

	SJP N Trust's Hirasugar Institute of Technology, Nidasoshi <i>Inculcating Values, Promoting Prosperity</i> Approved by AICTE, New Delhi, Permanently Affiliated to VTU, Belagavi Recognized under 2(f) & 12B of UGC Act, 1956 Accredited at 'A+' Grade by NAAC	EEE Dept. Academic Course Plan 2026-27 (Odd Sem)



INSTITUTE VISION

To be a preferred institution in Engineering Education by achieving excellence in teaching and research and to remain as a source of pride for its commitment to holistic development of individual and society.

INSTITUTE MISSION

To continuously strive for the overall development of students, educating them in a state of the art infrastructure, by retaining the best practices, people and inspire them to imbibe real time problem solving skills, leadership qualities, human values and societal commitments, so that they emerge as competent professionals.

DEPARTMENT VISION

To be a centre of excellence in teaching and learning to produce the competent & socially responsible professionals in the domain of Electrical & Electronics Engineering.

DEPARTMENT MISSION

- I. To educate students with core knowledge of Electrical and Electronics Engineering to excel in their professional career.
- II. To develop problem solving skills, professional skills and ethical values among the students for the betterment of mankind.
- III. To prepare technically competent and socially responsible Electrical Engineer to serve the future needs of the society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the program will be able to

- PEO1: Achieve successful professional career in Electrical Engineering and allied disciplines.
- PEO2: Pursue higher studies and continuously engage in upgrading the professional skills.
- PEO3: Demonstrate professional & ethical values, effective communication skills and teamwork to solve issues related to profession, society and environment.

PROGRAM OUTCOMES (POs):

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs) :

PSO1: Apply knowledge & competencies to analyze & design Electrical & Electronics Circuits, Controls and Power Systems, Machines & Industrial Drives.

PSO2: Use Software/Hardware tools for the design, simulation and analysis of Electrical and Electronics Systems.

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	Courses	
	1BMATEE301 - Complex Analysis, Transform Technique and Optimization	
	1BEE302 - Analog Electronic Circuits	
	1BEE303-Electric Circuit Analysis	
	1BEE304-Digital Electronic Circuits	
	1BEE305-Transformers and Generators	
	1BEEL306-Transformers and Generators lab	
	1BEEL307D- Digital Electronics Circuits Lab	

HSMS: -Humanity and Social Science and management Course, **PCC:** Professional Core Course, **IPCC:** Professional Core Course Theory Integrated with practicals, **PCCL:** Professional Core Course laboratory, **AEC:** Ability Enhancement Course, **ESC:** Engineering Science Course, **MC:** Mandatory Course (Non-credit), **PEC:-** Professional Elective Course, **OEC:-** Open Elective Course

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1.0 Student Help Desk

Sl. No	Coordination Work	Contact Person	
		Faculty	Instructor
01	Attestations	Dr. B. V. Madiggond	-
02	Exam forms signature, Overall department administration, Counseling/ interaction with Parents/Students.		
03	Research Centre Coordinator		
04	Project Coordinator, KSCST Coordinator, Hobby & Mini Project Coordinator,	Prof. O. B. Heddurshetti	-
05	Academic Coordinator, Dept. Library Coordinator, Mentorship Coordinator	Prof. H. R. Zinage	-
06	First Year Coordinator, Dept. NBA Coordinator, Alumni Coordinator	Dr. M. P. Yenagimath	-
07	Dept. Association Coordinator, Professional Body (ISTE & IEEE) Coordinator	Prof. S. D. Hirekodi	-
08	AICTE/VTU/NIRF/LIC Coordinator, AICTE Activity Coordinator	Prof. A. U. Neshti	-
09	IA & EMS Coordinator	Prof. S. J. Patil	Shri. G. B. Rendale
10	News letter/Technical Magazine Coordinator, News & Publicity Coordinator, Website Coordinator,	Prof. S. G. Huddar	--
11	TP Cell Coordinator, IIIC Cell, Internship Coordinator	Prof. P. I. Savadatti	--
12	Dispensary	Dr. Arun G. Bullannavar, Contact No.9449141549	
Class Teacher			
13	3 rd Semester	Prof. S. J. Patil	Shri. V.M. Mutalik
14	5 th Semester	Prof. A. U. Neshti	Shri. G. B. Rendale
15	7 th Semester	Prof. P. I. Savadatti	Shri. R. S. Bardol

2.0 Departmental Resources

Department of Electrical and Electronics Engineering was established in the year 1996 and is housed in a total area of **1339 Sq. Mtrs.**

2.1 Faculty Position

S.N.	Category	No. in position	Average experience
1	Teaching faculty	9	20 Y
2	Technical supporting staff	3	29 Y
3	Helper	2	23 Y

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2.2 Major Laboratories

SL. No.	Name of the laboratory	Area in Sq. Mtrs	Amount Invested (Rs)
01	Electronics Lab	71	4,49,488.00
02	Operational Amplifier & Linear Integrated Lab		1,29,776.00
03	Power Electronics Lab	92	7,85,162.00
04	Control Systems Lab		2,14,127.00
05	Power System Simulation Lab	71	17,95,111.00
06	Computer Aided Electrical Drawing Lab		6,50,988.40
07	Microcontroller Lab/ Digital Signal Processing Lab	72	5,94,122.00
09	Electrical Machines Lab	200	14,85,725.0
10	Relay & High Voltage Lab	94	11,72,383.00
11	Basic Electrical Engg. Lab	96	42,321.00
	Total	696	73,19,203.40

3.0 Faculty Details

S.N.	Faculty Name	Designation	Qualification	Area of specialization	Professional membership	Industry Experience (in years)	Teaching Experience (in years)	Contact Nos.
01	Dr.B.V.Madiggond	HOD/Prof.	Ph.D	Power Electronics	LMISTE, YHAI	-	33	9343454993
02	Dr. M. P.Yenagimath	Asst. Prof.	Ph.D	VLSI&ES	LMISTE	1	20	9341449466
03	Prof.S.D.Hirekodi	Asst. Prof.	M. Tech.	Power Electronics	LMISTE	1	26	9480849338
04	Prof.H.R.Zinage	Asst. Prof.	M. Tech.	Power System	LMISTE	-	26	9480849335
05	Prof.O.B. Heddurshetti	Asst. Prof.	M. Tech.	Power Electronics	LMISTE	1	19	9448420509
06	Prof. A. U. Neshti	Asst. Prof.	M. Tech.	Digital Electronics	ISTE	-	18	9538223362
07	Prof. S. G. Huddar	Asst. Prof.	M. Tech.	Power System Engg.	LMISTE	-	13	9742066852
08	Prof. P. I. Savadatti	Asst. Prof.	M. Tech.	Digital Electronics	-	-	11	9964315436
09	Prof. S. J. Patil	Asst. Prof.	M. Tech.	Industrial Electronics	-	-	15	9880931802



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Academic

Course Plan

2026-27
(Odd Sem)**4.0****Institute Calendar of Events**

		SJP N Trust's Hirasugar Institute of Technology, Nidasoshi. <i>Approved by AICTE, New Delhi and Affiliated to VTU, Belagavi</i> <i>Recognized under 2(f) & 12B of UGC Act, 1956 & Accredited at 'A+' Grade by NAAC</i>	IQAC AY:2026-27 CoE for Odd Sems
Comprehensive Calendar of Events (CoEs) <i>(I, III, V & VII Sems. for the AY: 2026-27)</i>			
Ref: 1) VTU Notification on the Revised Academic Calendar bearing no.: No.: VTU/BGM/BoS/1 st sem AC/ 2026-27/2465, Dated: 18 th Aug. 2026 2) Notification on the Tentative Academic Calendar bearing no.: No.: VTU/BGM/BoS/5 th sem AC/ 2026-27/2125, Dated: 30 th July. 2026 3) Notification on the Tentative Academic Calendar bearing no.: No.: VTU/BGM/BoS/3 rd sem AC/ 2026-27/2124, Dated: 30 th July. 2026 4) AICTE Academic Calendar: 2026-27, June Session, File No.: AICTE/RB-AC-2026-27/2, Dated: 13 th Aug. 2026			
Calendar with Holidays		Date	Events
August-2026		24 th -29 th Aug. 2026 24 th -29 th Aug. 2026 31 st Aug. 2026 13 th -14 th Aug. 2026 20 th -22 nd Aug. 2026 22 nd Aug. 2026 25 th Aug. 2026 29 th Aug. 2026 5 th Sept. 2026 7 th & 8 th Sept. 2026 11 th Sept. 2026 11 th Sept. 2026 12 th Sept. 2026 15 th Sept. 2026 23 rd Sept. 2026 24 th -26 th Sept. 2026 26 th Sept. 2026 26 th Sept. 2026 30 th Sept. 2026 22 nd Sept. 2026 30 th Sept. 2026	1, III & V Sems. Finalization of Electives, Academic Work load Distribution, Display of e-CPs & CIE in OBE-ERP & Time-Table/s Commencement of I Sem. SIP Orientation Programs & Commencement of I Sem. Classes International Conference IC-DAIS 2026 (By: R&D Cell) 1 st IAT & CCAs for VII Sem. (on CO1) 1 st e-Feedback on T&L of VII Sem Students e-Display of 1 st IAT & CCAs marks for VII Sem. 1 st Counseling of VII Sem Mentees by Mentor Teachers' Day Celebration (Org by NSS) Commencement of Classes for V & III Sems. respy (AY:2026-27) Commencement of IDT Lab (Completion of 3 IDT Steps) Alumni Association Activity (Tentative) (Org. by HAA) Workshop on Women's Empowerment & Health (Org. by WEC) Engineers' Day Celebration (Org. by NSS) I Sem. Fresher's' Day Celebration (Org. by FY Dept.) 2 nd IAT & CCAs for VII Sem. (on CO2 & CO3) 2 nd e-Feedback on T&L of VII Sem Students Project Synopsis Presentation & CIE-01 for IDT, Community & Mini Projects' of I, III & V respy. e-Display of 2 nd IAT & CCAs marks for VII Sem. HSIT QUEST (Host by EEE Dept.) (Tentative) Last date to complete the assessment of COs/POs/PSOs of AY:2025-26 through direct & indirect methods in OBE-ERP (NBA Coordinator)
September-2026		2 nd Oct. 2026 1 st Oct. 2026 14 th -16 th Oct. 2026 16 th Oct. 2026 9 th Oct. 2026 9 th Oct. 2026 12 th -15 th Oct. 2026 16 th Oct. 2026 23 rd Oct. 2026 24 th Oct. 2026 27 th Oct. 2026 29 th -31 st Oct. 2026 31 st Oct. 2026 3 rd Nov. 2026 4 th Nov. 2026 9 th Nov. 2026 14 th Nov.- 4 th Dec. 26 1 st Dec. 2026 4 th Dec. 2026 7 th , 18 th Dec. 26	International Day of Non-Violence (Org. by NSS & YRC) Blood Donation Day (Org. by YRC & NSS) 1 st IAT & CCAs for I, III & V Sems. (on CO1 & CO2) 1 st e-Feedback on T&L of I, III & V Sems. Students Academic Audit of the AY:2025-26 (By Dept.) Green/Energy Audit (By NSS) & Gender Audit (By WEC) (Tentative) Annual Sports Day (Host by SD) Fun Week & Dusserha Activities (Host by ECE Dept.) (Tentative) HSIT Sambhrama (Host by ECE Dept.) (Tentative) e-Display of 1 st IAT & CCAs marks for I, III & V Sems. 1 st Lab IAT & Display of marks for I, III & V Sems. (on CO1 & CO2) 1 st Counseling of I, III & V Sems. Mentees by Mentor 3 rd IAT & CCAs for VII Sem. (on CO4 & CO5) Project work (Phase-2) Exhibition cum Demonstration (VII Sem.) e-Display of 3 rd IAT & CCAs marks for VII Sem. 2 nd Lab IAT & Display of marks for VII Sem (on CO3-CO5) Last Working Day of VII Sem. VII Sem Theorv SEE 2 nd e-Feedback on T&L of I, III & V Sems. Students 2 nd Lab IAT & Display of marks for I Sem (on CO3-CO5) VII Sem Practical SEE Commencement of VIII Sem (AY: 2026-27) (15 Weeks Industry Internship & MOOCs by VTU-CoE) Project Exhibition cum Demonstration & CIE-01 for IDT, Community & Mini Projects' of I, III & V respy. 2 nd IAT & CCAs for I, III & V Sems. (on CO3, CO4 & CO5) 2 nd Counseling of I, III & V Sems. Mentees by Mentor e-Display of 2 nd IAT & CCAs marks for I, III & V Sems. Last Working Day of III & V Sems. Last Working Day of I Sem. 1 st , 3 rd & 5 th Sems. Theory Examinations National Youth Day & NMBA & Integrity Pledge (Org. by NSS, Sports & YRC) 1 st , 3 rd & 5 th Sems. Practical Examinations Martyrs' Day (Shahed Diwas) (Org. by NSS, SD & YRC) Commencement of II Sem Commencement of IV & VI Sems.
October-2026		2 nd Oct. 2026 10 th Oct. 2026 20 th Oct. 2026 21 st Oct. 2026	2 nd Oct. 2026 GH: Gandhi Jayanti 10 th Oct. 2026 GH: Mahalaya Amavasya 20 th Oct. 2026 GH: Mahanavami/Ayudh Pooja 21 st Oct. 2026 GH: Vijaya Dashami
November-2026		1 st Nov. 2026 8 th Nov. 2026 10 th Nov. 2026 27 th Nov. 2026	1 st Nov. 2026 GH: Kannada Rajyotsav 8 th Nov. 2026 GH: Narak Chaturdashi 10 th Nov. 2026 GH: Balipadyami/Deepavali 27 th Nov. 2026 GH: Karakdas Jayanti
December-2026		25 th Dec. 2026	25 th Dec. 2026 GH: Christmas
January-2027		14 th Jan. 2027 26 th Jan. 2027	14 th Jan. 2027 GH: Makar Sankranti 26 th Jan. 2027 GH: Republic Day

- 1) Dept. must plan for extra sessions on weekdays, Saturdays, and Sundays to complete the VTU prescribed syllabus within term end as per the VTU guidelines.
 2) Every 1st & 3rd Saturday will be holiday as per VTU notification
 3) Dept. shall adhere to the VTU guidelines for swappable 2022 scheme 7th & 8th semester Internship & Elective-MOOCs conducted by VTU- Centre for Online Education (COE)

Abbreviations:

IAT: Internal Assessment Test, T&L: Teaching & Learning Process, GH: General Holiday, CCA: Continuous Comprehensive Assessments, LH: Local Holiday, CO: Course Outcome, NSS: National Service Scheme, SD: Sports Dept. WEC: Women Empowerment Cell, YRC: Youth Red-Cross, OBE-ERP: OBE-ERP Software, MOOC: Massive Open Online Course, SEE: Semester End Examination, SIP: Student Induction Program, NMBA: Nasha Mukt Bharat Abhiyan, HAA: HSIT Alumni Association, R&D: Research & Development

Dr.S.N.Topannavar
Dean (Academics) & IQAC Coordinator
Nidasoshi, Tal: Hukkeri, Dist: Belgaum, Karnataka - 591 236, Phone: 9188833-278887, Fax:278886, Web: www.hsit.ac.in

Dr.S.C.Kamat
Principal

B.E. in Electrical and Electronics Engineering Scheme of Teaching and Examinations 2025 Outcome-Based Education (OBE) and Choice-Based Credit System (CBCS) (Effective from the academic year 2025-26)															
III SEMESTER															
Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)		Teaching and Learning Scheme					Examination				Credits
						Classroom Instruction (CI) hours per semester		Laboratory Instruction (LI) hours Per semester	Term work & self-learning in hours	Teaching-Learning hours per semester = CI +LI+TW+SL	Duration in h ours	CIE Marks	SEE Marks	Total Marks	
						L	T	P	TW+SL						
1	ASC	1BMATEE301	Complex Analysis, Transform Technique and Optimization	Mathematics		42	28	0	50	120	3	50	50	100	4
2	IPCC	1BEE302	Analog Electronic Circuits	EEE		42	0	28	50	120	3	50	50	100	4
3	PCC	1BEE303	Electric Circuit Analysis	EEE		42	28	0	50	120	3	50	50	100	4
4	PCC	1BEE304	Digital Electronic Circuits	EEE		42	0	0	48	90	3	50	50	100	3
5	PCC	1BEE305	Transformers and Generators	EEE		42	0	0	48	90	3	50	50	100	3
6	PCCL	1BEEL306	Transformers and Generators lab	EEE		0	0	28	2	30	2	50	50	100	1
7	AEC	1BEEL307x	Ability Enhancement Course Laboratory	EEE		0	0	28	2	30	2	50	50	100	1
8	SDC	1BCP308	Community Project (Project-Based Learning) / Societal Project	EEE		0	0	0	30	30	2	50	50	100	1
9	NCMC	1BNSS309	National Service Scheme (NSS)	Concerned campus Staff. (CIE: Viva - Voce and demonstrations)	NSS coordinator	The teaching-learning methodology shall be aligned with the specific nature of each subject, viz., NSS, PE, Yoga, and Music.			30	30	--	100	---	100	PP
		1BPE309	Physical Education (PE) (Sports and Athletics)												
		1BYOG309	Yoga												
		1BMUS309	Music												
Total (In case of regular students)										660	--	500	400	900	21
10	NCMC	1BMATDIP310	Additional Mathematics -I course for Lateral Entry Students	Assessment Structure as mentioned in the syllabus		42	0	0	48	90	---	100	---	100	PP
Total (In case of lateral-entry students not exempted from studying 1BMATDIP310)										750		600	400	1000	21
Ability Enhancement Course (Laboratory)															
1BEEL307A		Multisim /PSpice Lab for Circuit Analysis		1BEEL307C		Python Programming									
1BEEL307B		Transducers and Sensors Lab		1BEEL307D		Digital Electronics Circuits Lab									



Subject Title	Complex Analysis, Transform Techniques and Optimization		
Subject Code	1BMATEE301	IA Marks	50
Teaching Hours/Week(L:T:P)	3:2:0	Exam Marks	50
Total Number of Lecture Hrs	42:28:0:50	Exam Hours	03
CREDITS – 04			

FACULTY DETAILS:

Name: Prof. S.S.Thabaj	Designation: Asst. Professor	Experience: 13
No. of times course taught: 01		Specialization: Mathematics

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electronics and Electronics Engineering	II	Advanced Calculus & Numerical Methods

2.0 Course Objectives

Course Learning Objectives:

- To have an insight into Fourier series, Fourier transforms, Difference equations and Z- Transforms.
- Learn to use the Fourier series to represent periodical physical phenomena in engineering analysis and to enable the student to express non-periodic functions to periodic functions using the Fourier series and Fourier transforms. Analyze signals in terms of Fourier transforms.
- Develop the knowledge of solving differential equations and their applications in ECE.
- To find the association between attributes and the correlation between two variables

3.0 Course Outcomes

Having successfully completed this course, the student will be able to

Course Code	Course Outcome	RBTL	POs
C201.1	Apply the concepts of analytic functions, Cauchy-Riemann equations, complex integration, Cauchy's theorem, and Cauchy's integral formula to solve engineering and mathematical problems involving complex variables.	L1,L2,L3	1,2,3, 12
C201.2	Develop Fourier series representations of periodic functions and perform harmonic analysis for functions with different periodicities, discontinuities, and symmetry properties.	L1,L2,L3	1,2,3,12
C201.3	Utilize Fourier transforms and Z-transforms, including their inverse transforms and properties, to analyse signals and solve difference equations arising in engineering applications.	L1,L2,L3	1,2,3,12
C201.4	Apply probability distributions, sampling theory, and statistical hypothesis testing techniques for analysing uncertainty and making data-driven decisions	L1,L2,L3	1,2,3,12
C201.5	Formulate and solve linear programming problems using graphical, simplex, and Big-M methods to obtain optimal solutions in engineering and management applications.	L1,L2,L3	1,2,3,12
Total Hours of instruction		42	



4.0 Course Content

Module -1: Complex Analysis:

Analytic functions-Cauchy-Riemann equations in Cartesian and polar forms and consequences.

