K.L.N. COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

(Approved by AICTE, New Delhi, permanently affiliated to Anna University, Chennai)

(Accredited by NBA, New Delhi)

B.E. – EEE – V – Semester - Students Hand book – ODD Semester of 2016 – 2017

This book contains the following:

1. Vision and Mission of the College and Department, Program Educational Objectives, Program Specific Outcomes, Program Outcomes.
2. Outcome Based Education, Benefits and Significance of accreditation.
3. Engineering Ethics.
4. Blooms Taxonomy.
5. Academic Calendar – 2016 – 2017 (Odd semester).
6. Class Time Table.
7. B.E. – EEE – Syllabus – V Semester.
8. Lecture Schedule, Tutorial, Assignment questions.
9. Anna University question papers (Previous years).
10. Anna University - Malpractices and Punishment in University Examinations
11. OD Norms
12. About the College and Department
13. Faculty List, Mobile number, Mail ID
14. Placement Mock test paper.
15. GATE 2016 - Questions & Answers.
16. General tips for effective communication and Leadership skills.

K.L.N. COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION AND MISSION OF THE COLLEGE

VISION:

To become a Premier Institute of National Repute by Providing Quality Education, Successful Graduation, Potential Employability and Advanced Research & Development through Academic Excellence.

MISSION:

To Develop and Make Students Competent Professional in the Dynamic Environment in the field of Engineering, Technology and Management by emphasizing Research, Social Concern and Ethical Values through Quality Education System.

VISION AND MISSION OF THE DEPARTMENT

VISION:

To become a high standard of excellence in Education, Training and Research in the field of Electrical & Electronics Engineering and allied applications.

MISSION:

To produce excellent, innovative and Nationalistic Engineers with Ethical Values and to advance in the field of Electrical & Electronics Engineering and allied areas.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The Educational Objectives of the Electrical and Electronics Engineering (EEE) Programme represent major accomplishments that we expect our graduates to achieve after three to five years of graduation. More specifically our graduates are expected:

PEO1: to excel in industrial or graduate work in Electrical and Electronics Engineering and allied fields

PEO2: to practice their Professions conforming to Ethical Values and Environmentally friendly policies

PEO3: to work in international and multi-disciplinary Environments

PEO4: to successfully adapt to evolving Technologies and stay current with theirProfessions

PROGRAM SPECIFIC OUTCOMES (PSOs)

Electrical and Electronics Engineering Graduates will be able to:

PSO1:

Apply the fundamentals of mathematics, science and engineering knowledge to identify, formulate, design and investigate complex engineering problems of electric circuits, analog and digital electronic circuits, electrical machines and power systems.

PSO2:

Apply appropriate techniques and modern Engineering hardware and software tools in power systems to engage in life- long learning and to successfully adapt in multi-disciplinary environments.

PSO3:

Understand the impact of Professional Engineering solutions in societal and environmental context, commit to professional ethics and communicate effectively.

PROGRAM OUTCOMES (POs)

Electrical and Electronics Engineering Graduates will be able to:

PO1:Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: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.

PO3: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.

PO4: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.

PO5: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.

PO6: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.

PO7: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.

PO8:Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: 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.

PO11: 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.

PO12: 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.

OUTCOME BASED EDUCATION (OBE)

In a traditional education system, students are given grades and rankings compared to each other. Content and performance expectations are based primarily on what was taught in the past to students of a given age. The goal of traditional education was to present the knowledge and skills of an older generation to the new generation of students, and to provide students with an environment in which to learn. The process paid little attention (beyond the classroom teacher) to whether or not students learn any of the material.

An outcome is a culminating demonstration of learning; it is what the student should be able to do, at the end of a course/program, in-terms of the knowledge, skill and behavior.

Outcome-based education is an approach to education in which decisions about the curriculum are driven by the exit learning outcomes that the students should display at the end of the course. In outcome-based education, product defines process. Outcome-based education can be summed up as results-oriented thinking and is the opposite of input-based education where the emphasis is on the educational process. Outcome-based education promotes fitness for practice and education for capability.

BENEFITS AND SIGNIFICANCE OF ACCREDITATION

The process of accreditation helps in realizing a number of benefits, such as:

- Helps the Institution to know its strengths, weaknesses and opportunities
- Initiates Institutions into innovative and modern methods of pedagogy
- Gives Institutions a new sense of direction and identity
- Provides society with reliable information on quality of education offered
- Promotes intra and inter-Institutional interactions

Accreditation signifies different things to different stakeholders. These are:

Benefits to Institutions

Accreditation is market-driven and has an international focus. It assesses the characteristics of an Institution and its programmes against a set of criteria established by National Board of Accreditation. NBA's key objective is to contribute to the significant improvement of the Institutions involved in the accreditation process. Accreditation process quantifies the strengths, weaknesses in the processes adopted by the Institution and provides directions and opportunities for future growth. NBA provides a quality seal or label that differentiates the Institutions from its peers at the national level. This leads to a widespread recognition and greater appreciation of the brand name of Institutions and motivates the Institutions to strive for more.

Benefits to Students

Students studying in NBA accredited Institutions can be assured that they will receive education which is a balance between high academic quality and professional relevance and that the needs of the corporate world are well integrated into programmes, activities and processes. It signifies that he has entered the portals of an Institution, which has the essential and desirable features of quality professional education.

Benefits to Employers

Accreditation assures prospective employers that students come from a programme where the content and quality have been evaluated, satisfying established standards. It also signifies that the students passing out have acquired competence based on well-established technical inputs.

Benefits to the Public

Accredited status represents the commitment of the programme and the Institution to quality and continuous improvement.

Catalyst for International Accreditations

Due to accreditation from NBA, the Institution's systems and procedures get aligned with the Institution's Mission and Vision. All essential prerequisites for international accreditation are included in the accreditation process of NBA. Therefore, NBA acts as a catalyst for the Institutions planning to acquire International Accreditation.

Benefits to Industry and Infrastructure Providers
It signifies identification of quality of Institutional capabilities, skills and knowledge.
Benefits to Parents
It signifies that their ward goes through a teaching-learning environment as per accepted good practices.
Benefits to Alumni
It reassures alumni that alumni are products of an institute with a higher standing in terms of learning.
Benefits to Country
Accreditation helps in gaining confidence of stakeholders and in giving a strong message that as a country, our technical manpower is of international standards and can be very useful in enhancing the global mobility for our technical manpower.

ENGINEERING ETHICS

Engineering Ethics is the set of rules and guidelines that engineers adhere to as a moral obligation to their profession and to the world. Engineering is a professional career that impact lives. When ethics is not followed, disaster often occurs; these disasters not only include huge monetary costs and environmental impacts, but also often result in the loss of human life. Engineering Ethics applies to every engineer and is very important. The National Society of Professional Engineers (NSPE) decides the overall standards and codes of ethics for all the engineering professions. The Preamble of the NSPE *Code of Conduct for Engineers* (2007) states:
"*Engineers shall at all times recognize that their primary obligation is to protect the safety, health, property, and welfare of the public. If their professional judgment is overruled under circumstances where the safety, health, property, or welfare of the public are endangered, they shall notify their employer or client and such other authority as may be appropriate.*"

Electrical Engineering Ethics
Electrical Engineering is a type of engineering profession that deals with the creation of better electronics. Since our society is heading towards an era of technology, where all members of society will be affected, it is especially important for electrical engineers to follow a code of engineering ethics. For electrical engineers, an important set of guidelines is the *Electrical Engineering Code of Ethics*, published by IEEE.
IEEE code of ethics
We, the members of the IEEE, in recognition of the importance of our technologies in affecting the quality of life throughout the world, and in accepting a personal obligation to our profession, its members and the communities we serve, do hereby commit ourselves to the highest ethical and professional conduct and agree:
1. to accept responsibility in making decisions consistent with the safety, health, and welfare of the public, and to disclose promptly factors that might endanger the public or the environment;
2. to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;
3. to be honest and realistic in stating claims or estimates based on available data;
4. to reject bribery in all its forms;
5. to improve the understanding of technology; its appropriate application, and potential consequences;
6. to maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations;
7. to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;
8. to treat fairly all persons and to not engage in acts of discrimination based on race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression;
9. to avoid injuring others, their property, reputation, or employment by false or malicious action;
10. to assist colleagues and co-workers in their professional development and to support them in following this code of ethics.

Engineering Ethics in College/Education

The main engineering ethics problem that college students are face with is academic integrity. Academic integrity can show itself in the form of cheating by copying someone's work, intentional cheating, plagiarism, and/or self-plagiarism.

However, professional ethics is something that can be learned even when it conflicts with personal ethics, as for example, a situation where you are personally okay with building a product that can harm the environment, yet save lives. You can learn professional ethics and realize that something that is harmful to the environment is not okay. Ethics codes can even help you see the bigger picture. For example, in the previous scenario, these codes can help you re-evaluate your ethics and realize that something that is harmful to the environment will eventually be harmful to the people around you and yourself.

Engineering Ethics in the Professional World

In the professional world, ethical engineering problems come up in many cases. One of these includes the case of a professional using someone else's work that is published in the widespread market of publication. Another is the case of a professional using someone else's work that is not published yet and stealing their idea. Engineers who have good engineering ethics often have a good sense of the value of life. They don't hesitate to admit that they made a mistake because they know that the cost of not owning up to your mistakes can have disastrous consequences. It might even cost a human life.

Engineering Ethics in Companies

Not only do individual engineers have to be conscious of engineering ethics, but also companies. Companies have to be aware of their Corporate Social Responsibility and Environmental Responsibility. Corporate Social Responsibility is a company's responsibility to give back to the community that they profit from and to behave ethically so that both they and their community can benefit. Environmental Responsibility is a business's initiative to leave the environment (where it is taking its resources from) the same, if not better, that it is found it.

BLOOM'S TAXONOMY

Definitions of the different levels of thinking skills in Bloom's taxonomy

1. Remember– recalling relevant terminology, specific facts, or different procedures related to information and/or course topics. At this level, a student can remember something, but may not really understand it.

2. Understand– the ability to grasp the meaning of information (facts, definitions, concepts, etc.) that has been presented.

3. Apply– being able to use previously learned information in different situations or in problem solving.

4. Analyze– the ability to break information down into its component parts. Analysis also refers to the process of examining information in order to make conclusions regarding cause and effect, interpreting motives, making inferences, or finding evidence to support statements/arguments.

5. Evaluate– being able to judge the value of information and/or sources of information based on personal values or opinions.

6. Create– the ability to creatively or uniquely apply prior knowledge and/or skills to produce new and original thoughts, ideas, processes, etc. At this level, students are involved in creating their own thoughts an idea.

List of Action Words Related to Critical Thinking Skills

REMEMBER	UNDERSTAND	APPLY	ANALYZE	EVALUATE	CREATE
Count	Associate	Add	Analyze	Appraise	Categorize
Define	Compute	Apply	Arrange	Assess	Combine
Describe	Convert	Calculate	Breakdown	Compare	Compile
Draw	Defend	Change	Combine	Conclude	Compose
Identify	Discuss	Classify	Design	Contrast	Create
Label	Distinguish	Complete	Detect	Criticize	Drive
List	Estimate	Compute	Develop	Critique	Design
Match	Explain	Demonstrate	Diagram	Determine	Devise
Name	Extend	Discover	Differentiate	Grade	Explain
Outline	Extrapolate	Divide	Discriminate	Interpret	Generate
Point	Generalize	Examine	Illustrate	Judge	Group
Quote	Give	Graph	Infer	Justify	Integrate
Read	examples	Interpolate	Outline	Measure	Modify
Recall	Infer	Manipulate	Point out	Rank	Order
Recite	Paraphrase	Modify	Relate	Rate	Organize
Recognize	Predict	Operate	Select	Support	Plan
Record	Rewrite	Prepare	Separate	Test	Prescribe
Repeat	Summarize	Produce	Subdivide		Propose
Reproduce		Show	Utilize		Rearrange
Select		Solve			Reconstruct
State Write		Subtract			Related
		Translate			Reorganize
		Use			Revise
					Rewrite
					Summarize
					Transform
					Specify

K.L.N.COLLEGE OF ENGINEERING, POTTAPALAYAM -630 612

ACADEMIC CALENDAR - ODD Semester of 2016 - 2017.

UG & PG COURSES – III, V, VII SEMESTER – SUMMARY (Revised as on 02.07.2016)

S.No	Date	Programme / Events	Day
June 2016			
1.	27.06.2016(Mon)	Faculty Meeting – I- Student development and training programmes: III Year B.E./B.Tech &PGCourses.(27 June-1st July 2016)	
2.	29.06.2016(Wed)	Student development and training programmes: IV Year B.E./B.Tech Courses 29th June – 2nd July2016	
3.	04.07.2016(Mon)	Reopening Day-III, V&VII Semester B. E / B. Tech, M.E classes Class Committee Meeting – I (4-9 July 2016)	01
4.	05.07.2016(Tues)	Student Counselor Meeting – I –	02
5.	06.07.2016(Wed)	IIPC & IDCA review meeting-I	03
6.	07.07.2016(Thu)	*Ramzan – Holiday*	
7.	09.07.2016(Sat)	Grievance redressal Committee Meeting.	05
8.	22.07.2016(Fri)	Class Test-I- (22nd – 28th July 2016)	15
9.	27.07.2016(Wed)	Anti-Ragging Committee Meeting. Faculty Meeting – II -	19
August 2016			
10.	01.08.2016(Mon)	*Commencement of Classes-First year B.E./B.Tech.*	22
11.	10.08.2016(Wed)	CIT – I – 10th – 17th August 2016	29
12.	15.08.2016(Mon)	*Independence Day – Holiday*	
13.	19.08.2016(Fri)	Student Counselor Meeting – II-	36
14.	23.08.2016(Tues)	Class Committee Meeting – II-	38
15.	25.08.2016(Thur)	*Krishna Jeyanthi – Holiday*	
16.	27.08.2016(Sat)	Parents – Teachers Meeting	41
17.	30.08.2016(Tues)	Class Test II – 30th Aug- 7th Sep 2016	43
September 2016			
18.	02.09.2016(Fri)	Faculty Meeting – III-	46
19.	05.09.2016(Mon)	*VinayagarChathurthi – Holiday*	
20.	13.09.2016(Tues)	*Bakrid – Holiday*	
21.	20.09.2016(Tues)	CIT – II– 20th – 26th Sep 2016.	57
22.	28.09.2016 (Wed)	Model Practical Examinations 28th Sep – 4th Oct. 2016.	64
23.	30.09.2016(Fri)	NBA-CO Attainment-Even semester of 2015-2016-Last date for submission.	66
October 2016			
24.	02.10.2016(Sun)	*Gandhi Jeyanthi& Holiday*	
25.	03.10.2016 (Mon)	Anna University Practical Examinations – Tentative – Slot – I-Tentative Students feedback on faculty, college facility, Course Outcome Survey	67
26.	06.10.2016 Thurs)	Class Test-III-6th -8th Oct 2016	70
27.	08.10.2016(Sat)	Class Committee Meeting – III- Faculty Meeting – IV	72
28.	10.10.2016(Mon)	*Ayutha Pooja- Holiday*	
29.	11.10.2016(Tue)	*VijayaThasami – Holiday*	
30.	12.10.2016(Wed)	*Moharam - Holiday*	
31.	13.10.2016(Thurs)	Anna University Practical Examinations – Slot – II- Tentative	73
32.	19.10.2016(Wed)	Program Assessment Committee meeting-PO-Assessment-2012-2016 Batch-Planning for DAC meeting-	77
33.	20.10.2016(Thurs)	Last Working Day-III,V,VII Semester B.E./B.Tech,	78
34.	24.10.2016(Mon)	Commencement of end semester Examinations (III, V & VII semester B.E./B.Tech)	81
35.	29.10.2016(Sat)	*Deepavali – Holiday*	
November 2016			
	08.11.2016(Tues)	Last Working Day – III , V semester ,M.E / MCA	92
	14.11.2016 (Mon)	Commencement of end semester Examinations – III , V semester M.E/ MCA	97
	15.11.2016 (Tues)	Last Working Day – III semester MBA	98
	21.11.2016 (Mon)	Commencement of end semester Examinations – III semester MBA	102

Reopening day for the staff after Winter Vacation: 21.12.2016 (Monday)

Student Development and Training Programmes - II, III year UG: 21-31 Dec'2016

Reopening day for the Even semester of 2016 – 2017: 26.12.2016 (Monday).

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM-630612.
Department of Electrical and Electronics Engineering
CLASS WISE TIME TABLE -2016-2017 (ODD)

Batch: 2014-2018 **Year/Sem/Sec: III / V / A**
Faculty In-charge:A.P.S. Ramalakshmi **Staff Code: 10235059**

TIME / DAY	09.00 – 09.50	09.50 – 10.40		10.55-11.45	11.45-12.35		01.15-02.05	02.05-02.55	02.55-03.45
MON	PSA NVRV	CS APSR	B	EM-II SMK	EM-II SMK	L	PSA NVRV	PE MBL	PE MBL
TUE	CS APSR	C&I lab APSR,MBL	R	/ EM Lab-II / EJ, JS		U	PPE MB	MPMC EJ	CS APSR
WED	MPMC EJ	CS(T) APSR,MBL	E	PSA NVRV	PE MBL	N	EM-II/CS SMK/APSR	PPE MB	PSA NVRV
THU	PE MBL	PPE MB	A	MPMC EJ	CSSS lab TSP, MBL	C	CSSS – lab BASED TSP, MBL		
FRI	PPE MB	MPMC EJ	K	EM-II SMK	EM-II(t) SMK, JS	H	C&I lab/EM Lab-II APSR, MBL/EJ, JS		

Batch: 2014-2018 **Year/Sem/Sec: III / V / B**
Faculty In-charge: J. Merlin **Staff Code: 10235043**

TIME / DAY	09.00 – 09.50	09.50 – 10.40		10.55-11.45	11.45-12.35		01.15-02.05	02.05-02.55	02.55-03.45
MON	PSA CMS	MPMC JM	B	PE SR	PE SR	*L*	C&I lab / EM Lab-II JM,APSR / PLT,EJ		
TUE	PPE KRJ	PSA CMS	R	EM-II/CS SMK/SV	CSSS lab PPR,VS	*U*	CSSS – lab BASED PPR,VS		
WED	CS SV	PPE KRJ	E	EM-II SMK	EM-II SMK	*N*	C&I lab / EM Lab-II JM,RJR / PLT,JS		
THU	MPMC JM	CS(t) SV, APSR	A	EM-II SMK	EM-II(t) SMK, CVR	*C*	PSA CMS	CS SV	PPE KRJ
FRI	PE SR	CS SV	K	MPMC JM	PPE KRJ	*H*	PE SR	PSA CMS	MPMC JM

Batch : 2014-2018 **Year/Sem/Sec : III / V / C**
Faculty In-charge: A. Marimuthu **Staff Code: 10220003**

TIME / DAY	**09.00 – 09.50**	**09.50 – 10.40**		**10.55-11.45**	**11.45-12.35**		**01.15-02.05**	**02.05-02.55**	**02.55-03.45**
MON	PE SV	EM-II JS	**B**	PPE SPRR	PSA KG	***L***	MPMC RJR	CS AM	EM-II(t) JS, MGK
TUE	PPE SPRR	PSA KG	**R**	CS AM	MPMC RJR	***U***	C&I lab / EM Lab-II AM,MBL / JS, SPRR		
WED	PSA KG	MPMC RJR	**E**	EM-II JS	MPMC RJR	***N***	CS(T) AM, MBL	PE SV	PPE SPRR
THU	CS AM	EM-II/CS JS/AM	**A**	EM-II JS	PE SV	***C***	C&I lab / EM Lab-II AM,JM / JS, SPRR		
FRI	CSSS - lab BASED SSKK, RJR		**K**	CSSS - lab BASED SSKK, RJR		***H***	PPE SPRR	PSA KG	PE SV

STAFF NAME			SUB CODE	SUBJECT NAME	ABBR
A -Sec	B – Sec	C – Sec			
N.Vimal Radha Vignesh	C.Muthamilselvi	Dr.K.Gnanambal	EE6501	Power System Analysis	PSA
E.Jeyasri	J.Merlin	R. Jeyarohini	EE6502	Microprocessors and Microcontrollers	MPMC
K.R. Jeyavelumani	M.Balamurugan	S.P.Rajaram	ME6701	Power Plant Engineering	PPE
M. Bharani lakshmi	S.Rajalingam	Dr.S.Venkatesan	EE6503	Power Electronics	PE
Dr.S.M.Kannan	Dr.S.M.Kannan	J. Sangeetha	EE6504	Electrical Machines II	EM-II
A.P.S. Rama lakshmi	Dr.S.Venkatesan	A.Marimuthu	IC6501	Control Systems	CS
A.P.S. Rama lakshmi	J.Merlin	A.Marimuthu	EE6511	Control and Instrumentation Laboratory	C&I LAB
M. Bharani lakshmi	V. Sindhu	R. Jeyarohini	GE6674	Communication Skills and Soft Skills- Laboratory Based	CSSS LAB Based
E.Jeyasri	P.Loganthurai	J. Sangeetha	EE6512	Electrical Machines Laboratory - II	EM LAB-II

Syllabus

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	EE6501	Power System Analysis	3	0	0	3
2	EE6502	Microprocessors and Microcontrollers	3	0	0	3
3	ME6701	Power Plant Engineering	3	0	0	3
4	EE6503	Power Electronics	3	0	0	3
5	EE6504	Electrical Machines - II	3	1	0	4
6	IC6501	Control Systems	3	1	0	4
PRACTICAL						
7	EE6511	Control and Instrumentation Laboratory	0	0	3	2
8	GE6563	Communication Skills - Laboratory Based	0	0	4	2
9	EE6512	Electrical Machines Laboratory - II	0	0	3	2
TOTAL			18	2	10	26

EE6501 POWER SYSTEM ANALYSIS L T P C 3 0 0 3

OBJECTIVES:

- To model the power system under steady state operating condition.
- To apply numerical methods to solve the power flow problem.
- To model and analyze the system under faulted conditions.
- To model and analyze the transient behaviour of power system when it is subjected toa fault.

UNIT I INTRODUCTION 9

Need for system planning and operational studies – basic components of a power system.-Introduction to restructuring - Single line diagram – per phase and per unit analysis – Generator - transformer – transmission line and load representation for different power system studies.- Primitive network - construction of Y-bus using inspection and singular transformation methods – z-bus.

UNIT II POWER FLOW ANALYSIS 9

Importance of power flow analysis in planning and operation of power systems - statement of power flow problem - classification of buses - development of power flow model in complex variables form - iterative solution using Gauss-Seidel method - Q-limit check for voltage controlled buses – power flow model in polar form - iterative solution using Newton-Raphson method.

UNIT III FAULT ANALYSIS – BALANCED FAULTS 9

Importance of short circuit analysis - assumptions in fault analysis - analysis using Thevenin‘s theorem - Z-bus building algorithm - fault analysis using Z-bus – computations of short circuit capacity, post fault voltage and currents.

UNIT IV FAULT ANALYSIS – UNBALANCED FAULTS 9

Introduction to symmetrical components – sequence impedances – sequence circuits of synchronous machine, transformer and transmission lines - sequence networks analysis of single line to ground, line to line and double line to ground faults using Thevenin‘s theorem and Z-bus matrix.

UNIT V STABILITY ANALYSIS 9

Importance of stability analysis in power system planning and operation - classification of power system stability - angle and voltage stability – Single Machine Infinite Bus (SMIB) system: Development of swing equation - equal area criterion - determination of critical clearing angle and time – solution of swing equation by modified Euler method and Runge-Kutta fourth order method.

TOTAL : 45 PERIODS

OUTCOMES:

Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. Nagrath I.J. and Kothari D.P., Modern Power System Analysis, Tata McGraw-Hill, Fourth Edition, 2011.
2. John J. Grainger and W.D. Stevenson Jr.,Power System Analysis‘, Tata McGraw-Hill, Sixth reprint, 2010.
3. P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan, Electrical Power Systems- Analysis, Security and Deregulation‘, PHI Learning Private Limited, New Delhi, 2012.

REFERENCES:

1. HadiSaadat, _Power System Analysis‘, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
2. Kundur P.,Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
3. Pai M A, Computer Techniques in Power System Analysis‘, Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
4. J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, Power System Analysis &Design‘, Cengage Learning, Fifth Edition, 2012.
5. Olle. I. Elgerd, _Electric Energy Systems Theory – An Introduction‘, Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2012.
6. C.A.Gross, —Power System Analysis, Wiley India, 2011.

EE6502 MICROPROCESSORS AND MICROCONTROLLERS L T P C 3 0 0 3

OBJECTIVES:

- To study the Architecture of uP8085 &uC 8051
- To study the addressing modes & instruction set of 8085 & 8051.
- To introduce the need & use of Interrupt structure 8085 & 8051.
- To develop skill in simple applications development with programming 8085 & 8051
- To introduce commonly used peripheral / interfacing

UNIT I 8085 PROCESSOR 9

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.

UNIT II PROGRAMMING OF 8085 PROCESSOR 9

Instruction -format and addressing modes – Assembly language format – Data transfer, data manipulation& control instructions – Programming: Loop structure with counting & Indexing – Look up table - Subroutine instructions - stack.

UNIT III 8051 MICRO CONTROLLER 9

Hardware Architecture, pintouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts-Comparison to Programming concepts with 8085.

UNIT IV PERIPHERAL INTERFACING 9

Study on need, Architecture, configuration and interfacing, with ICs: 8255 , 8259 , 8254,8237,8251, 8279 ,- A/D and D/A converters &Interfacing with 8085& 8051.

UNIT V MICRO CONTROLLER PROGRAMMING & APPLICATIONS 9

Data Transfer, Manipulation, Control Algorithms& I/O instructions – Simple programming exercises- key board and display interface – Closed loop control of servo motor- stepper motor control – Washing Machine Control.

TOTAL : 45 PERIODS

OUTCOMES:

Ability to understand and analyse, linear and digital electronic circuits.

To understand and apply computing platform and software for engineering problems.

TEXT BOOKS:

1. Krishna Kant, —Microprocessor and Microcontrollers , Eastern Company Edition, Prentice Hall of India, New Delhi , 2007.

2. R.S. Gaonkar, _Microprocessor Architecture Programming and Application', with 8085, WileyEastern Ltd., New Delhi, 2013.

3. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.

REFERENCES:

1. Muhammad Ali Mazidi& Janice GilliMazidi, R.D.Kinely _The 8051 Micro Controller andEmbedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.

