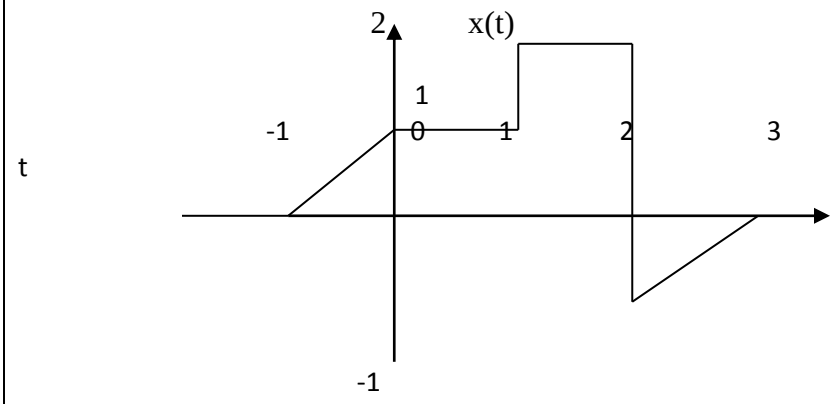
REFERENCES

Books	
1.	Linear systems and signals, B. P. Lathi, Oxford University Press, 2nd edition, 2005
2.	Signals and systems, Simon Haykin, Wiley Publications
3.	Signals and systems, M. J. Roberts, Tata Mc Graw Hill publications
4.	Signals and systems, C. T. Chen, Oxford Publications, 3rd edition, 2004
5.	Analog Signal Processing: Analysis & Synthesis, Alok Barua, Wiley Publications
6.	Signals & Linear Systems, Gabel, Wiley Publications, 3rd edition
7.	Signals and Systems, Krishnaveni, Wiley Publications
Data Manuals	
1.	*
E-books/E-Links	
1.	Sampling theorem: https://nptel.ac.in/courses/106106097/pdf/Lecture08_SamplingTheorem.pdf

2.	Inverse Z transform: http://ocw.utm.my/file.php/134/M5_-_Inverse_Z-Transform.pdf
3.	Classification of signal: https://www.tutorialspoint.com/signals_and_systems/signals_classification
NPTEL /Other Video Links	
1.	Properties of fourier transform: https://nptel.ac.in/courses/108104100/38
2.	Properties of fourier transform: https://www.youtube.com/watch?v=FQdhWQ9Z6mk
3.	Sampling theorem and analysis: https://nptel.ac.in/courses/117101055/23
4.	Inverse laplace transform: https://www.youtube.com/watch?v=BbqbvSig6Mc
5.	Classification of system: https://www.youtube.com/watch?v=JVX-dMzqzZ4

ASSIGNMENT QUESTIONS/QUESTION BANK
(Assignment 1)

Unit- I	**Introduction to signals & systems**		**16 to 24 Marks**
Que. No.	**Question**	**CO No.**	**Remark**
1.	Explain Elementary Continuous time signals with its 6 types?	EE315.1	Common for All
2.	**E**xplain 1.) CTS and DTS 2.) even and odd signal 3.) periodic and non periodic signal?	EE315.1	
3.	Explain different properties of Systems?	EE315.1	
4.	Determine and sketch the Even and Odd parts of the signal shown below, 	EE315.1	

5.	A CTS shown in fig Draw the signal. Y(t)={x(t)+x(2-t)}u(1-t).  	EE315.1	
6.	Determine whether i.) the CTS is periodic or not . x(t)=1/2[1+cos 4πt] ii.) the CTS are energy signal or power signal.	EE315.1	Additional questions for Fast Learner
7.	Find out whether the given system is linear or non linear, time invariance or time variance and memory less or memory. i.)T{x(n)}=x(n)+u(n+1) ii.) y(t)=dx(t)/dt	EE315.1	

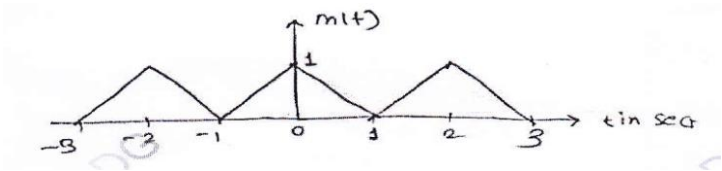
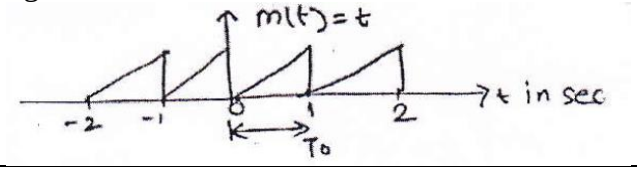
ASSIGNMENT QUESTIONS/QUESTION BANK
(Assignment 2)

Unit- 2	**Description and analysis of system**		**16 to 24 Marks**
Que. No.	**Question**	**CO No.**	**Remark**
1.	Find the natural response of the system described by difference Equation Y(n)-1.5y(n-1)+0.5y(n-2)=x(n), y(-1)=1; y(-2)=0.	EE315.2	Common for All
2.	Find the Forced response of the system described by difference Equation Y(n)-1.5y(n-1)+0.5y(n-2)=x(n), for an input x(n)=2”n(u(n)).	EE315.2	
3.	An LTIC system is specified by equation $(d^2y(t)/dt^2)+5(dy(t)/dt)+6y(t)= (dx(t)/dt)+4x(t)$. Find the natural response for initial conditions y(0)=3; (dy(t)/dt)=0.	EE315.2	
4.	Determine the convolution sum of 2 sequences x(n)={1,4,3,2}; h(n)={1,3,2,1}.	EE315.2	
5.	Define A.) natural response B.) forced response. For CTS and DTS with examples.	EE315.2	Additional questions for Fast Learner
6.	Define FIR & IIR systems, convolution integral. And compute	EE315.2	