Construction of analytic functions by Milne-Thomson method, Problems on electric flux.

Complex integration: Line integral of a complex function, Cauchy's theorem and Cauchy's integral formula and problems.

Number of Hours: 08+05

Module -2: Fourier series

Periodic functions, Euler's Formula, Conditions for Fourier expansion (Dirichlet's condition), Fourier series of functions i) having points of discontinuity, ii) with period 2π , iii) with change of interval (arbitrary period) and iv) Even and odd functions. Half range Fourier series. Practical harmonic analysis.

Number of Hours: 09+06

Module -3 Fourier Transforms and Z Transforms:

Infinite Fourier transforms: Definition, Fourier transforms, Fourier sine, and cosine transforms.

Inverse Fourier Transforms, inverse Fourier sine and cosine transforms. Problems.

Z-transforms: Definition, Standard Z-transforms, Damping, and shifting rules, Statements of initial value theorem and Final Value Theorem. Inverse Z-transform and applications to solve difference equations.

Number of Hours: 09+06

Module -4: Probability distributions:

Probability Distributions: Review of basic probability theory, Random variables-discrete and continuous. Probability distribution function, cumulative distribution function, Mathematical Expectation-mean and variance. Repeated Trials- Binomial, Poisson, Normal and Exponential distribution (without proofs for mean and SD).

Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, single proportions only. Student's t-distribution, Chi-square distribution as a test of goodness of fit.

Number of Hours: 08+05

Module -5: Linear Programming Problems:

Introduction to optimization techniques, formulation of the problems. Introduction to Linear programming, graphical solution, solution by simplex and Big M method.

Number of Hours: 08+06

5.0 Relevance to future subjects

Sl. No.	Semester	Subject	Topics
01	Common to all	Common to all engineering Subjects	Signal and Analysis, Field Theory, Thermodynamics, Fluid Dynamics etc

6.0 Relevance to Real World

Sl. No	Real World Mapping
01	Fourier series is that very little information is lost from the signal during the transformation. The Fourier transform maintains information on amplitude, harmonics, and phase and uses all parts of the waveform to translate the signal into the frequency domain.
02	Z-transform is used in Image processing and Filters, p-n junction, High-pass, low-pass, band-pass filters. Blur removal etc.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
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01	Tutorial	Topic: Differential equations
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8.0 Books Used and Recommended to Students

Text Books

1. B.S. Grewal: “Higher Engineering Mathematics”, 45th Edition , Khanna Publishers.
2. E. Kreyszig: “Advanced Engineering Mathematics”, John Wiley & Sons, 10th Ed., .

Reference Books

- (i)Complex Variables and Applications by James Ward Brown and Ruel V. Churchill, McGraw-Hill Education.
- (ii) Fourier Series and Boundary Value Problems by Ruel V. Churchill and James Ward Brown.
- (iii)Probability and Statistics for Engineers and Scientists by Ronald E. Walpole et al., Pearson Education.
- (iv)Operations Research by Hamdy A. Taha, Pearson Education.
- (v) Schaum's Outline of Complex Variables, McGraw-Hill.

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References

Web links and Video Lectures:

- (i)NPTEL Courses on Engineering Mathematics
 - (ii)MIT Open Course Ware Mathematics
 - (iii)SWAYAM Online Courses.
1. <http://nptel.ac.in/courses.php?disciplineID=111>
 2. [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))
 3. <http://academicearth.org/>
 4. VTU Edusat Programme
 5. VTU e-Shikshana Program
 6. <http://www.bookstreet.in>.

10.0 Magazines/Journals Used and Recommended to Students

Sl. No	Magazines/Journals	website
1	+ Plus Magazine	https://plus.maths.org/issue44 .
2	Mathematics Magazine	www.mathematicsmagazine.com

11.0 Examination Note

Assessment Details (both CIE and SEE)

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage.

- To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e. 20 marks.
- To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks.
- Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.



A minimum of two Internal Assessment Tests (IA) shall be conducted, carrying a total of 25 marks. In addition, Continuous Comprehensive Assessment (CCA) shall be conducted for a total of 25 marks. It is recommended to include a maximum of two learning activities as part of the CCA to foster the holistic development of students. These activities shall be:

Sl. No.	Name of the Learning activity	Maximum Marks
1	Assignment (at RBL3 levels)	10
2	GATE-based Aptitude Test	15

Suggested Learning Activities may include (but are not limited to):

Course Project, Case Study Presentation, Programming Assignment, Tool/Software Exploration, Literature Review, Open Book Test (preferably at RBL4 and RBL5 levels), GATE-based Aptitude Test, Assignment (at RBL3, RBL4, or RBL5 levels), Any other relevant and innovative academic activity, Use of MOOCs and Online Platforms.

Suggested Innovative Delivery Methods may include (but are not limited to):

Flipped Classroom, Problem-Based Learning (PBL), Case-Based Teaching, Simulation and Virtual Labs, Partial Delivery of course by Industry expert/ industrial visits, ICT-Enabled Teaching, and Role Play.

Term Work (TW) and Self Learning (SL) components in Number of Hours per semester		
Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)		
Sl. No.	Term Work(TW)Activity	Number of Hours Per Semester
1.	Group Assignment on Applications of Complex Variables in Electrical Engineering(AC circuits ,electric flux ,potential theory)	20
2.	MATLAB/Python Exploration of Fourier and Z-Transforms	
SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.		
Sl.No.	Self-Learning(SL)Activity	Number of Hours Per Semester
1.	Conformal transformations :Discussion of transformations: $w=z^2, w=e^z, w=z+\frac{1}{z}, z\neq 0$, Bilinear transformation	30
2.	Complex form of Fourier series	
3.	Convolution theorem for Fourier transforms and Z transforms. Applications of transforms to boundary value problems	
4.	Joint probability distributions.	
5.	Dual simplex method.	

Continuous Internal Evaluation (CIE)

1. The CIE marks shall be decided based on internal tests and other outcome-based activities. The continuous internal evaluation shall be carried out by the teacher handling the course.
2. Out of 50 marks earmarked for CIE, 25 marks shall be assigned for internal tests. The first test shall be conducted after completing two modules of the syllabus and the second one after completing the remaining three modules.
3. The remaining 25 marks shall be assigned for Continuous Course Assessment (CCA), conducted as per the rubrics listed in the assessment section of the respective syllabus.
4. A student shall obtain a minimum of 40% marks or 20 out of 50 marks allotted to CIE to Become eligible to appear for the SEE.



Passing requirement in SEE

1. For a pass in the Semester End Examination (SEE), a student shall secure a minimum of 35 marks out of 100.
2. For the declaration of a pass grade, the sum of the Continuous Internal Evaluation (CIE) marks (out of 50) marks and the SEE marks scaled down to 50 shall be greater than or equal to 40 marks.
3. If the total (CIE + SEE) is less than 40 marks, the student shall be awarded the grade 'F' (Fail).

12.0 Course Delivery Plan

Module No.	Lecture No.	Content of Lecturer	% of Portion
1	1	Review of a function of a complex variable, limits, continuity, differentiability	20
	2	Analytic functions-Cauchy-Riemann equation in Cartesian form	
	3	Problems	
	4	Cauchy-Riemann equation in Polar form	
	5	construction of analytic functions	
	6	Properties of Cauchy-Riemann equation	
	7	Milne-Thomson method	
	8	Application to flow problems	
2	9	Fourier series and practical harmonic analysis: Introduction, Periodic functions, Dirichlet's conditions	20
	10	Fourier series of periodic functions of period 2π & Problems	
	11	Fourier series of periodic functions of arbitrary period $2l$ & Problems	
	12	Fourier series of even & odd functions	
	13	Problems	
	14	Half range Fourier series of period 2π & Problems	
	15	Half range Fourier series of period $2l$ & Problems	
	16	Practical harmonic analysis of period 2π	
	17	Practical harmonic analysis of period $2l$	
3	18	Fourier Transforms : Introduction, Infinite Fourier transform	20
	19	Fourier sine and cosine transforms & Problems	
	20	Problems	
	21	Inverse FT, Fourier cosine & sine transforms-Problems	
	22	Z-Transforms : Introduction, Definition, Z-transforms of basic sequences	
	23	Standard z-transforms , Damping & Shifting rule- Problems	
	24	Inverse z-transform- Problems	
	25	Initial value theorem and Final Value Theorem	
	26	applications to solve difference equations	
4	27	Probability distributions: Introduction, Random variables (discrete & continuous)	20
	28	Probability mass/density functions	
	29	Mathematical expectation, mean and variance of Binomial distribution	
	30	Mathematical expectation, mean and variance of Poisson distribution.	
	31	Normal distributions	
	32	Sampling & Sampling distributions	
	33	student's t-distribution	
	34	Chi-square distribution as a test of goodness of fit.	
5	35	Formation of transportation problem	
	36	finding initial basic feasible solution	



	37	west corner rule	20
	38	Least cost method	
	39	Vogel's approximation method	
	40	Optimal solution-problems.	
	41	Formulation of assignment problem	
	42	Hungarian method-Problems	

13.0 Assignments

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 1,2&3 of the syllabus	6	Individual Activity.	Book 1, of the reference list. Website of the Reference list
2	Assignment 2: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4, &5 of the syllabus	10	Individual Activity.	Book 1, 2 of the reference list. Website of the Reference list

14.0 QUESTION BANK

MODULE-1: Calculus of complex functions

1. Derive Cauchy-Riemann equations in the Cartesian form.
2. Derive Cauchy-Riemann equations in the Polar form.
3. P.T if $f(z) = u + iv$ is an analytic then the family of curves $u(x,y) = C_1$, $v(x,y) = C_2$, C_1 & C_2 being Constants, intersect each other orthogonally
4. S.T $w = \log z$, $z \neq 0$ is analytic & find $\frac{dw}{dz}$.
5. Find the analytic function $f(z)$ as a function of z given that the sum of its real & imaginary parts is $x^3 + y^3 + 3xy(x - y)$
6. Determine the analytic function Whose imaginary part is $r^2 \cos 2\theta$
7. Determine the analytic function Whose real part is $\frac{2\cos x \cos hy}{\cos 2x + \cosh 2y}$
8. Find the analytic function $f(z) = u + iv$ given $u - v = e^x(\cos y - \sin y)$
9. If $f(z)$ analytic show that $\left[\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} \right] |f(z)|^2 = 4|f'(z)|^2$

square of to fit a curve of the form $v = ax^{bt}$ to this data

Module-2: Fourier series

1. Obtain a Fourier series to represent e^{-ax} from $(-\pi, x)$
2. Expand $f(x) = x \sin x$, $0 < x < 2$, in a Fourier series.
3. For a function $f(x)$ defined by $f(x) = |x|$, $-\pi < x < \pi$, obtain a Fourier series. Deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} = \frac{\pi^2}{8}$
4. Find the Fourier series for the function $f(x) = \frac{\pi - x}{2}$ in $(0, 2\pi)$. Hence deduce that $\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \dots$
5. Find the Fourier series to represent $f(x) = x + x^2$ from $x = -\pi$ to $x = \pi$ and deduce that



$$\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} = \frac{\pi^2}{12}$$

6. Expand $f(x) = e^{-x}$ as a Fourier series in the interval $(-l, l)$

7. Obtain Fourier series for the function

$$f(x) = \begin{cases} \pi x, & 0 \leq x \leq 1 \\ \pi(2-x), & 1 \leq x \leq 2 \end{cases} \quad \text{and deduce that } \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} + \dots$$

8. Develop $f(x)$ in Fourier series in the interval $(-2, 2)$ if $f(x) = \begin{cases} 0, & -2 < x < 0 \\ 1, & 0 < x < 2 \end{cases}$

9. Find the half range cosine series for the function $f(x) = x^2$ in the range $0 \leq x \leq 1$

10. Find the complex form of the Fourier series of the periodic function $f(x) = \cos ax$, in $-\pi < x < \pi$.

11. The following table gives the variation of periodic current over a period

t sec	0	T/6	T/3	T/2	2T/3	5T/6	T
A amp	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98

Show that there is a direct current part of 0.75 amp in the variable current and obtain the amplitude of the first harmonic.

12. Obtain the Fourier expansion of $f(x) = 2x - x^2$ in $0 \leq x \leq 2$

13. Obtain the constant term and the coefficient of the first sine and cosine terms in the Fourier expansion of y as given below.

x	0	1	2	3	4	5
y	9	18	24	28	26	20

Module-3: Infinite Fourier Transforms and Z Transform:

1. Find the Fourier transform of

$$f(x) = \begin{cases} 1, & |x| < 1 \\ 0, & |x| > 1 \end{cases} \quad \text{Hence evaluate } \int_0^\infty \frac{\sin x}{x} dx$$

2. Find the Fourier transform of the function

$$f(x) = \begin{cases} x, & |x| \leq \alpha \\ 0, & |x| > \alpha \end{cases} \quad \text{Where } \alpha \text{ is a positive constant?}$$

3. Find the Fourier transform of $\cos ax^2$

4. Find the Fourier sine transform of e^{-ax}/x

5. Find the Fourier sine and cosine transform of $f(x) = \begin{cases} 1, & 0 \leq x < a \\ 0, & x \geq a \end{cases}$

6. Find the finite Fourier sine and cosine transform of $f(x) = 2x$, $0 < x < 4$.

7. Find the cosine transform of $f(x) = \frac{1}{1+x^2}$

8. Find the Fourier sine transform of $e^{-|x|}$

9. Find the Fourier transform of $f(x) = \begin{cases} a^2 - x^2, & |x| < a \\ 0, & |x| > a \end{cases}$ and Evaluate $\int_0^\infty \frac{\sin x - x \cos x}{x^3} dx$.

10. Find the Fourier sine transform of $f(x) = \frac{e^{-ax}}{x}$, $a > 0$.

11. Find the Fourier cosine transform of $f(x) = \begin{cases} x, & 0 < x < 1 \\ 2-x, & 1 < x < 2 \\ 0, & x > 2 \end{cases}$

12. Find the Fourier transform of $f(x) = e^{-|x|}$ and Evaluate $\int_0^\infty \frac{x \sin mx}{1+x^2} dx$.

Z Transform

$$1. \text{ P.T. } z_T(n^2) = \frac{z^2 + z}{(z-1)^3}$$

$$2. \text{ P.T. } z_T(n^3) = \frac{z^3 + 4z^2 + 2}{(z-1)^4}$$



3. P.T. $z_T(\cos\theta) = \frac{z(z-\cos\theta)}{z^2-2z\cos\theta+1}$
4. P.T. $z_T(\sin\theta) = \frac{(z\sin\theta)}{z^2-2z\cos\theta+1}$
5. P.T. $z_T(a^n \cos n\theta) = \frac{z(z-a\cos\theta)}{z^2-2az\cos\theta+a^2}$
6. Find the Z-transform of $\cos hn\theta$ & $\sin hn\theta$.
7. Find the Z-transform of $(n+1)^2$
8. Using the inversion integral method find the inverse Z-transform of $\frac{3z}{(z-1)(z-2)}$
9. Solve $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ with $y_0 = y_1 = 0$ using Z-transform
10. Solve the difference equation $y_{n+2} + 2y_{n+1} + y_n = n$ with $y_0 = y_1 = 0$ using Z-Transform.
11. Obtain the z-transform of $\cos n\theta$ and $\sin n\theta$
12. Find the Inverse z-transform of $\frac{2z^2+3z}{(z+2)(z-4)}$.
13. If $\bar{u}(z) = \frac{2z^2+3z+12}{(z-1)^4}$, find the value of u_0, u_1, u_2, u_3 .
14. Solve the difference equation $u_{n+2} + 6u_{n+1} + 9u_n = 2^n$, $u_0 = u_1 = 0$.

Module-4: Probability Distributions

1. Find the mean & variance of Binomial distribution.
2. The marks of 1000 students in an examination follows in a normal distribution with mean 70 & SD 5. Find the number of students whose marks will be i) less than 65, ii) more than 75 & iii) between 65 & 75.
3. The probability mass function of a variate X is

X = x_i	-2	-1	0	1	2	3
p(x)	0.1	K	0.2	2k	0.3	k
4. Find i) The value of K, ii) $p(x \leq 0)$, iii) $p(x > 1)$ iv) $p(-2 < x \leq 1)$
5. If 10% of the rivets produced by a machine are defective, find the probability that, out of 12 rivets chosen at random.
6. In a test of 2000 electric bulbs, it was found that the life of a bulb is a normal variable with average life of 2040 hours & standard deviation of 60 hours. Estimate the number of bulbs to burn for i) More than 2150 hours, ii) less than 1950 hours, Given that $p[0 \leq z \leq 1.83] = 0.4664$ & $p[0 \leq z \leq 1.33] = 0.4082$.
7. 2% of the fuses manufactured by a firm are found to be defective. Find the probability that a box containing 200 fuses contains i) no defective fuse, ii) 3 or more defective fuses.
8. In length of a telephone conversation is an exponential variate with mean 3 minutes. Find the probability that call i) ends in less than 3 minutes, ii) takes between 3 to 5 minutes.
9. Suppose that the student IQ scores form a normal distribution with average 100 & standard deviation 20. Find the percentage of students whose (i) score less than 80 (ii) score more than 120 (iii) score falls between 80 & 120 (G T P(1)=0.3413)
10. In a certain town the duration of a shower is exponentially distributed with mean 5 minutes what is the probability that a shower will last for i) 10 minutes or more, ii) less than 10 minutes, iii) between 10 min & 12 min
11. The probability that a person aged 60 years will live up to 70 is 0.65. what is the probability that out of 10 persons aged 60 at least 7 of them will live up to 70.
12. Explain the following terms i) Null hypothesis, ii) Level of significance, iii) Type I & II errors, iv) Confidence limits.
13. A sample of 100 days is taken from meteorological records of certain districts & 10 of them are found to be fussy. Find the 99.73 % confidence interval of the % of fussy days in the district.



14. A certain stimulus administered to each of the 12 patients resulted in the following blood pressure 5,2,8,-1,3,0,6,-2,1,5,0,4, can it be calculated that stimulus will increase the blood pressure ?
[t_{0.05} for 11d.f= 2.201]
15. A die was thrown 9000 times & a throw of 5 or 6 was obtained 3240 times. On the assumption of random throwing, do the data abdicate that the die is biased?
16. A random sample of 100 records deaths in past year showed an average life span of 71.8 years. Assuming a population standard deviation of 8.9 years, does the data indicated that average life span today is greater than 70 years? Use a 0.05 level of significance.
17. In 324 throws of a six faced die, an odd number turned up 181 times. Is it reasonable to think that the die is an unbiased one?
18. Four coins are tossed 100 times & the following results were obtained

No. of Heads	0	1	2	3	4
Frequencies	5	29	36	25	5

Fit a Binomial distribution for the data & test the goodness of fit given $\chi^2_{0.05} = 9.49$ for 4 d. f

19. Find the student's 't' for the following variable values in a sample of eight -4,-2,-2,0,2,2,3,3 taking the mean of the universe to be zero.
20. A coin was tossed 400 times & the head turned up 216 times. Test the hypotheses that the coin is in biased at 5% level significance.
21. A die was thrown 1200 times & the number 6 was obtained 236 times. Can the die be considered fair at level of significance?