2. N.Senthil Kumar, M.Saravanan, S.Jeevananthan, Microprocessors and Microcontrollers, Oxford,2013.

3. Valder – Perez, —Microcontroller – Fundamentals and Applications with Pic,Yeesdee Publishers, Tayler & Francis, 2013.

ME6701 POWER PLANT ENGINEERING L T P C 3 0 0 3

OBJECTIVES:

Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

UNIT I COAL BASED THERMAL POWER PLANTS 10

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 10

Otto, Diesel, Dual & Brayton Cycle - Analysis &Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III NUCLEAR POWER PLANTS 7

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: B*oiling Water Reactor* (BWR), P*ressurized Water Reactor* (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV POWER FROM RENEWABLE ENERGY 10

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, *Solar* Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 8

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the Students can able to understand different types of power plant, and its functions and their flow lines and issues related to them.
- Analyse and solve energy and economic related issues in power sectors.

TEXT BOOK:

1. P.K. Nag, Power Plant Engineering, Tata McGraw – Hill Publishing Company Ltd., ThirdEdition,2008.

REFERENCES:

1. M.M. El-Wakil, Power Plant Technology, Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Black & Veatch, Springer, Power Plant Engineering, 1996.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, Standard Handbook of Power Plant Engineering, Second Edition, McGraw – Hill, 1998.
4. Godfrey Boyle, Renewable energy, Open University, Oxford University Press in association with the Open University, 2004.

EE6503 POWER ELECTRONICS L T P C 3 0 0 3

OBJECTIVES:

- To get an overview of different types of power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers
- To study the operation, switching techniques and basics topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and various configurations.

UNIT I POWERSEMI-CONDUCTOR DEVICES 9

Study of switching devices, Diode, SCR,TRIAC, GTO, BJT, MOSFET, IGBT-Static and Dynamic characteristics - Triggering and commutation circuit for SCR- Design of Driver and snubber circuit.

UNIT II PHASE-CONTROLLED CONVERTERS 9

2-pulse,3-pulse and 6-pulseconverters– performance parameters –Effect of source inductance–Gate Circuit Schemes for Phase Control–Dual converters.

UNIT III DC TO DC CONVERTER 9

Step-down and step-up chopper-control strategy–Forced commutated chopper–Voltage commutated, Current commutated, Load commutated, Switched mode regulators- Buck, boost, buck- boost converter, Introduction to Resonant Converters.

UNIT IV INVERTERS 9

Single phase and three phase voltage source inverters(both 120^0modeand 180^0mode)–Voltage& harmonic control--PWM techniques: Sinusoidal PWM, modified sinusoidal PWM - multiple PWM –Introduction to space vector modulation –Current source inverter.

UNIT V AC TO AC CONVERTERS 9

Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control –Multistage sequence control -single phase and three phase cyclo converters –Introduction to Matrix converters.

TOTAL:45 PERIODS

OUTCOMES:

Ability to understand and analyse, linear and digital electronic circuits.

TEXT BOOKS:

1. M.H.Rashid, Power Electronics: Circuits, Devices and Applications, Pearson Education, PHI Third Edition, New Delhi, 2004.
2. P.S.Bimbra —Power Electronics- Khanna Publishers, third Edition, 2003.
3. L. Umanand, — Power Electronics Essentials and Applications, Wiley, 2010.

REFERENCES:

1. Joseph Vithayathil,‘ Power Electronics, Principles and Applications‘, McGraw Hill Series, 6th Reprint, 2013.
2. Ashfaq Ahmed Power Electronics for Technology Pearson Education, Indian reprint, 2003.
3. Philip T. Krein, —Elements of Power Electronics Oxford University Press, 2004 Edition.
4.Ned Mohan, Tore. M. Undel and, William. P. Robbins, Power Electronics: Converters, Applications and Design‘, John Wiley and sons, third edition,2003.
5. Daniel.W.Hart, —Power Electronics , Indian Edition, Mc Graw Hill, 3rd Print, 2013.
6. M.D. Singh and K.B. Khanchandani, —Power Electronics,McGraw Hill India, 2013.

EE6504 ELECTRICAL MACHINES – II L T P C 3 1 0 4

OBJECTIVES:

- To impart knowledge on Construction and performance of salient and non – salient type synchronous generators.
- To impart knowledge on Principle of operation and performance of synchronous motor.
- To impart knowledge on Construction, principle of operation and performance of induction machines.
- To impart knowledge on Starting and speed control of three-phase induction motors.
- To impart knowledge on Construction, principle of operation and performance of single phase induction motors and special machines.

UNIT I SYNCHRONOUS GENERATOR 9

Constructional details – Types of rotors –winding factors- emf equation – Synchronous reactance – Armature reaction – Phasor diagrams of non-salient pole synchronous generator connected to infinite bus--Synchronizing and parallel operation – Synchronizing torque -Change of excitation and mechanical input-Voltage regulation – EMF, MMF, ZPF and A.S.A methods – steady state power- angle characteristics– Two reaction theory –slip test -short circuit transients - Capability Curves

UNIT II SYNCHRONOUS MOTOR 9

Principle of operation – Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power Developed-Hunting – natural frequency of oscillations –damper windings-synchronous condenser.

UNIT III THREE PHASE INDUCTION MOTOR 9

Constructional details – Types of rotors –- Principle of operation – Slip –cogging and crawling- Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram – Separation of losses – Double cage induction motors –Induction generators – Synchronous induction motor.

UNIT IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 9

Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star-delta starters – Speed control – Voltage control, Frequency control and pole changing – Cascaded Connection-V/f control – Slip power recovery Scheme-Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – Capacitor-start capacitor run Induction motor- Shaded pole induction motor - Linear induction motor – Repulsion motor - Hysteresis motor - AC series motor- Servo motors- Stepper motors - introduction to magnetic levitation systems.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

Ability to model and analyze electrical apparatus and their application to power system

TEXT BOOKS:

1. A.E. Fitzgerald, Charles Kingsley, Stephen. D.Umans, Electric Machinery, TataMc Graw Hill publishing Company Ltd, 2003.

2. D.P. Kothari and I.J. Nagrath, Electric Machines, Tata McGraw Hill Publishing Company Ltd, 2002.

3. P.S. Bhimbhra, Electrical Machinery‘, Khanna Publishers, 2003.

REFERENCES:

1. M.N.Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2009.

2. Charless A. Gross, Electric /Machines, —CRC Press, 2010.

3. K. Murugesh Kumar, Electric Machines‘, Vikas Publishing House Pvt. Ltd, 2002.

4. Syed A. Nasar, Electric Machines and Power Systems: Volume I, Mcgraw -Hill College; International ed Edition, January 1995.

5. Alexander S. Langsdorf, Theory of Alternating-Current Machinery, Tata McGraw Hill Publications, 2001.

IC6501 CONTROL SYSTEMS L T P C 3 1 0 4

OBJECTIVES:

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To introduce stability analysis and design of compensators
- To introduce state variable representation of physical systems and study the effect of state feedback

UNIT I SYSTEMS AND THEIR REPRESENTATION 9

Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Synchros – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

UNIT II TIME RESPONSE 9

Time response – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Root locus construction- Effects of P, PI, PID modes of feedback control –Time response analysis.

UNIT III FREQUENCY RESPONSE 9

Frequency response – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications- Effect of Lag, lead and lag-lead compensation on frequency response- Analysis.

UNIT IV STABILITY AND COMPENSATOR DESIGN 9

Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion- Performance criteria – Lag, lead and lag-lead networks – Lag/Lead compensator design using bode plots.

UNIT V STATE VARIABLE ANALYSIS 9

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability –Effect of state feedback.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

Ability to understand and apply basic science, circuit theory, theory control theory, Signal processing and apply them to electrical engineering problems.

TEXT BOOKS:

1. M. Gopal, Control Systems, Principles and Design‘, 4th Edition, Tata McGraw Hill, New Delhi,2012
2. S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.
3. Dhanesh. N. Manik, Control System, Cengage Learning, 2012.

REFERENCES:

1. Arthur, G.O.Mutambara, Design and Analysis of Control; Systems, CRC Press, 2009.
2. Richard C. Dorf and Robert H. Bishop, — Modern Control Systems , Pearson Prentice Hall,2012.
3. Benjamin C. Kuo, Automatic Control systems, 7th Edition, PHI, 2010.
4. K. Ogata, Modern Control Engineering‘, 5th edition, PHI, 2012.
5. S.N.Sivanandam, S.N.Deepa, Control System Engineering using Mat Lab, 2nd Edition, Vikas Publishing, 2012.
6. S.Palani, Anoop. K.Jairath, Automatic Control Systems including Mat Lab, Vijay Nicole/ Mcgraw Hill Education, 2013.

EE6511 CONTROL AND INSTRUMENTATION LABORATORY LT P C 0 0 3 2

OBJECTIVES:

To provide knowledge on analysis and design of control system along with basics of instrumentation

LIST OF EXPERIMENTS: CONTROLSYSTEMS:

1. P, PI and PID controllers
2. Stability Analysis
3. Modeling of Systems – Machines, Sensors and Transducers
4. Design of Lag, Lead and Lag-Lead Compensators
5. Position Control Systems
6. Synchro-Transmitter- Receiver and Characteristics
7. Simulation of Control Systems by Mathematical development tools.

INSTRUMENTATION:

8. Bridge Networks –AC and DC Bridges
9. Dynamics of Sensors/Transducers a. Temperature b. Pressure c. Displacement d. Optical e. Strain f. Flow
10. Power and Energy Measurement
11. Signal Conditioning
    a. Instrumentation Amplifier
    b. Analog – Digital and Digital –Analog converters (ADC and DACs)
12. Process Simulation.

GE6563 COMMUNICATION SKILLS – LABORATORY BASED LT P C 0 0 4 2

OBJECTIVES:

- To provide opportunities to learners to practice their communicative skills to make them become proficient users of English.
- To enable learners to fine-tune their linguistic skills (LSRW) with the help of technology to communicate globally.
- To enhance the performance of learners at placement interviews and group discussions and other recruitment procedures.

UNIT I LISTENING/VIEWING 10

Listening and note-taking – Listening to telephonic conversations – Ted talks – Inspiring Speeches – Watching documentaries on personalities, places, socio-cultural events, TV news programmes and discussions to answer different kinds questions, viz., identifying key idea and comprehension questions… so on.

UNIT II SPEAKING 12

Conversation practice – Interview – Group Discussion – Introducing oneself and others – Role play – Debate – Presentation – Panel discussion – Neutral accent.

UNIT III READING 10

Different genres of text (literature, media, technical) for comprehension – Reading strategies like note-making – reading graphs, charts and graphic organizer – Sequencing sentences – reading online sources like e-books, e-journals and e-newspapers.

UNIT IV WRITING 12

Blogs – Tweets – Online resume/ – e-mails – SMS and Online texting – Report writing – Describing charts and tables – Writing for media on current events.

UNIT V VOCABULARY 8

Idioms and Phrases – Proverbs – Collocations – Chunks of language.

UNIT VI GRAMMAR 8

Sentence structures – Subject-Verb agreement – Pronoun-Antecedent agreement – Tense forms – Active and passive voices – Direct and Indirect speeches – Cohesive devices.

TOTAL: 60 PERIODS

TEACHING METHODS:
1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.
4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for graining proficiency and better participation in the class.

EE6512 ELECTRICAL MACHINES LABORATORY - II LT P C 0 0 3 2

OBJECTIVES:

To expose the students to the operation of synchronous machines and induction motors and give them experimental skill.

LIST OF EXPERIMENTS:

1. Regulation of three phase alternator by emf and mmf methods.
2. Regulation of three phase alternator by ZPF and ASA methods.
3. Regulation of three phase salient pole alternator by slip test.
4. Measurements of negative sequence and zero sequence impedance of alternators.
5. V and Inverted V curves of Three Phase Synchronous Motor.
6. Load test on three-phase induction motor.
7. No load and blocked rotor test on three-phase induction motor(Determination of equivalent circuit parameters).
8. Separation of No-load losses of three-phase induction motor.
9. Load test on single-phase induction motor.
10. No load and blocked rotor test on single-phase induction motor.
11. Study of Induction motor Starters

TOTAL : 45 PERIODS

OUTCOMES:

Ability to model and analyze electrical apparatus and their application to power system

Format No.:11
Issue No.: 02
Revision No.: 01
Date: 23/06/12

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM 630 612

Lecture Schedule

Course/Branch : B.E/EEE Subject : Power System Analysis
Duration : July2016 - Oct2016 Subject Code : EE6501
Semester : VSection: C Staff Handling: Dr.K.Gnanambal
Regulation :2013 `

AIM:

To understand the necessity and to become familiar with the modeling of power system and components and to apply different methods to analyze power system for the purpose of system planning and operation.

OBJECTIVES:

- To model the power system under steady state operating condition. To apply efficient numerical methods to solve the power flow problem.
- To model and analyze the power systems under abnormal (or) fault conditions.
- To model and analyze the transient behavior of power system when it is subjected to a fault.

Prerequisites: Numerical Methods, Transmission and Distribution

COURSE OUTCOMES: After the course, the student should be able to:

CO	Course Outcomes	POs	PSOs
C301.1	Explain the operation of various power system components, Draw the per unit diagram and form the Y-bus matrix for the power system.	1,2,4,5,7	1
C301.2	Develop the power flow equation for power system problems and Determine the line flows using various algorithm	1,2,4,5,7	1
C301.3	Illustrate the types of faults and their effects, Calculate the fault currents for symmetrical fault condition.	1,2,4,5,7	1
C301.4	Draw the sequence network for L-G, L-L and L-L-G fault of the power system and Determine the fault current incase of L-G, L-L and D-L-G fault	1,2,4,5,7	1
C301.5	Explain the concept of power system stability, Analyze the stability of single machine infinite bus system	1,2,4,5,7	1

Sl. No	Date	Period Number	Topics to be Covered	Book No [Page No]
UNIT - I : INTRODUCTION			Target Periods 9	
1			Introduction - Modern power system (or) electric energy system - Analysis for system planning and operational studies	T1 [4], R2[5-11] T2[7]
2			Basic components of a power system	T1 [4]
3			Modelling of Generator	T1 [4], R2[76-80]
4			Modelling of Transformer with off-nominal tap ratio	T1[5,6],R2[195-204]
5			Modeling of Transmission line and load	T1[6-8], T2[9-12] R2[36-37]
6			Per unit system, Single line diagram representation	T1[36-42], T1[88-90]
7			Impedance and reactance diagrams, Change of base	T1[90-101]
8			Primitive network and network matrices. Formation of Y-bus	Material
9			Simple building algorithm for the formation of Z-Bus matrix	T1[190-195]
10			Tutorial	
11			Tutorial	
12			Tutorial	
*Class Test-I(22.7.16-28.7.16)*Total Planned periods -12				
Assignment-I Date of Submission:19.7.16				

UNIT - II : POWER FLOW ANALYSIS Target Periods: 9				
13			Importance of power flow analysis in planning and operation of power systems.	T1[189]
14			Statement of power flow problem - classification of buses into P-Q buses, P-V (voltage controlled) buses and slack bus.	T1[208]
15				
16			Development of Power flow model in complex variables form and polar variables form.	T1[26-30]
17			Iterative solution using Gauss-Seidel method including Q-limit check for voltage controlled buses - algorithm and flow chart.	T1[209-220] T2[247-254] R2[335-342]
18				
19			Iterative solution using Newton-Raphson (N-R) method (polar form) including Q-limit check and bus switching for voltage-controlled buses - Jacobian matrix elements – algorithm and flow chart. Development of Fast Decoupled Power Flow (FDPF) model and iterative solution – algorithm and flowchart; Comparison of solution techniques	T1[232-240] T2[257-262] R2[342-356] T1[240-245] T2[266-268] R2[368-373]
20				
21				
22			Tutorial	
23			Tutorial	
24			Tutorial	
25			Content Beyond Syllabus – Load Flow Analysis (Radial Load Flow)	Journals
26			Seminar I	
*CIT – I (10.8.16 to 17.8.16)*Total Planned periods -14				
Assignment II *Date of Submission: 9.8.16*				
UNIT- III : FAULT ANALYSIS – BALANCED FAULTS Target Periods : 9				
27			Introduction to fault analysis. Importance short circuit (or) for fault analysis - basic assumptions in fault analysis of power systems.	T1[353], R2[308]
28			Symmetrical (or) balanced three phase faults – problem formulation Internal voltages of loaded machines under fault conditions.	T1[354-361], R2[383-390]
29				
30				T2[376-388]
31				
32			Fault analysis using Z-bus matrix – algorithm and flow chart	T1[363-368]
33				
34			Tutorial	
35			Tutorial	
36			Tutorial	
Class Test-II(30.8.16-7.9.16) Total Planned periods -12				
Assignment III *Date of Submission:26.8.16*				
UNIT- IV : FAULT ANALYSIS – UNBALANCED FAULTS Target Periods :9				
37			Introduction to symmetrical components – sequence impedances – sequence networks	T1[399, 407-420], T2[400-406]R2[417-418]
38				
39			Single Line-Ground fault analysis - Derivation	T1[421-422], R2[482-488]
40			Solution of problems	T1[421-422], R2[482-488]
41			Line-Line fault analysis – Derivation and solution of problems	T1[423-425],

				R2[494-512]
42			Double Line-Ground fault analysis Derivation	T1[425-431]
43				
44			*Quiz I*	
45			Tutorial	
46			Tutorial	
47			Tutorial	
*CIT – II (20.9.16 to 26.9.16)*Total Planned periods -13				
UNIT- V : STABILITY ANALYSIS Target Periods: 9				
48			Importance of stability analysis in power system planning and operation	T1[460]
49			classification of power system stability - angle and voltage stability	R1[17-37]
50			Simple treatment of angle stability into small-signal and large-signal (transient) stability Single Machine Infinite Bus (SMIB) system	R1[17-37]
51			Development of swing equation	T1[461-464], R2[698-702]
52			Equal area criterion and solution of SMIB system problems	T1[486-488] R2[717-726]
53			Solution of swing equation by numerical integration techniques	R1[836-837]
54			Determination of critical clearing angle and time by using Runge - Kutta method	R1[838-841]
55			Determination of critical clearing angle and time by using Modified Euler method	R1[836-838]
56			Tutorial	
57			Tutorial	
58			Tutorial	
*Class Test-III(6.10.15-8.10.15)*Total Planned periods -12				

TEXT BOOKS

1. HadiSaadat, “Power System Analysis”, Tata McGraw Hill Publishing Company, NewDelhi, 2002.
2. Olle. I. Elgerd, “Electric Energy Systems Theory – An Introduction”, Tata McGraw Hill , Second Edition, 2003.

REFERENCE BOOKS

1. Kundur P., “Power System Stability and Control”, Tata McGraw Hill, Publications,1994.
2. John J. Grainger and W.D. Stevenson Jr., “Power System Analysis”, McGraw Hill, 1994.
3. Nagrath I.J. and Kothari D.P., “Modern Power System Analysis”, Tata McGraw-Hill , New Delhi, 1990.
4.Nagasarkar K.andSukhija M.S, “Power System Analysis”, Oxford University Press, 2007.

NPTEL Link:

https://www.youtube.com/watch?v=fBm1dr_gRBk&list=PL36A60B630E8C7B56&index=1
https://www.youtube.com/watch?v=BYtY61hOiaw&list=PL36A60B630E8C7B56&index=2

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C301.1	2	3	-	2	1	-	1	-	-	-	-	-	2	-	-
C301.2	2	3	-	2	1	1	1	-	-	-	-	-	2	-	-
C301.3	2	3	-	2	1	1	1	-	-	-	-	-	2	-	-
C301.4	2	3	-	2	1	1	1	-	-	-	-	-	2	-	-
C301.5	2	3	-	2	1	1	1	-	-	-	-	-	2	-	-
C301	2	3	-	2	1	1	1	-	-	-	-	-	2	-	-

Content Beyond Syllabus Added(CBS)	POs strengthened / vacant filled	CO / Unit
Load flow analysis (Radial Load Flow)	PO5 (3),PO6 (3),PO7 (3)(strengthened)	C301.2 / II

Format No.:11
Issue No.: 02
Revision No.: 01
Date: 23/06/12

K.L.N. COLLEGE OF ENGINEERING - 630612
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
LECTURE SCHEDULE

Degree/Program: B.E/EEE Course code & Name: EE6502 - Microprocessors and Microcontrollers
Duration : Jul'16- Oct'16 Semester : V Section : A, B, C
Regulation ~~2008/2010~~/2013:2013 AUC/~~AUT/AUM~~: AUC
Staff handling: J.Merlin, E.Jeyasri, R.Jeyarohini

AIM:

To introduce Microprocessor Intel 8085 and Micro Controller 8051

OBJECTIVE:

- To study the Architecture of µP8085 &µC 8051
- To study the addressing modes & instruction set of 8085 & 8051.
- To introduce the need & use of Interrupt structure 8085 & 8051.
- To develop skill in simple applications development with programming 8085 & 8051
- To introduce commonly used peripheral / interfacing

PRE – REQUISITE : Digital Logic Circuits

COURSE OUTCOMES: After the course, the student should be able to:

CO	Course Outcomes	POs	PSOs
C302.1	Describe the basic Architecture of 8085 Microprocessor and working of all blocks of the processor, IO and memory interfacings with necessary timing diagrams.	1,7,5	PSO1
C302.2	Classify the instructions with the help of Addressing modes of 8085 with necessary programs.	1,3,2,5	PSO2
C302.3	Explain the basic Architecture of 8051 Microcontroller with working of various blocks of the controller like Interrupts, Timer, IO ports etc. with necessary timing diagram and compare the programming concepts with 8085.	1,7,5	PSO1
C302.4	Analyze the architecture of various Interfacing Devices like 8255 PPI, 8259 PIC, 8251 USART, 8279, 8253, ADC and DAC and Programming of all the Interfacing IC's.	1,3,2,5	PSO2
C302.5	Apply the knowledge of programming concepts of 8051 Microcontroller for various applications like keyboard display interface, servo motor etc.,	1,3,2,5	PSO2

S.No	Date	Period Number	Topics to be Covered	Book No [Page No]
UNIT I - (*8085 Processor*) Target periods : 9				
			Architecture &Pinouts with signals of 8085 Processor	2(71-92), 1(22-30), 4(73-75),6(1-3to1-11)
			Functional Building Blocks of Processor	6(1-3 to1-11)
			Memory Interfacing in 8085	2(71-92), 1(22-30), 1(31-46),6(9-4 to9-16)
			I/O interfacing of 8085	1(31-46), 4(130-155), 6(10-2 to 10-11)
			Timing diagram of 8085	1(66-74), 4(122-124), 6(5-2 to 5-19)
			Interrupt structure of 8085	4(141-153),6(4-2 to 4-16)
			Quiz	
Class Test I – 24.07.2016				
UNIT II - (*Programming of 8085 Processor*) Target periods :9				
			Instruction format & Addressing modes	2(102-109),4(79-112), 6(2-2,2-3,2-31 to 2-33)

			Assembly language format	6(2-37 to 2-41)
			Data transfer & Arithmetic instructions	6(2-4 to 2-19)
			Data manipulation & control instructions	6(2-19 to 2-31)
			Programming: Loop structure with counting & indexing	2(102-109), 4(79-112), 1(Appendix F)
			Look up table, sub routines & stack	Notes
Assignment –1			*Date of Announcement : 05.08.2016*	*Date of Submission : 11.08.2016*
CIT – I – 12.08.2016				
UNIT III–*(8051 Microcontroller)*			Target Periods: 9	
			Functional block diagram with Memory organization	3(54-66, 490-493), 6(17-3 to 17-15)
			Instruction format & Addressing modes	3(119-185), 6(18-2 to 18-5)
			Interrupt structure	3(82-86), 6(19-37 to 19-43)
			Timing diagram	6(17-15 to 17-20)
			Timer	3(72-76), 6(19-9 to 19-19)
			I/O ports	3(66-70), 6(19-2 to 19-4)
			Serial communication	3(287-306),6(19-27to19-32)
			Seminar	
Class Test II – 02.09.2016				
UNIT IV - (*Peripheral Interfacing*)			Target Periods :9	
			Study of Architecture and programming of 8255 PPI	1(442-458), 4(134-141), 6(11-2to11-9,11-12 to11-21)
			Study of Architecture and programming of 8259 PIC	6(12-2 to 12-15)
			Study of Architecture and programming of 8254 PIC	NPTEL Material
			Study of Architecture and programming of 8237 PIC	NPTEL Material
			Study of Architecture and programming of 8251 USART	1(442-458), 6(13-7 to 13-17, 13-20)
			Study of Architecture and programming of 8279 Key board display controller	1(431-438), 4(835-866), 6(14-15 to 14-34)
			A/D converter interfacing with 8085& 8051	3(194-201),6(16-12 to16-19)
			D/A converter interfacing with 8085& 8051	3(353), 6(16-2 to 16-8)
Assignment –2			*Date of Announcement : 15.09.2016*	*Date of Submission :22.09.2016*
CIT – II – 24.09.2016				
UNIT V - *(Microcontroller Programming & Applications)*			Target Periods:9	
			Data Transfer, Arithmetic, Logical & Manipulation instructions	3(119-185), 6(18-5 to 18-40)
			Control & I/O instructions	3(119-185), 6(18-5 to 18-40)
			Simple programming exercises	3(89-113), Notes

			Key board and display interface	3(231-251),6(20-2 to 20-19)
			Closed loop control of servo motor	6(20-21 to 20-23)
			Stepper motor control	6(20-23 to 20-25)
			Washing Machine Control	6(20-27 to 20-30)
			Programming using PIC Controller	*Beyond Syllabus*
			Revision	-
Assignment –3 Date of Announcement :05.10.2016 Date of Submission :14.10.2016				
Class Test - 18.10.2016				

Book Reference

Book No	Title of the Book	Author	Publisher	Year
1.	Microprocessor Architecture, Programming and Application with 8085	Gaonkar, R. S	Prentice Hall,	4th Edition 2000
2.	'Microprocessor: Principles and Applications'	Charles M. Gilmore	McGraw Hill International	1989.
3.	Micro controller architecture and programming	Kenneth J.Ayala	Penram International Publishers	2nd Edition, 1996.
4.	Microprocessors and Micro-computer Based System Design	Mohamed Raffiquzzaman	Intel and Motorola" Prentice Hall,	2003
5.	Microprocessors Theory and Applications	Mohamed Raffiquzzaman	Intel and Motorola	Prentice Hall, 2003
6.	Microprocessors and Microcontroller	A.P.Godse D.A.Godse	Technical publications	2011

NPTEL LECTURES:

http://www.nptel.ac.in/courses/108105057/Pdf/Lesson16.pdf

http://www.nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors%20and%20Microcontrollers/pdf/Teacher_Slides/mod3/M3L3.pdf

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C302.1	2	-	-	-	1	-	1	-	-	-	-	-	1	-	-
C302.2	2	3	3	-	1	-	-	-	-	-	-	-	2	-	-
C302.3	2	-	-	-	1	-	1	-	-	-	-	-	1	-	-
C302.4	2	2	3	-	1	-	-	-	-	-	-	-	2	-	-
C302.5	2	3	3	-	1	-	-	-	-	-	-	-	2	-	-
C302	2	2	2	-	1	-	-	-	-	-	-	-	2	-	-

Content Beyond Syllabus Added(CBS)	POs strengthened / vacant filled	CO / Unit
Programming using PIC microcontroller	PO4(2), PO12(2) (vacant filled), PSO1(3) (strengthened)	C302.5 / V

SELF STUDY TOPICS:

S.No	UNIT	TOPIC	Text / Ref book
1	IV Peripheral Interfacing	8254 PIC	Gaonkar, R. S, 'Microprocessor Architecture, Programming and Application with 8085', Prentice Hall, 4th Edition, 2000.
2	V Microcontroller Programming & Applications	Washing Machine Control	Kenneth J.Ayala,'Micro controller architecture and programming',Penram International Publishers, 2nd Edition, 1996.