ASSIGNMENT QUESTIONS/QUESTION BANK (Assignment 3)			
Unit- 3	**System Analysis using Laplace transform**		**16 to 24 Marks**
Que. No.	**Question**	**CO No.**	**Remark**
1.	Find inverse laplace transform of the following X(s)=1/s(s+2) and x(s)=(1+e^(-2s))/(3s^2+2s)	EE315.3	Common for All
2.	Given x1(t)=e^(-2t)u(t) and x2(t)=e^(-3t). determine y(s) where y(t)=x1(t-2)*x2(-t+3)	EE315.3	
3.	Explain time shifting property and frequency shift property?	EE315.3	
4.	**Fi**nd the unilateral laplace transform of i.) x(t)=cos(w0)t . ii.) x(t)=sin(w0)t	EE315.3	
5.	What is ROC of laplace transform? Explain properties of ROC for laplace transform?	EE315.3	Additional questions for Fast Learner
6.	Find the laplace transform of the signal x(t)=e^(-3t) u(t)+e^(-2t)u(t). And find its ROC.	EE315.3	

ASSIGNMENT QUESTIONS/QUESTION BANK (Assignment 4)			
Unit- 4	**System analysis using Z-transform**		**16 to 24 Marks**
Que. No.	**Question**	**CO No.**	**Remark**
1.	Define z transform and inverse z transform anf fint the z transform and ROC for the signal. i.) x(n)=a^(n)u(n) ii.) x(n)=-b^(n)u(-n-1). Find ROC.	EE315.4	Common for All
2.	Explain the properties of ROC of x(Z).	EE315.4	
3.	Determine the z transform, ROC and pole zero locations of x(z) for X(n)=(2/3)^(n)u(n)+(-1/2)^(n)u(n)	EE315.4	
4.	Explain the properties of z transform i.) linearity ii.) time shifting iii.) time reversal.	EE315.4	
5.	Explain the properties of z transform i.) parsevals relation ii.) convolution iii.) time expansion.	EE315.4	Additional questions for Fast Learner
6.	Determine the z transform of the following signal X(n)=(1/2)(n^2+n)(1/3)^(n-1)u(n-1)	EE315.4	

ASSIGNMENT QUESTIONS/QUESTION BANK (Assignment 5)			
Unit- 5	**Fourier analysis of continuous signals**		**16 to 18 Marks**
Que. No.	**Question**	**CO No.**	**Remark**

1.	i.) Explain and state Dirichilets condition ii) Derive Parsaval's Theorem.	EE315.5	Common for All
2.	Explain Fourier series Properties?	EE315.5	
3.	For the following signal, find the exponential series. 	EE315.5	
4.	Find the Trigonometric Fourier series for the following periodic signal. 	EE315.5	
5.	Find the convolution of signals given below using Fourier Transform $x_1(n)=\left(\frac{1}{2}\right)^n u(n)$ $x_2(n)=\left(\frac{1}{3}\right)^n u(n)$	EE315.6	Additional questions for Fast Learner
6.	Verify Parseval's theorem for the following sequence $X(n)=(1/2)^n u(n)$	EE315.6	

ASSIGNMENT QUESTIONS/QUESTION BANK **(Assignment 6)**			
Unit- 6	**Fourier analysis of discrete signals**		**16 to 24 Marks**
Que. No.	**Question**	**CO No.**	**Remark**
1.	Explain the properties for fourier transform.	EE315.6	Common for All
2.	Find the discrete time fourier transform of the following. $x(n)=(0.5)^n u(n)+2^{-n}u(n-1)$	EE315.6	
3.	Explain relation between Fourier transfom and Laplace transform.	EE315.6	
4.	For the continuous time periodic signal X(t)=2+cos(2*pi*t/3)+4sin(5*pi*t/3)	EE315.5	
5.	Find the Fourier series coefficients for the continuous time periodic signal. x(t)=1.5 for 0<t<1 =-1.5 for 1<t<2	EE315.5	Additional questions for Fast Learner
6.	Determine the signal x(n) for the given fourier transform $x(e^{jw})=e^{-jw}$ for –pi<w<pi.	EE315.6	

ASSIGNMENT QUESTIONS/QUESTION BANK (Assignment 7)			
Unit- 7	**Sampling, correlation and spectral density**		**08to 18 Marks**
Que. No.	**Question**	**CO No.**	**Remark**
1.	Write a short note on sampling and explain in detail various types of sampling methods.	EE315.7	Common for All
2.	State sampling theorem. Explain effect of under sampling.	EE315.7	
3.	For the following signal x (t) determine the energy spectral density of a sine pulse given by: i) x (t) =A sinc (2Wt) ii) Also Calculate the total energy for the signal x (t) =A sinc (2Wt)	EE315.7	
4.	Explain properties of power spectral densities.	EE315.7	