Module-5: Linear Programming Problem (L.P.P)

1. Calculate the maximal and minimal value of $z = 5x + 3y$ for the following constraints.
 $x + 2y \leq 14, 3x - y \geq 0, x - y \leq 2$
2. Use penalty method to Maximize $Z = 3x_1 + 2x_2$ Subject to the constraints $2x_1 + x_2 \leq 2, 3x_1 + 4x_2 \geq 12, x_1, x_2 \geq 0$
3. Max $z = 5x_1 + 4x_2$ subject to: $x_1 \leq 4$ (1) $x_1 + 2x_2 \leq 10$ (2) $3x_1 + 2x_2 \leq 16$ (3) $x_1, x_2 \geq 0$
4. Maximize $z = x_1 + 5x_2$ subject to $3x_1 + 4x_2 \leq 6, x_1 + 3x_2 \geq 2, x_1, x_2 \geq 0$
5. Maximize $z = -4x_1 - 2x_2$ subject to $3x_1 + x_2 \geq 27, x_1 + x_2 \geq 21, x_1 + 2x_2 \geq 30, x_1, x_2 \geq 0$
6. Maximize $-200x_1 - 300x_2$ subject to $2x_1 + 3x_2 \geq 1200, x_1 + x_2 \leq 400, 2x_1 + 3/2x_2 \geq 900, x_1, x_2 \geq 0$
7. Maximize $2000x_1 + 3000x_2$ subject to $6x_1 + 9x_2 \leq 100$ & $2x_1 + x_2 \leq 20, x_1, x_2 \geq 0$
8. Rewrite the following linear programming problem in canonical form: Maximize $Z = 2x_1 + x_2 + 4x_3$ Subject to the constraints $-2x_1 + 4x_2 \leq 4, x_1 + 2x_2 + x_3 \geq 15, 2x_1 + 3x_2 \leq 2$
9. The point which provides the optimal solution of the linear programming problem $\max z = 45x + 55y,$
 $6x + 4y \leq 120, 3x + 10y \leq 180, x \geq 0, y \geq 0$
10. Maximize $Z = 6x_1 + 8x_2$ Subject to: $30x_1 + 20x_2 \leq 300, 5x_1 + 10x_2 \leq 110, x_1 + x_2 \geq 0$
11. Maximize $z = x_1 + 5x_2$ subject to $3x_1 + 4x_2 \leq 6, x_1 + 3x_2 \geq 2, x_1, x_2 \geq 0$
12. Maximize $z = -4x_1 - 2x_2$ subject to $3x_1 + x_2 \geq 27, x_1 + x_2 \geq 21, x_1 + 2x_2 \geq 30, x_1, x_2 \geq 0$
13. Maximize $z = 200x_1 - 300x_2$ subject to $2x_1 + 3x_2 \geq 1200, x_1 + x_2 \leq 400, 2x_1 + 3/2x_2 \geq 900, x_1, x_2 \geq 0$
14. Maximize $2000x_1 + 3000x_2$ subject to $6x_1 + 9x_2 \leq 100$ & $2x_1 + x_2 \leq 20, x_1, x_2 \geq 0$

Prepared by	Checked by		
			
Prof. S.S.Thabaj	Dr. S. L. Patil	HOD	Principal



Subject Title	ANALOG ELECTRONICS CIRCUITS		
Subject Code	1BEE302	CIE Marks	50
Teaching hours/week(L:T:P:S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	42	Exam Hours	03
CREDITS – 04			

FACULTY DETAILS:

Name: Prof. S. J. Patil	Designation: Asst. Professor	Experience: 14Years
No. of times course taught(including present): 01	Specialization: Industrial Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	First year Engineering	I/II	Basic Electrical Engg.
02	First year Engineering	I/II	Basic Electronics.

2.0 Course Objectives

1. To provide the knowledge for the analysis of transistor biasing and thermal stability circuits.
2. To develop skills to design the electronic circuits like amplifiers, power amplifiers and oscillators.
3. To understand the importance of FET and MOSFET and FET/MOSFET amplifiers

3.0 Course Outcomes

At the end of the course, student will be able to

	Course Outcome	RBT Level	POs
C203.1	Explain the operating principles, characteristics and applications of semiconductor diodes, rectifiers, Bipolar Junction Transistors (BJTs) and FETs in different configurations	L1 L2 L3	1, 2, 3, 5,8, 9, 10, 11,12
C203.2	Apply the principles of BJT and FET biasing techniques, small-signal models, and AC/DC analysis to determine the operating point and performance of electronic circuits	L1 L2 L3	1, 2, 3, 5,8, 9, 10, 11, 12
C203.3	Analyse the frequency response, multistage amplifiers, feedback amplifiers, oscillators, and power amplifier circuits to evaluate their performance under different operating conditions.	L1 L2 L3	1, 2, 3, 5,8, 9, 10, 11, 12
C203.4	Design electronic circuits using BJTs and FETs, including biasing networks, amplifiers, oscillators, feedback circuits, and power amplifiers to meet specified performance requirements.	L1 L2 L3	1, 2, 3, 5,8, 9, 10, 11, 12
C203.5	Apply modern engineering tools and professional practices to design, analyse, and implement engineering solutions while demonstrating ethical responsibility, effective communication, teamwork, and project management skills.	L1 L2 L3	1, 2, 3, 5,8, 9, 10, 11, 12
Total Hours of instruction			42

4.0 Course Content



MODULE-1

Semiconductor Diode: Introduction, semiconductor materials, working principle and forward and reverse bias conditions, resistance levels, diode equivalent circuit, transition and diffusion capacitance, reverse recovery time. Half-wave and full-wave rectifiers, necessity of clippers and clampers, different types of clippers and clampers. Zenor diode, power Supply and series and parallel Voltage Regulators. Light emitting diodes (LEDs)

Bipolar Junction Transistors: Introduction, NPN and PNP transistors, construction, operation. Characteristics of common base (CB), common emitter (CE) and common collector configuration, cutoff region, active region, and saturation region. Relation between collector current, base current and emitter current.

MODULE-2

BJT Biasing: Introduction to biasing, operating point, bias configurations; fixed-bias, emitter bias, voltage- divider bias, DC bias with voltage feedback, design of bias circuits, effect of temperature on bias; thermal runaway, bias stabilization, stability, stability factors of bias circuits. BJT AC Analysis: Amplification in AC domain, Transistor modelling for small signal analysis; resistance (r_e) model of CB, CE, and CC configurations, hybrid equivalent model CB, CE, and CC configurations, hybrid π model. Low frequency analysis, high frequency analysis.

MODULE-3

BJT AC Analysis: Determination voltage and current gains, effect of RL and RS . General frequency considerations, low frequency response, miller's capacitance, high frequency response. Amplifier operation, common emitter amplifier - DC and AC analysis (base and voltage divider bias only), multistage amplifier, Cascade and cascode connections, amplifier frequency response: decibel scale, Darlington circuits, analysis and design

MODULE-4

Feedback Amplifiers: Feedback concept, different types, practical feedback circuits, analysis and design of feedback circuits. Feedback amplifier; phase and frequency considerations, oscillators operation, phase-shift, Wien-bridge, tuned and crystal oscillators. Power Amplifiers: Classification, analysis and design of Class A – Directly Coupled and Transformer Coupled, Class B- Complementary Symmetry and Push Pull, Class C and Class AB

MODULE-5

Field Effect Transistors: Introduction to FET, Construction, difference between FET, JFET and metal oxide Semiconductor Field Effect Transistor (MOSFET), N-Channel and P-Channel MOSFET in the Enhancement Mode and Depletion Mode, Characteristics, Transfer Characteristics, Fixed Bias, Self Bias and Voltage Divider Bias, DC and AC Analysis



Sl. NO	Experiments
1	Design and verify a full wave bridge rectifier with and without a capacitor filter for given output voltage obtainable from 230 V supply. Determine the performance parameters
2	Experiments on clippers and clampers.
3	Static Transistor characteristics for CE, CB and CC modes and determination of h parameters
4	Single stage BJT RC coupled CE amplifier and determination of voltage gain, current gain, input and output impedances. Determine the bandwidth from the frequency response curve.
5	Single stage FET RC coupled CE amplifier and determination of voltage gain, current gain, input and output impedances..
6	Determination of gain, input and output impedance of BJT Darlington emitter follower with and without bootstrapping and determine gain and bandwidth from its frequency response curve
7	Conduct an experiment on BJT cascade configuration and determine the dynamic resistance, gain of each transistor and the overall no load gain
8	Conduct an experiment on a class B push-pull emitter-follower power amplifier to determine rms output power, DC supply power supplied to the amplifier and amplifier percent efficiency
9	Design a BJT - Crystal Oscillator for a given frequency.
10	Design a FET Hartly oscillator for a given frequency.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	V	Power Electronics	Design of converters.
02	VII	Project work	Design of power supplies, amplifiers and oscillators.

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Design of clippers, clampers, rectifiers, amplifiers, oscillators for various applications in analog electronics domains.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Lab visit	To gain practical knowledge about analog electronics circuits.
02	Industry /Field visit	To study design and manufacturing process of electronic based gadgets, appliances etc.



8.0 Books Used and Recommended to Students

Text Books: Suggested Learning Resources

1. Electronic Devices and Circuit Theory by Robert L Boylestad Louis Nashelsky, Pearson, 11th Edition, 2015.
2. Electronic Devices and Circuits, Millman and Halkias, Mc Graw Hill, 4th Edition, 2015
3. Electronic Devices and Circuits by David A Bell, Oxford University Press, 5th Edition, 2008

Reference Books: Suggested Learning Resources

1. Microelectronics Circuits Analysis and Design, Muhammad Rashid, Cengage Learning, 2nd Edition, 2014
2. A Text Book of Electrical Technology, Electronic Devices and Circuits, B.L. Theraja, A.K. Theraja, S. Chand, Reprint, 2013
3. Electronic Devices and Circuits, Anil K. Maini, Vasha Agarwal, Wiley, 1st Edition, 2009
4. Electronic Devices and Circuits, S. Salivahanan, Suresh, Mc Graw Hill, 3rd Edition, 2013
5. Fundamentals of Analog Circuits, Thomas L Floyd, Pearson, 2nd Edition, 2012

Additional Learning Resources

1. Analog Electronic Circuits- a simplified Approach by U.B. Mahadevaswamy Sanguine Technical Publication.

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References

<http://www.nptel.ac.in/>
<https://www.ti.com/design-development/analog-circuits.html>
<https://www.analog.com/en/education/education-library/tutorials/analog-electronics.html>
https://en.wikipedia.org/wiki/transistor_amplifier
<https://www.electronicsforu.com>

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	Website
1	AEÜ - International Journal of Electronics and Communications	https://www.scimagojr.com/journalsearch.php?q=17683&tip=sid
2	International Journal of Electronics and Communications	https://www.sciencedirect.com/journal/aeu-international-journal-of-electronics-and-communications

11.0 Examination Note

Assessment Details (both CIE and SEE)

- (i) Theory component The CIE marks of 25 shall be earmarked for two tests. The first test shall be conducted after completing two modules of the syllabus and the second one after completing the rest three modules. Each test shall be conducted for 25 marks. The average of the two tests scaled down to 25 marks shall constitute the test marks for a maximum of 25 marks.
- (ii) Laboratory component Out of 25 marks, 15 marks shall be assigned for assessment as per the rubrics listed in the course syllabus.



The remaining 10 marks shall be based on the practical test conducted by two Internal examiners appointed by the HoD. The allotment of marks shall be as per the rubrics defined for regular class work and practical test as indicated in the Table – ICs/IPCCs 1.

(i) To qualify and become eligible to appear for the SEE of the IC/IPCC, a student shall secure at least 40 % of 25 marks, i.e., 10 marks, in the CIE theory component, and at least 40 % of 25 marks, i.e., 10 marks in the CIE Practical component.

Table – ICs/IPCCs 1 Distribution of marks		
Component	Description	Marks
Allotment of marks for regular class work		
Ability in Conducting Experiments	Initiative, skill, safety practices, teamwork, and independent handling of equipment during regular lab sessions.	5 marks
Laboratory Record / Journal	Regular and neat maintenance of lab record, accuracy of results, and timely submission.	10 marks
Subtotal		15
Allotment of marks for CIE practical test		
Laboratory Test / Experiment Performance	Ability to set up apparatus, follow procedure, take observations, and obtain correct results in the test experiment.	5 marks
Viva-Voce	Understanding of theory, concepts, and experimental procedure; ability to explain results and answer related questions.	5 marks
Subtotal		10
Total		25

Semester End Examination (SEE):

Passing requirement in SEE For a pass in the Semester End Examination (SEE), a student shall secure a minimum of 35 marks out of 100. For the declaration of a pass grade, the sum of the Continuous Internal Evaluation (CIE) marks (out of 50) marks and the SEE marks scaled down to 50 shall be greater than or equal to 40 marks. If the total (CIE + SEE) is less than 40 marks, the student shall be awarded the grade 'F' (Fail)

12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecture	Teaching Methods	% of Portion coverage
I	1.	Semiconductor Diode: Introduction, semiconductor materials	Chalk & Talk PPT	20
	2.	Working principle and forward and reverse bias conditions, resistance levels		
	3.	Diode equivalent circuit, transition and diffusion capacitance		
	4.	Reverse recovery time. Half-wave and full-wave rectifiers		
	5.	Necessity of clippers and clampers, different types of clippers and clampers		
	6.	Zenor diode, power Supply and series and parallel Voltage Regulators. Light emitting diodes (LEDs)		



	7.	Bipolar Junction Transistors: Introduction, NPN and PNP transistors, construction, operation		
	8.	Characteristics of common base (CB), common emitter (CE) and common collector configuration, cutoff region, active region, and saturation region		
	9.	Relation between collector current, base current and emitter current.		
II	10.	BJT Biasing: Introduction to biasing, operating point, bias configurations	Chalk & Talk PPT	20
	11.	Fixed-bias, emitter bias, voltage- divider bias, DC bias with voltage feedback, design of bias circuits,		
	12.	Effect of temperature on bias; thermal runaway		
	13.	Bias stabilization, stability, stability factors of bias circuits		
	14.	BJT AC Analysis: Amplification in AC domain		
	15.	Transistor modelling for small signal analysis; resistance (r_e)		
	16.	Model of CB, CE, and CC configurations		
	17.	Hybrid equivalent model CB, CE, and CC configurations, hybrid π model		
	18.	Low frequency analysis, high frequency analysis.		
III	19.	BJT AC Analysis: Determination voltage and current gains	Chalk & Talk PPT	20
	20.	Effect of R_L and R_S . General frequency considerations		
	21.	Low frequency response, miller's capacitance		
	22.	High frequency response. Amplifier operation		
	23.	Common emitter amplifier - DC and AC analysis (base and voltage divider bias only),		
	24.	Multistage amplifier, Cascade and cascode connections		
	25.	Amplifier frequency response: decibel scale		
	26.	Darlington circuits, analysis and design		
IV	27.	Feedback Amplifiers: Feedback concept, different types, practical feedback circuits	Chalk & Talk PPT	20
	28.	Analysis and design of feedback circuits. Feedback amplifier		
	29.	Phase and frequency considerations, oscillators operation		
	30.	Phase-shift, Wien-bridge, tuned and crystal oscillators.		
	31.	Power Amplifiers: Classification,		
	32.	Analysis and design of Class A – Directly Coupled and Transformer Coupled		
	33.	Class B- Complementary Symmetry		
	34.	Push Pull, Class C and Class AB.		
V	35.	Field Effect Transistors: Introduction to FET	Chalk & Talk PPT	20
	36.	Construction, difference between FET		
	37.	JFET and metal oxide Semiconductor Field Effect Transistor (MOSFET),		
	38.	N-Channel and P-Channel MOSFET in the Enhancement Mode and Depletion Mode Characteristics		
	39.	Transfer Characteristics		



	40.	Fixed Bias, Self Bias		
	41.	Voltage Divider Bias		
	42.	DC and AC Analysis.		

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Faculty handling the subject can decide	Term work includes Assignments, seminars, micro projects, industrial visits, any other student activities etc	Module 1-5 of the syllabus	9	Team Work	Books 1,2 and 3 of the text books.
2	Faculty handling the subject can decide	Self Learning, MOOCs, spoken tutorials, online educational resources etc.	Module 1-5 of the syllabus	12	Self Learning	Books 1, 2 and 3 of the text books.

14.0 QUESTION BANK

MODULE 1

1. Draw and explain the working of the clamper circuit which clamps the positive peak of a signal to zero volts.
2. Define clipping circuit. Mention few applications.
3. How series clipper can be used to obtain i) Clipping above the reference voltage V_R
ii) Clipping below the reference voltage V_R .
4. Draw and explain a double diode clipper circuit which limits the output at two independent levels.
5. With neat diagram and waveforms explain the working of a negative clamper.
6. Explain voltage divider bias with neat circuit diagram and necessary equations.
7. With suitable graph, explain the significance of operating point.
8. Derive the expressions for stability factor for voltage divider circuit.
9. A voltage divider bias circuit has $R_1 = 39\text{Kohm}$, $R_2 = 82\text{ Kohm}$, $R_c = 3.3\text{Kohm}$, $R_E = 1\text{Kohm}$ and $V_{CC} = 18\text{V}$. the silicon transistor used has $\beta = 120$. Find Q-point and stability factor.

MODULE 2

1. Using exact hybrid model of a C-E transistor amplifier, obtain the expressions for current gain, voltage gain, output resistance and input resistance.
2. State and explain Miller's theorem.
3. Obtain an expression in terms of h- parameters for a transistor as a two port network. Using the above developed equations obtain the hybrid model of CE,CC and CB configurations.
4. Derive an expression for voltage gain and current gain of an amplifier circuit using BJT in CE



configuration using approximate hybrid model.

5. What are the advantages of h-parameters?
6. A transistor is connected as a common emitter amplifier driving a load of $10\text{K}\Omega$. It is supplied by a source of $1\text{K}\Omega$ internal resistance. The h parameters are $h_{ie}=1.1\text{k}\Omega$, $h_{fe}=50$, $h_{re}=2.5\times 10^{-4}$ and $h_{oe}=1/40\text{K}\Omega$.
7. Find i) Current gain iii) input impedance ii) Voltage gain iv) output impedance
Using complete or exact hybrid model equivalent model of a transistor, obtain the expressions for current gain, voltage gain, output impedance and input impedance.
8. Discuss the factors that affect the low frequency response of a BJT-CE amplifier.