Format No.:11
Issue No.: 02
Revision No.: 01
Date: 23/06/12

K.L.N. COLLEGE OF ENGINEERING

LECTURE SCHEDULE[Tue5,Wed6,Thu2,Fri1]

Course/Branch : B.E/EEE Subject: Power Plant Engineering

Duration :July 2016- October 2016 Subject Code : ME6701

Semester : V Section : A Staff handling: M.Balamurugan

Regulation : 2013 (AUC)

AIM : Expose the students to basics of various power plants so that they will have the comprehensive idea of power system operation.

OBJECTIVE: Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

Pre-requisites: Basic Civil and Mechanical Engineering, Engineering Chemistry

Course Outcomes – : After the course Student should be able to

Course	Course Outcome	POs	PSOs
C303.1	Draw the layout of modern coal power plant and list the various components used in thermal power plant.(K1)	1,3,6,7	1,3
C303.2	Identify the components of diesel and gas turbine power plants and construct the integrated gasifier based combined cycle systems. (K1)	1,3,6,7	1,3
C303.3	Describe the layout of subsystems of various nuclear power plants and express safety measures for nuclear power plants.(K1)	1,3,6,7	1,3
C303.4	Distinguish different hydroelectric power plants and construct various renewable energy power plants such as wind, tidal, spv, solar thermal, geo thermal, biogas and fuel cell. (K2)	1,3,6,7	1,3
C303.5	Calculate the per unit cost of electrical energy based on Power tariff, load factor, demand factor, diversity factor and plant safety factor. (K2)	1,3,6,7	1,3

S.No	Date	Period No	Topics to be Covered	Book No [Page No]
UNIT I - (COAL BASED THERMAL POWER PLANTS) Target periods :10 Total Planned Periods:13				
1.			Rankine cycle –improvisations	T1(39), R5(30,47,53,76),R8(15)
2.			Layout of modern coal power plant	T1(70), R5(93),R8(142)
3.			Super Critical Boilers, FBC Boilers	T1(283,385),R5(176),R8(175)
4.			Turbines, Condensers	T1(432,561),R5(211),R8(195)
5.			Steam & Heat rate	T1(374),R5(198),R8(219)
6.			Subsystems of thermal power plants – Fuel handling	T1(250),R5(99),R8(217,144)
7.			Subsystems of thermal power plants –ash handling	T1(408),R5(131),R8(167)
8.			Draught system	T1(204),R5(143)
9.			Feed water treatment.	T1(573),R5(290)
10.			Binary Cycles	T1(97),R5(17)
11.			Cogeneration systems.	T1(74),R5(279)
12.			Content beyond Syllabus:(Analysis of thermal power plants in tamilnadu)	Notes
13.			NPTEL Video :Lec 08 Thermal power Plant	
14.			Class Test-I 26.07.2016 (9.00am to 9.50 am)	
UNIT II - (DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS) Target periods :10Total Planned Periods:10				

15.			Otto Cycle - Analysis	R7(94)
16.			Otto Cycle - Optimisation.	R7(95)
17.			Diesel Cycle – Analysis	R7(110)
18.			Diesel Cycle - Optimisation.	R7(112)
19.			Dual Cycle	R7(120)
20.			Brayton Cycle	R7(140)
21.			Components of Diesel power plants.	R7(349)
22.			Components of Gas Turbine power plants.	T1(785),R5(432),R8(272)
23.			Combined Cycle Power Plants.	R8(297)
24.			Integrated Gasifier based Combined Cycle systems.	Notes
Assignment –(1) Date of Announcement :27.07.2016 Date of Submission:04.08.2016				
			CIT –I 13.08.2016 (9.10 am to 10.40 am)	
UNIT III - (NUCLEAR POWER PLANTS) Target Periods :7Total Planned Periods:9				
25.			Basics of Nuclear Engineering	T1(598),R5(640),R8(307)
26.			Layout and subsystems of Nuclear Power Plants	T1(628),R5(659),R8(331)
27.			Working of Nuclear Reactors : Boiling Water Reactor (BWR)	T1(628),R5(660),R8(320)
28.			Pressurized Water Reactor (PWR)	T1(632),R5(662)
29.			CANada Deuterium-Uranium reactor (CANDU)	T1(633),R5(664)
30.			Breeder and gas cooled Reactor	R5(666)
31.			Liquid Metal Cooled Reactor	R5(668)
32.			Safety measures for Nuclear Power plants.	T1(635),R5(670)
33.			NPTEL Video :Lec 13 Nuclear Power Plants.	
34.			Class Test-II(06.09.2016) 9.00 am to 9.50 am	
Assignment –(2) Date of Announcement : 17.08.2016 Date of Submission :24.08.2016				
UNIT IV - (POWER FROM RENEWABLE ENERGY) Target Periods:10 Total Planned Periods:12				
35.			Hydro Electric Power Plants – Classification	T1(676), R5(528),R8(352)
36.			Hydro Electric Power Plants – Typical Layout	T1(667), R5(547),R8(343)
37.			Hydro Electric Power Plants - Associated components including Turbines.	T1(679), R5(547),R8(362)
38.			Principle, Construction and working of Wind power systems.	T1(912), R5(799),R8(58)
39.			Tidal power systems.	T1(917), R5(814),R8(97)
40.			Solar Photo Voltaic (SPV) power systems.	T1(899), R5(823),R8(6)
41.			Solar Thermal power systems.	T1(900), R5(821),R8(68)
42.			Geo Thermal power systems.	T1(888), R5(831),R8(86)
43.			Biogas power systems.	T1(935), R5(850),R8(53)
44.			Fuel Cell power systems.	T1(879), R5(856),R8(73)
45.			Quiz	
46.			NPTEL Video:Lec 10 Hydro Power Plant	
			CIT – II26.09.2016(9.10 am to 10.40 am)	
Assignment –(3) Date of Announcement : 08.09.2016Date of Submission : 15.09.2016				
UNIT V - (ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS) Target Periods:8 Total Planned Periods: 9				
47.			Power tariff types	T1(2),R5(755),R8(132)
48.			Load distribution parameters	R5(270),R8(121)
49.			load curve	R5(736),R8(296)

50.			Comparison of site selection criteria of different power plants.	T1(652,728), R5(736),R8(296)
51.			Comparison of relative merits and demerits of different power plants.	R5(730),R8(122)
52.			Comparison of Capital and operating Cost of different power plants.	R5(730),R8(124)
53.			Pollution control technologies including Waste Disposal Options for Coal Power Plant.	R5(280),R8(425)
54.			Pollution control technologies including Waste Disposal Options for Nuclear Power Plant.	R5(670),R8(431)
55.			Seminar	
			Class Test-III19.10.2016 (9.00 am to 9.50 am)	

Website Reference: www.electrical4u.com, www.nptel.ac.in

Book Reference

Book No	Title of the Book	Author	Publisher	Year
T1	Power Plant Engineering	P.K. Nag	Tata McGraw – Hill	2008
R1	Power Plant Technology	M.M. El-Wakil	Tata McGraw – Hill	2010
R2	Power Plant Engineering	Black & Veatch	Springer	1996
R3	Standard Handbook of Power Plant Engineering,	Thomas C. Elliott, Kao Chen and Robert C. Swanekamp	Second Edition, McGraw – Hill.	1998
R4	Renewable energy	Godfrey Boyle	Oxford University Press.	2004
R5	A text book of Power Plant Engineering	R.K.Rajput	Laxmi Publications P(ltd).	2010
R6	Power Station Engineering and Economy	Bernhardt, G.A., Skrotzki and William A. Vopat	Tata McGraw Hill, 20th Reprint.	2002
R7	Internal Combustion Engines	R.K.Rajput	Laxmi Publications P(ltd).	2010
R8	Power Plant Engineering	A.K. Raja Amit P. Srivastava Manish Dwivedi	New Age international (p)Ltd, publishers	2006

Mapping ofCourse Outcomes (COs) , Course (C), Program Specific Outcomes (PSOs) with Program Outcomes. (POs) – Before CBS

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
C303.1	3	-	2	-	-	2	1	-	-	-	-	-	1	-	1
C303.2	3	-	2	-	-	2	1	-	-	-	-	-	1	-	1
C303.3	3	-	2	-	-	2	2	-	-	-	-	-	1	-	1
C303.4	3	-	2	-	-	2	2	-	-	-	-	-	1	-	1
C303.5	3	-	2	-	-	2	2	-	-	-	-	-	1	-	1
C303	3	-	2	-	-	2	2	-	-	-	-	-	1	-	1

Identification of Content Beyond Syllabus (CBS) Content Beyond Syllabus Added(CBS)	POs strengthened / vacant filled	CO / Unit
Analysis of Thermal Power Plants in Tamilnadu	PO11(1),PO12(1) (vacant filled)	C303.1 / I

Format No.:11
Issue No.: 02
Revision No.: 01
Date: 23/06/12

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM - 630 612
Department of Electrical and Electronics Engineering
Lecture Schedule

Course/Branch : B.E / EEE Subject: Power Electronics Duration: Jul'2016 – Oct'2016
Subject Code : EE6503 Semester:V Section: A,B&C Regulation: 2013
Staff Handling: Dr.S.VENKATESAN, S.RAJALINGAM,M.BHARANI LAKSHMI

AIM

To expose the students, the application of power electronic devices for conversion, control and conditioning of electric power.

OBJECTIVES

i. To get an overview of different types of power semi-conductor devices and their switching characteristics.
ii. To understand the operation, characteristics and performance parameters of controlled rectifiers.
iii. To study the operation, switching techniques and basic topologies of DC-DC switching regulators.
iv. To learn the different modulation techniques of PWM inverters and to understand the harmonic reduction methods**.**
v. To study the operation of AC voltage controller and Matrix converters and to study simple applications.

Prerequisites: Electronic devices and circuits.

COURSE OUTCOMES: After the course, the student should be able to:

Course	Course Outcome	POs	PSOs
C304.1	Explain the significance of switching devices and its application to power converters and demonstrate the triggering circuit and snubber circuits.	**1,2,3,5**	**1,2**
C304.2	Compare the operation of two, three Pulse Converters and draw output waveforms with and without source and load inductance.		**1,2**
C304.3	Classify the operation of Choppers and outline the application of SMPS.		**1,2**
C304.4	Analyze the operation of single phase and three phase Inverters with and without PWM techniques.		**1,2**
C304.5	Illustrate the operation of AC voltage controller and cyclo-converter and its application.		**1,2**

S.No	Date	Period Number	Topics to be Covered	Book No [Page No]
UNIT I: POWER SEMI-CONDUCTOR DEVICES Target Periods : 9				
1			Structure, operation and characteristics of Power Diodes-Types	T1(33-39)
2			Structure, operation and characteristics of SCR,	T1(304-309)
3			SCR-Turn-on & Turn-off methods,	T1(309-313)
4			Structure, operation and characteristics of TRIAC	T1(770-772)
5			Structure, operation and characteristics of GTO	T1(318-322)
6			Structure, operation and characteristics of BJT & MOSFET	T1(123-144)
7			Triggering Circuits for SCR	T2(123-126)
8			Structure, operation and characteristics of IGBT	T1(147-150)
9			Commutation circuit for SCR	T2(228-240)
10			Design of driver; Snubber circuits	T1(761-769) T2(153-162)
Test-I-Class test – I Total Periods: 10				
UNIT II: PHASE CONTROLLED CONVERTERS Target Periods : 9				
11			Introduction to Phase Controlled Converters	T1(431-434)
12				T1(434-440)

13			2-pulse converter for R,RL& RLE load with and without freewheeling diode; performance measures	
14			3-pulse converter for R,RL& RLE load with and without freewheeling diode , performance measures	T1(443-447)
15				
16			6-pulse converter for R,RL& RLE load with and without freewheeling diode, performance measures	T1(447-453)
17				
18			Gate circuit schemes for phase control	T2(214-217)
19			Effect of Source Impedance	T1(492-494)
20			Effect of load Inductance	T1(492-494)
21			Dual converters: single phase, three-phase	T1(440-443) T1(453-455)
22			Quiz – 1	-
Assignment 1			*Date of Announcement(DOA) :*	*Date Of Submission(DOS) :*
			Test-II- CIT-I	Total Periods: 11+1
UNIT III: DC TO DC CONVERTER			Target Periods : 9	
23			Introduction to dc-dc Converters; Step-down choppers	T1(166-176)
24			Principle of Step-up chopper	T1(176-181)
25			Control Strategy: Time ratio control; Current limit control	T2(349-351)
26			Forced commutated chopper: Voltage commutated converter	T2(377-385)
27			Current and Load commutated converter	T2(388-398)
28			Introduction to Switching mode regulators: Buck Converter	T1(186-190)
29			Boost Converter	T1(190-194)
30			Buck-Boost Converter	T1(194-198)
31			Introduction to Resonant Converter	T1(388-396)
32			Seminar-1	-
33			NPTEL video	-
Assignment - 2	*DOA:*		*DOS:* *Test-III-Class test II*	Total Periods: 9+2
UNIT IV: INVERTERS				Target Periods : 9
34			Single-phase inverters	T1(232-237)
35			Three-phase inverters (120° mode conduction)	T1(246-248)
36			Three-phase inverters (180° mode conduction)	T1(237-245)
37			Voltage control	T2(452-454)
38			Harmonic control	T1(280-284)
39			PWM techniques Sinusoidal PWM, modified sinusoidal PWM - multiple PWM	T1(248-260)
40			Introduction to space vector modulation	T1(271-279)
41			Current source inverters	T2(468-482)
42			Content beyond syllabus: Harmonic control techniques for inverters and adaptive active power filters	Material
43			Quiz-2	-
44			NPTEL Video	-
Assignment - 3			*Date of Announcement :*	*Date Of Submission:*
			Test-IV-CIT – II	Total Periods: 9+2
UNIT V: AC TO AC CONVERTERS				Target Periods : 9
45			Introduction to AC voltage controllers	T1(500-501)
46			Control strategy: ON-OFF control, Phase Control	T1(501-504)
47			Single phase AC voltage controllers	T1(506-513)
48			Three phase AC voltage controllers	T1(514-520)
49			Multistage sequence control	T2(527)

50			Introduction to Cycloconverters: single phase cycloconverter	T1(526-529)
51			Three-phase cycloconverter	T1(530-534)
52			Power factor control	Material
53			Matrix converter	T1(536-537)
54			Seminar-2	-
Test-V-Class test III				Total Periods: 9+1

Books: Text/Reference

S. No	Title of the Book	Author	Publisher	Year
1	Power Electronics: Circuits, Devices and Applications **(T)**	M.H.Rashid	Pearson Education, PHI Third Edition, New Delhi	2004
2	Power Electronics **(T)**	P.S.Bimbra	Khanna Publishers, fourth Edition	2012
3	Power Electronics Essentials and Applications **(T)**	L. Umanand	Wiley	2010
4	Power Electronics, Principles and Applications **(R)**	JosephVithayathil	McGraw Hill Series, 6thReprint	2013
5	Elements of Power Electronics **(R)**	Philip T. Krein	Oxford University Press	2004
6	Power Electronics **(R)**	M.D. Singh and K.B. Khanchandani	Mc Graw Hill India	2013
7	Power Electronics for Technology **(R)**	Ashfaq Ahmed	Pearson Education, Indian reprint	2003
8.	Power Electronics: Converters, Applications and Design **(R)**	Ned Mohan, Tore. M. Undel and, William. P. Robbins	John Wiley and sons, third edition	2003
9.	Power Electronics **(R)**	Daniel.W.Hart	Mc Graw Hill,3rdPrint	2013

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C304.1	2	2	1	-	2	-	-	-	-	-	-	-	1	1	-
C304.2	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-
C304.3	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-
C304.4	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-
C304.5	2	2	1	-	2	-	-	-	-	-	-	-	1	1	-
C304	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-

Content Beyond Syllabus Added(CBS)	POs strengthened / vacant filled	CO / Unit
Harmonic control techniques for inverters and adaptive power filters.	PO5(3) (Strengthened), PO6(1) (Vacant filled)	C304.4/ IV

NPTEL LECTURES:

S.No	UNIT	TOPIC	Ref / Link
1	III DC-DC Converter	4 quadrant DC-DC converter	https://www.youtube.com/watch?v=WMi-ZN3qtSs&list=PLED1B6C0DE8A84B6E&index=8
2	IV INVERTERS	Space Vector modulation	https://www.youtube.com/watch?v=w_go3Q85UIM&index=27&list=PLED1B6C0DE8A84B6E

SELF STUDY TOPICS:

S.No	UNIT	TOPIC	Text / Ref book
1	II- Phase Controlled Converters	12- Pulse converter	M.H.Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, PHI Third edition, 2004.
2	III -DC-DC Converter	Cuk Converter	M.H.Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, PHI Third edition, 2004.
3	V- AC - AC Converters	Two – stage Sequence control	P.S.Bimbra "Power Electronics" Khanna Publishers, fourth Edition, 2012.

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM - 630 612

Lecture Schedule

Degree/Program: **B.E / EEE.**Course code &Name: **EE6504 –**Electrical Machines-II

Duration: **July -Oct 2016.**Semester: V**.** Section : A,B Staff : Dr.S.M.KANNAN. Regulation :**2013.**

AIM: To expose the students to the concepts of synchronous and asynchronous machines and analyze their performance.

OBJECTIVES

To impart knowledge on

(i)Construction and performance of salient and non – salient type synchronous generators.

(ii)Principle of operation and performance of synchronous motor.

(iii)Construction, principle of operation and performance of induction machines.

(iv)Starting and speed control of three-phase induction motors.

(v)Construction, principle of operation and performance of 1ϕ induction motor and special machines.

Prerequisites: Electrical machines-I, Electromagnetic theory, Circuit theory.

COURSE OUTCOMES: After the course, the student should be able to:

C305.1	Draw the constructional details and explain the performance of salient and non – salient type synchronous generators.	**POs**	**PSOs**
C305.2	Draw and explain the Principle of operation and performance of synchronous motor.	**1,2, 3,4**	**1**
C305.3	Draw and describe the construction, principle of operation and performance of induction machines.		**1**
C305.4	Describe the starting and speed control of three-phase induction motors.		**1**
C305.5	Explain the construction, principle of operation and performance of single phase induction motors and special machines.		**1**

S.N.	Date	Period	Topics to be Covered	Book & Page. No.
			UNIT -I -SYNCHRONOUS GENERATOR Target periods :14	
1.		1	Introduction-Classification of Electrical machines-DC Vs AC generator-advantages of stationary armature-**constructional details** of alternator-**types of rotors**-salient-non-salient pole construction -applications	R4(1.1-1.4) R2(191-198)
2.		1	Principle of operation-frequency of induced emf-pitch factor-distribution factor-**winding factor-EMF equation** of alternator-short/full pitch winding-	R4(1.4-1.12) R2(198-209)
3.		1	Tutorial-I-	R4(1.12-1.30) R2(209-213)
4.		1	Rating of alternator-**armature reaction**-resistive, inductive and capacitive load-harmonics-reduction-leakage reactance-**synchronous reactance**	R4(1.30-1.33) R2(215-219)
5.		1	Alternator on load-phasor diagrams of alternator for resistive, inductive and capacitive load-SCR-Voltage regulation	R4(1.33-1.38) R2(219-225)
6.		1	Determination of voltage regulation-EMF method-MMF method-pessimistic-optimistic-regulation curve-	R4(1.38-1.42) R2(225-226)
7.		1	Tutorial-II	R4(1.42-1.65) R2(226-234)
8.		1	Tutorial-III	R4(1.42-1.65)
9.		1	Zero Power Factor method-ASA method	R4(1.66-1.70) R2(234-239)

10.		1	SCR-Parallel operation of alternator -advantages-conditions-methods of synchronization-synchroscope-synchronizing switch-dark lamp method-	R4(1.71-1.76) R2(324-329)
11.		1	Losses and Efficiency-Synchronizing current- Synchronizing power-Synchronizing torque-	R4(1.77-1.83) R2(253,330)
12.		1	Effect of change in excitation- Effect of change in steam Supply-Hunting	R4(1.84-1.96) R2(232-335,351)
13.		1	Two reaction theory-direct and quadrature axis reactance-slip test	R4(1.96-1.100) R2(239-243)
14.		1	Power angle characteristics-infinite bus-capability curve-	R4(1.100-1.105)
			Class test –I-	
UNIT II -SYNCHRONOUS MOTOR Target periods :12				
15.		1	Introduction-construction-salient features-	R4(2.1-2.3) R2(273-274)
16.		1	Principle of operation-non self starting-How to get continuous unidirectional torque? starting methods	R4(2.1-2.3) R2(274-276)
17.		1	Effect of load on a synchronous motor-equivalent circuit and phasor diagram of synchronous motor	R4(2.3-2.9) R2(276,280,281)
18.		1	Tutorial-II-	R4(2.28-2.49) R2(285-298)
19.			Tutorial-III-	R4(2.28-2.49)
20.		1	Torque equation-maximum power developed-power flow diagram	R4(2.9-2.13) R2(282-284)
21.		1	Different torque of synchronous motor-starting methods of synchronous motor	R4(2.13-2.15) R2(284-285)
22.		1	*V curves and inverted V curves-*	R4(2.18-2.9) R2(301-302)
23.		1	*Effect of varying excitation on armature current and power factor-*	R4(2.19-2.21) R2(278-280)
24.		1	*Current locus for constant power lines and constant excitation-*	R4(2.22-2.25) R2(303-307)
25.		1	Hunting and methods of suppression-advantages and disadvantages of synchronous motor-applications-synchronous condenser-synchronous phase modifier	R4(2.25-2.27) R2(308-312)
26.		1	Tutorial-III-	R4(2.50) R2(309
			CIT-I-Unit-I,II	
UNIT III -THREE PHASE INDUCTION MOTOR Target Periods :15				
27.		1	Introduction-construction-squirrel cage rotor-slip ring rotor-comparison-	R4(3.1-3.4) R2(358-365)
28.		1	Concept of rotating magnetic field-	R4(3.4-3.8) R2(268-272)
29.		1	Principle of operation of three phase induction motor-merits and demerits-applications-	R4(3.9-3.10) R2(365-366)
30.		1	Slip-speed-frequency of rotor current-rotor emf-rotor current and power factor-	R4(3.18-3.19) R2(366-368)
31.		1	Tutorial-I-	R4(3.11-3.32)
32.		1	Torque equation-condition for maximum running torque-starting and maximum torque-Effect of change in supply voltage-	R4(3.32-3.35) R2(369-372)
33.		1	Tutorial-II-	R4(3.36-3.53)

34.		1	Torque-slip characteristics-losses in induction motor-power flow diagram	R4(3.53-3.60) R2(373-378)
35.		1	Tutorial-III-	R4(3.60-3.84)
36.		1	Equivalent circuit of induction motor-performance calculation-maximum power output	R4(3.84-3.91) R2(392-396)
37.		1	Tutorial-IV-	R4(3.91-3.100)
38.		1	No load &Blocked rotor tests-circle diagram-construction of circle diagram	R4(3.102-3.108) R2(399-416)
39.		1	Tutorial-V-	R4(3.109-3.115)
40.		1	Double cage induction motor-equivalent circuit-induction generator-synchronous induction motor	R4(3.116-3.119) R2(420,501)
41.		1	Induction generator- Cogging and crawling	R4(3.119-3.122) R2(496)
			CONTENT BEYOND SYLLABUS: Wind Power plant-introduction-Green energy-Power Demand-salient features-cost of installation-Government policy-principle of operation-Power rating-operation difficulties-Industrial visit	
			Class test-II-Unit-III-	
UNIT IV - STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR.Target Periods :12				
42.			Need for starters-types of induction motor Starters-Direct on line starter	R4(4.1-4.2) R2(440-442)
43.			Primary resistor Starter-Auto transformer starter	R4(4.3-4.6) R2(443-446)
44.			Star-Delta starter	R4(4.6-4.7) R2(446-452)
45.			Rotor resistance starter	R4(4.7-4.8) R2(452-455)
46.			Tutorial-I-	R4(4.30-4.42)
47.			Speed control of three phase induction motor-stator side control-change in stator voltage-	R4(4.8-4.12) R2(455-458)
48.			voltage/frequency control-Changing number of poles	R4(4.12-4.15) R2(458-460)
49.			Rotor side control-cascade control-	R4(4.15-4.18) R2(464-465)
50.			Adding external resistance in the rotor circuit-injecting emf into the rotor circuit	R4(4.18-4.20) R2(465-474)
51.			Slip power recovery Scheme-Kramer system-	R4(4.20-4.23) R2(474-477)
52.			Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.	R2(478-488)
53.			Tutorial-II,III-	R4(4.30-4.42)
			CONTENT BEYOND SYLLABUS: Harmonics issues using different types of Starters-Demonstration	
			CIT –II-Unit-III,IV	
UNIT V - SINGLE PHASE INDUCTION MOTOR AND SPECIAL MACHINES.Target Periods:12				
54.			Introduction—construction-principle of operation	R4(5.1-5.2) R2(521-523)
55.			Double field revolving theory-cross field theory-	R4(5.3-5.6) R2(524-527)

56.			Starting of single phase induction motor-types-split phase-capacitor start-capacitor run	R4(5.6-5.11) R2(536-547)
57.			Capacitor start-capacitor run-shaded pole motor	R4(5.11-5.15) R2(547-549)
58.			Equivalent circuit-performance analysis- No load and blocked rotor tests	R4(5.15-5.21) R2(528-536)
59.			Tutorial-I-	R4(5.21-5.26)
60.			Tutorial-II-	R4(5.21-5.26)
61.			Special machines-stepper motor-classification-step angle-	R4(5.26-5.5.41) R2(524-527,585
62.			Reluctance Motor-Repulsion motor-linear induction motor-magnetic levitation system(T1-690)	R4(5.43-5.45) R2(566,578,508)
63.			Hysteresis motor-AC series motor-servo motors	R4(5.46-5.49) R2(550,579,581)
64.			Universal motor	R4(5.49-5.50) R2(562)
65.			Tutorial-III-	

Text/ Ref	**Title of the Book**	**Author**	**Publisher/Edition**
T1	Electrical Machines	D.P.Kothari&I.J.Nagrath	TMH/2010
T2.	Electrical machinery	P.S.Bhimbhra	Khanna/2015
R1.	Electric machinery	Fitgerald,CharlesKingsley,D.Umans	TMH/2014
R2.	Theory &Performance of Electrical Machines	J.B.Gupta	S.K.Kataria/2015
R3.	Electric Machines	MurugeshKumar.K,	Vikas Publishing HousePvt Ltd, 2014
R4	Electrical machines-II	J.Gnanavadivel	Anuradha,Chennai2015

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
C305.1	2	3	1	3	-	-	-	-	-	-	-	-	2	-	-
C305.2	2	3	1	3	-	-	-	-	-	-	-	-	2	-	-
C305.3	2	3	1	3	-	-	-	-	-	-	-	-	2	-	-
C305.4	2	3	1	3	-	-	-	-	-	-	-	-	2	-	-
C305.5	2	3	1	3	-	-	-	-	-	-	-	-	2	-	-
C305	2	3	1	3	-	-	-	-	-	-	-	-	2	-	-

Content Beyond Syllabus Added(CBS)	POs	Unit
Wind Power plant-introduction-Green energy-Power Demand-salient features-cost of installation-Government policy-principle of operation-Power rating-operation difficulties-Industrial visit	PO6(l)	III
Harmonics issues using different types of starters-Demonstration	PO7(1)	IV

Staff Incharge **HOD/EEE.**

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K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM

LECTURE SCHEDULE

Degree/ Program	:	**B.E/ Electrical and Electronics Engineering**	Course code & Name	:	**IC6501- Control systems**
Duration	:	**July 2016 to Nov 2016**	Semester	:	**V-**Section :**A,B& C**
Regulation	:	**2013**	Staff handling	:	**Dr S. Venkatesan, A. Marimuthu A.P.S.Ramalakshmi**

AIM

To study about control system which is a combination of elements arranged in a planned manner wherein each element causes an effect to produce a desired output.