MODULE 3

1. What are the advantages of negative feedback in an amplifier?
2. Explain positive feedback and negative feedback mentioning the merits and demerits of each.
3. Give the classification of multistage amplifier. Explain the various distortions in amplifiers.
4. Discuss the general characteristics of a negative feedback amplifier.
5. Explain the concept of 'feedback' in amplifiers.
6. Explain the working of any one type of feedback amplifier and list its characteristics.
7. Derive an expression for the input resistance with feedback amplifier employing voltage series feedback.
8. For voltage series feedback derive expressions for output impedance.

MODULE 4

1. How is power amplifiers classified? Discuss them briefly.
2. Bring out the salient features of class A, class b, class c and class AB operation
3. What are classifications of power amplifiers based on the location of Q-point? Indicate the operating cycle in each case.
4. Explain the working of series fed directly coupled class A amplifier, with the help of neat circuit diagram.
5. Prove that the maximum efficiency of a series fed directly coupled class a amplifier is just 25%.
6. Explain with neat circuit diagram, the working of a transformer coupled class A power amplifier.
7. Prove that a transformer coupled class A amplifier has maximum power efficiency of 50%.
8. Draw the circuit diagram of a class B push pull amplifier and explain the operation with relevant waveforms.
9. Show that the maximum conversion efficiency of the class B push pull amplifier is 78.5%.
10. Show that even harmonics are absent in the output of a push pull amplifier.
11. Explain the three point method of calculating the second harmonic distortion.
12. Explain the working of complementary symmetry class B amplifier.
13. Derive the condition for maximum power dissipation of a class B amplifier. State the expression for maximum power dissipation.
14. What is cross over distortion? Explain.
15. What are the conditions for sustained oscillator or what is Barkhausen criterion?
16. What is Oscillator circuit? What are the classifications of Oscillators? What are the conditions for oscillation?
17. Define piezoelectric effect. Draw the equivalent circuit of crystal oscillator.
18. What are sinusoidal oscillators? Explain any two sinusoidal oscillators?
19. Explain the concept involved in crystal oscillator with its characteristics?
20. With the help of a neat circuit diagram, explain transistor Hartley oscillator. Write the expression for the frequency of oscillation.



21. Explain the characteristics of quartz crystal. With a neat diagram explain the oscillator in parallel resonant circuits.
22. Explain the working of RC phase shift oscillator and derive an expression for frequency of oscillation.
23. Draw the wein bridge oscillator using BJT. Show that the gain of the amplifier must be at least 3 for the oscillations to occur.

MODULE 5

1. Explain the differences between FET and BJT.
2. Give the output characteristic of JFET and mark the salient regions on the graph.
3. Write the comparison between depletion type MOSFET and enhancement type MOSFET.
4. With neat sketch, explain basic construction of depletion type MOSFET.
5. Draw and explain transfer and drain characteristics of n-channel depletion type MOSFET.
6. Determine Z_i , Z_o , and A_i for JFET common source amplifier with fixed bias configuration using AC equivalent small signal model.
7. Derive expressions for V_{gs} , I_d , V_{ds} , V_d and V_s for a voltage divider bias circuit using FET.
8. A JFET has a device parameter of $g_m = 10\text{m S}$, $I_{bss} = 12\text{mA}$, when the device is suitably biased, the drain current was found to be 8mA . Determine V_p , g_m , V_{gs}

Prepared by	Checked by		
			
Prof. S. J. Patil	Prof. S. D. Hirekodi	HOD	Principal



Subject Title	ELECTRIC CIRCUIT ANALYSIS		
Subject Code	1BEE303	CIE Marks	50
Number of Lecture Hrs / Week(L:T:P:S)	3:1:0	SEE Marks	50
Total Number of Lecture Hrs	42 hours Theory	Exam Hours	03
Credits-04			

FACULTY DETAILS:			
Name: Dr. B. V. Madiggond	Designation: Professor & HOD	Experience: 33 Years	
No. of times course taught: 03 times		Specialization: Power Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	First Year	I/II	Basic Electrical Engg, Physics, Mathematics

2.0 Course Objectives

1. To familiarize the basic laws, source transformations theorems and the methods of analyzing electrical circuits.
2. To explain the use of network theorems and the concept of resonance.
3. To familiarize the analysis of three-phase circuits, two port networks and networks with non-sinusoidal inputs.
4. To explain the importance of initial conditions, their evaluation and transient analysis of R-L and R-C circuits.
5. To impart basic knowledge on network analysis using Laplace transforms.

3.0 Course Outcomes

Having successfully completed this course, the student will be able to,

	Course Outcome	RBT Level	POs
C203.1	Apply the basic concepts, basic laws and methods of analysis of DC and AC networks and reduce the complexity of network reduction using	L3	1,2,3,5,8,9,12
C203.2	Analyze complex electric circuits using network theorems.	L4	1,2,3,5,8,9,12
C203.3	Discuss resonance in series and parallel circuits and also the importance of initial conditions and their evaluation.	L3	1,2,3,5,8,9,12
C203.4	Develop solutions of electrical network using Laplace transformation.	L4	1,2,3,5,8,9,12
C203.5	Discuss unbalanced three phase systems and also evaluate the performance of two port networks.	L3	1,2,3,5,8,9,12
Total Hours		40	



4.0 Course Content

Module-1

Electric Circuits: Introduction to electric circuit, Classification of circuits, Concept of ideal and practical sources. Independent and dependent current and voltage sources, Source transformation and Source shifting, Star- Delta transformation. Analysis of networks by Mesh Current and Node voltage methods for DC and AC circuits with independent and dependent sources. Concept of Super-Mesh and Super-Node analysis. Duality.

Module-2

Network Theorems: Superposition theorem, Reciprocity Theorem, Thevenin's theorem, Norton's theorem and Maximum power transfer theorem. DC and AC circuit analysis of networks with and without dependent sources.

Module-3

Resonant Circuits: Analysis of simple series R-L-C and parallel R-L-C circuits under resonances. Derivation of Resonant frequency, cut-off frequency, bandwidth and quality factor at resonance. Examples on simple series R-L-C and parallel R-L-C circuits.

Initial and Final Conditions: Definition of initial and final condition, Virtues of initial conditions, Behavior of circuit elements for initial and final condition, Evaluation of initial conditions for series and parallel circuits.

Transient Analysis: Transient analysis of R-L and R-C circuits under DC excitations, Examples on simple R-L and R-C Circuits.

Module-4

Laplace Transformation (LT): Introduction to Laplace transformation, Solution of electrical circuits using LT, Transformed electrical circuit, Laplace transformation of standard signals: Impulse, Step, Ramp, Sinusoidal signals and shifted functions. shifting theorem, Initial and Final value theorems, Waveform Synthesis, Laplace transformation of periodic waveform.

Module-5

Unbalanced Three Phase Systems: Analysis of three phase unbalanced systems, Neutral shifting method, Calculation of real and reactive Powers. Two Port networks: Definition, necessity of two port networks, Open circuit impedance, short circuit admittance and Transmission parameters, Relation among all the three parameters, Evaluation of two port networks for simple circuits.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	IV	Transmission and Distribution	Transmission line parameters
02	VII	Power system analysis II	Orientation of elements with loops

6.0 Relevance to Real World

Sl. No	Real World Mapping
01	From the electrical wiring in your home that powers the lights and TV, to the ignition system starts car



7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Practical	Simulation of electric networks using software tool

8.0 Books Used and Recommended to Students

Text Books

1. Engineering Circuit Analysis, William H Hayt et al, Mc Graw Hill, 8th Edition, 2014
2. Fundamentals of Electric Circuits, Charles K Alexander Matthew N O Sadiku, Mc Graw Hill, 5th Edition, 2013

Reference Books

1. Engineering Circuit Analysis, J David Irwin et al, Wiley India, 10th Edition, 2014
2. Electric Circuits Mahmood Nahvi Mc Graw Hill 5th Edition, 2009
3. Introduction to Electric Circuits, Richard C Dorf and James A Svoboda, Wiley, 9th Edition, 2015
4. Circuit Analysis; Theory and Practice, Allan H Robbins Wilhelm C Miller, Cengage, 5th Edition, 2013

Additional Study material & e-Books

1. Network theory by Ganesh Rao
2. Network analysis by P M Chandrashekaraiiah
3. <https://www.khanacademy.org/science/electrical-engineering/ee-circuit-analysis-topic>

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References

- 1) <http://nptel.ac.in/courses/108102042/>
- 2) <http://nptel.ac.in/courses/108102042/#>
- 3) [http://videos.vtu.ac.in/video_groups.php?group=EDUSAT 2016](http://videos.vtu.ac.in/video_groups.php?group=EDUSAT%202016)
- 4) <https://www.docsity.com/en/subjects/electrical-circuit-analysis/>
- 5) <https://sites.google.com/site/eeenotes2u/courses/network-analysis>

10.0 Magazines/Journals Used and Recommended to Students

Sl. No	Magazines/Journals	website
1	IEEE transactions on circuit theory	http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=8147
2	IRE Transactions on Circuit Theory	http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=8148

11.0 Examination Note

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together.

CIE for the theory component of IPCC

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are 25 marks and that for the practical component is 25 marks.
- Three IA tests conducted each of 25 Marks, average of best two IA tests considered and scaled down to 15 marks it will be final IA marks.



- 1st, 2nd, and 3rd tests shall be conducted after completion of the syllabus of 30-35%, 70-75%, and 90-100% of the course/s respectively.
- Assignments/Seminar/quiz/group discussion /field survey & report presentation/ course project/Skill development activities, suitably planned to attain the COs and POs for a total of 50 Marks.
- One quiz of 25 marks scaled down to 5 marks and one assignment of 25 marks scaled down to 5marks
- Sum of Scaled-down marks of IA tests, one assignments& one quiz will be CIE marks for the theorycomponent of IPCC for 25 marks.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of IPCC

- 15 marks for the conduction of the experiment and preparation of laboratory record, and 10 marks for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments write-ups are added and scaled up to 15 marks.
- The laboratory test (duration 02/03 hours) after completion of all the experiments shall be conducted for 50 marks and scaled down to 10 marks.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 25 marks.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

- Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)
- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only.
- Questions mentioned in the SEE paper shall include questions from the practical component.
- The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecture	% of Portion
I	1.	Basic Concepts: Overview and Introduction, Network terminology and classification of electric circuits	20
	2.	Active and passive elements, Concept of ideal and practical sources	
	3.	Derivation of Star – delta, delta– Star transformation.	
	4.	Problems on Star – delta, delta– Star transformation	
	5.	Problem on mesh analysis for dc circuits with independent & dependent sources and concept of super-mesh	
	6.	Problem on nodal analysis for dc circuits with independent &	



		dependent sources and concept of super-mesh	
	7.	Problem on mesh analysis & nodal analysis dc circuits with independent source	
	8.	Problem on Duality	
II	9.	Network Theorems: Super Position Theorem	20
	10.	Problem on Super Position Theorem	
	11.	Thevenin's Theorem	
	12.	Problem on Thevenin's Theorem	
	13.	Norton's Theorem.	
	14.	Problem on Norton's Theorem	
	15.	Maximum power transfer theorem	
	16.	Problem on maximum power transfer theorem	
III	17.	Resonant Circuits: Introduction, Quality factor Analysis of simple series RLC circuits under resonances.	20
	18.	Resonant frequency, Bandwidth, selectivity and Quality factor	
	19.	Problems on Resonant frequency, Bandwidth, selectivity and Quality factor at resonance, Analysis of simple parallel RLC circuits	
	20.	Problems on analysis of simple parallel RLC circuits	
	21.	Transient Analysis: Introduction, general and particular solution, initial condition in basic passive element: Behavior of circuit elements	
	22.	Transient analysis of RL and RC circuits under dc excitations.	
	23.	Problems on transient analysis of RL and RC circuits dc excitations.	
	24.	Problems on transient analysis of RL and RC circuits dc excitations.	
IV	25.	Laplace Transformation: Introduction & Concept of LT	20
	26.	Properties overview	
	27.	Discussion on Initial and final value theorems	
	28.	Problems on LT of normal and standard functions.	
	29.	LT of standard functions.	
	30.	Transform of basic R, L, C elements	
	31.	Solution of electrical circuit using LT with zero initial condition	
	32.	Solution of electrical circuit using LT with initial condition	
V	33.	Unbalanced Three phase systems: Analysis of three phase systems.	20
	34.	Problems on three phase systems.	
	35.	Problems on three phase systems	
	36.	Two Port networks: Introduction and definition	
	37.	Problems Open circuit impedance,	
	38.	Problems on Short circuit admittance	
	39.	Problems on transmission parameters.	
	40.	Evaluation for simple circuits.	

13

Assignments, Pop Quiz, Mini Project, Seminars

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1	Students study the topics on basic concepts of network theory, Network theorem, Resonant circuits and transient analysis.	Module 1, 2 and 3 of the syllabus	4	Individual Activity.	Books 1 of Text Book list.



2	Quiz	Students study the topics and prepare the multiple choice questioner with answer.	All Modules of the syllabus	9	Group Activity.	Books 1 of Text Book list.
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14.0 QUESTION BANK

Module 1

1. Define the following i) Active & Passive elements ii) Independent & Dependent source iii) Power & Energy iv) Bilateral & Unilateral elements. v) Linear & Non-linear elements. vi) Ideal & Practical voltage sources. vii) Ideal & Practical current sources.
2. Explain the procedure for solving the given network using i) mesh analysis, ii) node analysis.
3. Obtain the expression for i) Star to delta & ii) delta to star transformation.
4. What do you mean by super node & super mesh? Explain with example.
5. Write the loop equations of the circuit and find V_x in fig.1.1
6. Determine the voltages at node 1 & 2 using nodal analysis in fig 1.2
7. Determine the current supplied by the battery in in fig.1.3.
8. Find the value of R & current through it, in fig.1.4. , when branch AD carries no current.
9. Calculate the power dissipated in 3Ω resistor in fig.1.5. using mesh current analysis.
10. Using source transformation technique, reduce the network given between the terminals AB to a single voltage source network for fig.1.6.
11. For the network shown in fig.1.7, obtain the single delta connected equivalent circuit.
12. For the network shown in fig.1.8 , find the equivalent resistance between AB.
13. Find the current through 10Ω & 5Ω resistor in the circuit shown in fig.1.9.
14. Find the current in 10 ohm resistor in fig.1
15. Reduce the network shown in fig 3 to a single voltage source in series with resistance by source transformation and source shifting.
16. Use mesh analysis to find the current through 4 ohm resistor for the circuit shown in fig 5
17. Find the voltages V_1 , V_2 , V_3 , V_4 and current in 1 ohm resistor in fig7

Module 2

1. State and prove superposition theorem.
2. By the superposition theorem calculate the current through $(2+j3)\Omega$ impedance branch of the circuit shown in fig.3.1
3. Determine the current in 1Ω resistor across AB of the network shown in fig 3.2 using superposition theorem.
4. Find the current through 5-ohm resistor shown in fig 3.3 and hence verify reciprocity theorem.
5. Obtain the Thevenin's and Norton's equivalent circuits at terminals XY of the network shown in fig.4.1
6. Find the Thevenin's equivalent circuit at terminals a-b of the network shown in fig.4.2 and hence obtain the current through $R=10\Omega$ resistor.
7. Obtain the Norton's equivalent circuit of the network shown in fig.4.3 at terminals A&B.
8. State and explain Thevenin's theorem using suitable example.
9. State and explain Norton's theorem using suitable example.
10. Find the current in $3+j4$ ohm resistance in using superposition theorem in fig2
11. Find V_x and verify reciprocity theorem in fig 4
12. Using Thevenin theorem find the current through $R=2$ ohm in fig 9
13. Find Thevenin equivalent of fig10
14. Using Norton theorem find current in 4ohm resistor in fig 11
15. Find Norton Equivalent of fig12



Module 3

1. What is resonance? What are its types?
2. Explain series resonance? Obtain the condition for resonance
3. Define quality factor and band width & obtain the relationship between them in a series resonance circuit.
4. In case if a series resonant circuit with frequency variation, obtain expression for i) ω_c at which maximum voltage occurs across C ii) ω_L at which maximum voltage occurs across L & show that $\omega_L > \omega_c$
5. Derive the expression for the resonant frequency for a parallel resonance when R_L connected parallel to R_c . Also show that the circuit will resonate at all frequencies if $R_L = R_c = \sqrt{L/C}$
6. Derive the following terms i) Resonance, ii) Bandwidth iii) Selectivity iv) Quality factor, v) Half power frequencies.
7. An RLC series circuit has an inductive coil of $R\Omega$ and inductance L Henrys in series with a capacitance of C Farads. The circuit draws a maximum current of 15A, when connected to 230V, 50Hz supply. If the Q factor is 5, find the parameters of the circuit.
8. A series resonance circuit with $R = 10\Omega$, $L = 0.1H$ & $C = 50\mu F$ has an applied voltage $V = 50\angle 0^\circ$ volts with a variable frequency, find the resonant frequency, the value of frequency at which maximum voltage occurs across inductor and the value of frequency at which maximum voltage occurs across capacitor.
9. For the circuit shown in fig5.1 determine resonance frequency and the input impedance.
10. Write the comparison between series and parallel resonant circuits
11. Determine RL and RC for the circuit shown in fig1 resonates at all frequencies.
12. Find the resistance of the circuit if circuit draws a current of 10mA at resonance with supply voltage of 50V Find also quality factor of circuit.
13. Define terms i) Resonance ii) Q factor iii) Half power frequencies iv) Bandwidth
14. Obtain an expression for the resonant frequency for the circuit shown in fig2
15. Establish the relationship between quality factor and bandwidth in series resonant circuit and thereby prove that $Q = f_0/BW$
16. In a series RLC network under resonance, voltage across capacitor is 400V and impedance is 100ohm. Bandwidth is 75Hz with applied voltage of 70.7V. Find the R,L,C
17. A 220V, 100Hz AC source supplies a series RLC circuit with a capacitor and a coil. If the coil has 50 mili ohm resistance 5 mH inductance, find at a resonance frequency of 100Hz what is the value of capacitor. Also calculate the Q factor and half power frequencies of the circuit.
18. Why do we need to study initial conditions? Write the equivalent form of the elements in terms of the initial condition of the element.
19. Explain the procedure for evaluating initial conditions with suitable examples.
20. Explain the behavior of resistor, inductor and capacitor elements under transient conditions.
21. Show that the voltage across capacitor and inductor cannot change instantaneously.
22. In the network shown in fig 6.1 the switch K is changed from position a to b at $t=0$. A steady state having been established at position a, obtain the loop currents at $t=0^+$
23. In the network shown in fig 6.2 the capacitor C1 is charged to voltage $V_0 = 1000v$ and the switch K is opened at $t=0$. solve for d^2i_z/dt^2 at $t=0^+$
24. The network shown in fig 6.3 has the switch K opened at $t=0$. Solve for v , dv/dt , d^2v/dt^2 at $t=0^+$
25. Determine V , dV/dt and d^2V/dt^2 at $t=0^+$ when the switch K is opened at $t=0$ in fig 3, $R=100ohm$, $L=1H$ and $I=2A$
26. In the circuit a fig4 the switch is opened at $t=0$ find the values of V , dV/dt and d^2V/dt^2 at $t=0^+$
27. Determine i , di/dt , d^2i/dt^2 at $t=0^+$ when the switch K is moved from position 1 to 2 at $t=0$ in network shown in fig5
28. In the network shown in fig6, K is changed from position a to b at $t=0$, solve for i , di/dt , d^2i/dt^2 at $t=0^+$, Assume that capacitor is initially uncharged.



Module 4

1. State and prove initial value and final value theorem.
2. What are the limitations of initial and final value theorem.
3. State and prove convolution theorem
4. Define and obtain the Laplace transform of i) UNIT impulse function ii) UNIT ramp function iii) UNIT step function
5. Obtain the Laplace transform of full wave rectified sine wave of amplitude 1 and period π sec.
6. Determine the current expression $V_o(t)$ in the circuit shown in fig.7.1, when the switch S is closed at $t=0$. The inductor is initially de-energized.
7. Find the response of current of a series R-L circuit consisting of $R=4\Omega$, $L=2H$, when each of the following driving force voltages are applied
8. i) UNIT ramp voltage $r(t-5)$ ii) UNIT impulse voltage $\delta(t-5)$
9. iii) UNIT step voltage $U(t-5)$ Assume zero initial conditions.
10. For the circuit shown in fig.7.2 Find $V_o(t)$ using convolution theorem.
11. A pulse voltage of magnitude 5 and duration 1 sec is applied to a series RC circuit having $R=5\Omega$, $C=0.2f$. Calculate the current $i(t)$ in the circuit using Laplace transform.

Module 5

1. Explain i) Z-parameters ii) Y-Parameters iii) Transmission parameters, iv) Hybrid parameters v) Inverse transmission parameter vi) inverse hybrid parameters.
2. Obtain relation between
i) Y & Z parameters ii) Y & h parameters iii) Y & ABCD parameters iv) Z & h Parameters v) Z & T parameters vi) H & T parameters
3. Two 2port networks are connected in cascade obtain T-parameters of the inter connected network in terms of T parameters of the individual networks.
4. A two-port network in terms of Z-parameters is said to be symmetric if $Z_{11}=Z_{22}$ and reciprocal if $Z_{12}=Z_{21}$. Obtain the corresponding conditions in terms of i) h Parameters ii) T-parameters using the relationship between different two-port parameters.
5. Obtain ABCD parameters in terms of z-parameters and show that $AD-BC = 1$
6. Find the relationship between the z-parameters and h-parameters of a two-port network.
7. Define Z and Y parameters of a 2-port network.
8. Define Z- parameters. Express Z-parameters in terms of Y parameters.
9. Find Z and Y parameters for the two-port network shown in fig.8.1
10. Following are the hybrid parameters of the network given. Define the Y parameters for the network.
$$\begin{matrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{matrix} = \begin{matrix} 5 & 2 \\ 3 & 6 \end{matrix}$$
11. Write explanation on star connected three phase network and delta connected three phase networks.



Sample networks for the question bank given (fig 1.1 to 3.2)

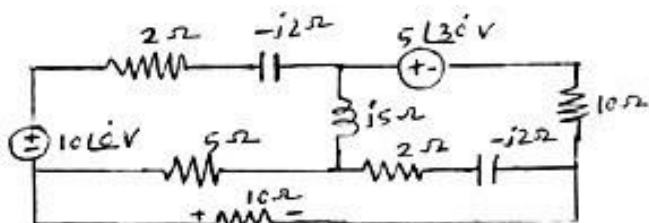


Fig 1.1

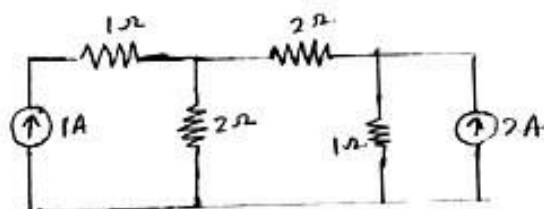


Fig 1.2

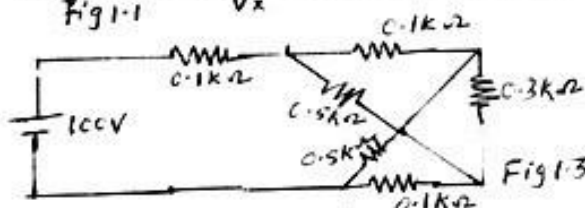


Fig 1.3

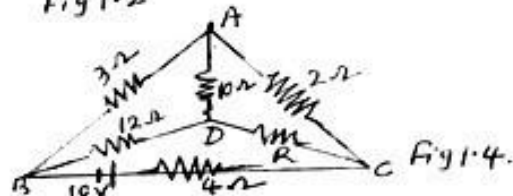


Fig 1.4

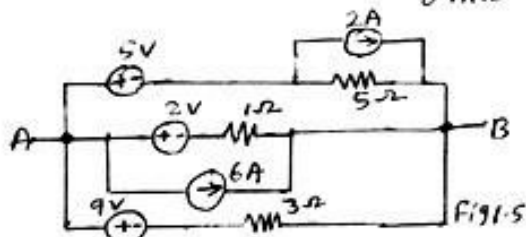


Fig 1.5

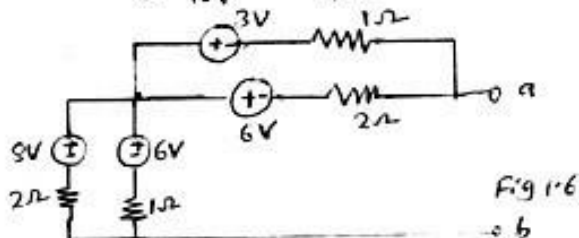


Fig 1.6

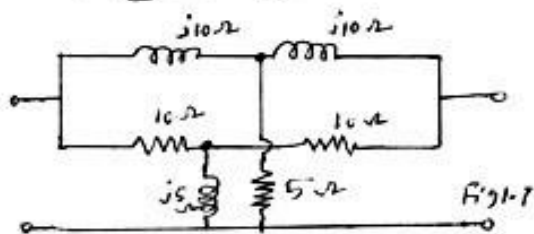


Fig 1.7

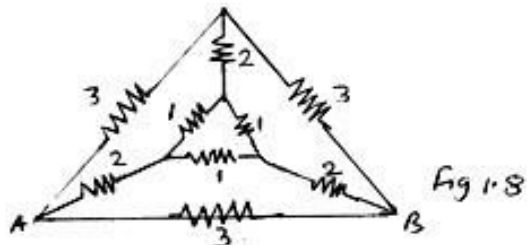


Fig 1.8

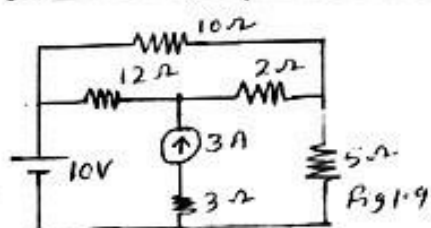


Fig 1.9

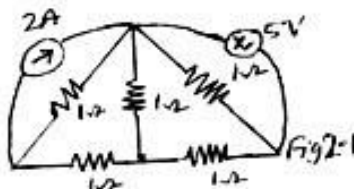


Fig 2.1

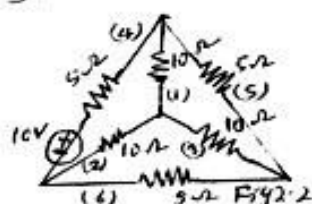


Fig 2.2

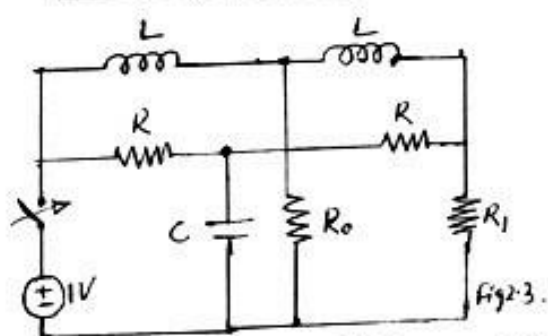


Fig 2.3

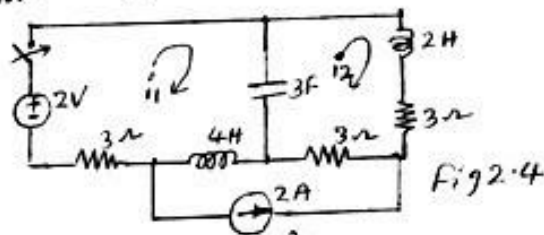


Fig 2.4

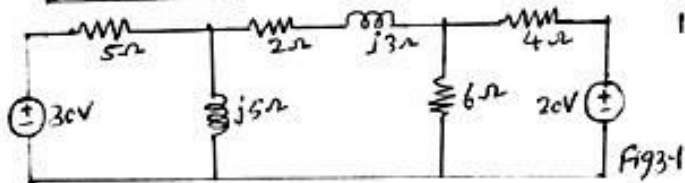


Fig 3.1

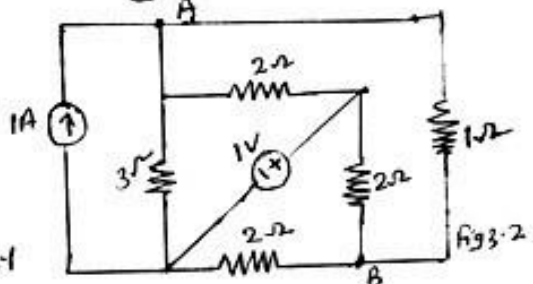


Fig 3.2



Sample circuits for the question bank given (fig 3.3 to 8.1)

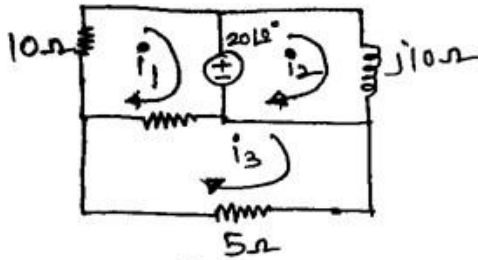


fig 3.3

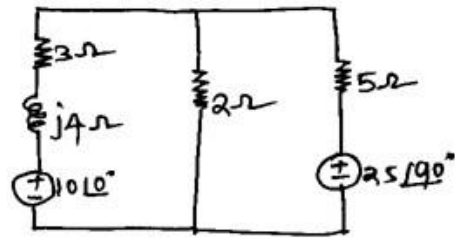


fig 3.4

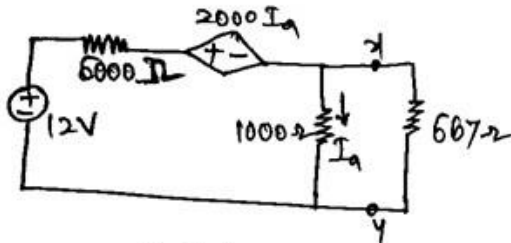


fig 4.1

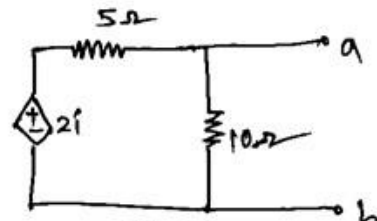


fig 4.2

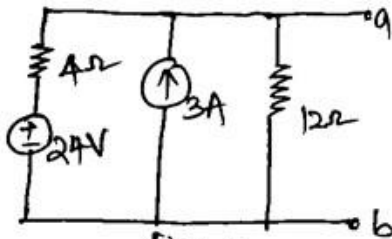


fig 4.3

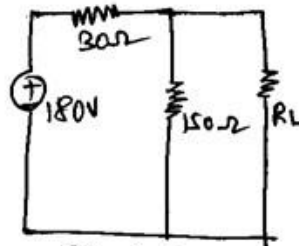


fig 4.4

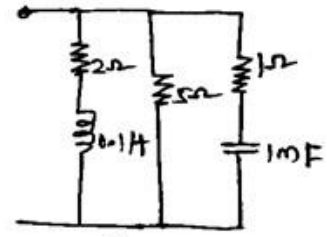


fig 5.1

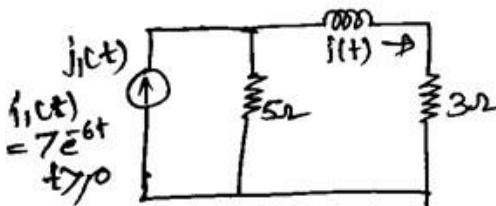


fig 6.2

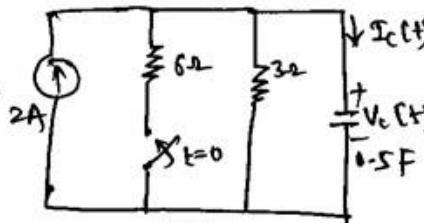


fig 6.1

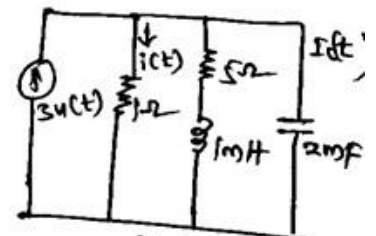


fig 6.3

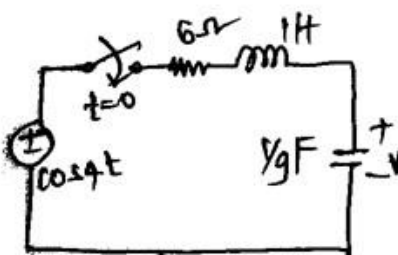


fig 7.1

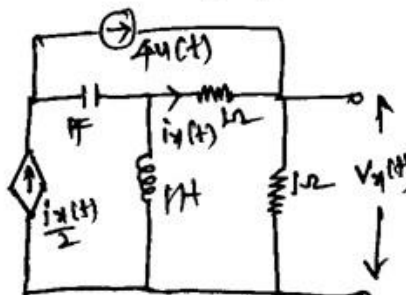


fig 7.2

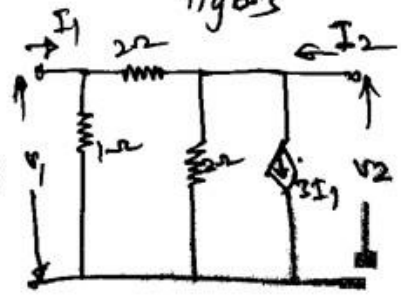


Fig 8.1



Circuits on network reduction techniques and KVL, KCL (fig 1-fig 8)

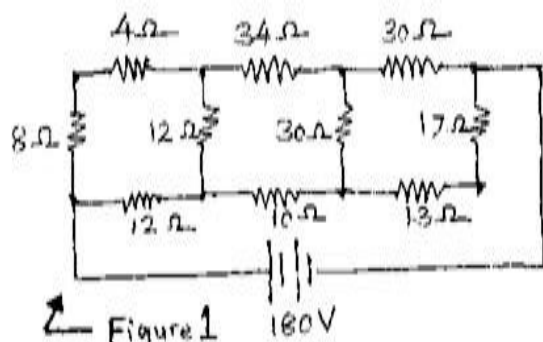


Figure 1

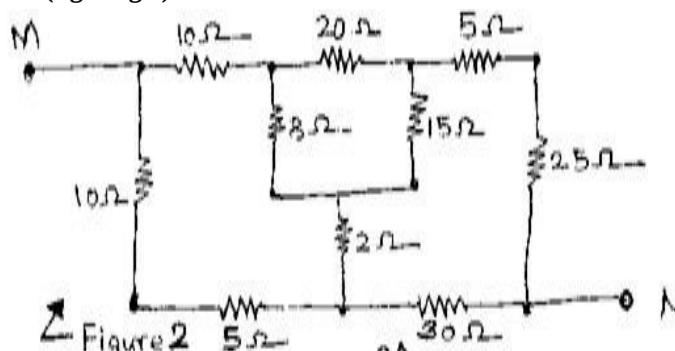


Figure 2

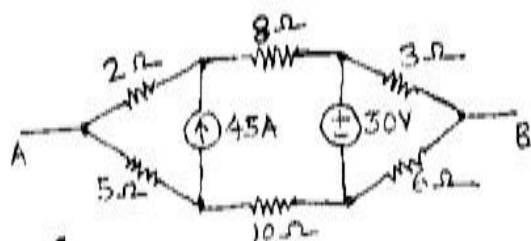


Figure 3

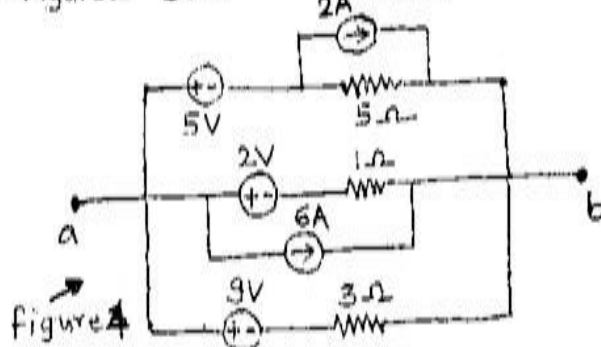


Figure 4

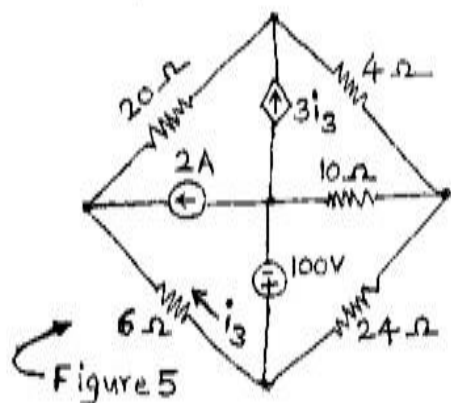


Figure 5

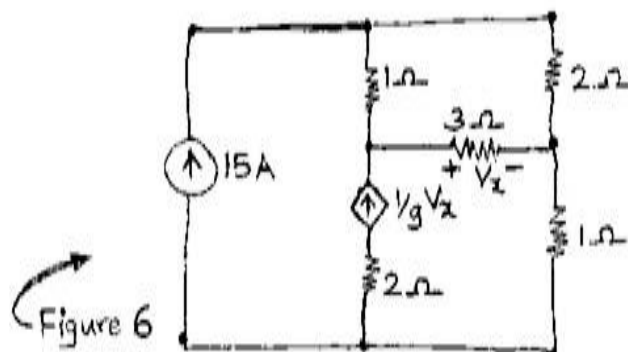


Figure 6

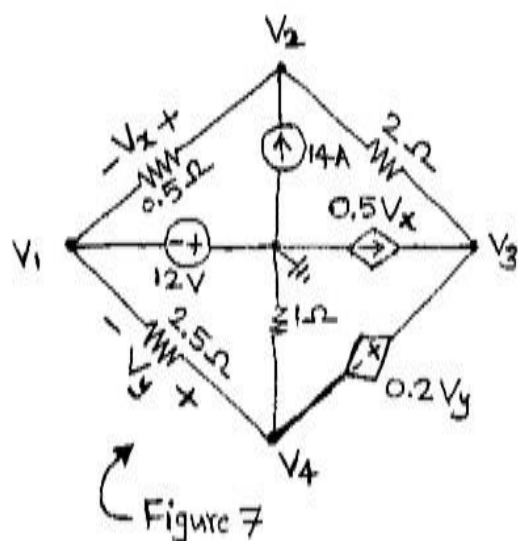


Figure 7

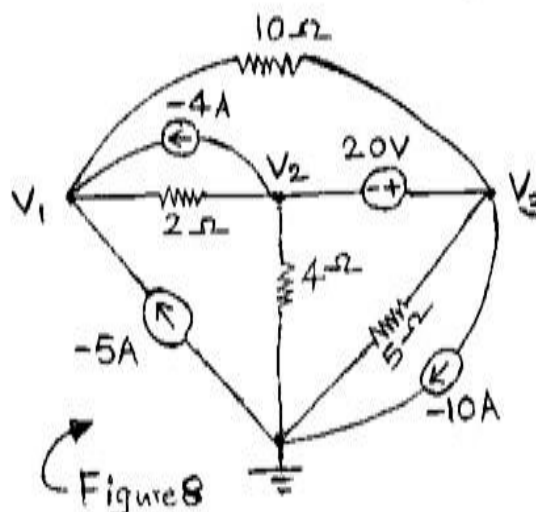


Figure 8



Sample Circuits on network theorems.(fig 1-fig12)