OJECTIVES

- To understand the methods of representation of systems and getting their Transfer function.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To give basic knowledge in obtaining the open loop and closed loop frequency responses of systems.
- To understand the concept of stability of control system and methods of stability analysis
- To study the state variable representation of physical systems and the effect of state feedback.

Prerequisites: Mathematics

COURSE OUTCOMES: After the course, the student should be able to:

Course	Course Outcome	POs	PSOs
C306.1	Discuss the use of transfer function models for analysis, physical systems and the control system components.	1, 2, 3, 4, 9	1,2
C306.2	Analyze the time response of systems and steady state error.		1,2
C306.3	Apply the basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.		1,2
C306.4	Explain the stability analysis and types of compensators.		1,2
C306.5	Describe the state variable representation of physical systems and the effect of state feedback.		1,2

S.No	Date	Period	Topics to be Covered	Book No [Page No]
UNIT I -SYSTEMS AND THEIR REPRESENTATION				**Target Hours : 12**
1.			Basic elements in control systems Open and closed loop systems	R1(1-8)R3(1-25) R2(2-20)
2.			Transfer function	R1(55-58)R3(46-58)
3.			Electrical analogy of mechanical systems	R1(85-92) R3(77-86) R2(25-36)
4.			Electrical analogy of thermal systems	R1(188-191)R2(36-38) R3(100-109)
5.			Block diagram reduction techniques	R3(151-159) R2(54-62)
6.			Signal flow graphs	R1(104-111) R3(159-168) R2(62-72)
7.			AC and DC servomotors	R3(168-205)

				R2(82-121)
8.			*Seminar –I* - Synchros	
9.			Tutorial	
				Total Planned Periods: 12
			Assignment –I-DOS: ***Test-I***	
UNIT II -TIME RESPONSE				**Target Hours : 12**
10.			Time response	R1(219-224) R2(195-199)
11.			Time domain specifications	R3(361-365)
12.			Types of test input – I and II order system response	R3(366-376) R1(224-233)
13.			Error coefficients – Generalized error series – Steady state error	R1(288-293) R3(390-395) R3(409-417) R2(210-214)
14.			Effects of P, PI, PID modes of feedback control- Time response analysis	R1(396-406) R3(409-417)
15.			Root locus construction	R1(337-416)
16.			Tutorial	
				Total Planned Periods: 12
			Assignment –II-DOS: ***CIT-I-***	
UNIT III -FREQUENCY RESPONSE				**Target Hours :12**
17.			Frequency response	R3(612-617) R2(346)
18.			Correlation between frequency domain and time domain specifications	R3(617-622) R2(347-352)
19.			Bode plot	R1(497-515) R2(371-376) R3(580-585)
20.			Polar plot	R1(523-539)R3(558-562) R3(597-602)
21.			Determination of closed loop response from open loop response	R2(367-370)R3(584-588) R1(575-583)R2(409-413)
22.			Effect of Lag, lead and lag-lead compensation on frequency response- Analysis.	R1(621-629)R3(467-481) R2(435-437)
23.			Tutorial	
				Total Planned Periods: 12
			Assignment –III-DOS: ***Test-3***	
UNIT IV - STABILITY AND COMPENSATOR DESIGN				**Target Hours :12**
24.			Characteristics equation	R3(330-338)R2(270-277)
25.			Routh Hurwitz criterion	R1(275-280) R3(339-356) R2(277-295)
26.			The Nyquist stability criterion	R3(535-543)R2(381-394)
27.			Performance criteria – Lag, lead and lag-lead networks	R1(621-629)R3(467-481) R2(435-437)
28.			Lag/Lead compensator design using bode plots.	R1(621-638)R3(467-489) R2(435-440)
29.			Tutorial	
				Total Planned Periods: 12
			CIT-II :	
UNIT V - STATE VARIABLE ANALYSIS				**Target Hours :12**
30.			Concept of state variables	R1(29-32)
31.			State models for linear and time invariant Systems	R1(32-39) R1(649-655)

32.			Solution of state and output equation in controllable canonical form	R1(660-668)
33.			Concepts of controllability and observability	R1(675-687)
34.			*Seminar –II*-Effect of state feedback	R1(723-728)
35.			Tutorial	
36.			**Content Beyond Syllabus** Develop and run a computer simulation of a control system using MATLAB	
37.			Quiz(I & II)	
CIT-III :				
Total Planned Periods: 12				
NPTEL: http://nptel.ac.in/courses/108101037/				

Book Reference

	Title of the Book	**Author**	**Publisher**	**Year**
R1	Modern Control Engineering	KATSUHIKO OGATA	PH India	2003
R2	Control Systems Engineering	I.J.NAGRATH& M.GOPAL	Wiley Eastern Ltd	2005
R3	Control Systems Engineering	M.GOPAL	TMH	1997
R4	Automatic Control Systems	B.C.KUO	PHI	1995
R5	Control Engineering Theory and Practice	M.N.BANDYOPADHYAY	PHI	2003

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
C306.1	3	2	3	1	-	-	-	-	2	-	-	-	2	1	-
C306.2	3	2	3	1	-	-	-	-	2	-	-	-	2	1	-
C306.3	3	2	3	1	-	-	-	-	2	-	-	-	2	1	-
C306.4	3	2	3	1	-	-	-	-	2	-	-	-	2	1	-
C306.5	3	2	3	1	-	-	-	-	2	-	-	-	2	1	-
C306	3	2	3	1	-	-	-	-	2	-	-	-	2	1	-

Content Beyond Syllabus Added(CBS)	POs	Unit
Develop and run a computer simulation of a control system using MATLAB	PO5(1)	II, III, IV, V

STAFF INCHARGE **HOD/EEE**

K.L.N. College of Engineering

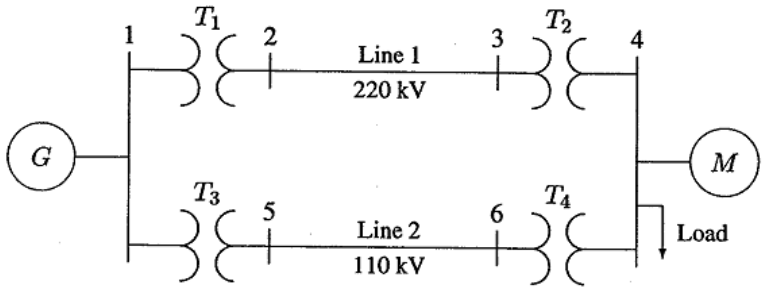
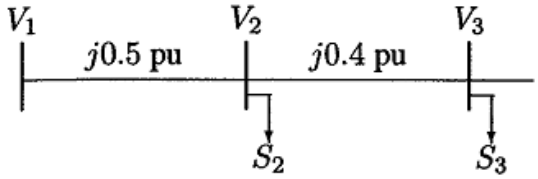
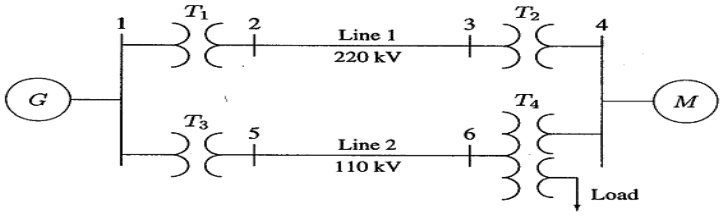
Department of Electrical and Electronics Engineering

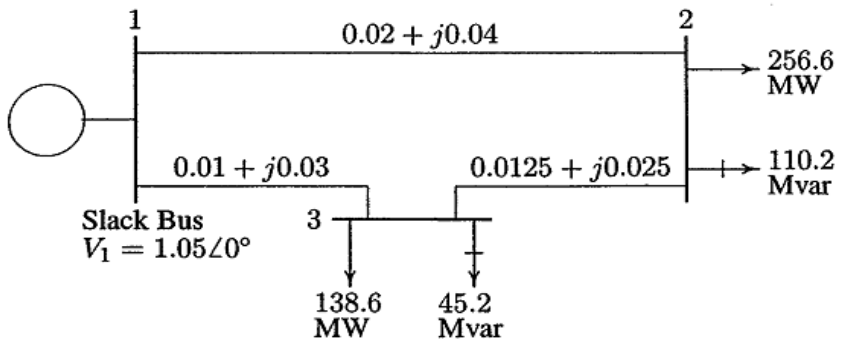
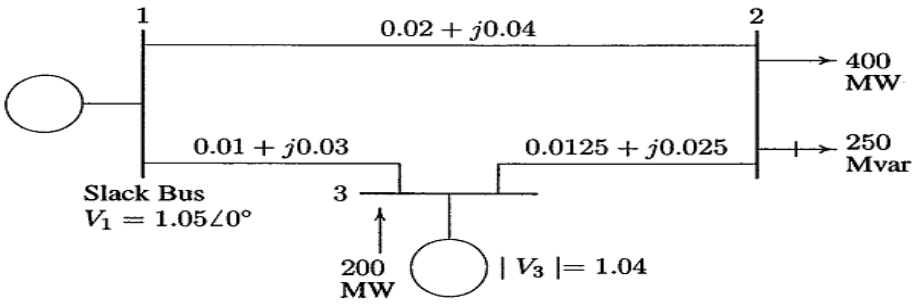
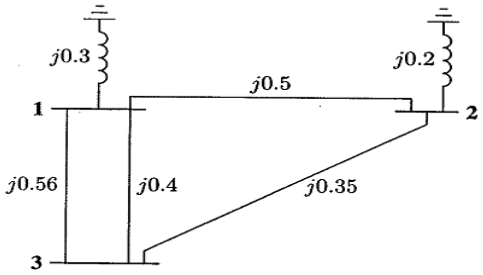
EE6501–Power system Analysis- **[C301]**

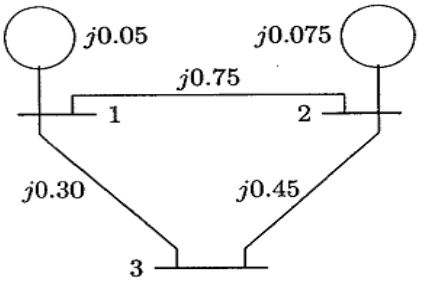
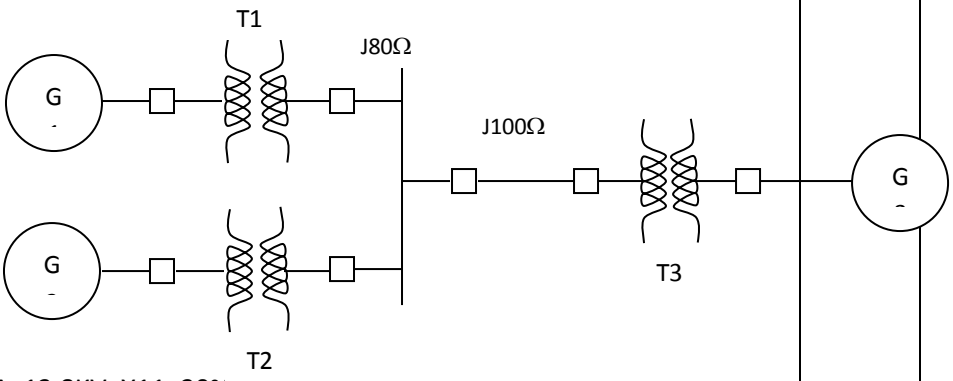
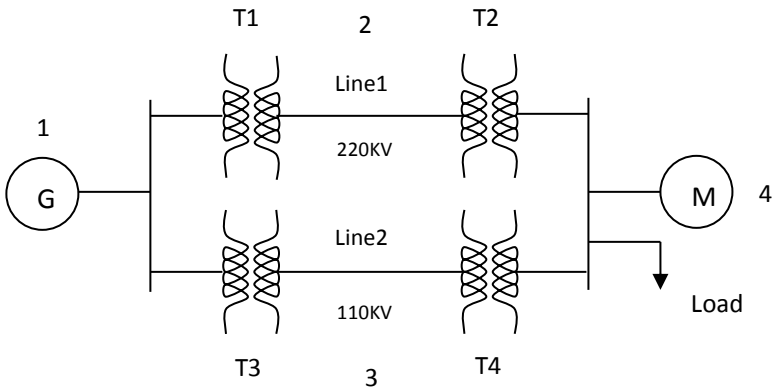
Questions/Tutorials/Assignments/Self study /Seminar topics.

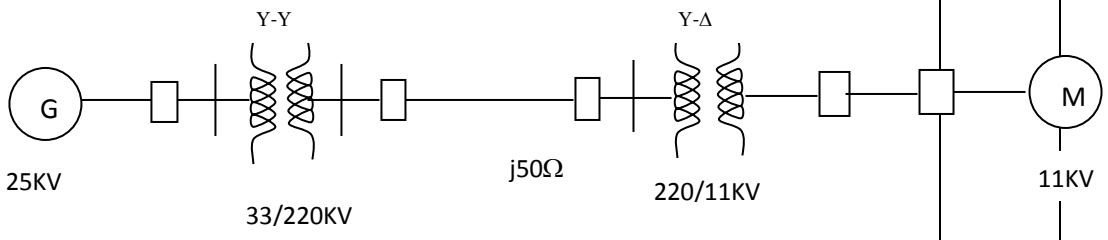
S.No.	**1. Questions.**	COs	POs
Q.1.1.	Define single line diagram.	C301.1	1,2,7
Q.1.2.	Draw the symbols of important power system components.	C301.1	1,2,7
Q.1.3.	Define per unit value. State the advantages of per unit value	C301.1	1,2,7
Q.1.4.	State the assumptions made in reactance diagram. What is impedance diagram.	C301.1	1,2
Q.1.5.	Describe how bus admittance matrix is framed using singular transformation method and direct method.	C301.1	1,2
Q.1.6.	State the properties of bus impedance matrix and bus admittance matrix	C301.1	1,2
Q.1.7.	Frame bus admittance matrix for the given data	C301.1	1,2,4, 5,7
Q.1.8.	Describe the steps to form bus impedance matrix.	C301.1	1,2
Q.1.9.	Draw the per unit reactance diagram for the given power system	C301.1	1,2
Q.1.10.	Develop bus impedance matrix for the given data	C301.1	1,2,4, 5,7
Q.2.1.	Classify various types of buses in power system. What is the necessity of slack bus?	C301.2	1,2,4, 5,7
Q2.2.	Draw the flowchart of Gauss-seidel method of solving power flow problem	C301.2	1,2,4, 5,7
Q.2.3.	Write the power equations	C301.2	1,2
Q2.4.	Derive the equations necessary for forming Jacobian matrix of NR method for solving load flow problem	C301.2	1,2
Q.2.5.	Derive the algorithm and flow chart for NR method of power flow solution	C301.2	1,2
Q.2.6.	Compare GS and NR method	C301.2	1,2
Q2.7.	Write the equation for calculating power loss and slack bus power	C301.2	1,2
Q.2.8.	Problem on GS and NR method	C301.2	1,2
Q.3.1.	What are the causes of faults and effects of faults?	C301.3	1,2
Q.3.2.	Classify various faults. Arrange the faults in ascending in the order of frequency of occurrence of fault and severity of fault	C301.3	1,2
Q.3.3.	Why three phase fault is considered as symmetrical fault?	C301.3	1,2
Q.3.4.	Explain the step by step procedure of calculating the fault current using Z bus.	C301.3	1,2
Q.3.5.	How the MVA rating of Circuit Breakers are calculated?	C301.3	1,2,4, 5,7
Q.3.6.	A synchronous generator and motor are rated 20 MVA,13.2 KV and both have sub transient reactance of 20%,the line connecting them has a reactance of the 10%on the base of the machine rating. The motor is drawing 20MVA at 0.8 pf leading and a terminal voltage of 12.9KV.When a symmetrical 3ph fault occurs at a motor terminals. Find the fault current and the delivered by generator and motor.	C301.3	1,2,4, 5,7
Q.3.7.	A generator is connected through a circuit breaker to a transformer. The ratings of the generator are 50 MVA.18KV,Xd"=19%,Xd'=26% and Xd=130%.The transformer ratings are 50 MVA,240/18KV,star-Delta. X=10% with 18KV on a side. If a 3-phase short circuit occurs on the high tension side of a transformer at rated voltage and no load, find(i)initial symmetrical rms current in the transformer winding on the high tension side.(ii)The initial symmetrical rms current in the line on the low tension side.	C301.3	1,2,4, 5,7

Q.4.1.	Define symmetrical components. Draw the positive, negative and zero sequence components of power system	C301.4	1,2,4
Q.4.2.	Prove that power is invariant when symmetrical components are used	C301.4	1,2
Q.4.3.	Derive the expression for fault current when single line to ground fault occurs and draw the sequence diagram	C301.4	1,2,4
Q.4.4.	Derive the expression for fault current when LL fault occurs and draw the sequence diagram	C301.4	1,2,4
Q.4.5.	Derive the expression for fault current when LLG fault occurs and draw the sequence diagram	C301.4	1,2,4
Q.4.6.	In which fault zero sequence component is not present and justify your answer	C301.4	1,2,4, 7
Q.4.7.	Discuss the method of calculating the fault current and post fault voltages using Zbus when an LG, LL and DLG faults occur in the powers	C301.4	1,2,4, 7
Q.4.8.	A three phase, 10 MVA,6.6 KV alternator with a reactance of 8% is connected to a feeder of series impedance 0.12+j0.48 ohms/phase/km. The transformer is rated at 5 MVA,6.6KV/33KV and has a reactance of 5%. Determine the fault current supplied by the generator operating under no load with a voltage of 6.9KV when a three phase symmetrical fault occurs at a point 15KM along the feeder.	C301.4	1,2,4, 5,7
Q.5.1.	Define Stability of power system. What is rotor angle stability? Discuss on voltage stability	C301.5	1,2,4, 5,7
Q5.2.	Derive the swing equation	C301.5	1,2
Q.5.3.	Explain the transient stability analysis using equal area criterion	C301.5	1,2
Q.5.4.	Explain the step by step procedure of solving swing equation using RungeKutta method	C301.5	1,2
Q.5.5.	Explain the step by step procedure of solving swing equation using Modified Euler's method	C301.5	1,2
Q.5.6.	What are the methods of improving stability	C301.5	1,2
Q.5.7.	A balanced 3-phase fault occurs at middle point of line 2 when the power transfer is 1.5pu in the system .E=1.2,V=1,Xd=0.2,X1=X2=0.4pu. (a)Determine whether the system is stable for a sustained fault. (b)The fault is cleared at 60 degree. Is the system stable? If so find the maximum rotor swing. (c)Find the critical clearing angle	C301.5	1,2,4, 5,7
Q.5.8.	Draw the power angle curve and explain how it is drawn. Define the swing curve. What is its importance?	C301.5	1,2
Q.5.9.	Derive the expression for critical clearing time.	C301.5	1,2
2. Assignment Questions			
A.1.1	The one-line diagram of a three-phase system shown in fig (1). Select common base of 100 MVA and 22KV on a generator side. Determine the P.U impedance values and draw an impedance diagram with all impedances including the load impedances marked in P.U. Data is given as follows. G = 90MVA, 22KV, X =18%. T_1 = 50MVA, 22/220 KV, X=10%. T_2 = 40MVA, 220/11KV, X=6%. T_3= 40MVA, 22/110KV, X=6.4%. T_4= 40MVA, 110/11KV, X=8%. M= 66.5MVA, 10.45KV, X=18.5% The three phase at bus 4 absorb 57MVA, 0.6 p.f lagging at 10.45KV. Line 1 and 2 has reactance of 48.4 and 65.43 ohm respectively	C301.1	1,2,4, 5,7

			
A.1.2	The one-line diagram of a three-phase system shown in fig (2). The impedances are marked in P.U on a100MVA, 400KV base. The load at bus-2 is S_2 =15.93MW-j33.4MVAR, and at bus 3 is S_3 = 77MW + j14MVAR. It is required to hold the voltage at bus-3 at 400∠ 0°KV. Working in P.U, estimate the voltages at buses 2 and 1. 	C301.1	1,2,4, 5,7
A1.3	The one line diagram of power system is shown in fig  The three phase power and line to line ratings are given below. G = 80MVA, 22KV, X=24% T_1 = 50MVA, 22/220KV, X=10% T_2 = 40MVA, 220/22KV, X=6% T_3 = 40MVA, 22/110KV, X=6.4% Line 1: 220KV X=121ohm Line 2:110KV X= 42.35 ohm. M: 68.85 MVA, 20KV, X=22.5% Load: 10MVAR, 4KV, delta connected capacitors. The three phase rating of the transformers are; Primary: star connected 40 MVA, 110KV. Secondary: star connected 40MVA, 22KV Tertiary: delta connected 15MVA, 4KV. The per phase measured reactance at the terminal of a winding with the second one short circuited and third one open circuited are Z_{ps} =9.6%, 40MVA, 110/22KV. Z_{pt} =7.2%, 40MVA, 110/4KV Z_{st} =12%, 40MVA, 22/4KV. Develop T-circuit equivalent impedance of three winding transformer to the common 100MVA base. Draw an impedance diagram showing all impedances in P.U on a 100MVA base. Choose 22KV as the voltage base for generator.	C301.1	1,2,4, 5,7
A2.1	Figure shows the oneline diagram of the simple three bus power system with generation at bus 1. The magnitude of voltage at bus 1 is adjusted to 1.05P.U.	C301.2	1,2,4, 5,7

	The scheduled loads at bus 2 and 3 are as marked on the diagram. Line impedance is marked in perunit on a 100 MVA base and the line charging susceptances are neglected.  Using the Gauss-Seidel method, determine the phasor values of the voltage at the load buses 2 and 3. Find the slack bus real and reactive power and Determine the line flows and losses **Ans: V_2= 0.9800-j0.0600; V_3=1.0000-j0.0500** **S_{12}= 8.5MW+j17.0MVAR;S_{13} = 5MW+j15MVAR; S_{23}= 0.8MW+j1.60MVAR**		
A.2.2	Figure shows the one line diagram of a simple three bus power system with generation at bus 1 and 3. The magnitude of voltage at bus 1 is adjusted to 1.05P.U. The voltage at bus 3 is fixed as 1.04P.U with a real power generation 200MW. A load consisting of 400MW and 250 MVAR is taken from bus 2. Line impedances are marked in P.U on a 100 MVA base and the line charging susceptances are neglected. Obtain the power flow solution by the Newton Raphson method  **Ans: V_2= 0.97168∠-2.6948 P.U ; V_3= 1.04∠-0.498 P.U**	C301.2	1,2,4, 5,7
A 3.1	Determine the bus impedance matrix for a given three bus system using bus building algorithm. Modify the bus impedance matrix after removing line 1 to 3 (j0.56)  **Ans:** **Z_{bus}= j0.1875 j0.0750 j0.1275** **j0.0750 j0.1500 j0.1150** **j0.1275 j0.1150 j0.3075**	C301.3	1,2,4, 5,7

A 3.2	The one line diagram of a simple three bus power system is shown in fig. each generator is represented by an emf behind the subtransient reactance.All impedances are expressed in p.u on a common MVAbase. All resistances and shunt capacitance are neglected.The generators are operating on no load at their rated voltage with their emfs in phase.A three phase fault occurs at bus 3 through a fault impedance of Z_F =j0.19p.u. (a) Using thevenin's theorem obtained the impedance to the point of fault and the fault current in p.u. (b)Determine the bus voltages and line currents during fault.  Ans: j0.4p.u,2.5∠-90P.U ; V_1=0.925pu,V_2=0.925pu,V_3=0.475pu. I_{12}=0pu,I_{13}=1.5∠-90pu,I_{23}=1.0∠-90pu,	C301.3	1,2,4, 5,7
3. Tutorial Questions.			
T.1.1.	Draw the reactance diagram using a base of 50MVA, 13.8KV on generator G1.  G1 = 20 MVA, 13.8KV, X11=20% G2 = 30 MVA, 18KV, X11=20% G3 = 30 MVA, 20KV, X11=20% T1 = 25 MVA, 220 / 13.8KV, X1=10% T2 = 35 MVA, 220 / 22KV, X = 10% T3 = 1 Unit rated at 10MVA, 127 / 18KV, X=10%	C301.1	
T.1.2.	Draw the reactance diagram  	C301.1	

	G = 90 MVA, 22 KV, X = 10% T_1 = 50 MVA, 22 / 220 KV, X = 10% T_2 = 40 MVA, 220 / 11 KV, X = 6% T_3 = 40 MVA, 22 / 110 KV, X = 6.4% T_4 = 40 MVA, 110 / 11 KV, X = 8% M = 66.5 MVA, 10.45 KV, X = 18.5% Line 1 = 48.4Ω Line 2 = 65.43Ω Load = 57 MVA, 0.6PF lag, 10.45 KV 2. 22 / 220 KV = V_B New = 220 KV 3. T_3 22 / 110 KV = V_B New = 110 KV 4. V_B New = 110 / 11 = 11 KV.		
T.1.3.	Draw the reactance diagram for the Power System shown in fig. Use a base of 100MVA, 200KV in 50 Ωline.  G: 40 MVA, 20KV, X^{11}=20% Synchronous Motor: 50MVA, 11KV, X^{11}=30% Y-Y Transformer: 40MVA, 33/220KV, X=15% Y-Δ Transformer: 30MVA, 11/220KV, X=15%	C301.1	
T.1.4.	Determine Ybus Bus | Resistance in p.u. | Reactance in p.u. 1 – 2 | 0 | 0.2 2 – 3 | 0 | 0.1 1 – 3 | 0 | 0.3 3 – 4 | 0 | 0.4 0 - 1 | 0 | 0.6 0 – 3 | 0 | 0.8	C301.1	
T.1.5.	Determine the Ybus Bus | Line impedance p.u. | Line charging admittance p.u. | Half line charge 1 – 2 | 0.2+j0.8 | j0.02 | j0.01 2 – 3 | 0.3+j0.9 | j0.03 | j0.015 2 – 4 | 0.25+j1 | j0.04 | j0.02 3 – 4 | 0.2+j0.8 | j0.02 | j0.01 1 – 3 | 0.2+j0.4 | j0.01 | j0.005	C301.1	
T2.1.	A five bus power system.Each line has as impedance of 0.05+j0.15 pu.The line shunt admittance may be neglected. The bus power and voltage specifications are given below. (a)Form Y bus (b)Find Q2,V3,V4,V5 after the first iteration using gauss seidel method. Assume Q2,min=0.2pu and Q2,max=0.6 pu.		