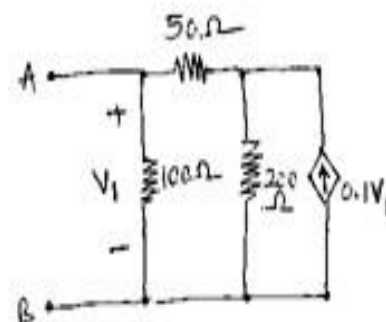
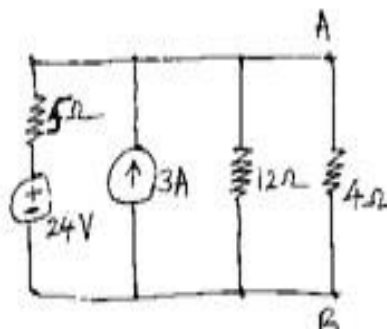
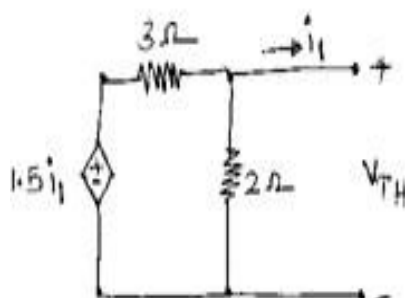
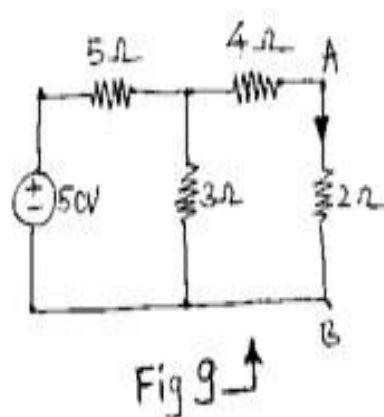
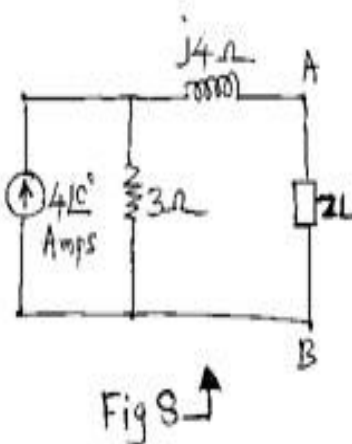
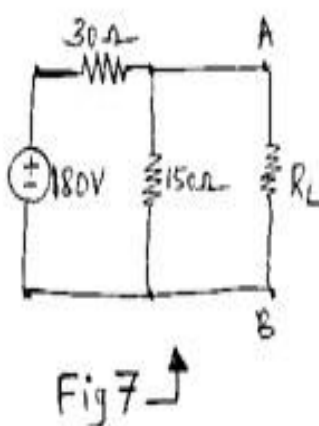
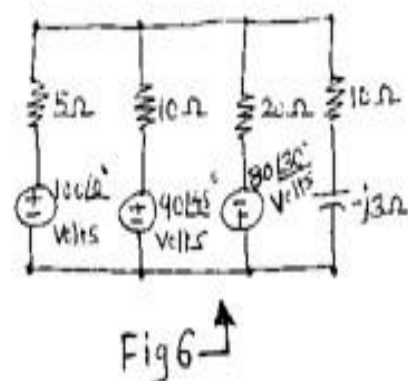
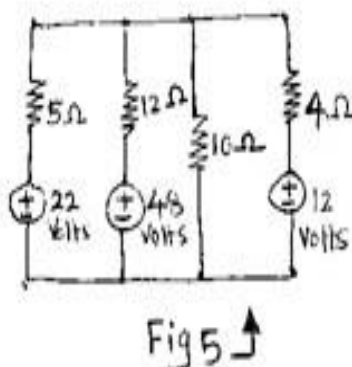
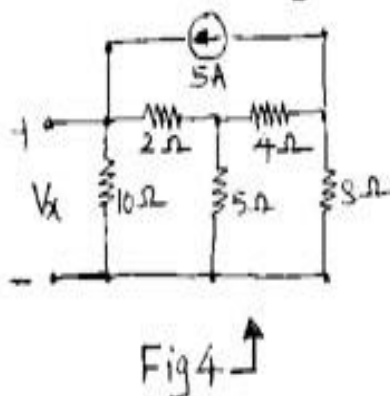
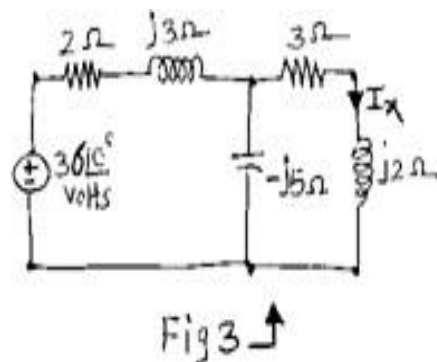
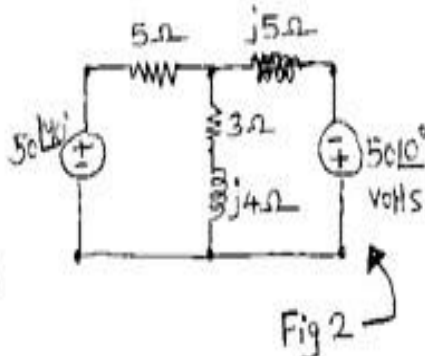
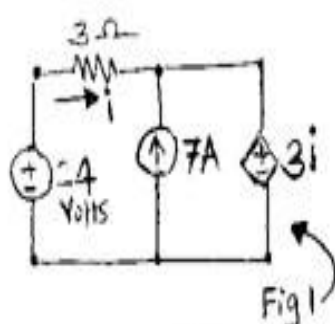
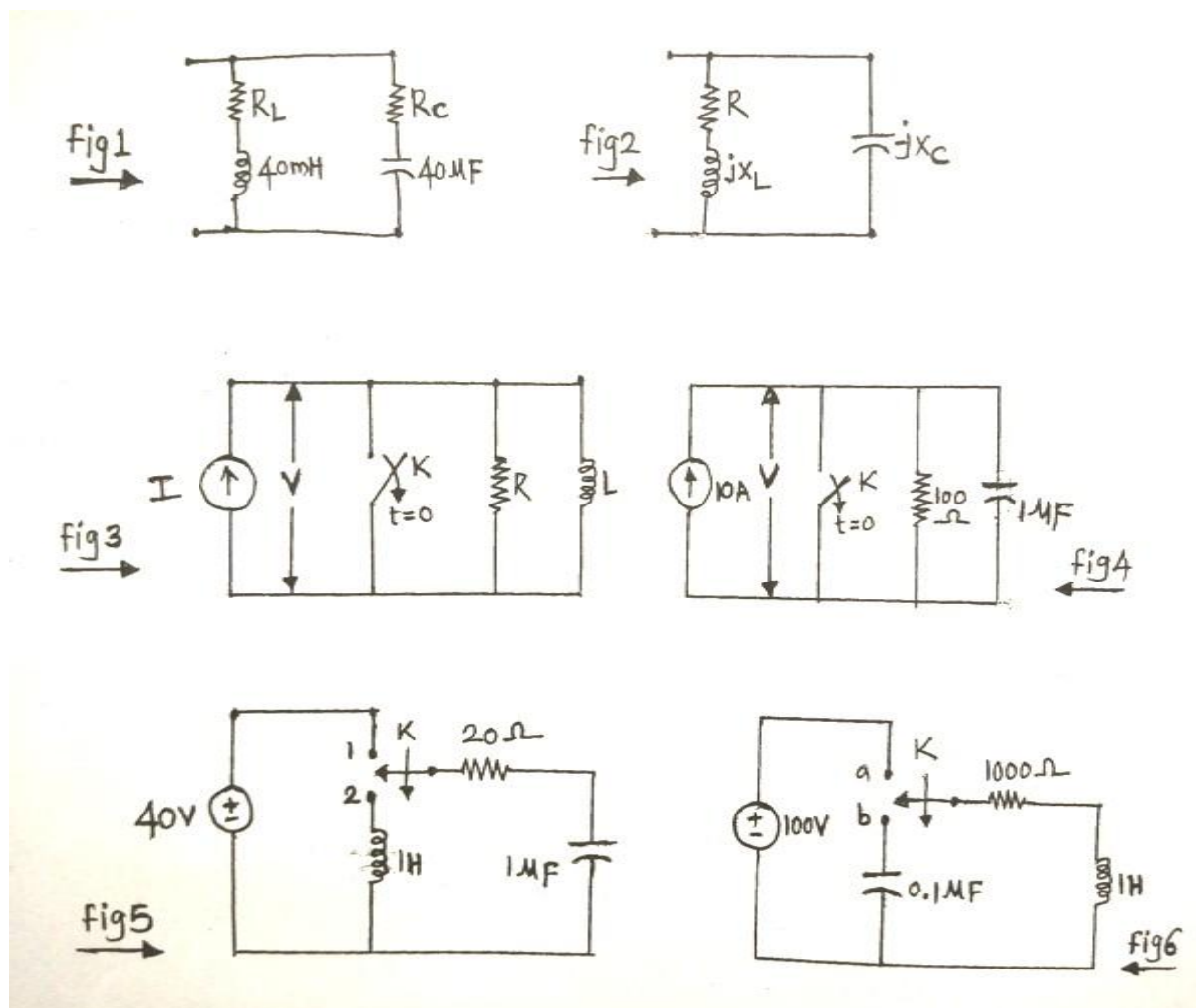


Fig 10 Fig11 Fig 12



Sample networks on resonance, transient analysis



Prepared by	Checked by		
			
Dr. B. V. Madiggond	Prof. A. U. Neshti	HOD	Principal



Subject Title	DIGITAL ELECTRONIC CIRCUITS		
Subject Code	1BEE304	CIE Marks	50
Number of Lecture Hrs / Week(L:T:P)	3:0:0	SEE Marks	50
Total Number of Lecture Hrs(L/T/P/SL&TW)	42:0:0:48	Exam Hours	03
CREDITS – 03			

FACULTY DETAILS:

Name: Prof. P. I. Savadatti	Designation: Asst Professor	Experience: 10
No. of times course taught: 03	Specialization: Digital Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical & Electronics Engineering	I/II	Basic Electronics

2.0 Course Objectives

Upon completion of this course, a student should be able to:

- Illustrate simplification of Algebraic equations using Karnaugh Maps and Quine- McClusky Techniques.
- Design combinational logic circuits..
- Design Decoders, Encoders, Digital Multiplexer, Adders, Subtractors and Binary Comparators.
- Describe Latches and Flip-flops, Registers and Counters.
- Analyze Mealy and Moore Models.
- Develop state diagrams, Synchronous Sequential Circuits and to understand the basics of various Memories.

3.0 Course Outcomes

At the end of the course the student will be able to:

	Course Outcome	RBT Level	POs
C204.1	Explain the concept of combinational and sequential logic circuits.	L1,L2,L3	PO1,PO2,PO3, PO8,PO10,PO12
C204.2	Analyse and design combinational circuits.	L1,L2,L3	PO1,PO2,PO3, PO8,PO10,PO12
C204.3	Describe and characterize flip flops and its applications.	L1,L2,L3	PO1,PO2,PO3, PO8,PO10,PO12
C204.4	Design the sequential circuits using SR, JK, D and T flip-flops and Melay and Moore applications.	L1,L2,L3	PO1,PO2,PO3, PO8,PO10,PO12
C204.5	Design applications of combinational and Sequential circuits also employ the digital circuits for different applications.	L1,L2,L3	PO1,PO2,PO3, PO8,PO10,PO12
Total Hours of instruction		42	



4.0 Course Content

MODULE-1:

Principles of Combinational Logic: Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3,4,5 variables, Incompletely specified functions (Don't care terms) Simplifying Max term equations, Quine-McCluskey minimization technique, Quine - McCluskey using don't care terms, Reduced prime implicants Tables. Design with basic gates NAND gates and NOR gates.

MODULE-2:

Analysis and Design of Combinational logic: General approach to combinational logic design, Decoders, BCD decoders, Encoders, digital multiplexers, Using multiplexers as Boolean function generators, Adders and subtractors, Cascading full adders, Look ahead carry, Binary comparators.

MODULE-3:

Flip-Flops: Basic Bistable elements, Latches, Timing considerations, The master-slave flip-flops (pulse triggered flip-flops): SR flip-flops, JK flip-flops, Edge triggered flip-flops, Characteristic equations. **Flip-Flops Applications:** Registers, binary ripple counters, synchronous binary counters, Counters based on shift registers, Design of a synchronous counter, Design of a synchronous mod-n counter using clocked T, JK, D and SR flip-flops.

MODULE-4:

Sequential systems: Analysis of clocked sequential circuits, state reduction and assignment, design procedure, design with state equation, sequence detector.

Sequential Circuit Design: Mealy and Moore models, State machine notation, Synchronous Sequential circuit analysis, Construction of state diagrams, counter design

MODULE-5:

.Memories: Read only and Read/Write Memories, Programmable ROM, EPROM, Flash memory. Characteristics of digital ICs, Transistor-Transistor logic (NOT, NAND, NOR) complementary MOS logic (NOT, NAND, NOR) comparison of TTL and CMOS families.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	V	Microcontroller	--
02	VII	Project	--

6.0 Relevance to Real World

SL. No	Real World Mapping
01	VLSI & Embedded Systems
02	Computer field

7.0 Gap Analysis and Mitigation



Sl. No	Delivery Type	Details
02	NPTEL videos	Practical exposure regarding designing of digital circuit.

8.0 Books Used and Recommended to Students

Text/Reference Books				
1	Digital Logic Applications and Design	John M Yarbrough	Cengage Learning	2011
2	Digital Principles and Design	Donald D Givone	McGraw Hill Education	2002
3	Digital design	M. Morris Mano	Prentice Hall of India	3 rd Edition
4	Fundamentals of logic design	Charles H Roth, JR	Cengage Learning	5 th Edition,

9.0 Relevant Websites (Reputed Universities and Others) for Notes /Animation / Videos Recommended

Website and Internet Contents References	
1.	NPTEL Videos
2.	www.wikipedia.com

10.0 Magazines/Journals Used and Recommended to Students

Sl. No	Magazines/Journals	website
1	Electronics for you	https://electronicsforu.com/
2	New electronics	http://www.newelectronics.co.uk/digital-magazine/

11.0 Examination Note

Continuous Internal Evaluation (CIE)

1. The CIE marks shall be decided based on internal tests and other outcome-based activities. The continuous internal evaluation shall be carried out by the teacher handling the course.
2. Out of 50 marks earmarked for CIE, 25 marks shall be assigned for internal tests. The first test shall be conducted after completing two modules of the syllabus and the second one after completing the remaining three modules.
3. The remaining 25 marks shall be assigned for Continuous Course Assessment (CCA), conducted as per the rubrics listed in the assessment section of the respective syllabus.
4. A student shall obtain a minimum of 40% marks or 20 out of 50 marks allotted to CIE to become eligible to appear for the SEE.

Passing requirement in SEE

1. For a pass in the Semester End Examination (SEE), a student shall secure a minimum of 35 marks out of 100.



2. For the declaration of a pass grade, the sum of the Continuous Internal Evaluation (CIE) marks (out of 50) marks and the SEE marks scaled down to 50 shall be greater than or equal to 40 marks.
3. If the total (CIE + SEE) is less than 40 marks, the student shall be awarded the grade 'F' (Fail).

Continuous Comprehensive Assessments (CCA)+ Internal Assessment Test (IA) = Continuous Internal

Evaluation CIE [25+25=50 marks]

A minimum of two Internal Assessment Tests(IA) shall be conducted, carrying a total of 25 marks. In addition, Continuous Comprehensive Assessment (CCA) shall be conducted for a total of 25 marks.

It is recommended to include a maximum of two learning activities as part of the CCA to foster the holistic development of students.

These activities shall be:

Sl. No.	Name of the Learning activity	Maximum Marks
1.	To develop mini projects using digital electronics concepts	15
2.	To simulate the digital electronics circuits using any open source software	10

12.0 Course Delivery Plan

MODULE	Lect. No.	Content of Lecture	% of Portion
MODULE-1 Principles of Combinational Logic:	1	Introduction & definition of combinational & canonical forms	20
	2	Generation of switching equations from truth tables, Examples	
	3	Karnaughmaps-3, 4 and 5 variables.	
	4	Incompletely specified functions (Don't care terms). examples	
	5	Simplifying Max term equations	
	6	Quine-McCluskey minimization technique	
	7	Quine-McCluskey using don't care terms	
	8	Reduced Prime Implicants table	
MODULE-2 Analysis and Design of Combinational logic	9	General approach to combinational logic design	20
	10	Decoders , BCD decoders	
	11	Encoders	
	12	Digital multiplexers	
	13	using multiplexers as Boolean function generators	
	14	Adders and Subtractors	
	15	Cascading full adders/ lookahead carry	
	16	Binary comparators	
MODULE-3 Flip-Flops and Flip-flop applications	17	Basic Bistable element, Latches, Timing considerations	20
	18	The master-slave Flip-Flop, SR Flip flops	
	19	JK Flip flops, Edge triggered flip flops Characteristic equations	
	20	Registers, Binary Ripple Counter	
	21	Synchronous Binary counters, Counters based on Shift Registers	
	22	Design of a synchronous counter	
	23	Design of a synchronous mod-n counter using clocked T flip-flops.	
	24	JK and D flip flop	
	25	SR flip flops	



MODULE-4 Sequential systems and sequential circuit design	26	Analysis of clocked sequential circuits	20
	27	State reduction and assignment	
	28	Design procedure	
	29	Design with state equations	
	30	Sequence detector	
	31	Mealy & Moore model	
	32	State Machine Notation	
	33	Synchronous Sequential Circuit Analysis	
	34	Construction of state Diagrams, Counter design	
MODULE-5 Memories and Logic families	35	Read only and Read/Write Memories	20
	36	Programmable ROM	
	37	EPROM	
	38	Flash memory	
	39	Characteristics of digital ICs	
	40	TTL logic(OT,NAND,NOR)	
	41	CMOS logic(NOT,NAND,NOR)	
	42	comparison of TTL and CMOS families	

13.0 Assignments, Quiz

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/webs ite /Paper
1	Assignment	Student will be able to develop simplified switching equation	All 5 modules	9	Individual	Book no 1,2
2	GATE based aptitude Test	Students will study the topics of all five modules	All 5 Modules	12	Individual	Book no 1,2

14.0 QUESTION BANK

MODULE-1

- What is combinational Logic circuit? Explain.
- Write the following minterm canonical formulas in algebraic form and construct truth tables $f(w,x,y,z)=\sum m(1,3,7,8,9,14,15)$
- Explain canonical form of Boolean equations with an example.
- Explain Karnaugh map representation in detail & discuss the merits & demerits.
- Explain the definition of combinational logic circuit.
- Transform each of the following canonical expression in to its other canonical form in decimal notation
a. $f(x,y,z)=\prod M(0,3,4)$ b. $f(x,y,z)=\sum m(1,3,5)$ c. $(a,b,c,d)=\sum m(1,2,4,6,9,15)$
b. $f(w,x,y,z)=\sum m(0,1,2,3,7,9,11,12,15)$
- Express each of the following functions by a Maxterm Canonical formulae
a. $f(x,y,z)=(y+z')(xy'+z)$
b. $f(x,y,z)=x+x'z'(y+z)$
- Using K-maps, determine all the prime implicants of each of the following functions. In each case, indicate the essential prime implicants



- a. $f(w,x,y,z) = \sum m(0,1,2,5,6,7,8,9,10,13,14,15)$
- b. $f(w,x,y,z) = \prod M(0,2,3,8,9,10,12,14)$
- c. $f(w,x,y,z) = w'y'z + w'yz + x'y'z' + wx'y + w'x'yz'$
9. Using k-maps, determine all the minimal sums and minimal products for each of the following Boolean functions
 - a. $f(a,b,c,d) = \prod M(0,4,5,7,8,9,11,12,13,15)$
 - b. $f(x,y,z) = \sum m(0,1,2,3,4,6,7)$
 - c. $f(x,y,z) = \prod M(1,4,5,6)$
 - d. $f(w,x,y,z) = \sum m(0,1,6,7,8,14,15)$
 - e. $f(w,x,y,z) = \prod M(1,3,4,5,10,11,12,14)$
10. Give two simplified irredundant expressions for
 - a. $F(w,x,y,z) = \sum (0,4,5,7,8,9,13,15)$
 - b. Design a combinational logic ckt whose i/p is a 4-bit binary number and whose o/p is the 2's complement of the i/p number. Implement by using suitable logic
11. Using the Quine-McCluskey method, obtain all the prime implicants for each of the following Boolean functions
 - a. $f(w,x,y,z) = \sum (0,2,3,4,8,10,12,13,14)$
 - b. $f(w,x,y,z) = \sum (7,9,12,13,14,15) + dc(4,11)$
 - c. $f(w,x,y,z) = \prod M(1,3,6,10,11,12,14,15,17,19,20,22,24,29)$
12. Simplify $f(a,b,c,d) = \sum (2,3,4,5,13,15) + dc(8,9,10,11)$ taking least significant as map-entered variable.