		Bus	PL	QL	PG	QG	V	Bus Specificatio	C301.2	
		1	1	0.5	Not specified	Not specified	1.02	Slack bus		
		2	0	0	2	Not specified	1.02	PV bus		
		3	0.5	0.2	0	0	Not specified	PQ bus		
		4	0.5	0.2	0	0	Not specified	PQ bus		
		5	0.5	0.2	0	0	Not specified	PQ bus		
T2.2.	Using gauss Seidal method, find the voltage for each bus presented in the following system at first iteration								C301.2	

Bus Code	Admittance
1-2	2-j8
1-3	1-j4
2-3	0.666-j2.664
2-4	1-j4
3-4	2-j8

Bus Code	P_G	Q_G	P_d	Q_d	V
1	-	-	-	-	1.06
2	0.5	-	-	-	1.04
3	-	-	-0.4	-0.3	1+j0
4	-	-	-0.3	-0.1	1+j0

T2.3.	Figure shows a 5-bus power system. Each line has an impedance of (0.02+j0.2) per unit. Consider the following bus data (all are in P.U). Neglect the line charging admittance. Calculate the bus voltages at the end of first iteration using G-S method.							C301.2	

Bus Code	Load		Generation		Voltage	Remarks
	P	Q	P	Q		
1	-	--	-	-	$1.02\angle 0^0$	Slack
2	0.4	0.3	-	-	-	PQ
3	0.6	0.3	-	-	-	PQ
4	0.6	0.3	-	-	-	PQ
5	0.5	0.2	-	-	-	PQ

T2.4.	Figure shows a 5-bus power system. Each line has an impedance of (0.02+j0.2) per unit. Consider the following bus data (all are in P.U). Neglect the line charging admittance. Calculate the bus voltages at the end of first iteration using N-R method.							C301.2	

Bus Code	Load		Generation		Voltage	Remarks
	P	Q	P	Q		
1	-	--	-	-	$1.02\angle 0^0$	Slack
2	0.4	0.3	-	-	-	PQ
3	0.6	0.3	-	-	-	PQ
4	0.6	0.3	-	-	-	PQ
5	0.5	0.2	-	-	-	PQ

T.3.1.	A generator is connected through a circuit breaker to a transformer. The ratings of the generator are 100MVA.18KV,Xd"=19%,Xd'=26% and Xd=130%.The transformer ratings are 100MVA,240/18KV,star-Delta. X=10% with 18KV on a side. If a 3-phase short circuit occurs on the high tension side of a transformer at rated voltage and no load, find(i)initial symmetrical rms current in the transformer winding on the high tension side.(ii)The initial symmetrical rms current in the line on the low tension side.	C301.3	
T.3.2.	A 625KVA,480KV alternator supplies a purely resistive load of 500 watts at 480KV.The sub transient reactance of generator is 8% assuming the load to be directly connected across the generator terminals. Find initial symmetrical RMS current in pu at the generator terminals for a 3ph short circuit line.	C301.3	
T.3.3.	A synchronous generator and motor are rated 30 MVA,13.2 KV and both have sub transient reactance of 20%,the line connecting them has a reactance of the 10%on the base of the machine rating. The motor is drawing 20MVA at 0.8 pf leading and a terminal voltage of 12.9KV.when a symmetrical 3ph fault occurs at a motor terminals. Find the fault current and the current delivered by generator and motor.	C301.3	
T.4.1.	A three phase ,5MVA,6.6 KV alternator with a reactance of 8% is connected to a feeder of series impedance 0.12+j0.48 ohms/phase/km. The transformer is rated at 3MVA,6.6KV/33KV and has a reactance of 5%.Determine the fault current supplied by the generator operating under no load with a voltage of 6.9KV when a three phase symmetrical fault occurs at a point 15KM along the feeder.	C301.4	
T.4.2.	Two 11KV,20 MVA, 3ph star connected generator operate in parallel the positive,negative and zero sequence reactance of each begin j0.18,j0.15,j0.1 pu respectively.Thus star point of one of the generator is isolated and that of the other is earthed through 2ohm of the terminals of generator. Estimate the fault current and the current in the grounding resister .	C301.4	
T.4.3.	A simple power system shown in the fig.The pu reactance of generator and motor are same .The reactance of the generator areX1=X2=0.2pu.X0=0.1puCalculate the fault current when a single line to ground fault occurs at a motor terminal. The reactance of the tie bar is negligible. Ratings of generator and motor are 1500KVA.11KV.	C301.4	
T.4.4.	A simple power system shown in the fig. The pu reactance of generator and motor are same. The reactance of the generator areX1=X2=0.2pu.X0=0.1pu.Calculate the fault current when a line to ground fault occurs at a motor terminal. The reactance of the tie bar is negligible. Ratings of generator and motor are 1500KVA.11KV.	C301.4	
T.4.5.	A simple power system shown in the fig.The pu reactance of generator and motor are same .The reactance of the generator are X1=X2=0.2pu.X0=0.1pu.Calculate the fault current when a double line to ground fault occurs at a motor terminal.The reactance of the tie bar is negligible.Ratings of generator and motor are 1500KVA.11KV.	C301.4	
T.5.1.	A 60HZ synchronous generator having Inertia constant 5MJ/MVA and direct axis transient reactance is 0.3p.u,is connected to a input bus through a purely reactive circuit as shown in the figure. Reactance are marked on diagram on constant system. Generator is delivering real power P=0.8 pu and Q=0.074pu through the infinite bus at the voltage of V=1pu.Dtermine the critical clearing angle when a 3ph fault occurs at the middle of the transmission line.	C301.5	
T.5.2.	A balanced 3-phase fault occurs at middle point of line 2 when the power transfer is 1.5pu in the system. E=1.2,V=1,Xd=0.2,X1=X2=0.4pu.	C301.5	

	(a)Determine whether the system is stable for a sustained fault. (b)The fault is cleared at 60 degrees. Is the system stable? If so find the maximum rotor swing. (c)Find the critical clearing angle		
T.5.3.	A balanced 3-phase fault occurs at middle point of line 2 when the power transfer is 1.5pu in the system .E=1.2,V=1,Xd=0.2,X1=X2=0.4pu.Find the critical clearing angle if a 3-phase fault occurs on the line 2close to the generator bus.	C301.5	

K.L.N. College of Engineering, Pottapalayam.
Department of Electrical and Electronics Engineering
EE6502– Microprocessors and Microcontrollers [C302]
Important Questions/Assignments/Self-study/Seminar topics

CO	Course Outcomes	POs	PSOs
C302.1	Describe the basic Architecture of 8085 Microprocessor and working of all blocks of the processor, IO and memory interfacings with necessary timing diagrams.	1,7,5	PSO1
C302.2	Classify the instructions with the help of Addressing modes of 8085 with necessary programs.	1,3,2,5	PSO2
C302.3	Explain the basic Architecture of 8051 Microcontroller with working of various blocks of the controller like Interrupts, Timer, IO ports etc. with necessary timing diagram and compare the programming concepts with 8085.	1,7,5	PSO1
C302.4	Analyze the architecture of various Interfacing Devices like 8255 PPI, 8259 PIC, 8251 USART, 8279, 8253, ADC and DAC and Programming of all the Interfacing IC's.	1,3,2,5	PSO2
C302.5	Apply the knowledge of programming concepts of 8051 Microcontroller for various applications like keyboard display interface, servo motor etc.,	1,3,2,5	PSO2

2. Mapping of Course Outcomes (COs) ,Course (C), Program Specific Outcomes (PSOs) with Program Outcomes. (POs) – Before CBS[Levels of correlation:3(High),2(Medium),1(low)]

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C302.1	2	-	-	-	1	-	1	-	-	-	-	-	1	-	-
C302.2	2	3	3	-	1	-	-	-	-	-	-	-	2	-	-
C302.3	2	-	-	-	1	-	1	-	-	-	-	-	1	-	-
C302.4	2	2	3	-	1	-	-	-	-	-	-	-	2	-	-
C302.5	2	3	3	-	1	-	-	-	-	-	-	-	2	-	-
C302	2	2	2	-	1	-	-	-	-	-	-	-	2	-	-

S.No.	4. Important Questions	COs	POs
Q.1.1	Explain with a neat block diagram, the hardware architecture of 8085 microprocessor	C302.1	1
Q.1.2	Describe the interrupt structure of 8085 Microprocessor from the order of their priority.	C302.1	1
Q.1.3	Describe the functional pin diagram of 8085	C302.1	1
Q.1.4	Draw the timing diagram of Opcode Fetch machine cycle	C302.1	1,2
Q.1.5	a) With suitable examples explain how I/O devices are connected using memory mapped I/O and peripheral I/O. b) Design a microprocessor system to interface an 8K×8 EPROM and 8K × 8 RAM	C302.1	1,2,3

Q.1.6	Draw timing diagrams for the following instruction with appropriate control and status signal. Explain in briefSTA 2000	C302.1	1,2
Q.1.7	Explain the I/O read and write operation of 8085 processor with timing diagram	C302.1	1
Q.1.8	Compare memory mapping and I/O mapping technique in 8085	C302.1	1
Q.2.1	Describe the different addressing modes of 8085 microprocessor	C302.2	1
Q2.2	Explain the Different types of instruction in 8085.	C302.2	1,2
Q.2.3	Describe the 8085 Assembly Language Program for the loop structure with counting of 10 numbers.	C302.2	1,3,5
Q.2.4	Write short notes on Look up table and its usage.	C302.2	1
Q.2.5	Write a program to find the number of negative, zero and positive numbers.	C302.2	1,2,3,5
Q.2.6	Develop an 8085 ALP to perform the following, a2+b2, where a and b are 8-bit binary numbers with flowchart	C302.2	1,2,3,5
Q.2.7	Determine the value of ab+ac using 8085 assembly language program, where a,b and c are 8-bit binary numbers.	C302.2	1,2,3,5
Q.2.8	Identify the number of times the data 05 is present in a set of 30 numbers.	C302.2	1,3,5
Q.3.1	Explain with a neat functional block diagram, the 8051 Microcontroller hardware	C302.3	1
Q.3.2	Explain the interrupt structure of 8051 MC Explain how interrupts are prioritized	C302.3	1,2
Q.3.3	Explain various I/O ports and its functions of 8051 Microcontroller	C302.3	1,2
Q.3.4	Explain how the internal timers are used to generate time delay by using 8051 Microcontroller	C302.3	1,2,3
Q.3.5	State the differences between the Microprocessors and Microcontrollers	C302.3	1,2
Q.3.6	i) Explain the different serial communication modes in 8051. ii) Explain the memory structure of 8051.	C302.3	1
Q.4.1	With a neat functional block diagram, explain the functions of 8255 PPI	C302.4	1
Q.4.2	With a neat functional block diagram, explain the functions of 8279 keyboard controller (8 or 16m)	C302.4	1
Q.4.3	With a neat functional block diagram, explain the function of 8259 PIC	C302.4	1
Q.4.4	Explain with a neat sketch, the A/D converter interfacing with 8085 microprocessor	C302.4	1
Q.4.5	i) Bring about the features of 8251. ii) Discuss how 8251 is used for serial communication of data with its block diagram	C302.4	1
Q.4.6	Draw and explain the functional block diagram of 8254 (8 or 16m)	C302.4	1
Q.5.1	Write an 8051 Assembly Language Program to copy 10 bytes of data stored from location 30H to another location starting from 50H	C302.5	1,3,5
Q.5.2	Write 8051 ALP to transmit 'Hello World' to PC at 9600 baud for external crystal frequency of 11.0592MHz	C302.5	1,2,3,5
Q.5.3	(i) Explain various types of jump instructions according to range. (ii) Write a 8051 ALP to find Fibonacci series of N given numbers	C302.5	1,2,3,5
Q.5.4	Explain how to controla stepper motor using 8051 Microcontroller with a neat interfacing diagram and assembly program.	C302.5	1,2,3,5
Q.5.5	(i) Explain with a neat diagram, a 4 X 4 keyboard interfacing with 8051 microcontroller (ii) Draw the schematic for interfacing a servo motor with 8051 microcontroller and explain	C302.5	1,2

Q.5.6	Describe with a neat diagram, the washing machine control using 8051 microcontroller	C302.5	1,2
5. Assignments			
A.2.1	Write an 8085 assembly language program to solve the following equation: Z=2X+Y where X and Y are stored in memory locations 4500 & 4501 respectively. The value of Y should be stored in 4502 (Lower byte) and 4503 (Higher byte)	C302.2	1,2,3, 5
A.2.2	Write a program to calculate the factorial of a number	C302.2	1,2
A.2.3	With use of 8085 ALP, generate time delay of 0.52 sec using register pairs	C302.2	1,2,3
A.4.1	Develop an ALP to generate staircase waveform using 8085	C302.4	1,2
A.4.2	Explain the functions of 8279 keyboard controller with a simple program	C302.4	1
A.4.3	Write a BSR control word subroutine to set bits PC7and PC3 and reset them after 10ms whose control register has the address of 83H and analyze the program.	C302.4	3,5
A.5.1	In a semester, a student has to take six courses. The marks of the student (out of 25) are stored in RAM locations 47H onwards. Compute the average marks and output it on port 1	C302.5	3,5
A.5.2	Write an ALP using 8051 to generate a square wave of 50% duty cycle on P1.5 bit. Use timer 0 to generate time delay.	C302.5	2,3
A.5.3	Design a counter for counting the pulses of an input signal. The pulses to be counted are fed to pin P3.4. XTAL=22 MHz	C302.5	2,3
A.5.4	(i) Assume that P1 is an input port connected to a temperature sensor. Write a program to the temperature and test it for the value of 75. According to the test results, place the temperature value into the registers indicated by the following: If T = 75 then A = 75; If T < 75 then R1 = T; If T > 75 then R2 = T (ii) Read and test P1 to see whether it has the value 45H. If it does, send 99H to P2; otherwise it stays cleared.	C302.5	1,2,3

6. Self-Study Topics

S. No	UNIT	TOPIC	Text / Ref book
1	IV Peripheral Interfacing	8254 PIC	Gaonkar, R. S, 'Microprocessor Architecture, Programming and Application with 8085', Prentice Hall, 4th Edition, 2000.
2	V Microcontroller Programming & Applications	Washing Machine Control	Kenneth J.Ayala, 'Micro controller architecture and programming', Penram International Publishers, 2nd Edition, 1996.

K.L.N. College of Engineering, Pottapalayam-630612.
Department of Electrical and Electronics Engineering
ME6701 & POWER PLANT ENGINEERING [C303]
Important Questions/Assignments/ Self-study /Seminar topics.

1. Course outcomes

COs	Course Outcomes	POs	PSOs
C303.1	Draw the layout of modern coal power plant and list the various components used in thermal power plant.(K1)	1,3,6,7	1,3
C303.2	Identify the components of diesel and gas turbine power plants and construct the integrated gasifier based combined cycle systems. (K1)	1,3,6,7	1,3
C303.3	Describe the layout of subsystems of various nuclear power plants and express safety measures for nuclear power plants.(K1)	1,3,6,7	1,3
C303.4	Distinguish different hydroelectric power plants and construct various renewable energy power plants such as wind, tidal, spv, solar thermal, geo thermal, biogas and fuel cell. (K2)	1,3,6,7	1,3
C303.5	Calculate the per unit cost of electrical energy based on Power tariff, load factor, demand factor, diversity factor and plant safety factor. (K2)	1,3,6,7	1,3

2. Mapping of Course Outcomes (COs) , Course (C), Program Specific Outcomes (PSOs) withProgram Outcomes. (POs) – before CBS[Levels of correlation:3(High),2(Medium),1(low).

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C303.1	3	-	2	-	-	2	1	-	-	-	-	-	1	-	1
C303.2	3	-	2	-	-	2	1	-	-	-	-	-	1	-	1
C303.3	3	-	2	-	-	2	2	-	-	-	-	-	1	-	1
C303.4	3	-	2	-	-	2	2	-	-	-	-	-	1	-	1
C303.5	3	-	2	-	-	2	2	-	-	-	-	-	1	-	1
C303	3	-	2	-	-	2	2	-	-	-	-	-	1	-	1

S.No.	**4. Important Questions.** **Unit-1**	COs	Pos
Q.1.1.	**Rankine cycle –improvisations:** How will you improve the thermal efficiency of rankine cycle? Mention the basic cycle on which thermal power plant working. List down the thermodynamic process involved in rankine cycle. Derive the rankine cycle efficiency with neat neat PV, TS and HS diagram.	C303.1	1,3
Q.1.2.	**Layout of modern coal power plant:** Explain with a neat sketch the working of a thermal electric power plant station and discuss the function of major components in it. Enlist the advantages of Pulverized Coal Burners. What is the function of super heaters in a thermal plant? Discuss the functions of air heater types. What is pulverize and why it is used.Identify the need of air preheater and economizer? Give any two thermal power plants in tamilnadu with place, number of units and their ratings. Enlist the merits and demerits of thermal plants. Why efficiency of thermal power plant is low? Specify the role of super heater in thermal power plant? List the types of pulverisers. Draw the layout of a modern steam power plant and explain its working principle.	C303.1	3

Q.1.3.	**Super Critical Boilers, FBC Boilers:** What is meant by super critical boiler? What are once through boilers? Describe the working of FBC boiler with a neat diagram. Briefly discuss the Loeffler boiler and enumerate its advantages. Why dolomites introduce with input fuel of fluidized bed combustion boilers?Explain the operation of supercritical boiler with neat sketch.	C303.1	7
Q.1.4.	**Turbines, Condensers ,Steam& Heat rate** Specify the role of condenser in thermal power plant. Explain the arrangement and operation of a surface condenser. Describe with neat sketches the operation of the following i.jet condenser ii. Evaporative condenser. Define steam rate and heat rate.	C303.1	3
Q.1.5.	**Subsystems of thermal power plants – Fuel handling** Explain the working of coal handling system with neat sketch. What is the function of fuel handling systems? Mention the various stages of fuel handling systems. List the equipment's used in fuel handling systems. Explain the working of coal handling system with neat sketch.	C303.1	3,7
Q.1.6.	**Subsystems of thermal power plants –ash handling** Write short notes on (i) Ash handling system .Name the various types of ash handling systems.Describe the operation the ash handling equipments with neat sketch.	C303.1	3,7
Q.1.7.	**Draught system** What are the functions of a draught system? Differentiate between induced and forced draft systems. List the different types of draught systems. Write short notes on (i) Different draught systems Explain the operation of various types of draught systems with neat sketch.	C303.1	3
Q.1.8.	**Feed water treatment.** Discuss the feed water treatment in thermal power plants. Define pH. Why high pH value is preferred to prevent the corrosion? Explain the various types of deaerators with neat sketch.	C303.1	3,7
Q.1.9.	**Binary Cycles** Describe with a sketch the working of a mercury-water binary cycle. Mention the various types of binary cycles. what is meant by binary cycles.	C303.1	1
Q.1.10.	**Cogeneration systems.** List the benefits of co- generation systems. Explain the cogeneration systems with neat sketch. Mention the types of cogeneration systems.What is meant by topping cycle. What is meant by bottoming cycle.	C303.1	1
	Unit-2		
Q.2.1.	**Otto Cycle Analysis &Optimisation** Derive the otto cycle efficiency with thermodynamics process diagram and explain the optimization technique involved it. Discuss the analysis and optimization involved in Otto cycle	C303.2	1,3
Q.2.2.	**Diesel Cycle Analysis &Optimisation** Derive the diesel cycle efficiency with thermodynamics process diagram and explain the optimization technique involved it. Discuss the analysis and optimization involved in diesel cycle	C303.2	1,3
Q.2.3.	**Dual Cycle Analysis &Optimisation** Derive the dual cycle efficiency with thermodynamics process diagram and explain the optimization technique involved it.	C303.2	1,3
Q.2.4.	**Brayton Cycle Analysis &Optimisation**	C303.2	1,3

	Derive the Brayton cycle efficiency with thermodynamics process diagram and explain the optimization technique involved it.Draw and explain PV and TS diagrams of Brayton Cycle.		
Q.2.5.	**Components of Diesel power plants.** With a layout of a diesel power plant, explain its working and compare the difference between thermal and diesel plants. Point out the merits and demerits of diesel and gas turbine power plants? With neat sketch explain the operation of diesel power plants.	C303.2	3,7
Q.2.6.	**Components of Gas Turbine power plants.** Explain the working of open cycle and closed cycle gas turbine power plant and discuss its advantages and disadvantages. With the help of diagram,explain the functions of essential components of diesel power plant. Bring out the difference between closed cycle and open cycle gas turbine power plants. Give them any two diesel and gas turbine power plants in Tamilnadu with their rating. Classify the gas turbine power plants. How will improve the efficiency of gas turbine power plants? Name the gases that can be used for gas power plant?	C303.2	3,7
Q.2.7.	**Combined Cycle Power Plants.** Discuss the combined cycle power generation is so important in present day power scenario.	C303.2	1,3
Q.2.8.	**Integrated Gasifier based Combined Cycle systems.** Explain in detail about the construction and working of IGCC. What is IGCC system?Briefly Explain.	C303.2	1,3
	Unit-3		
Q.3.1.	**Basics of Nuclear Engineering,** Explain the chain reaction in connection with a nuclear reactor**.** Distinguish between fertile and fissile materials. What is a nuclear fission? What do you understand by radioactive decay? What is uranium enrichment?	C303.3	1,3
Q.3.2.	**Layout and subsystems of Nuclear Power Plants** Explain the functions of reflectors and cladding. Describe the general components of a nuclear reactor. Explain with a neat diagram the various parts of nuclear power plant and mentioning the function of each part.	C303.3	3,7
Q.3.3.	**Working of NuclearReactors : Boiling Water Reactor (BWR)** List and brief the characteristics features of a BWR. Draw the diagrams of PWR and BWR and explain the advantages and dis advantages. What are the conditions which prefer PWR over BWR vice versa?	C303.3	1,7
Q.3.4.	**Working of NuclearReactors : Pressurized Water Reactor (PWR)** Explain the necessity of pressurizer in a PWR power plant.	C303.3	1,7
Q.3.5.	**Working of NuclearReactors :CANada Deuterium-Uranium reactor (CANDU)** Explain CANDU reactor with neat sketch. Give its advantages and dis advantages. Explain the working of CANDU reactor with neat sketch	C303.3	1,7
Q.3.6.	**Working of NuclearReactors : Breeder** Explain the breeder reactor with neat diagram.	C303.3	1,7
Q.3.7.	**Working of NuclearReactors : Gas Cooled Reactors.** Name the gases used in gas cooled nuclear power plant. Describe the gas cooled reactor with neat sketch.	C303.3	1,7
Q.3.8.	**Working of NuclearReactors : Liquid Metal Cooled Reactors.** Describe the working principle of Liquid metal cooled reactor with neat diagram	C303.3	1,7
Q.3.9.	**Safety measures for Nuclear Power plants.**	C303.3	6,7

	Write a note on India's three stage nuclear power programme. What are the safety precaution measurements in Nuclear plants? Discuss about merits, demerits, applications and selection site of nuclear power plants		
	Unit-4		
Q.4.1.	**Hydro Electric Power Plants – Classification,** Classify the hydroelectric plants according to availability of head and nature of load.	C303.4	3,7
Q.4.2.	**Hydro Electric Power Plants -Typical Layout and associated components including Turbines** Write on the factors that should be considered while selecting a site for a hydroelectric plant. what is pumped storage plant? Explain with a sketch. Discuss the pumped storage hydro plant with neat sketches and high light their advantages.Draw a schematic diagram of a hydro plant and explain the operation. What are the different factors to be considered while selecting the site for hydro-electric power plants? What is a surge tank? Why it is important in Hydro power plant? Explain the working of Hydro power plant with neat sketch with merits and demerits. Distinguish between impulse and reaction turbine.	C303.4	3,6
Q.4.3.	**Principle, Construction and working of Wind power systems.** Explain the working of the vertical axis windmill mentioning special arrangements of the blades. Also state how the volatility in wind power is manages in practice. List the types of wind turbines. Name the two wind power plants in Tamilnadu.	C303.4	3,6
Q.4.4.	**Principle, Construction and working of Tidal power systems.** Enlist the merits and demerits of tidal power. Explain the single basin tital power generation with neat diagram. Describe the double basin type tidal power generation with neat diagram.	C303.4	3,6
Q.4.5.	**Principle, Construction and working of Solar Photo Voltaic (SPV) power systems.** Describe the functions of a solar PV electric plant. Briefly state the advantages and thermo electricity to electricity generation by solar PV system. Explain the construction and working of parabolic solar collectors. Briefly explain about solar PV system.	C303.4	3,6
Q.4.6.	**Principle, Construction and working of Solar Thermal power systems.** Explain the working of solar thermal power system with examples.	C303.4	3,6
Q.4.7.	**Principle, Construction and working of Geo Thermal power systems.** Discuss the geo thermal power systems with neat diagram.	C303.4	3,6
Q.4.8.	**Principle, Construction and working of Biogas power systems.** Write short notes on bio energy.	C303.4	3,6
Q.4.9.	**Principle, Construction and working of Fuel Cell power systems.** Enumerate the advantages of fuel cell power sources with specific reference to environment. what are the various kinds of fuel cell and explain the working of any one	C303.4	3,6
	Unit-5		
Q.5.1.	**Power tariff types,** List and discuss any 4 power tariff structure adopted by TANGEDCO?Elucidate the objective and requirements to tariff and general form of tariffWhat are the objectives of tariff? List the requirements of tariff.Explain the different types of tariff with neat sketch	C303.5	1,6
Q.5.2.	**Load distribution parameters, load curve,**	C303.5	1,3