MODULE- 2

1. What is decoder? What are its advantages? Design a decimal decoder, which converts information from BCD to decimal
2. Construct 4 to 16 line decoder using 2-4 decoders
3. Using AND/NAND gates along with a 3-8-line decoder realize the pairs of expressions with minimum i/ps
 - a. $f_1(a,b,c) = \prod M(0,3,5,6,7)$
 - b. $f_2(a,b,c) = \prod M(2,3,4,5,7)$
4. Construct 16:1 MUX using 4 to 1 line MUX
 - a. Realize each of the following Boolean expressions using an 8 to 1 line Multiplexer where w,x,y appear on select lines S₂, S₁, S₀ respectively
 - b. $f(w,x,y,z) = \sum m(1,2,6,7,9,11,12,14,15)$
 - c. $f(w,x,y,z) = \sum m(2,5,6,7,9,12,13,15)$
Realize the Boolean expression. $f(w,x,y,z) = \sum m(4,5,7,8,10,12,15)$ Using a 4 to 1 line MUX and external Gates with I) Let w and x appear on the select lines S₁ and S₀ respectively II) y and z appear on the select lines S₁ and S₀ respectively.
5. Design full adder and full subtractor. Implement using gates
6. What is a multiplexer? With neat sketch, describe 4:1 MUX. Implement the given Boolean functions by using multiplexer chip
 - a. $F_1(A,B,C) = \sum m(1,2,4,7)$
 - b. $F_2(A,B,C) = \sum m(3,5,6,7)$



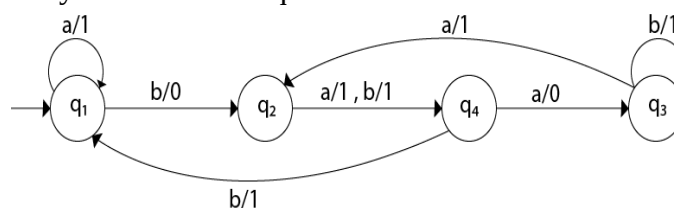
7. With neat block diagram explain carry look ahead adder in detail.
8. Design 2 bit comparator circuit using logic gates.
9. Design & implement 4 bit look ahead carry adder.
10. Implement 16:1 multiplexer using 4:1 multiplexer
11. Implement full subtractor using 3-8 line decoder with the decoder having high outputs & active low enable inputs
12. What is magnitude comparator? Write the truth table & logic diagram of a 1-bit comparator.

MODULE- 3:

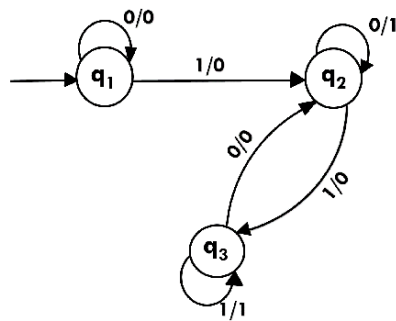
1. Design a switch debouncer using SR and $\bar{S}$ $\bar{R}$ latch.
2. Explain the operation of SR latch.
3. Explain the operation of the master-slave JK f/f and SR f/f along with its circuit diagram.
4. Explain the working of SR f/f by using NOR gates.
5. What is race around condition in f/f? Discuss in brief.
6. Difference between f/fs and latches and its definition.
7. What is edge triggered f/fs .Explain positive edge triggered D f/fs.With neat timing diagrams
8. Explain negative edge triggered D f/fs using NAND gates and timing diagrams.
9. What is propagation delay?
10. Explain with neat timing diagrams S $\bar{R}$ latch?
11. Write the next state tables and characteristic equations for SR,JK,D and T f/f.
12. Write the next state tables and characteristic equations for SR, JK, D and T flip flop.
13. What is a register? Explain with neat diagrams all the types of register.
14. Explain Universal shift register.
15. With a neat logic diagram and timing waveforms explain synchronous binary counters.
16. Design synchronous mod-6 counter using JK and D flip flop.
17. Design a counter that has a repeated sequence of 06 states listed $0 \rightarrow 3 \rightarrow 4 \rightarrow 0 \rightarrow 5 \rightarrow 6$ diagram.
18. Design mod-3 counter using JK flip flop. Sketch the waveforms for outputs when clock is applied and verify its operation

MODULE- 4:

1. Explain state reduction technique.
2. Write down the state equations reduction steps
3. Explain with neat diagram Mealy machine.
4. Explain with neat diagram Moore network.
5. Explain different types of sequential networks?
6. Convert the following Mealy machine into equivalent Moore machine.

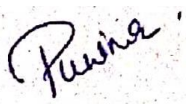
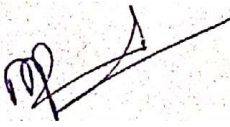
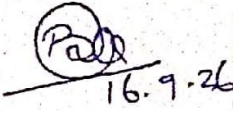


7. Convert the following Mealy machine into equivalent Moore machine.



Module 5:

1. Explain RAM, ROM, EPROM and flash memories.
2. Explain the characteristics of digital ICs.
3. Write down the comparison between TTL and CMOS families.
4. Explain TTL logic for NAND, NOR and NOT gates.
5. Explain CMOS logic for NOT, NAND and NOR gates.

Prepared by	Checked by		
		 16.9.26	
Prof. P.I. Savadatti	Dr. M. P. Yenagimath	HOD	Principal



Subject Title	Transformers and Generators		
Subject Code	1BEE305	CIE Marks	50
Number of Lecture Hrs / Week	3:0:0	SEE Marks	50
Total Hours of Pedagogy L/T/P/(SL&TW):	42: 0: 0 :48	Exam Hours	03
CREDITS – 03			

FACULTY DETAILS:

Name: Dr. Mahesh Yenagimath	Designation: Associate Professor & First Year Coordinator	Experience: 21 Years
No. of times course taught: 02 (including present)		Specialization: VLSI & ES

1.0 Prerequisite Subjects:

Sl.No	Branch	Semester	Subject
01	Electrical & Electronics Engineering	I/II	Basic Electrical Engineering
02	Electrical & Electronics Engineering	1/II	Renewable Energy Sources

2.0 Course Objectives

1. To understand the concepts of transformers and their analysis.
2. To suggest a suitable three phase transformer connection for a particular operation.
3. To understand the concepts of generator and to evaluate their performance.
4. To study regulation of AC Generators using different methods.
5. To explain the requirement for the parallel operation of transformers and synchronous generators.

3.0 Course Outcomes

Having successfully completed this course, the student will be able

CO	Course Outcome	RBT Level	POs
C205.1	Explain the construction, operation, working and evaluate the performance of single phase Transformer.	L1, L2, L3	PO1, 2, 3, 6, 7, 8, 9, 10, 12
C205.2	Analyse the operation, and performance of parallel operation of three-phase transformers.	L1, L2, L3	PO 1, 2, 3, 6, 7, 8, 9, 10, 12
C205.3	Evaluate the construction, operation and performance and applications of special transformers.	L1, L2, L3	PO 1, 2, 3, 6, 7, 8, 9, 10, 12
C205.4	Analyse the construction, operation and performance of synchronous generators	L1, L2, L3	PO 1, 2, 3, 6, 7, 8, 9, 10, 12
C205.4	Evaluate the steady-state performance of salient-pole and cylindrical-rotor synchronous generators.	L1, L2, L3	PO 1, 2, 3, 6, 7, 8, 9, 10, 12
Total Hours of instruction		40	

4.0 Course Content

Module-1

Single phase Transformers: Necessity of transformers, principle of operation, Constructional details of core and windings, EMF equation, equivalent circuit, Operation of practical transformer under no-load and on load with phasor diagrams. Losses, Variation of losses with load, methods of reducing losses. Efficiency and condition for maximum efficiency. Reasons for rating of transformers in kVA. Open circuit and short circuit tests, calculation of equivalent circuit parameters. Polarity test, Sumpner's test. Predetermination of efficiency, voltage regulation and its significance. parallel operation of single-phase transformers. Numerical Problems.



Module-2

Three-phase Transformers: Introduction, Three phase transformers in single units or in banks of three, Transformer connection for three phase operation– star/star, delta/delta, star/delta, and delta/open delta, comparative features with reference to vector group, Labelling of three-phase transformer terminals, Parallel Operation of Transformers: Necessity of Parallel operation, conditions for parallel operation of three phase transformers including vector group conditions, Load sharing in case of similar and dissimilar transformers., Numerical Problems.

Module-3

Three-Phase Transformers (continued): Voltage regulation by Tap changing on load and on no-load. Scott connected transformer, Necessity of transformers with tertiary windings. transformer Noise. Autotransformers: Introduction, copper economy, equivalent circuits, numerical problems. Instrument transformers- Current Transformers (CT) and Potential Transformers (PT): Construction, Operation, and Applications. Welding transformers: construction and operation. Introduction to pulse transformer.

Module-4

Synchronous Generators: Constructional features of salient and cylindrical types, excitation systems – static and brushless, working, Armature windings, winding factors, EMF equation; Harmonics–causes, reduction and elimination; Armature reaction, Synchronous reactance, Equivalent circuit; Synchronous Generators Analysis: Open circuit and short circuit characteristics, short circuit ratio, Alternator on load; Voltage regulation, Voltage regulation by EMF, MMF, and ZPF methods; Excitation control for constant terminal voltage when operating on its own load and on infinite bus. Numerical Problems.

Module-5

Synchronous Generators (Salient Pole): Effects of saliency, two-reaction theory, Direct and quadrature axis reactances, slip test, electromagnetic power developed in the salient generators. Power angle characteristic (salient and non-salient pole), power angle diagram, reluctance power, capability curve for large turbo generators. Parallel operation of generators and load sharing; Methods of synchronization, Synchronizing power, Hunting and damper windings. Numerical Problems.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	IV	Electric motors	Principles of Machine
02	VII&VIII	Seminar and project	Knowledge of Machine

6.0 Relevance to Real World

SL No	Real World Mapping
01	Power transmission and Distribution
02	Energy-intensive industrial applications

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Lab and industrial visit.	Familiarization of real machine parts and its constructional features. Included animation slides demonstrating the working of various machines.
02	NPTEL	Assembly Application

8.0 Books Used and Recommended to Students

Text Books
1. Electric Machines, D. P. Kothari, et al, 4th Edition, 2011.
2. Electric Machines, Ashfaq Hussain, Dhanpat Rai & Co, 2nd Edition, 2013.
3. Electric Machinery, P.S. Bimbhra, Khanna Publishers.
4. Theory & Performance of Electrical Machine, J.B. Gupta, S.K. Kataria & Sons.
Reference Books
1. Electric Machinery, A E Fitzgerald, Charles Kingsley, Stephan Umans, McGraw-Hill.
Additional Study material & e-Books



1. Transformers & Generators by Bakshi, Technical publications.
2. Electrical Machines M.V. Deshpande PHI Learning 2013.

9.0

Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References

- 1) www.nptel.ac.in
- 2) <http://www.electrical4u.com>
- 3) www.nptel.com
- 4) <https://en.wikipedia.org/wiki/Transformer>
- 5) <https://www.youtube.com/watch?v=LAtpHANEfQo>
- 6) www.electrical4u.com/transformer/
- 7) <http://www.electrical4u.com/working-principle-of-dc-generator-and-alternator/>
- 8) www.ijset.net/journal/68.pdf
- 9) www.electrical4u.com/dcgenerator
- 10) www.electrical4u.com/alternator
- 11) www.electrical4u.com/.../alternator
- 12) <http://eeeinterviewtips.blogspot.in/2011/09/discuss-different-types-of-generator>

10.0

Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	EC&M Magazines	http://ecmweb.com/ops-maintenance/generators
2	IPT Magazine	https://www.intelligent-power-today.com/
3	Electric apparatus magazine	https://electricalapparatus.wordpress.com/2016/06/30/electric-generator-up-and-running/
4	E drive magazine	http://www.e-driveonline.com/main/
5	Motor magazine	https://www.motor.com/newsletters/20110410/WebFiles/ID1_IonizingAmerica.html

11.0

Examination Note

Assessment Details (both CIE and SEE)

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage.

- To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks.
- To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks.
- Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

Continuous Comprehensive Assessments (CCA) + Internal Assessment Test (IA) = Continuous Internal Evaluation CIE [25+25=50 marks].

A minimum of two Internal Assessment Tests(IA) shall be conducted, carrying a total of 25 marks. In addition, Continuous Comprehensive Assessment (CCA) shall be conducted for a total of 25 marks.

It is recommended to include a maximum of two learning activities as part of the CCA to foster the holistic development of students.



12.0 Course Delivery Plan

Module No.	Lecture No.	Content of Lecture	% of Portion
1	1.	Single phase Transformers: Necessity of transformers, principle of operation,	20%
	2.	Constructional details of core and windings, EMF equation, equivalent circuit,	
	3.	Operation of practical transformer under no-load and on load with phasor diagrams.	
	4.	Losses, Variation of losses with load, methods of reducing losses. Efficiency and condition for maximum efficiency. Reasons for rating of transformers in kVA	
	5.	Open circuit and short circuit tests, calculation of equivalent circuit parameters.	
	6.	Polarity test, Sumpner's test.	
	7.	Predetermination of efficiency, voltage regulation and its significance	
	8.	Parallel operation of single-phase transformers. Numerical Problems.	
2	9.	Three-phase Transformers: Introduction, Three phase transformers in single units or in banks of three,	20%
	10.	Transformer connection for three phase operation– star/star, delta/delta, star/delta, and delta/open delta,	
	11.	comparative features with reference to vector group,	
	12.	Labelling of three-phase transformer terminals,	
	13.	Parallel Operation of Transformers: Necessity of Parallel operation,	
	14.	conditions for parallel operation of three phase transformers including vector group conditions,	
	15.	Load sharing in case of similar and dissimilar transformers	
	16.	Numerical Problems.	
3	17.	Three-Phase Transformers (continued): Voltage regulation by Tap changing on load and on no-load	20%
	18.	Scott connected transformer,	
	19.	Necessity of transformers with tertiary windings. transformer Noise.	
	20.	Autotransformers: Introduction, copper economy, equivalent circuits,	
	21.	Numerical problems	
	22.	Instrument transformers- Current Transformers (CT) and Potential Transformers (PT): Construction, Operation, and Applications.	
	23.	Welding transformers: construction and operation.	
	24.	Introduction to pulse transformer.	
4	25.	Synchronous Generators: Constructional features of salient and cylindrical types,	20%
	26.	excitation systems – static and brushless, working,	
	27.	Armature windings, winding factors, EMF equation	
	28.	Harmonics—causes, reduction and elimination; Armature reaction, Synchronous reactance, Equivalent circuit;	
	29.	Synchronous Generators Analysis: Open circuit and short circuit characteristics, short circuit ratio,	
	30.	Alternator on load; Voltage regulation	
	31.	Voltage regulation by EMF, MMF, and ZPF methods; Excitation control for constant terminal voltage when operating on its own load and on infinite bus.	
	32.	Numerical Problems.	
5	33.	Synchronous Generators (Salient Pole): Effects of saliency, two-reaction theory,	20%
	34.	Direct and quadrature axis reactances, slip test	
	35.	Electromagnetic power developed in the salient generators.	
	36.	Power angle characteristic (salient and non-salient pole), power angle diagram,	
	37.	reluctance power, capability curve for large turbo generators	
	38.	Parallel operation of generators and load sharing	
	39.	Methods of synchronization, Synchronizing power, Hunting and damper windings	



	40.	Numerical Problems.	
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13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl.No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference book/website /Paper
1.	Self Learning Activity: Assignment 1	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4	10	Individual Activity	Text book no.1
2.	Group Activity: Industrial Visit and Technical Report	Students study the topics of all five modules.	-	8	Individual Activity	-

14.0 QUESTION BANK

Module 1

1. Explain with neat sketch the construction of single phase core type and shell type transformer?
2. Difference between shell and core type transformer?
3. Explain in brief the working principle of single phase transformer.
4. Derive the EMF equation of a transformer.
5. Explain in brief Starting from fundamental develop the exact equivalent circuit and approximate equivalent circuit of a single phase transformer referred to primary?
6. Draw the phasor diagrams of single phase transformer with unity pf and lagging pf loads.
7. Draw the phasor diagrams of single phase transformer with unity pf and lagging pf loads.
8. Explain how the flux in the core of transformer remains constant, from no load to full load. Develop the phasor diagram of an actual transformer when it is inductively loaded.
9. Explain in details OC and SC test (with circuit diagram) for determination of efficiency and regulation of single phase transformer.
10. What are the losses in a transformer? How to reduce these losses? Derive the condition for maximum efficiency? Efficiency and voltage regulation of transformer
11. Define all day efficiency and explain
12. Write a short note on efficiency and voltage regulation of transformer.
13. Discuss the ideal transformer & practical transformer under load and no load.
14. Explain With neat diagram explain in detail Sumpner's test for determining the efficiency and voltage regulation of transformer. Mention its advantages and disadvantages.
15. Explain the separation of hysteresis and eddy current losses in a transformer.