	Brief: base load, peak load and average load of a thermal power plant. What is load curve? Mention the significance of load duration curve. Define the load factor and demand factor. Mention the different types of loads.		
Q.5.3.	**Comparison of site selection criteria of different power plants.** What the different methods are for calculate the depreciation cost? Compare the site selection criteria, merits and demerits of thermal, nuclear and hydropower plants. Enlist the merits of combined operation of hydro and steam power plants.	C303.5	7
Q.5.4.	**Comparison of relative merits & demerits of different power plants.** Compare merits and demerits of nuclear, thermal and hydro power plants.	C303.5	1,6
Q.5.5	**Comparison of Capital & Operating Cost of different power plants.** Name and elaborate on the elements that contribute to the total cost of electricity. Indicate the likely % cost of capital and operating cost of a thermal power plant take the like of the power plant as 25 years. Write down the factors depends on the cost of the power system. Describe the different types of cost of the power plants. Explain the various methods of calculate the depreciation cost.	C303.5	1,6
Q.5.6	**Pollution control technologies including Waste Disposal Options for Coal Power Plant.** Name the pollution control technologies adopted in thermal power plants and describe any one. Explain the analysis of pollution from thermal power plant. Discuss the Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants	C303.5	7
Q.5.7	**Pollution control technologies including Waste Disposal Options for Nuclear Power Plants.** Write short note on nuclear and waste disposal.	C303.5	7
5.Assignments			
Assignment : I	**Date of submission:**		**Max. Marks: 10**
A.1.1.	A Steam turbine receives steam at 15 bar and 350^0C and exhausts to the condenser at 0.06 bar. Determine the thermal efficiency of the ideal Rankine cycle operating between these two limits. **(ans 32%)**	C303.1	1,3
A.1.2.	The steam used by the turbine is 5.4kg/kWh at a pressure of 50 bar and a temperature of 350^0C. the efficiency of boiler is 82 percent with feed water at 150^0C.i. How many kg of 28100 kJ coal are required /kWh? ii. If the cost of coal/tonne is Rs.500, what is fuel cost /kWh? **(ans i.0.572 kg/kWh, ii. 28.6 paise/kWh)**	C303.1	1,3
A.1.3.	A steam power plant operates on a theoretical reheat cycle. Steam at boiler at 150 bar, 550^0C expands through the high pressure turbine. It is reheated at a constant pressure of 40 bar to 550^0C and expands through the low pressure turbine to a condenser at 0.1 bar. Draw T-s and h-s diagrams.Find: i.quality of steam at turbine exhaust ii cycle efficiency iii. Steam rate in kg/kWh. **(ans i.0.88 ii.44% iii.2.17 kg/kWh)**	C303.1	1,3
Assignment : II	**Date of submission:**		**Max. Marks: 10**
A.2.1.	The following data refer to a four stroke double acting diesel engine having cylinder diameter 200 mm and piston stroke 350 mm. m.e.p on cover side=6.5 bar m.e.p on crank side= 7 bar speed =420 r.p.m	C303.2	1,3

	Diameter of piston rod= 20mm Dead load on the brake=1370 N Spring balance reading=145N Brake wheel diameter=1.2m, Brake rope diameter= 20 mm Calculate the mechanical efficiency of the engine**(ans 63.59%)**		
A.2.2.	An open cycle gas turbine uses heavy oil is fuel. The maximum pressure and temperature in the cycle are 5 bar a and 650^0C. The pressure and temperature of air entering into the compressor are 1 bar and 27^0C. The exit pressure of the turbine is also 1 bar. Assuming isometric efficiencies of compressor and turbine to be 80% and 85% respectively, find the thermal efficiencies of the cycle. The overall A:F ratio used is 60:1. Take C_p(for air and gas) =1.004 KJ/kg^{0}C and γ(for air and gas)=1.4. if the plant consumes 5kg of fuel /sec, fine the power generating capacity of the plant.	C303.2	1,3
A.2.3.	In a gas turbine cycle, the turbine output is 600 kJ/kg. the compressor work is 400kJ/kg and the heat supplied is 1000 kJ/kg. calculate the thermal efficiency.**(ans 20%)**	C303.2	1
A.2.4.	An engine is required to develop 100kW, the mechanical efficiency of the engine is 86% and the engine uses 55kg/h of fuel. Due to improvement in the design and operating conditions, there is reduction in engine friction to the extent of 4.8kW. If the indicated thermal efficiency remains the same, determine the saving in fuel in kg/h. (ans. 4.127%)	C303.2	1,3
Assignment : III	**Date of submission:**	**Max. Marks: 10**	
A.3.1.	Calculate the following:i. the fission rate of U^{235} for producing a power of one watt.ii. the energy released in the complete fissioning of 1 kg of U^{235}. Assume that 200 MeV are released per fission of the uranium nucleus. **(ans i.3.1×10^{10} fission/ second ii.8.2×10^{13} J)**	C303.3	1,3
A.3.2.	200 MW of electrical power (average) is required for a city. If this is to be supplied by a nuclear reactor of efficiency 20 percent, using U^{235} as the nuclear fuel, calculate the amount of fuel required for one day's operation. Assume that energy released per fission of U^{235}nuclide=200MeV.**(ans 1.054kg.)**	C303.3	1,3
6.Seminar topics.			
Seminar : I	**Date of Presentation:**	**Max. Marks: 10**	
S.4.1	Magneto Hydro Dynamic Generation	C303.4	1,3
S.4.2	Wave Energy	C303.4	7
S.4.3	Recent Trends in Renewable Energy	C303.4	7
S.4.4	Renewable Energy sources in India	C303.4	7
S.4.5	Renewable Energy sources in the World	C303.4	7
S.4.6	Hybrid Renewable energy systems	C303.4	1,3
S.4.7	Ocean thermal energy conversion	C303.4	7
S.4.8	Solar power generation in Tamilnadu	C303.4	1,7
S.4.9	Wind power generation in Tamilnadu	C303.4	1,7
S.4.10	Integrated energy systems	C303.4	1,3
	7.Self Study topics		
SS.5.1	Energy saving tips in electrical appliances.	C303.5	6
SS.5.2	Rain water harnessing Methods and safety precautions during flood.	C303.5	7
SS.5.3	Causes of global warming.	C303.5	7

K.L.N. College of Engineering, Pottapalayam.
Department of Electrical and Electronics Engineering
EE6503– Power Electronics [C304]
Important Questions/Assignments/Self-study/Seminar topics

Course outcomes

Course	Course outcomes	POs
C304.1	Explain the significance of switching devices and its application to power converters and demonstrate the triggering circuit and snubber circuits.	1,2,3,5
C304.2	Compare the operation of two, three Pulse Converters and draw output waveforms with and without source and load inductance.	
C304.3	Classify the operation of Choppers and outline the application of SMPS.	
C304.4	Analyze the operation of single phase and three phase Inverters with and without PWM techniques.	
C304.5	Illustrate the operation of AC voltage controller and cyclo-converter and its application.	

3. Mapping of Course Outcomes (COs) ,Course (C), Program Specific Outcomes (PSOs) with Program Outcomes. (POs) – Before CBS[Levels of correlation:3(High),2(Medium),1(low)]

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C304.1	2	2	1	-	2	-	-	-	-	-	-	-	1	1	-
C304.2	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-
C304.3	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-
C304.4	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-
C304.5	2	2	1	-	2	-	-	-	-	-	-	-	1	1	-
C304	3	2	1	-	2	-	-	-	-	-	-	-	2	1	-

S.No.	4. Important Questions	COs	POs
UNIT I: POWER SEMI-CONDUCTOR DEVICES			
Q.1.1	Explain the V-I, transfer, turn-on and turn-off characteristics of IGBT with suitable diagram.	C304.1	1
Q.1.2	Describe the switching characteristics of MOSFET with suitable diagram and also draw its equivalent circuit.	C304.1	1
Q.1.3.	(i) Draw the turn – off characteristics of SCR and explain its mechanism. (ii) Explain the various triggering methods of SCR. Which is the universal method and why?	C304.1	3,5
Q.1.4.	Explain the operating principle of a thyristor in terms of the two transistor model of SCR.	C304.1	1,3
Q.1.5.	Explain the structure, different modes of operation and characteristics of TRIAC	C304.1	1
Q.1.6.	Explain the operation of driver and snubber circuits for power MOSFET.	C304.1	1,3
Q.1.7.	Explain the switching performance of BJT with relevant waveforms indicating clearly the turn on, turn off times and their components.	C304.1	1,3
Q.1.8.	Explain various commutation techniques for SCR with suitable circuit diagram.	C304.1	1,3
UNIT II: PHASE CONTROLLED CONVERTERS			
Q.2.1.	Explain the working principle of single phase two pulse fully controlled converter with RL load discontinuous current mode of operation with suitable waveforms.	C304.2	1
Q2.2.	Explain the operation of three phase 3-pulse converter with R –load. Derive the average output voltage.	C304.2	1,3
Q.2.3.	Discuss the effect of source inductance on the performance of single phase full converter.	C304.2	1,3

Q2.4.	With neat sketch, describe voltage and current waveforms of a circulating current type dual converter.	C304.2	1,3
Q.2.5.	Explain the operating principle of 3-phase dual converter with necessary waveforms. (16)	C304.2	1
Q.2.6.	Explain the operation of three phase half wave controlled converter with inductive load. Sketch the associated waveforms.	C304.2	1,3
Q.2.7.	(i) Derive an expression for harmonic factor, displacement factor and power factor of a single phase semi-converter. (ii) Discuss the effect of source inductance of three phase converter.	C304.2	1,3,5
Q.2.8.	(i) A single phase half controlled rectifier supplies a load of R=10Ω and L=10mH. It is operated from 230V 50Hz ac main. Calculate average voltage and current. (ii) A single phase semi-converter is operated from 120V,50 Hz ac supply. The load current with an average value Idc is continuous and ripple free firing angle $\alpha = 30^{\circ}$. Determine i) displacement factor, ii) harmonic factor of input current and iii) input power factor.	C304.2	2,3
Q.2.9.	Discuss and derive the expression of single phase full converter Performance parameter.	C304.2	1,3
UNIT III: DC TO DC CONVERTER			
Q.3.1.	Describe the principle of operation of step – up converter with suitable diagram.	C304.3	1,3
Q.3.2.	With neat sketch explain the operation of Buck – Boost converter with its wave for continuous current mode of operation.	C304.3	1,2,3
Q.3.3.	(i) Discuss the principle of operation of DC – DC step down chopper with suitable waveform. Derive an expression for its average DC output voltage. (ii) A step down DC chopper has resistive load of R=10 Ω and input voltage Vs= 200 V. When the chopper remains ON its voltage drop is 2 for a duty cycle of 0.6. Calculate: (i) Average and RMS value of output voltage (ii) power delivered to load.	C304.3	1,2,3
Q.3.4.	Discuss in detail, the voltage commutated chopper.	C304.3	1,3
Q.3.5.	(i)Explain the various control strategies of chopper. (ii) Design a filter component of a buck converter which has an input voltage of 12V and output voltage of 5V. The peak to peak output ripple voltage is 20mV and peak to peak ripple current of inductor is limited to 0.8A. The switching frequency is 25KHz.	C304.3	1,2,3
Q.3.6.	Explain L type zero current switching resonant converters.	C304.3	1
Q.3.7.	Explain M type zero current switching resonant converters.	C304.3	1
Q.3.8.	Explain zero voltage switching resonant converters.	C304.3	1
Q.3.9.	(i)A dc chopper has an input voltage of 200V and a load of 15ohm resistance. When the chopper is on, its voltage drop is 1.5V and the chopping frequency is 10KHz. If the duty cycle is 80%.Find i)average and rms output voltage ii)chopper on time. (ii)Prove the output voltage of step down chopper is Vo = D Vs.	C304.3	2,3
UNIT IV: INVERTERS			
Q.4.1.	Explain with waveform of three phase inverter for180 degree conduction of each thyristor.	C304.4	1
Q.4.2.	Explain with waveform of three phase inverter for120 degree conduction of each thyristor.	C304.4	1
Q.4.3.	Describe the operation of single phase full bridge inverter supplying R, RL loads with relevant circuit diagrams and waveforms.	C304.4	1,3
Q.4.4.	Explain the multiple pulse modulation inverters with necessary diagrams.	C304.4	1

Q.4.5.	Explain different methods of voltage control adopted in inverter with suitable waveforms. (16)	C304.4	1
Q.4.6.	Explain the single phase current source inverter. State the merits and demerits of them.	C304.4	1
Q.4.7.	Explain different PWM techniques in detail.	C304.4	1
Q.4.8.	Explain the various harmonic reduction techniques for inverters.	C304.4	1
Q.4.9.	Explain the concept of Space Vector PWM technique for inverter with necessary waveforms.	C304.4	1,3
Q.4.10	Explain the operation of Auto sequential CSI with suitable diagram.	C304.4	1
UNIT V: AC TO AC CONVERTERS			
Q.5.1.	With the necessary circuit diagram and waveforms, explain the principle of operation of single phase ac voltage controller having only thyristor feeding resistive load by on-off control and phase control. Derive the expression for rms value of output voltages in both cases.	C304.5	1,3,5
Q.5.2.	Explain operating principle of single phase to single phase cycloconverter with continuous and discontinuous load current with circuit and waveform.	C304.5	1
Q.5.3.	Explain the working of three phase to single phase cycloconverter with neat circuit diagram and necessary waveforms.	C304.5	1
Q.5.4.	(i) Write short notes on matrix converter. (ii) Explain the operation of single phase full wave AC voltage regulator with help of voltage and current waveform.	C304.5	1
Q.5.5.	(i) Explain the principle of operation of 3 phase full wave ac voltage controller. (ii) An AC voltage controller supplies power to a resistive load of 20Ω. The rms input voltage is 220V at 50 Hz. The thyristors are switched ON for 30 cycles and OFF for 70 cycles. Calculate i) rms output voltage ii) input power factor and iii) average and rms values of thyristor currents.	C304.5	1,2
Q.5.6.	Discuss the operation of 3-phase to 3-phase cycloconverter.	C304.5	1
Q.5.7.	(i) Explain in detail about integral cycle control with neat sketches. (ii)Describe the operation of 3-phase AC voltage controller with delta connected load and derive rms output voltage.	C304.5	1
Q.5.8.	(i) Explain the operation of multistage sequence control. (ii) A single phase bridge-type cycloconverter has input voltage of 230V, 50 Hz and load of R = 10Ω. Output frequency is one-third of input frequency. For a firing angle delay of 30°, calculate (a) rms value of output voltage (b) rms current of each converter (c) rms current of each thyristor and (d) input power factor.	C304.5	1,2
	5. Assignments		
UNIT II: PHASE CONTROLLED CONVERTERS			
A.2.1	What is an ideal thyristor switch?	C304.2	1
A.2.2.	When does line commutated converter act as a line commutated inverter?	C304.2	1
A.2.3.	How is power factor of semi-converter better than that of full converter?	C304.2	1
A.2.4.	Draw the 2 pulse converter circuit for various loads.	C304.2	3
A.2.5.	A single phase full wave converter from a 120V, 50Hz for R-load of 10 ohm. If the average output voltage is 25% of maximum possible average output voltage, find (i) the delay angle (ii) average and rms output currents (iii) average and rms thyristor currents.	C304.2	2
A.2.6.	A 3 phase fully controlled rectifier is connected to 3 phase ac supply of 400V, 50 Hz and operates with a firing angle 45 degree. The load current is maintained constant at 10A and the load voltage is 360V. Compute (i) source inductance (ii) load resistance (iii) overlap angle.	C304.2	2
UNIT III: DC TO DC CONVERTER			

A.3.1.	A step-up chopper with a pulse-width of 100μs is operating from 230V dc supply. Compute the average value of load voltage for a chopping frequency of 2000 Hz.	C304.3	2
A.3.2.	What is current limit control? How does it differ from time ratio control? Which of these control strategies is preferred over the other and why?	C304.3	1
A.3.3.	In a type A chopper, the input supply voltage is 230 V, the load resistance is 10 ohm and there is a voltage drop of 2V across the chopping thyristor when it is on. For a duty ratio of 0.4, calculate the average and RMS values of the output voltage. Also find the chopper efficiency.	C304.3	2
A.3.4.	Compare merits and demerits of various switching regulator.	C304.3	1
A.3.5.	Why is forced commutation used in chopper circuits?	C304.3	1
A.3.6.	Compare ZCS and ZVS.	C304.3	1
UNIT IV: INVERTERS			
A.4.1.	Explain the operation of any one application in inverter.	C304.4	1
A.4.2.	What are the performance parameters of inverter?	C304.4	1
A.4.3.	Distinguish voltage source inverter and current source inverter.	C304.4	1
A.4.4.	Enumerate some requirements of good inverter.	C304.4	1
A.4.5.	A single phase half bridge inverter has a resistive load of 2.4 ohm and the input voltage of 48V. Determine the rms output voltage at the fundamental frequency, output power and the total harmonic distortion.	C304.4	2
A.4.6.	A single-phase full bridge inverter has a resistive load of 10 ohm and the input voltage is 100 v. find the rms output voltage at fundamental frequency.	C304.4	2

6. Self-Study Topics

S.No	UNIT	TOPIC	Text / Ref book
1	II - Phase Controlled Converters	12- Pulse converter	M.H.Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, PHI Third edition, 2004.
2	III -DC-DC Converter	Cuk Converter	M.H.Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, PHI Third edition, 2004.
3	V -AC - AC Converters	Two – stage Sequence control	P.S.Bimbra "Power Electronics" Khanna Publishers, third Edition, 2003.

7. Seminar topics

Seminar-1

S.No	UNIT	TOPIC
1.	3	Resonant Converter
2.	3	Load commutated chopper
3.	3	Switched mode power supply (any 2 type)
4.	3	Switched mode power supply (any 2 type)
5.	3	Application of chopper – Battery charging
6.	3	Application of chopper – Electric braking
7.	3	Application of chopper – Electric traction

Seminar-2

S.No	UNIT	TOPIC
1.	5	Bidirectional ac voltage controller
2.	5	Power factor control
3.	5	3-phase to 3-phase cycloconverter
4.	5	Application of ac voltage controller lighting control
5.	5	Application of ac voltage controller Starting of three phase induction motors
6.	5	Application of cycloconverter Induction heating
7.	5	Application of cycloconverter speed control of high power dc drives

K.L.N. College of Engineering

Department of Electrical and Electronics Engineering

EE6504 –Electrical Machines-II- **[C305]**

Questions/ Tutorials/Assignments/Self study /Seminar topics.

S.No.	**1. Questions.**	COs	POs
Q.1.1.	Draw and explain the constructional details of synchronous generators and explain its principle of operation. Give the typical values of rating of an alternator. What are the advantages of revolving magnetic field and stationary armature in alternator?	C305.1	1,2
Q.1.2.	Compare (i).D.C.&AC Generator.(ii).Salient pole & non-salient pole synchronous alternator.(iii).short pitch& full pitch winding (iv) concentrated &distributed winding.	C305.1	1,2
Q.1.3.	Define pitch factor, distribution factor and develop an expression for emf equation of an alternator. How will you reduce harmonics in alternator?	C305.1	1,2
Q.1.4.	Describe armature reaction in alternator for different load conditions. What are the effects of armature reaction?	C305.1	1,2
Q.1.5.	Define Voltage regulation of an alternator. What are the reasons for drop in terminal voltage of an alternator? Draw the phasor diagram of an alternator for (i) resistive (ii) inductive (iii) capacitive load and write the expression for generated emf.	C305.1	1,2,3
Q.1.6.	Explain the voltage regulation of an alternator by (i).EMF (ii)Ampere-turn (iii)ZPF method. Why it is called pessimistic and optimistic method.	C305.1	1,2,3
Q.1.7.	What is meant by synchronization of alternators? Mention the advantages of parallel operation of alternator. What are the conditions for the parallel operation of alternators? Describe (i) Two Bright and one dark lamp (ii).Synchroscope method of parallel operation of alternator.	C305.1	1,2,3, 4
Q.1.8.	Brief (i) losses in alternator (ii).synchronizing current (iii). synchronizing power (iii) synchronizing Torque(iv).Effect of change in excitation (v)effect of change in steam supply	C305.1	2
Q.1.9.	Explain (i) two reactance concept of salient pole machines. (ii)slip test (iii)Capability curve (iv). Infinite bus	C305.1	2
Q.1.10.	For the salient pole synchronous machine, derive the expression for power developed as a function of load angle. Draw the power angle characteristics of salient pole machine	C305.1	2
Q.2.1.	Describe with neat sketches, the construction and principle of operation a three phase synchronous motor.What could be the reasons if a three phase synchronous motor fails to start? Discuss the starting methods of Synchronous motor.	C305.2	2
Q2.2.	Derive the expression for the power developed by a synchronous motor, interms of the load angle. What is the condition for maximum power developed?	C305.2	2
Q.2.3.	Draw the equivalent circuit, phasor diagram of a synchronous motor for leading, lagging and unity power factor load. Write the expression for excitation voltage for each case.	C305.2	2,3,4
Q2.4.	Describe briefly the effect of varying excitation upon the armature current and power factor of a 3 phase synchronous motor when the input power to the motor is maintained constant.	C305.2	2,3
Q.2.5.	Draw ‘V’and inverted ‘V’ curves of a synchronous motor. Explain the experimental method of determining V and inverted V curves.	C305.2	2

Q.2.6.	Give short notes on the features of a Synchronous motor. Explain how synchronous motor can be operated as a synchronous condenser. Mention the merits, demerits and applications of a Synchronous motor.	C305.2	
Q2.7.	Show that the locus of the current phasor of a synchronous motor for constant excitation is a circle. State the assumptions made.	C305.2	
Q.2.8.	Explain various torques associated with synchronous motor. Explain the phenomenon of hunting in an synchronous motor and how it sis remedied?	C305.2	
Q.3.1.	Explain with the help of suitable diagrams how rotating magnetic field is produced.	C305.3	
Q.3.2.	Explain the constructional details and principle of operation of three phase induction motor. Sketch the two types of induction motor and compare them.	C305.3	
Q.3.3.	Derive an expression for toque developed in a 3 ϕ IM and find the condition for maximum torque during(i)starting (ii)running	C305.3	
Q.3.4.	Draw the torque –speed characteristics of poly phase induction motor and clearly indicate the effect of change in rotor resistance.	C305.3	
Q.3.5.	For an induction motor, derive a relationship between (i)starting torque and maximum torque (ii) Full load torque and maximum torque	C305.3	
Q.3.6.	Prove that the ratio of actual speed of rotor of an induction motor to its synchronous speed is given by rotor input to rotor output. Show that P_g: rotor ohmic loss: P_m =1: s: (1-s)	C305.3	
Q.3.7.	Develop the equivalent circuit of a 3 phase induction motor. From the approximate equivalent circuit,find the (i) rotor input (ii)outputpower (iii) output torque. Also find slip at maximum torque.	C305.3	
Q.3.8.	Describe the No-load test and Blocked rotor test of an induction motor. Explain how the parameters of 3 phaseinduction motor can be obtained from the test results.	C305.3	
Q.3.9.	Describe double cage induction motor. Explain in detail, how the desirable features of high starting torque and low operating slip are attained.	C305.3	
Q.3.10.	Discuss the working of (i) induction generator.(ii).synchronous induction generator.	C305.3	
Q.3.11.	Explain the procedure for drawing Circle Diagram.	C305.3	
Q.4.1.	Why a starter is necessary to start 3phase induction motor? Mention the various methods of starting three phase induction motor. Which is the cheapest method of starting a 3 phase induction motor? Explain with the help of diagram the working of an automatic direct –on- line starter. Develop an expression for the torque developed on starting of induction motor by Direct Switching.	C305.4	
Q.4.3.	Explain, with diagram the working of a star-delta starter with necessary protective devices. What is its limitations?	C305.4	
Q.4.4.	Explain auto transformer starter in detail.Compare DOL,Star-Delta and auto transformer Starters.	C305.4	
Q.4.5.	Explain,with the help of a neat diagram the working of a starter used for starting slip-ring induction motor. Derive the expression for the resistance steps for 3-phase slip ringinduction motor.	C305.4	
Q.4.6.	On what factors does the speed of an induction motor depend? What are the various methods of speed control of (i).Squirrel cage induction motor (ii).SRIM?.Discuss the method of speed control of squirrel cage induction motor by (i). Changing thenumber of poles (ii).cascade operation.(iii) frequency control. Derive the expression for the speed of the cascaded set.	C305.4	

Q.4.7.	Explain how the speed of slip ring induction motor can be changed by changing the rotor circuit resistance. What are the limitations and disadvantages of this method?	C305.4	
Q.4.8.	Explain the slip power recovery scheme of speed control of induction motor.	C305.4	
Q.4.9.	What are the different types of electrical braking? Explain with necessary sketches.	C305.4	
Q.5.1.	Explain why a single phase induction motor does not self start. Discuss its operation based on (i) Double revolving field theory. (ii).Cross field theory .Sketch and explain its torque –slip characteristics.	C305.5	
Q5.2.	Explain the constructional details and principle of operation of single phase induction motor.	C305.5	
Q.5.3.	Derive the equivalent circuit of a single phase induction motor with the help of double field revolving theory. Discuss the experimental procedure to obtain the equivalent circuit parameters.	C305.5	
Q.5.4.	Explain with neat diagrams the following types of single phase induction motor (i).Split phase induction motor (ii).Capacitor start induction motor. Also draw their torque-speed characteristics. Mention few applications of these motor. How will y you reverse the direction of rotation of such motors? Draw its the torque-slip characteristics.	C305.5	
Q.5.5.	Draw the connection diagrams of (i).Capacitor start and capacitor run (ii).Capacitor run induction motor. Mention few applications of these motor. How will you reverse the direction of rotation of such motors? Draw its the torque-slip characteristics.	C305.5	
Q.5.6.	Describe the constructional details, operating characteristics, and applications of a shaded pole single phase induction motor. Is it possible to reverse the direction of rotation of such motors? If yes, how? If not why?	C305.5	
Q.5.7.	Mention the problems usually encountered when dc series motor is operated on ac. What design modifications are to be incorporated for its satisfactory operation on ac. Explain the constructional details and principle of operation of AC series motor. Draw its the torque-slip characteristics and mention its applications.	C305.5	
Q.5.8.	Describe the constructional details, operating characteristics, and applications of (i)universal motor (ii).repulsion motor. Mention few applications of these motor. How will you reverse the direction of rotation of such motors? Draw its the torque-slip characteristics.	C305.5	
Q.5.9.	Describe the construction, working and uses of (i)reluctance motor (ii).hysteresis motor .	C305.5	
Q.5.10.	Explain the construction, working and applications of a stepper motor.	C305.5	
4. Tutorial Questions.			
T.1.1.	(i) Calculate the number of poles required for generating frequency of 50Hz using a turbine running at (a).3000 rpm (b).1000rpm (c).300 rpm and (d) 40 rpm.[Ans:2,6,20,150]. (ii). A 60Hz,1200 rpm, alternator is running at 1000.Calculate the frequency of the induced EMF.[Ans:For 1200 rpm, p=6;for 1000 rpm ,f=50Hz] (iii). Calculate distribution factor for 36 slot, 4 pole, single layer, 3 phase winding.(0.96) (iv)An alternator has 18 slots per pole and the first coil lies in the slots 1 and 16.Calculate the pitch factor, for (i).fundamental (ii).3^{rd},5^{th} 7^{th}harmonic.(0.966, 0.707,0.259, 0.258.)	C305.1	

<table>
<tr><td></td><td>(v).Calculate distribution factor for 36 slot, 4 pole, single layer, 3 phase winding.</td><td></td><td></td></tr>
<tr><td>T.1.2.</td><td>(i). A 3 phase 16 pole alternator has a star connected winding with 144 slots and 10 conductors per slot.the flux per pole is 0.03 Wb, sinusoidally distributed and the speed is 375rpm.Find the frequency, the phase and line value of induced emf.Assume full pitched coil.(50Hz,240Turns,K_p=1, $\mathbf{K_d}$ =0.9598, E_{ph}=1534Volts,E_L=√3E_{ph}=2657Volts.).
(ii) A 4 pole,50Hz,star connected alternator has a flux per pole of 0.12Wb.It has 4 slots per pole per phase,conductors per slot being 4.If the winding coil span is 150°,find the phase and line emf.
[n=12,S=48,Z_{ph}=48,T_{ph}=32,E_{ph}=788V,E_L=1366V.]</td><td>C305.1</td><td></td></tr>
<tr><td>T.1.3.</td><td>(i).A 3phase, star connected alternator supplies a load of 10MW at 0.85 lagging and at 11KV.Its resistance is 0.1Ω per phase and synchronous reactance is 0.06Ω per phase. Calculate the line value of emf generated. (11.125KV,line)
(ii). A 3 phase star connected synchronous generator is rated at 1.5MVA, 11KV.The armature effective resistance and synchronous reactance are 1.2Ω and 25Ω respectively per phase.Calculate the percentage voltage regulation for a load of 1.4375MVA at 0.8pf lagging and (ii)0.8pf leading.Also find out the pf at which the regulation becomes zero.
(21.6%,-13.1%.,0.981(lead)</td><td>C305.1</td><td></td></tr>
<tr><td>T.1.4.</td><td>Find the synchronous impedance and reactance of alternator in which a given field current produces an armature current of 200A on short circuit and generated emf of 50V, on open circuit. The value of armature resistance is 0.1Ω.To what induced voltage, must the alternator be excited, if it is to deliver a load of 100A at pf of 0.8 lagging, with a terminal voltage of 200V.(X_s =0.229Ω,E_o=222V.)</td><td>C305.1</td><td></td></tr>
<tr><td>T.1.5.</td><td>From the following test results, determine the voltage regulation of a 2000V, 1ϕ,alternator delivering a current of 100A at (i)UPF (ii)0.71 lagging (iii)0.8lead.Test results: Full load current of 100A is produced on short circuit by a field excitation of 2.5A.An emf of 500V is obtained on open circuit by the same excitation. The armature resistance is 0.8Ω.
(6.88%.,20.7%.,=-8.6%.)</td><td>C305.1</td><td></td></tr>
<tr><td>T.1.6.</td><td>A 100kVA,3000V,50Hz, 3ϕ star connected alternator has an effective armature resistance of 0.2Ω.The field current of 40A produces a short circuit current of 200A and open circuit emf of 1040V(line).Calculate the full load voltage regulation at 0.8 pf lagging and 0.8pf leading. Draw the phasor diagram.(2.2%.,=-1.78%.)</td><td>C305.1</td><td></td></tr>
<tr><td>T.1.7.</td><td>(a) A 3 phase, star connected alternator is rated at 1600kVA,1350V has armature resistance and synchronous reactance as 1.5Ω,30Ω respectively per phase. Calculate voltage regulation for a load of 1280kW at 0.8 pf leading.[Ans:I_L=68A,E_0=6859V,%VR=-1.21%]
(b) The following test results are obtained for a 6600v alternator.
<table>
<tr><td>I_f(Amps)</td><td>16</td><td>25</td><td>37.5</td><td>50</td><td>70</td></tr>
<tr><td>Emf(Volts)</td><td>3100</td><td>4900</td><td>6600</td><td>7500</td><td>8300</td></tr>
</table>
A field current of 20A is found necessary to circulate full load current on short circuit of armature. Calculate by (i).mmf (ii).emf method, full load regulation at 0.8pf (lagging).Neglect armature resistance.[(i).mmf method:%R=14.8%.(ii).38.7%.]</td><td>C305.1</td><td></td></tr>
<tr><td>T.1.8.</td><td>A 3 phase, 6000V alternator has the following open circuit characteristics at normal speed.</td><td>C305.1</td><td></td></tr>
</table>

		I_f(Amps)	14	18	23	30	43	
		Emf(Volts)	4000	5000	6000	7000	8000	
	With armature short circuited & full load current flowing, the field current is 17A. when the machine is supplying full load of 2000kVA at ZPF, the field current is 42.5A and the terminal voltage is 6000V.Determine the voltage regulation of alternator at 0.8pf lagging using Potier triangle method. ∴%VR=27.5%.							
T2.1.	A 50kW,400V,synchronous motor is operating at full load with efficiency of 92%.If the field current is adjusted to make its pf 0.8 leading, estimate the armature current.[98A]						C305.2	
T2.2.	A 75kW,400V,3ϕ,star connected synchronous motor has a resistance and synchronous reactance per phase of 0.04Ω and 0.4Ω respectively.Compute for full load 0.8pf (lead), the open circuit emf / phase and gross mechanical power developed.Assume full load efficiency of 92%.[265Volts.(phase), 80.7kW.]						C305.2	
T2.3.	A 3ϕ, star connected synchronous motor has synchronous reactance of 4Ω per phase working on 1100V busbar. Calculate the power factor of the machine when taking 90kW from the mains, the excitation being adjusted to a value corresponding to induced emf of 1200V.Neglect armature resistance.[0.986]						C305.2	
T2.4.	A 2000V,3 phase ,star connected synchronous motor has an effective resistance and reactance of 0.2Ω and 2.2Ω respectively. The input is 800kW at normal voltage and the emf(line) is 2500V.Calculate the line current and power factor of the load. [0.93, 247.5A.]						C305.2	
T2.5.	A 2000V, 3 phase, 4 pole, star connected synchronous motor runs at 1500rpm.The excitation is constant and related to OCC voltage of 2000V.The resistance is negligible as compared to synchronous reactance of 3Ω per phase. Determine the input power, power factor and torque developed for an armature current of 200A.[669kW, 0.96, 4258Nm.]						C305.2	
T2.6.	A 3phase 6600V,50Hz,star connected synchronous motor takes 50A current. The resistance and reactance per phase are 1Ω and 20Ω respectively. Find the power supplied to the motor and induced emf for a pf of (i)0.8pf lagging (ii)0.8 pf leading (iii).UPF. Draw the vector diagram for each case.						C305.2	
T2.7.	A 3Φ sync motor absorbing 60 kW is connected in parallel; with a factory load of 240 kW having pf 0.8 lag. If the combined load has p.f. 0.9 What is the value of leading kVAR supplied by motor and at what p.f. it is working? [34.7 kVAR]						C305.2	
T2.8.	A 3-phase star connected non-salient pole synchronous motor connected to 6.6kV,mains has an armature impedance of (2.5+j15.0) ohm/phase. The excitation of the machine gives a generated emf of 7kV.The iron loss and friction losses amount to 10kW.Determine the output of the motor when operating at a load angle of 31º(electrical).[1576.3kW] $P_{max}=P_m-P_{fwi}$;$P_m=3EV/X_s$;E&V in phase.						C305.2	
T2.9.	A synchronous motor having 40% reactance and a negligible resistance is to be operated at rated load at UPF, 0.8 power factor lag and 0.8 power factor lead. What are the values of induced emf?[E_b=82.5V,128V]						C305.2	
T 2.10.	A 9kW,400V,three phase star connected synchronous motor has synchronous impedance per phase of (0.4+j3)Ω.Find the angle of retard and the voltage to which the motor must be excited to give a full-load output at 0.8 leading power factor. Assume an efficiency of 90%.[10.46º,262V]						C305.2	

T.3.1.	(i).A six pole induction motor is fed from 50Hz supply. If the frequency of the rotor emf at full load is 2Hz,find the full load speed and slip.[960rpm, 4%] (ii). A 3ϕIM,has 2 poles and is connected to 400V, 50Hz supply. Calculate the actual rotor speed and rotor frequency when the slip is 4%.[2880rpm, 2Hz.]	C305.3	
T.3.2.	In a 6pole,3□,50Hz motor with star connected rotor, the rotor resistance per phase is 0.3Ω, the reactance at standstill is 1.5Ω per phase and emf between the slip rings on open circuit is 175V.Calculate the slip at a speed of 950rpm and rotor emf per phase, rotor frequency and reactance at a speed of 950rpm.[5%,101V, 2.5Hz, 0.075 Ω]	C305.3	
T.3.3.	A 6 pole, 50Hz, 3□, slip ring induction motor has a resistance and reactance of 0.5Ω and 5Ω per phase respectively. Calculate (i).at what speed the torque is maximum?(ii).The ratio of maximum to starting torque.(iii).What must be external resistance per to be added so that the starting torque is half the maximum torque.[900rpm, ;T_{max}/T_{st} =5.05, a=3.72.]	C305.3	
T.3.4.	A 746kW,3□,50Hz,16 pole IM has a rotor impedance of (0.2+j1.5)Ω at standstill.Full load torque is obtained at 360rpm.Calculate (i).Ratio of maximum to full load torque. (ii).speed for maximum torque.(iii).Rotor resistance to be added to get maximum starting torque.[T_{max}/T_f =1.82, 331rpm, r=0.13Ω.]	C305.3	
T.3.5.	The power input to rotor of a 440V,50Hz,3□, 6pole IM is 60kW.It is observed that the rotor emf make 90 complete cycles per minute. Calculate (i).slip (ii).The rotor speed (iii).rotor Cu loss. (iv).mechanical power developed.[0.03, 970rpm, 1800Watts, 58.2kW]	C305.3	
T.3.6.	A 3□, 6 pole,50Hz,IM develops 3700W at 950rpm.What is the stator input if the stator loss is 300W.[4194W]	C305.3	
T.3.7.	The power input to a 500V, 50Hz,6 pole 3□, squirrel cage IM running at 975rpm is 40kW.The stator losses are 1kW and the friction and windage losses are 2kW.Calculate (i).slip (ii).rotor cu loss (iii).efficiency (iv).BHP.[0.025, 975W ,90%,50HP]	C305.3	
T.3.8.	Estimate the stator current ,pf and efficiency at slip of 5% for a motor having the following data. Stator impedance =(1+j3)Ω. Rotor standstill impedance=(1+j2)Ω. No load shunt impedance=(10+j50)Ω. Voltage per phase=250V.[14.33, 0.853, 83%].	C305.3	
T.3.9.	A 25HP, 6 pole,50Hz induction motor has stator/rotor phase voltage ratio of 6/5.The stator &rotor impedance per phase are (0.25+j0.75)Ω and (0.173+j0.5)Ω respectively. Find the starting torque developed by the motor when external resistance of 1Ω inserted in each phase. The motor being started directly on the 400V supply system. Assume Y-Y connection.[63Nm]	C305.3	
T.3.10.	A 3□,400V,IM gave the following test readings. No load test:400V,1250W,9A. SC test:150V,4KW,38A.Draw the circle diagram.If the normal rating is 14.9kW,find from the circle diagram, the full load value of current, pf ,slip and efficiency.[s=6%,η=82.5%.]	C305.3	
T.3.11.	Draw the circle diagram for a 5.6KW,400V,3phase,4pole,50Hz,slip ring IM from the following data.No load readings-400V,6A,pf = 0.087.SC test-100V,12A,720watts. The ratio of primary to secondary turns is 2.62,stator resistance per phase is 0.67 ohm and of the rotor is 0.185ohm.calculate (i)full load current (ii).full load slip (iii)full load pf,(iv).maximum torque (v) maximum power.[s= 6.06%,η= 83.8%,cosϕ=0.8,Pmax=10460.5 watts]	C305.3	
T.4.1.	A small 3phase IM has short circuit current 5 times of full load and full load slip is 5%. Determine starting current, if the starting resistance starter is used to reduce the impressed. voltage to 60% of normal.	C305.4	

T.4.2.	A 12kW,3phase,6pole,50Hz,400V,delta connected IM runs at 960rpm,on full load. If it takes 85A,on direct switching (starting),find the ratio of T_{st}/T_f with star-delta starter. Full load efficiency and pf of 88% and 0.85 respectively.	C305.4	
T.4.3.	Design the five sections of a 6-stud rotor starter for a 3-phase wound rotor induction motor. The slip at full load is 2% and the starting current is 1.5times the full load current. The resistance of the rotor is 0.02Ω per phase.	C305.4	
T.4.4.	Calculate the steps in 5 step rotor resistance starter, for a 3phase IM, the slip at the maximum starting current is 2% with slip ring short circuited and the resistance per rotor phase is 0.02Ω.	C305.4	
T.4.5.	Determine approximately, the starting torque of a 3 phase IM interms of full load torque, when started by(i). star delta starter (ii).Auto-transformer starter with 50% tapping. The SC current of motor is 5 times the full load current and the full load slip is 5%.	C305.4	
T.4.6.	The rotor of a 4 pole 50Hz SRIM has a resistance of 0.3Ωper phase and runs at 1440rpm at full load. Calculate the external resistance/phase which must be added to lower the speed to 1320rpm, the torque being the same.	C305.4	
T.4.7.	Two,50Hz,3 phase IM having 6&4Poles respectively are cumulatively cascaded. The 6 pole motor being connected to the main supply. Determine the frequency of the rotor current and slip referred to each stator field, if the set has a slip of 2%.	C305.4	
T.4.8.	A 4 pole IM and a six pole IM are connected in cumulative cascade. The frequency in the secondary circuit of the 6 pole motor is observed to be 1 Hz. Determine the slip in each machine & the combined speed of the set. Take supply frequency as 50 Hz.	C305.4	
T.4.9.	A 4 pole, 3 phase, 50 Hz SRIM, when fully loaded runs with a slip of 3% . Determine the value of resistance to be inserted per phase in the rotor circuit by reduce the speed by 10% and the new slip. The rotor resistance per phase is 0.2Ω. The load torque remaining the same.	C305.4	
T.5.1.	Find the mechanical power output at a slip of 0.05 of the 185Watts, 4 pole,110V,60Hz,1□IM whose constants are given below,Resistance of stator main winding =1.86Ω, Reactance of stator main winding =2.56Ω,Magnetizing reactance of stator main winding =53.5Ω, Rotor resistance at standstill =3.56Ω, Rotor reactance at standstill =2.56Ω.[201W]	C305.5	
T.5.2.	A 250V ,50Hz,single phase capacitor start Induction motor has the following constants for the main winding and auxiliary windings.Main winding,Zm=(4.5+j3.7).,auxiliary winding Za=(9.5+j3.5).Determine the value of the capacitor that will place the main and auxiliary winding currents in quadrature at starting.[C=211.4F]	C305.5	
T.5.3.	Determine the step angle of a single stack,4phase,6 pole stepper motor.	C305.5	
T.5.4.	The equivalent impedance of the main and auxiliary windings in a capacitor motor are (15+j22.5) Ω and(50+j120) Ω respectively while the capacitance of the capacitor is 12μF.Determine the line current at starting on a 230V, 50Hz supply.	C305.5	

K.L.N. College of Engineering

Department of Electrical and Electronics Engineering

IC6501- Control systems [C306]

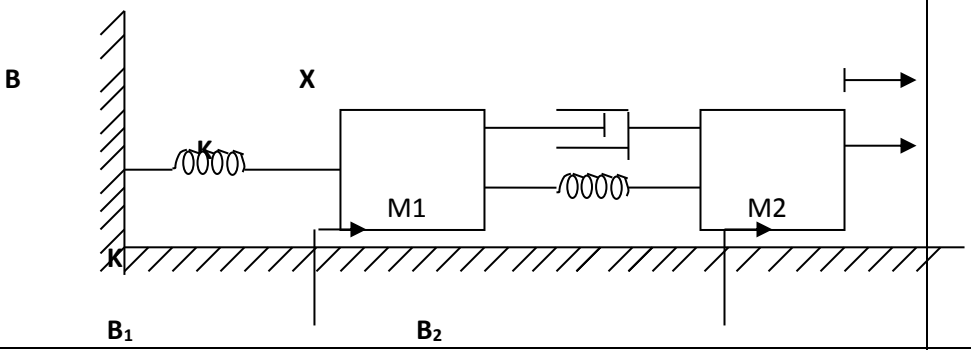
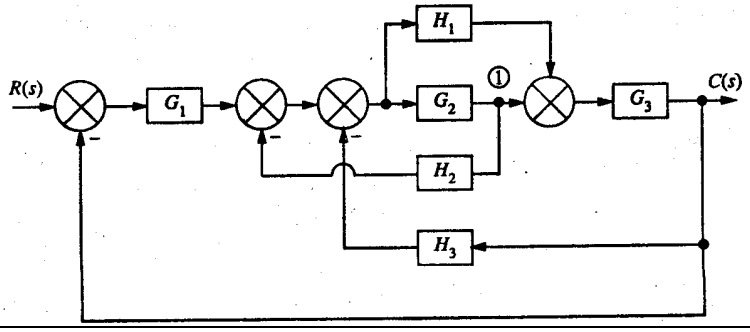
Important Questions /Tutorials /Assignments /Self study /Seminar topics.

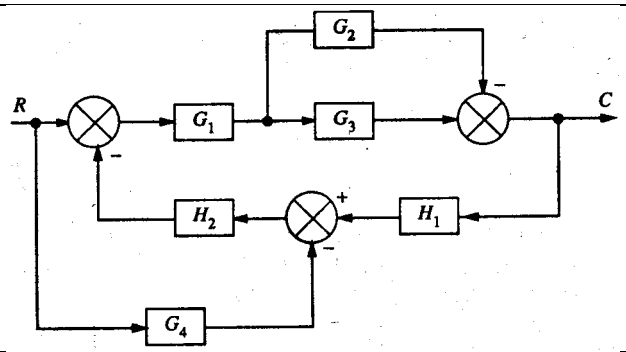
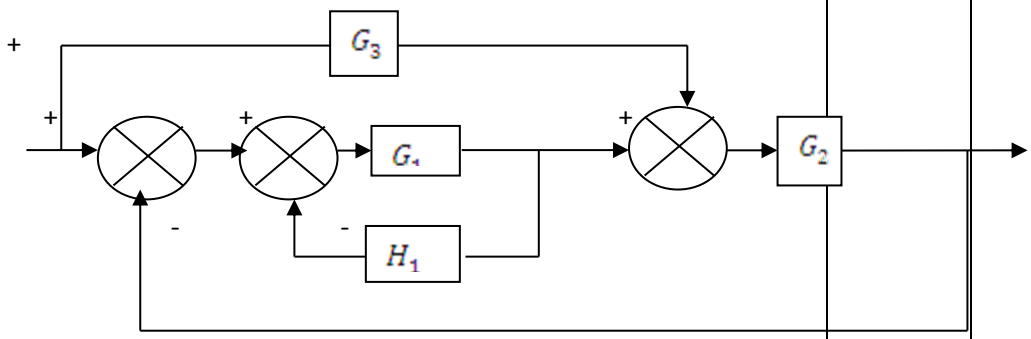
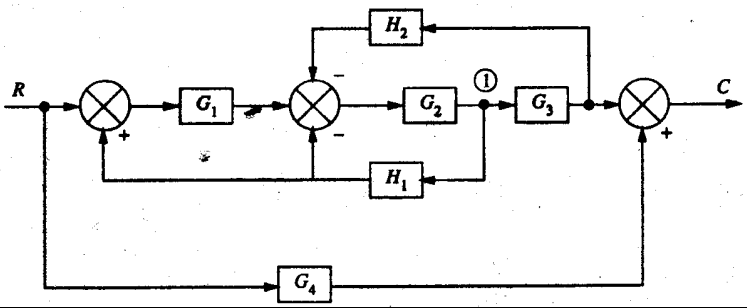
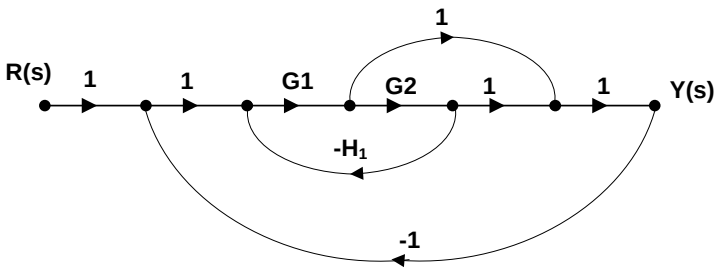
Table.1 Course Outcomes

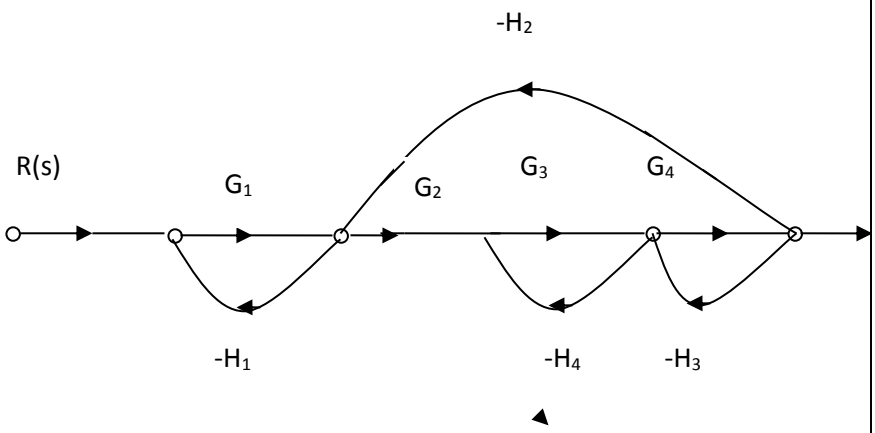
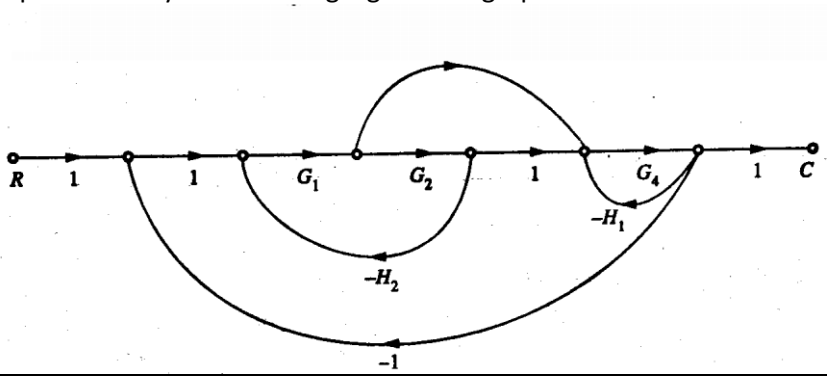
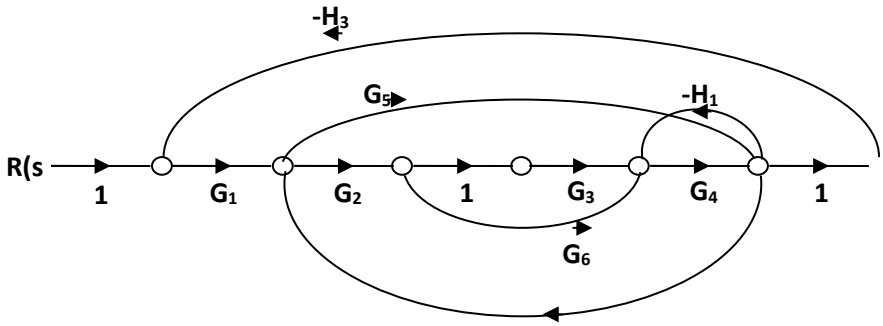
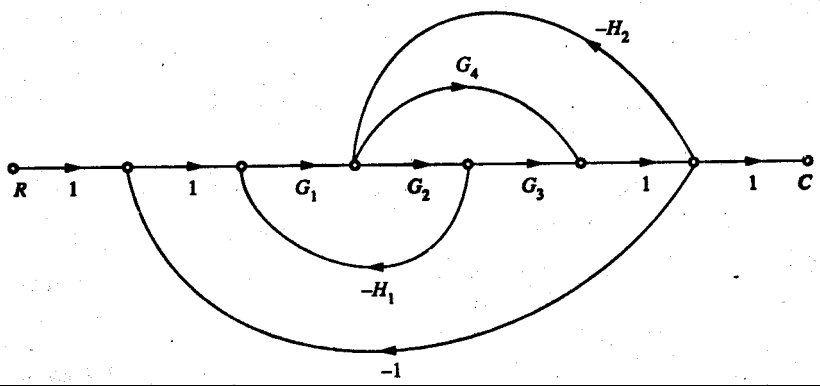
Course	Course Outcome
C306.1	Discuss the use of transfer function models for analysis, physical systems and the control system components.
C306.2	Analyze the time response of systems and steady state error.
C306.3	Apply the basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
C306.4	Explain the stability analysis and types of compensators.
C306.5	Describe the state variable representation of physical systems and the effect of state feedback.