Module 2

1. Describe the necessity parallel operation of transformers
2. Explain the Necessary conditions for parallel operation of single phase transformers and then the three phase.
3. Discuss the Load sharing in case of similar and dissimilar transformers.
4. Explain the Necessary conditions for parallel operation of single phase transformers and then the three phase.
5. Explain the classification of polyphase connection of three phase transformer.
6. Discuss the Phase conversion – Scott connection for three-phase to two-phase conversion.
7. Discuss the Labeling of three-phase transformer terminals & vector groups.
8. Discuss the Equivalent circuit of three phase transformers.



Module 3

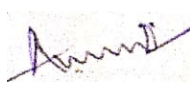
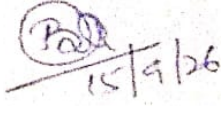
1. What is an autotransformer? Discuss merits and demerits of autotransformer?
2. What is an autotransformer? Derive an expression for the saving of copper when an autotransformer is used? Mention its applications?
3. Discuss the equivalent circuit, three phase autotransformer connection and voltage regulation.
4. Discuss the Voltage regulation by tap changing – off circuit and on load.
5. Explain the construction and operation of welding transformer.

Module 4

1. Explain the armature reaction in synchronous generators.
2. Draw and explain the equivalent circuit of synchronous generators.
3. Explain the causes & effects of harmonics generated by transformers.
4. List the advantage of stationary armature in synchronous machine.
5. Explain the essential difference between cylindrical and salient pole rotors used in large alternators
6. List the advantage of chording of armature coils in synchronous machine. Derive the expression for pitch factor.
7. Define the breadth factor. Derive expression for it.
8. Derive an equation for EMF induced in an alternator.
9. Discuss open circuit and short circuit characteristics of synchronous generator.
10. Explain MMF or ampere turn's method of finding the Regulation of alternator.
11. Describe the construction and working of synchronous generator.
12. Discuss the Synchronous generator load characteristics.
13. Discuss the Electrical load diagram & mechanical load diagram.

Module 5

1. Explain the excitation control for constant terminal voltage of synchronous generator.
2. An alternator is supplying constant load. With suitable vector diagram and explain the effect of variation on excitation on armature current and power factor.
3. Explain the open circuit and short circuit characteristics of synchronous generator.
4. Explain how two or more alternators are made to share the load in proportion to rating.
5. Derive an expression for mechanical power developed by salient pole synchronous motor Hence Explain what is meant by reluctance torque.
6. With neat circuit diagram, explain how an alternator is synchronized with bus bars.
7. Describe synchronous impedance method to determine the regulation of alternator for lagging and leading power factor.

Prepared by	Checked by		
		 15/9/26	
Dr. Mahesh Yenagimath	Prof. Amit Neshti	HOD	Principal



Subject Title	TRANSFORMERS AND GENERATORS LAB		
Subject Code	1BEEL306	CIE Marks	50
No. of Lecture hrs./Week(L:T:P:S)	0:0:2:0	SEE Marks	50
		Exam Hours	03
CREDITS – 01			

FACULTY DETAILS:

Name: Prof.S. J. Patil	Designation: Asst.Professor	Experience: 14Years
No. of times course taught: 02 Times	Specialization: Industrial Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical & Electronics Engineering	I	Basic electrical Engineering

2.0 Course Objectives

- To conduct various tests on transformers and synchronous machine and evaluation of their performance.
- To perform the parallel operation of two single phase transformers of different KVA rating.
- To study and verify the performance of synchronous generator.
- To calculate the voltage regulation of an alternator using different methods for comparison.

3.0 Course Outcomes

The student, after successful completion of the course, will be able to

CO	Course Outcome	RBT Level	POs
C205.1	Conduct standard tests on single-phase and three-phase transformers and determine equivalent circuit parameters and performance..	L ₁ ,L ₂ ,L ₃	1,2,3,5,8,9,10, 12
C205.2	Analyse the performance of transformers under different operating conditions	L ₁ ,L ₂ ,L ₃	1,2,3,5,8,9,10, 12
C205.3	Perform experimental investigations on synchronous generators and to determine their performance	L ₁ ,L ₂ ,L ₃	1,2,3,5,8,9,10, 12
C205.4	Evaluate the voltage regulation of synchronous generators using different standard methods, to compare the results obtained	L ₁ ,L ₂ ,L ₃	1,2,3,5,8,9,10, 12
C205.5	Determine the steady-state operating characteristics of synchronous generators.	L ₁ ,L ₂ ,L ₃	1,2,3,5,8,9,10, 12
Total Hours of instruction		28	

4.0 Course Content

Experiments

- 1 Open-circuit and short-circuit tests on a single-phase step-up/step-down transformer and pre- determination of: (i) Efficiency and regulation, and (ii) Parameters of the equivalent circuit
- 2 Polarity Test and Star–Delta Connection of Three Single-Phase Transformers with Efficiency and Regulation under Balanced Load.



- 3 Determination of Combined and Individual Transformer Efficiencies using Sumpner's Test
- 4 Parallel operation of two dissimilar single-phase transformers of different kVA ratings and determination of load sharing.
- 5 Separation of hysteresis and eddy current losses in a single-phase transformer
- 6 Comparison of performance of three single-phase transformers in delta–delta and V–V (open- delta) connections under load.
- 7 Scott connection for conversion of 3 phase supply to 2 phase supply and plot of secondary side voltages with respect to load variation
- 8 Direct load test on a three-phase synchronous generator to determine efficiency and regulation.
- 9 Determination of voltage regulation of an alternator by the EMF and MMF method
- 10 Determination of power-angle characteristics of a synchronous generator and determination of maximum power developed
- 11 Performance of a synchronous generator connected to an infinite bus under constant load and variable excitation.
- 12 Slip test and determination of X_d and X_q .

5.0 Relevance to future subjects

SL. No	Semester	Subject	Topics / Relevance
01	IV	Electric motors	Construction, working & operation of different types of machines.

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Energy Regeneration Material Handling Oil and Gas Mining and Drilling Industry (Hazardous Environment)
02	Off-highway Sector, Automotive Marine, Pump Drives

7.0 Books Used and Recommended to Students

Text Books
1.(i)Electric Machines, D. P. Kothari, et al, 4th Edition, 2011. (ii)Electric Machines, Ashfaq Hussain, Dhanpat Rai & Co, 2nd Edition, 2013. (iii)Electric Machinery, P.S. Bimbhra, Khanna Publishers. (iv) Theory & Performance of Electrical Machine, J.B. Gupta, S.K. Kataria & Sons.
Reference Books
1.Principles of Electric Machines and power Electronics P.C.Sen Wiley 2nd Edition, 2013 2.Electrical Machines, Drives and Power systems Theodore Wildi Pearson 6th Edition, 2014. 3.Electric Machinery and Transformers Bhag S Guru at el Oxford University Press 3rd Edition, 2012 4.Theory of Alternating Current Machines Alexander Langsdorf Mc Graw Hill 2nd Edition, 2001



Additional Study material & e-Books

Electric machines by godse & bakshi

8.0

Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References

- 1) www.electrical4u.com/transformer/
- 2) [http://www.electrical4u.com/working-principle-of-dc generator and alternator/](http://www.electrical4u.com/working-principle-of-dc-generator-and-alternator/)
- 3) www.ijset.net/journal/68.pdf
- 4) [www.electrical4u.com/dc generator](http://www.electrical4u.com/dc-generator)
- 5) www.electrical4u.com/alternator

9.0

Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	EC&M Magazines	http://ecmweb.com/ops-maintenance/generators
2	Oil & gas journal	https://www.sub-forms.com/dragon/init.do?site=PNW23_OGogpenew
3	IPT Magazine	https://www.intelligent-power-today.com/
4	Electric apparatus magazine	https://electricalapparatus.wordpress.com/2016/06/30/electric-generator-up-and-running/

10.0

Examination Note

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

- CIE marks for the practical course are **50 Marks**.
- The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.
- Each experiment is to be evaluated for conduction with an observation sheet and record write-up.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.



- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to 20 marks (40% of the maximum marks).

SemesterEndEvaluation(SEE):

- SEE marks for the practical course are **50 Marks**.
- SEE shall be conducted jointly by the two examiners appointed by the university.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly. Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners. General rubrics suggested for SEE are mentioned here,
- Writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks.
- SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.
- The minimum duration of SEE is **02 hours**

11.0 Self-Learning & Term Work (TW) Activity

Sl. No.	Self-Learning & Term Work (TW) Activity	Number of Hours / Semester
1.	Review one IEEE paper, NPTEL lecture, or technical article related to transformers or synchronous generators and summarize the key learning outcomes.	2
2.	Explore simulation of transformer or synchronous generator characteristics using MATLAB/Simulink or any other simulation software.	2
3.	Develop a comparative chart showing transformer connections (Star-Star, Delta-Delta, Star-Delta, Delta-Star, Scott, and Open Delta) with applications.	2
4.	Prepare a maintenance checklist for transformers and synchronous generators based on industry practices.	2
5.	Analyse and present the industrial applications of different transformer connections with suitable illustrations	2

12.0 Course Delivery Plan

Expt . No.	Aim of the Experiment	% of Portion
1.	Open-circuit and short-circuit tests on a single-phase step-up/step-down transformer and pre- determination of: (i) Efficiency and regulation, and (ii) Parameters of the equivalent circuit	8.33



2.	Polarity Test and Star–Delta Connection of Three Single-Phase Transformers with Efficiency and Regulation under Balanced Load.	8.33
3.	Determination of Combined and Individual Transformer Efficiencies using Sumpner’s Test	8.33
4.	Parallel operation of two dissimilar single-phase transformers of different kVA ratings and determination of load sharing..	8.33
5.	Separation of hysteresis and eddy current losses in a single-phase transformer	8.33
6.	Comparison of performance of three single-phase transformers in delta–delta and V–V (open- delta) connections under load.	8.33
7.	Scott connection for conversion of 3 phase supply to 2 phase supply and plot of secondary side voltages with respect to load variation	8.33
8.	Direct load test on a three-phase synchronous generator to determine efficiency and regulation	8.33
9.	Determination of voltage regulation of an alternator by the EMF and MMF method	8.33
10.	Determination of power-angle characteristics of a synchronous generator and determination of maximum power developed	8.33
11.	Performance of a synchronous generator connected to an infinite bus under constant load and variable excitation.	8.33
12.	Slip test and determination of X_d and X_q ..	8.33

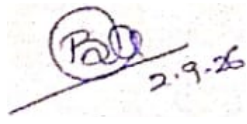
12.0

QUESTION BANK

1. Define Transformer?
2. Mention different classifications of Transformer?
3. Give the constructional details of the core & winding part of the transformer,
4. Compare core type & shell type transformers.
5. Power transformer are designed to give good
 - a. all day efficiency b) power efficiency
6. Distribution transformer are designed to give good
 - a. all day efficiency b) power efficiency
7. Transformer is “Constant flux Machine” True/False, Justify
8. Give the classification of transformers in details.
9. Draw the phasor diagram for single phase transformer considering,
 - a. Resistive Load b) Inductive Load c) Capacitive Load
10. Draw the Exact & approximate Equivalent Electric Circuit of single phase transformer
11. What do you mean by the term “Voltage Regulation of Transformer?”
12. Give the expression for the Voltage regulation in terms of approximate voltage drop.
13. Give the condition for maximum power efficiency of the transformer, Use the condition to decide the KVA load to be applied on the transformer to give maximum efficiency.
14. Give the comparison between Power efficiency & Energy efficiency.
15. Give the importance of Energy efficiency in case of Distribution Transformer & that of Power efficiency in case of Power transformer.
16. Mention & justify the conditions for parallel operation of the transformers.
17. Write the expressions for power shared by two unequal voltage ratios transformer.
18. What is zero voltage regulation, Give the condition for the same?
19. What do you mean by Testing of transformers, why is it required?
20. Give the comparison between OC, SC & Back to Back Test.



21. What do you mean by predetermination of Efficiency & Regulation of transformers?
22. Give the procedural details of finding efficiency & regulation of the transformers at different load condition.
23. Write the voltage current relationships at primary & secondary of star Delta transformer.
24. Mention the applications where 2-phase supply is required, Explain how 3-phase to 2-phase conversion is achieved in case of Scott connection.
25. How are alternators classified?
26. Name the types of alternator based on their rotor construction.
27. Why do cylindrical alternators operate with steam turbines?
28. Which type of synchronous generators are used in hydro-electric plants and why?
29. What are the advantages of salient pole type construction used for synchronous machines?
30. Why is stator core of alternator laminated?
31. How does electrical degree differ from mechanical degree?
32. What is distributed winding?
33. Why short pitch is preferred over full pitch winding?
34. Define winding factor.
35. Why alternators rated in KVA and not in MW?
36. What are the causes of changes in voltage in alternators when loaded?
37. What you meant by armature reaction in alternators/
38. What is meant by synchronous impedance of a alternator?
39. What you mean by synchronous reactance ?
40. What is meant by load angle of an alternator?
41. Upon what factor does load angle depend?
42. Define the terminal voltage of alternator.
43. What is the necessity for predetermination of voltage regulation?
44. How synchronous impedance is calculated from OCC and SCC?
45. Why is EMF method called as pessimistic method?
46. In what way does ampere turn method differ from emf method?
47. State the conditions to be satisfied before connecting two alternators in parallel.
48. How synchronous scope is used for synchronizing alternators?
49. List the factors that affect the load sharing in parallel operating generators?
50. How the change in excitation does affect the load sharing?
51. What is meant by infinite bus bars?
52. Why MMF method is called as optimistic method?
53. Why is the resistance of field winding of a d.c shunt generator kept low?
54. What will happen if a d.c machine is operated below the rated speed?
55. What do you understand by the external characteristics of a d.c generator?
56. What you mean by V and inverted V curve of synchronous motor.

Prepared by	Checked by		
		 2.9.26	
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Subject Title	DIGITAL ELECTRONIC CIRCUITS LAB		
Subject Code	1BEEL307D	CIE Marks	50
Number of Lecture Hrs / Week(L:T:P)	0:0:2	SEE Marks	50
Total Hrs of Pedagogy L:T:P:(SL:TW)	0:0:28:2	Exam Hours	03
CREDITS – 01			

FACULTY DETAILS:

Name: Prof. P.I.Savadatti	Designation: Asst Professor	Experience: 10
No. of times course taught: 02	Specialization: Digital Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical & Electronics Engineering	I/II	Basic Electronics

2.0 Course Objectives

Upon completion of this course, a student should be able to:

- Illustrate simplification of Algebraic equations using Karnaugh Maps and Quine- McClusky Techniques.
- Design combinational logic circuits..
- Design Decoders, Encoders, Digital Multiplexer, Adders, Subtractors and Binary Comparators.
- Describe Latches and Flip-flops, Registers and Counters.
- Develop state diagrams, Synchronous Sequential Circuits and to understand the basics of various Memories.

3.0 Course Outcomes

At the end of the course the student will be able to:

CO	Course Outcome	RBT Level	POs
C210.1	Verify the operation of basic logic gates, universal gates, Boolean algebra theorems, and flip-flops through truth tables and digital logic circuits.	L1,L2,L3	PO1,PO2,PO3, PO8,PO10,PO12
C210.2	Construct and test combinational digital circuits such as adders, subtractors, code converters, and arithmetic circuits using logic gates and standard digital ICs.	L1,L2,L3	PO1,PO2,PO3, PO8,PO10,PO12
C210.3	Analyze the performance of combinational and sequential digital circuits by interpreting experimental results, identifying logical errors, and validating circuit operation against theoretical	L1,L2,L3	PO1,PO2,PO3, PO8,PO10,PO12
C210.4	Design, develop, troubleshoot, and validate digital electronic systems using appropriate hardware, software, and laboratory practices while working effectively in teams and communicating technical findings.	L1,L2,L3	PO1,PO2,PO3, PO8,PO10,PO12



List of experiments

- (1) Verify Truth Table of Logic Gates AND, OR, NAND, NOR, EX-OR, EX-NOR, NOT, and Buffer gates, and demonstrate the use of the universal NAND gate.
- (2) Construct the logic circuit to simplify a Boolean function and verify De Morgan's theorem for 2 variables.
- (3) Realize half/full adder and half subtractor, and full subtractor circuits using logic gates.
- (4) Realize a 4-bit parallel adder/Subtractors using IC 7483 and perform BCD to Excess-3 code conversion and Vice - Versa.
- (5) Realize of Binary to Gray code conversion and Gray-to-Binary code conversion.
- (6) Design, implement, and test Ring counter and Johnson counter circuits.
- (7) Design and investigate the operation of 4-bit shift registers with parallel loading.
- (8) Design, implement, and testing a Sequence generator.
- (9) Realize 3-bit counters as a sequential circuit and design MOD – N counters using ICs 7476, 7490, 74192.
- (10) Verify the logic operation of RS and JK flip-flops and obtain their truth tables.

Reference Books:

- (i) Digital Principles and Design, Donald D. Givone, McGraw Hill, 2002.
- (ii) Digital Design, Morris Mano, Prentice Hall of India, Third Edition.
- (iii) Digital Logic Applications and Design, John M Yarbrough, Thomson Learning, 2001.
- (iv) Fundamentals of logic design, Charles H Roth, Jr, Cengage Learning. Fifth Edition.
- (v) Digital Systems Design, A Nagoor Kini, CBS Publishers and Distributors, 2026.

Web links and video lectures(e-resources)

1. <https://vlab.co.in>
2. <https://circuitverse.org>
3. <https://nptel.ac.in/courses/108105132>
4. <https://www.youtube.com/watch?v=x7MrUxUpOc&list=PLbRMhDVUMngePP5JcezxImF-FzOC9wstz>

Teaching-Learning Process (Innovative Delivery Methods):

The following are sample strategies that educators may adopt to enhance the effectiveness of the teaching-learning process and facilitate the achievement of course outcomes.

- (i) Hands-on experimental learning through implementation and testing of digital logic circuits using ICs and laboratory hardware.
- (ii) Design-based learning involving the realization and verification of combinational and sequential logic circuits.
- (iii) Problem-solving learning through logic simplification, code conversion, and counter design exercises.
- (iv) Simulation-assisted learning for analysis, verification, and troubleshooting of digital electronic circuits.

Assessment Structure:

The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying 50% weightage (i.e., 50 marks each).

The CIE marks awarded shall be based on the continuous evaluation of the laboratory report using a defined set of rubrics. Each experiment report can be evaluated for 30 marks. Total marks for the all

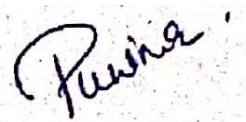
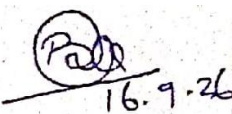


report shall be scaled down to 30 marks. The laboratory test (duration 03 hours) at the end of the last week of the semester/after completion of all the experiments (whichever is early) shall be conducted for 50 marks and Marks scored shall be scaled down to 20 marks. Final average of marks for report and test shall be out of 50 marks.

To qualify and become eligible to appear for SEE, in the CIE component, a student must secure a minimum of 40% of 50 marks, i.e., 20 marks.

To pass the SEE component, a student must secure a minimum of 35% of 50 marks, i.e., 18 marks.

A student is deemed to have successfully completed the course if the combined total of CIE and SEE is at least 40 out of 100 marks.

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