Table.2 Mapping of COs, C, PSOs with POs- before CBS (1 for low, 2 for medium, 3 for high, "-" for no correlation)

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C306.1	3	2	3	1	-	-	-	-	2	-	-	-	2	1	-
C306.2	3	2	3	1	-	-	-	-	2	-	-	-	2	1	-
C306.3	3	2	3	1	-	-	-	-	2	-	-	-	2	1	-
C306.4	3	2	3	1	-	-	-	-	2	-	-	-	2	1	-
C306.5	3	2	3	1	-	-	-	-	2	-	-	-	2	1	-
C306	3	2	3	1	-	-	-	-	2	-	-	-	2	1	-

S.No.	Important Questions.	COs	POs
Q.1.1.	Write the differential equations governing the mechanical systems as shown in figure. Draw force - current electrical analogous circuit and verify by writing mesh and Nodal Equations and Obtain the Transfer function? 	C306.1	1,2,3
Q.1.2.	Using block diagram reduction techniques find closed loop transfer function of the system whose block diagram shown in figure 	C306.1	1,2,3
Q.1.3.	Determine the closed loop transfer function C/R of the block diagram shown in figure Using block diagram reduction techniques.	C306.1	1,2,3

			
Q.1.4.	Simplify the block diagram by using block diagram reduction and hence find the transfer function for the following block diagram. 	C306.1	1,2,3
Q.1.5.	Simplify the block diagram by using a block diagram reduction and hence find the transfer function for the following block diagram. 	C306.1	1,2,3
Q.1.6	Obtain the closed-loop transfer function, Y(s)/R(s) using Mason's gain formula. 	C306.1	1,2,3
Q.1.7	Using Mason's gain formula, determine the ratio C/R for the system represented by the following Signal flow graph	C306.1	1,2,3

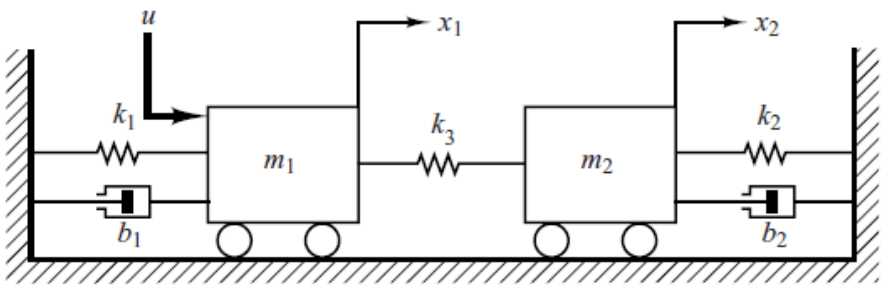
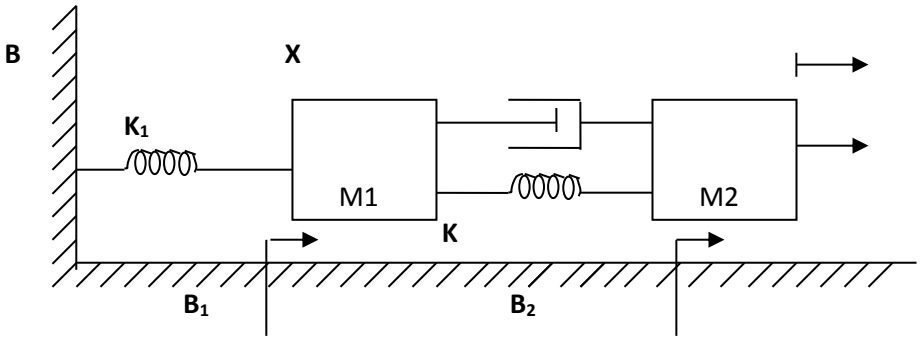
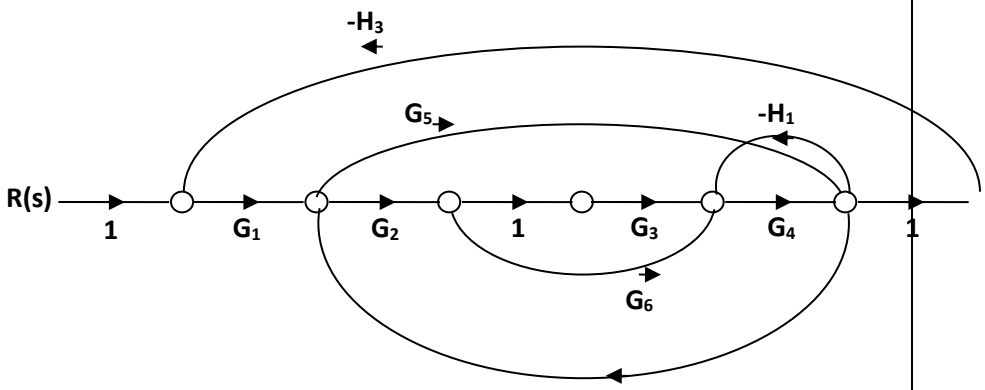
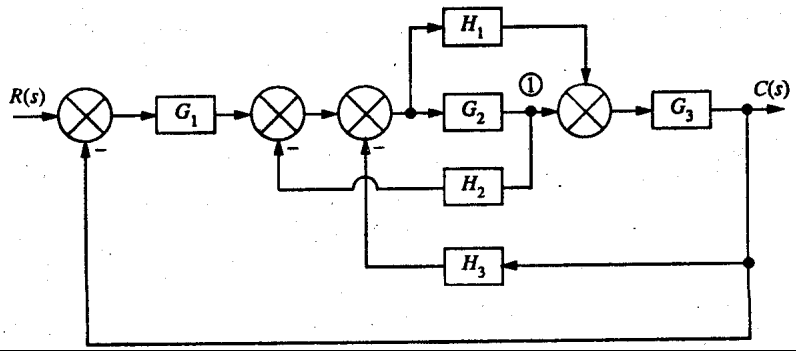
			
Q.1.8	Using Mason's gain formula, determine the ratio C/R for the system represented by the following Signal flow graph 	C306.1	1,2,3
Q.1.9	Using Mason's gain formula, determine the ratio C/R for the system represented by the following Signal flow graph 	C306.1	1,2,3
Q.1.10	Using Mason's gain formula, determine the ratio C/R for the system represented by the following Signal flow graph 	C306.1	1,2,3

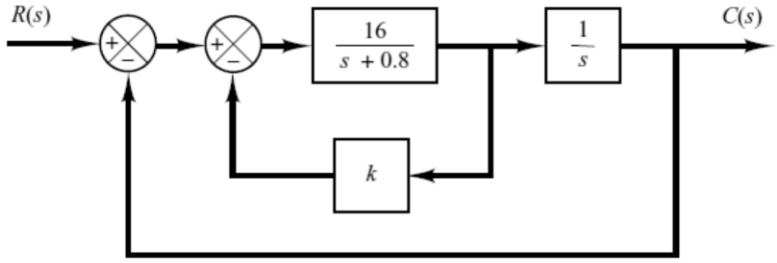
Q.2.1.	Consider the unit-step response of a unity feedback control system whose open-loop transfer function is: $G_2(s) = \frac{1}{s(s+1)}$ Obtain the rise time, peak time, maximum overshoot and settling time.	C306.2	1,2,3
Q.2.2.	Consider the closed loop system given by: $\frac{C(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$ Determine the values so that the system responds to a step input approximately 5% overshoot and with a settling time of 2 sec (use the 2% criterion).	C306.2	1,2,3
Q.2.3.	Obtain the transfer function of the second order system which has a peak overshoot of 9.5% for unit step input. The time to peak overshoot is $\frac{\pi}{12}$ seconds.	C306.2	1,2,3
Q.2.4.	Determine the error constants from the generalized error series for the system with feed forward transfer function $G(s) = \frac{20(s+2)}{s^2(1+10s)}$	C306.2	1,2,3
Q.2.5.	The open loop transfer function of a unity feedback system is given by G(s) = K/s (sT +1), where K and T are positive constants. By what factor should the amplifier gain K be reduced, so that the peak overshoot of unit step response of the system is reduced from 75% to 25%.	C306.2	1,2,3
Q.2.6.	The open loop transfer function of a servo system is G(s) = $\frac{10}{s(0.1s+1)}$. Evaluate the dynamic error coefficients when the system is subjected to the input r(t)=4+6t+2 t^3	C306.2	1,2,3
Q.2.7.	A unity feedback system is characterized by a loop transfer function $G(s0 = \frac{k}{s(s+10)}$. Determine the gain k so that the system will have a damping ratio of 0.5. Obtain the setting time; peak overshoot and time to peak overshoot for a unit step input.	C306.2	1,2,3
Q.2.8	Sketch the root locus of the system whose characteristic equation 1+ K $\frac{1}{s(s+1)(s+2)}$ = 0	C306.2	1,2,3
Q.2.9	Sketch the root locus for a feedback system with open loop Transfer function $G(s)H(s) = \frac{k}{s(s+3)(s^2+2s+2)}$	C306.2	1,2,3
Q.2.10	Sketch the root locus for a feedback system with open loop Transfer function $G(s)H(s) = \frac{k(s+1)}{s(s+4)(s^2+6s+40)}$	C306.2	1,2,3
Q.2.11	Sketch the root locus for a feedback system with open loop Transfer function $G(s)H(s) = \frac{k}{s(s+1)(s+4)}$	C306.2	1,2,3
Q.2.12	Sketch the root locus for a feedback system with open loop Transfer function	C306.2	1,2,3

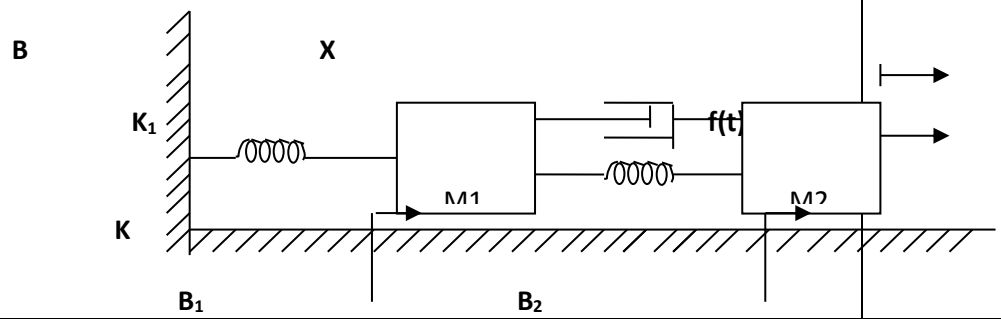
	$G(s)H(s) = \frac{k(s+4)(s+5)}{s(s+3)(s+1)}$		
Q.2.13	Sketch the root locus for a feedback system with open loop Transfer function $G(s)H(s) = \frac{k(s+4)}{s(s^2+6s+13)}$	C306.2	1,2,3
Q.2.14	Sketch the root locus for a feedback system with open loop Transfer function $G(s)H(s) = \frac{k}{s(s^2+8s+17)}$	C306.2	1,2,3
Q.2.15	Sketch the root locus for a feedback system with open loop Transfer function $G(s)H(s) = \frac{k}{s(s+3)(s^2+2s+2)}$	C306.2	1,2,3
Q.3.1.	Sketch the Bode plot for the following transfer function G(s) and determine the system gain K for the gain cross over frequency to be 5 rad/sec. G(s) = k s^2/ (1+0.2s)(1+0.02s)	C306.3	1,2,3
Q.3.2.	For the following transfer function, draw the Bode plot and obtain gain crossover frequency. $G(s) = \frac{5(1+2s)}{(1+4s)(1+0.25s)}$	C306.3	1,2,3
Q.3.3.	For the following transfer function, draw the polar plot and obtain gain crossover frequency. $G(s) = \frac{20}{s(1+3s)(1+4s)}$	C306.3	1,2,3
Q.3.4.	Sketch the polar plot and determine the gain margin and phase margin for the open loop transfer function of a unity feedback system is given by G(s) = $\frac{1}{s(1+s)(1+2s)}$.	C306.3	1,2,3
Q.3.5.	Draw the bode plot and find the value of K when gain margin is 10 db for a unity feedback control system whose transfer function is given by $G(s) = \frac{40K}{s(s+4)(s+10)}$ Find the gain margin, phase margin, phase cross over frequency, and gain cross over frequency?	C306.3	1,2,3
Q.3.6.	The open loop transfer function of a unity feedback system is given by $G(s) = \frac{10(s+3)}{s(s+2)(s^2+4s+100)}$ Sketch the polar Plot and hence find the gain margin, phase margin, phase cross over frequency, and gain cross over frequency	C306.3	1,2,3
Q.3.7.	The open loop transfer function of a unity feedback system is given by $G(s) = \frac{40(s+1)}{(5s+1)(s^2+2s+4)}$ Sketch the Bode Plot and hence find the gain margin, phase margin, phase cross over frequency, and gain cross over frequency	C306.3	1,2,3
Q.3.8.	The open loop transfer function of a unity feedback system is given by	C306.3	1,2,3

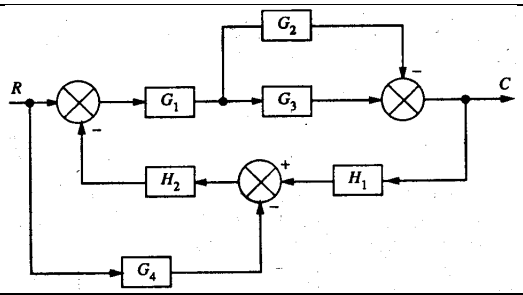
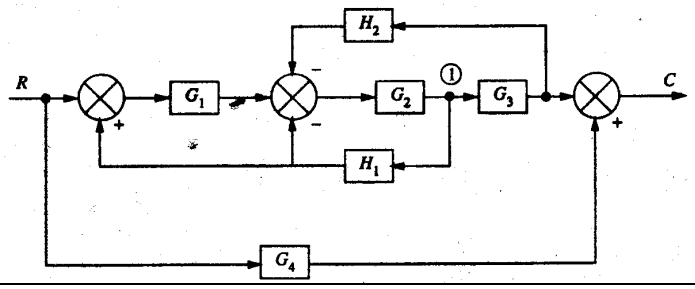
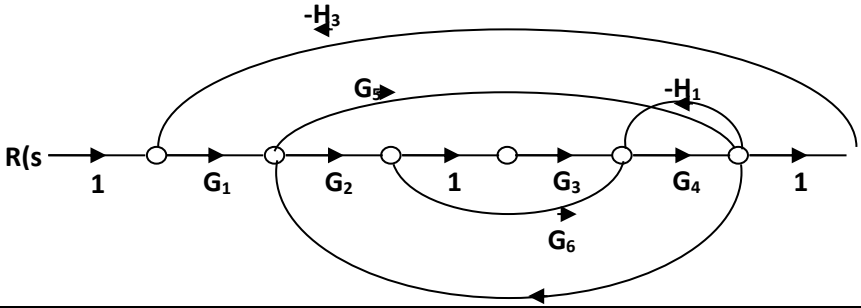
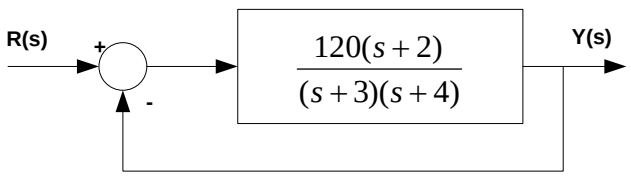
	$G(s) = \frac{4}{s(0.5s+1)(0.08s+1)}$ Sketch the Bode Plot and hence find the gain margin, phase margin, phase cross over frequency, and gain cross over frequency		
Q.3.9.	Discuss the correlation between frequency and time domain specifications?	C306.3	1
Q.4.1	Determine the range of K for stability of unity feedback system whose open loop transfer function is G(s) = $\frac{K}{(s+4)(s+2)(s^2+6s+25)}$.	C306.4	1,2,3
Q.4.2.	Check for the stability of given characteristic equation $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$	C306.4	1,2,3
Q.4.3.	For G(s) H(s) = $1/s^2(s+2)$. Sketch the Nyquist plot and determine the stability of the system?	C306.4	1,2,3
Q.4.4.	The open loop transfer function of certain unity feedback control system is given by G(s) = K/s(s+4) (s+80). It is desired to have the phase margin to be at least 33° and the velocity error constant K_V = 30sec^{-1}. Design a phase lag series compensator.	C306.4	1,2,3
Q.4.5.	Design a phase lead compensator for a negative unity feedback system whose open loop transfer function is G(s) = $\frac{K}{s(s+1)}$ to satisfy the following specifications. The phase margin of the system ≥ 45˚.Steady state error for a unit ramp input ≤1/15.The gain cross over frequency of the system must be less than 7.5 rad/sec.	C306.4	1,2,3
Q.4.6.	Consider the unity feedback system whose open loop transfer function is $G(s)=\frac{K}{s(s+3)(s+6)}$. Design a lag-lead compensator to meet the following specifications. 1). Velocity error constant, K_V =80. 2).Phase margin, $\gamma \geq 35^o$.	C306.4	1,2,3
Q.5.1.	The state model of a system is given by $\dot{X} = AX + Bu;\ Y = CX$ Where $A = \begin{bmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix} B = \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} C = [1 \quad 0 \quad 0]$ Convert the state model to controllable canonical variable form	C306.5	1,2,3
Q.5.2.	Show the following system is completely state controllable and observable $\dot{X} = \begin{bmatrix} -1 & -2 & -2 \\ 0 & -1 & 1 \\ 1 & 0 & -1 \end{bmatrix} X + \begin{bmatrix} 2 \\ 0 \\ 1 \end{bmatrix} u$ $Y = [1 \quad 1 \quad 0]X$	C306.5	1,2,3

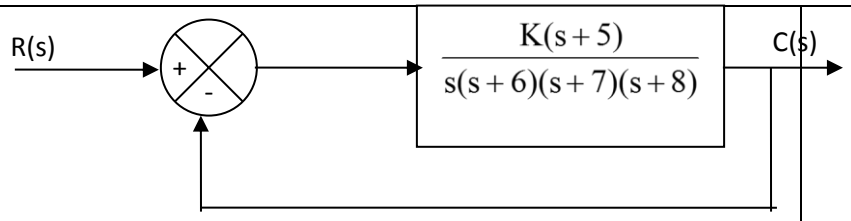
Q.5.3.	Obtain the state model of the system described by the following transfer function $\frac{y(s)}{u(s)} = \frac{5}{s^2+6s+7}$.	C306.5	1,2,3
Q.5.4.	A LTI system is characterized by the state equation $\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U$ Where U is a unit step function. Compute the solution of this equation assuming initial condition $x_o = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$.	C306.5	1,2,3
Q.5.5.	The state modal matrices are given below: $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u \; Y = [3 \quad 4 \quad 1] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$ Determine the observability property using Kalman's test.	C306.5	1,2,3
Q.5.6.	Consider the system with state equation, $\dot{X} = \begin{bmatrix} -1 & -1 \\ 2 & -1 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U$ Determine the controllability property of the system	C306.5	1,2,3
Q.5.7.	Determine the transfer function of the system with state space model $\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & -1 & 1 \\ 0 & -1 & -10 \end{bmatrix} X + \begin{bmatrix} 0 \\ 0 \\ 10 \end{bmatrix} U \qquad Y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} X$	C306.5	1,2,3
Q.5.8.	Obtain the state transition matrix for the state model whose system matrix A is given by $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$.	C306.5	1,2,3
Q.5.9.	Consider a system with state space model given below $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 4 \end{bmatrix} u \quad y = \begin{bmatrix} 2 & -4 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$ Verify that the system is observable and controllable.	C306.5	1,2,3
	Assignment		
A.1.1.	Compute the transfer functions $X_1(s)/U(s)$ and $X_2(s)/U(s)$ of the mechanical system shown in Figure and find the electrical analogous system	C306.1	1,2,3

			
A.1.2.	Compute the transfer function of the mechanical translational system shown below and obtain the (f-v) and (f-i) electrical analogous systems. 	C306.1	1,2,3
A.1.3.	Using Mason's gain formula, calculate the ratio C/R for the system given 	C306.1	1,2,3
A.1.4.	Using block diagram reduction techniques and signal flow graph find closed loop transfer function of the system whose block diagram shown in figure 	C306.1	1,2,3
A.1.5.	Compute the value of k such that the damping ratio is 0.5. Then Compute the rise time t_r, peak time t_p, maximum overshoot M_p, and settling time $t_s$in the unit-step response.	C306.2	1,2,3

			
A.2.1.	The open loop transfer function of a servo system with unity feedback is $G(s) = \frac{10}{S(0.1S+1)}$. Compute the dynamic error using dynamic error coefficients. Obtain the steady state error of the system when subjected to an input given by the polynomial $r(t) = a_o + a_1 t + \frac{a_2 t^2}{2}$.	C306.2	1,2,3
A.2.2.	A unity feedback system has $G(s) = \frac{40\,(S+2)}{S(S+1)(S+4)}$. Compute type of the system, all the error coefficients and error for ramp input with magnitude 4.	C306.2	1,2,3
A.2.3.	Draw the Bode Plot and hence compute the GM, PM, ω_{cg} and ω_{cp} for the open loop transfer function of a unity feedback system is given by $G(s) = \frac{4}{s(0.5s+1)(0.08s+1)}$	C306.3	1,2,3
A.2.4.	For the following transfer function, draw the polar plot and obtain GM, PM, ω_{cg} and ω_{cp}. $G(s) = \frac{20}{s(1+3s)(1+4s)}$	C306.3	1,2,3
A.2.5.	Draw the bode plot and find the value of K when gain margin is 10 db for a unity feedback control system whose transfer function is given by $G(s) = \frac{40K}{s(s+4)(s+10)}$ Find the phase margin, phase cross over frequency, and gain cross over frequency?	C306.3	1,2,3
A.2.6.	The open loop transfer function of a unity feedback system is given by $G(s) = \frac{40(s+1)}{(5s+1)(s^2+2s+4)}$ Draw the Bode Plot and hence find the gain margin, phase margin, phase cross over frequency, and gain cross over frequency	C306.3	1,2,3
A.3.1.	Identify the stability of given characteristic equation: $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$	C306.4	1,2,3
A.3.2.	The open loop transfer function of certain unity feedback control system is given by G(s) = K/s(s+4) (s+80). It is desired to have the phase margin to be at least 33° and the velocity error constant K_V = 30sec^{-1}. Design a phase lag series compensator.	C306.4	1,2,3

A.3.3.	Design a phase lead compensator for a negative unity feedback system whose open loop transfer function is G(s) = $\frac{K}{s(s+1)}$ to satisfy the following specifications. The phase margin of the system ≥ 45˚.Steady state error for a unit ramp input ≤1/15. The gain cross over frequency of the system must be less than 7.5 rad/sec.	C306.4	1,2,3
A.3.4.	Consider the unity feedback system whose open loop transfer function is $G(s)=\frac{K}{s(s+3)(s+6)}$. Design a lag-lead compensator to meet the following specifications. 1). Velocity error constant, K_V =80. 2). Phase margin, $\gamma \geq 35^o$	C306.4	1,2,3
A.3.5.	Design a lead compensator for a unity feedback with open loop transfer function,G(s) = K/[s(1+s)(s+5)] to satisfy the following specifications (i) $K_V \geq$ 50 (ii) phase margin is ≥ 20˚.	C306.4	1,2,3
A.3.6.	The state model of a system is given by $\dot{X} = AX + Bu$ $Y = CX$ Where $A = \begin{bmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix} B = \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} C = [1 \quad 0 \quad 0]$ Convert the state model to controllable canonical variable form	C306.5	1,2,3
A.3.7.	Show the following system is completely state controllable and observable $\dot{X} = \begin{bmatrix} -1 & -2 & -2 \\ 0 & -1 & 1 \\ 1 & 0 & -1 \end{bmatrix} X + \begin{bmatrix} 2 \\ 0 \\ 1 \end{bmatrix} u$ $Y = [1 \quad 1 \quad 0]X$	C306.5	1,2,3
	Tutorials		
T.1.1.	Write the differential equations governing the mechanical systems as shown in figure. Draw (f-v) and (f-i) electrical analogous circuit and verify by writing mesh and Nodal Equations and Obtain the Transfer function? 	C306.1	1,2,3
T.1.2.	Determine the closed loop transfer function C/R of the block diagram shown in figure Using block diagram reduction techniques.	C306.1	1,2,3

			
T.1.3.	Simplify the block diagram by using block diagram reduction and hence find the transfer function for the following block diagram. 	C306.1	1,2,3
T.1.4.	Using Mason's gain formula, determine the ratio C/R for the system represented by the following Signal flow graph 	C306.1	1,2,3
T.2.1.	Consider the unit-step response of a unity feedback control system whose open-loop transfer function is: $$G_2(s) = \frac{1}{s(s+1)}$$ Obtain the rise time, peak time, maximum overshoot and settling time	C306.2	1,2,3
T.2.2.	Determine the static error constants, steady-state error and type of systems for the following inputs for the system shown in figure 6 for Step-input r(t) = 5u(t) , Ramp-input r(t) = 5tu(t), Parabolic-input r(t) = $5t^2u(t)$ 	C306.2	1,2,3
T.2.3.	The open loop transfer function of a unity feedback system is given by G(s) = K/s (sT +1), where K and T are positive constants. By what factor should the amplifier gain K be reduced, so that the peak overshoot of unit step response of the system is reduced from 75% to 25%.	C306.2	1,2,3
T.2.4.	Evaluate the value of gain K, such that the system in the fig has a 10% steady state error for a ramp input	C306.2	1,2,3

			
T.2.5.	Sketch the root locus of the system whose characteristic equation $1+ K\frac{1}{s(s+1)(s+2)} = 0$	C306.2	1,2,3
T.2.6.	Sketch the root locus for a feedback system with open loop Transfer function $G(s)H(s) = \frac{k(s+1)}{s(s+4)(s^2+6s+40)}$	C306.2	1,2,3
T.2.7.	Sketch the root locus for a feedback system with open loop Transfer function $G(s)H(s) = \frac{k(s+4)(s+5)}{s(s+3)(s+1)}$	C306.2	1,2,3
T.2.8.	Sketch the root locus for a feedback system with open loop Transfer function $G(s)H(s) = \frac{k(s+4)}{s(s^2+6s+13)}$	C306.2	1,2,3
T.2.9.	Sketch the root locus for a feedback system with open loop Transfer function $G(s)H(s) = \frac{k}{s(s+3)(s^2+2s+2)}$	C306.2	1,2,3
T.3.1.	Sketch the Bode plot for the following transfer function G(s) and determine the system gain K for the gain cross over frequency to be 5 rad/sec. G(s) = k s^2/ (1+0.2s)(1+0.02s)	C306.3	1,2,3
T.3.1.	For the following transfer function, draw the polar plot and obtain gain crossover frequency. $G(s) = \frac{20}{s(1+3s)(1+4s)}$	C306.3	1,2,3
T.3.1.	Draw the bode plot and find the value of K when gain margin is 10 db for a unity feedback control system whose transfer function is given by $G(s) = \frac{40K}{s(s+4)(s+10)}$ Find the gain margin, phase margin, phase cross over frequency, and gain cross over frequency?	C306.3	1,2,3
T.3.1.	The open loop transfer function of a unity feedback system is given by $G(s) = \frac{40(s+1)}{(5s+1)(s^2+2s+4)}$ Sketch the Bode Plot and hence find the gain margin, phase margin, phase cross over frequency, and gain cross over frequency	C306.3	1,2,3
T.4.1.	Determine the range of K for stability of unity feedback system whose open loop transfer function is	C306.4	1,2,3

	G(s) = $\frac{K}{(s+4)(s+2)(s^2+6s+25)}$.		
T.4.2.	The open loop transfer function of certain unity feedback control system is given by G(s) = K/s(s+4) (s+80). It is desired to have the phase margin to be at least 33° and the velocity error constant K_V = 30sec^{-1}. Design a phase lag series compensator.	C306.4	1,2,3
T.4.3.	Consider the unity feedback system whose open loop transfer function is $G(s)=\frac{K}{s(s+3)(s+6)}$. Design a lag-lead compensator to meet the following specifications. 1). Velocity error constant, K_V =80 2). Phase margin, $\gamma \geq 35^o$.	C306.4	1,2,3
T.5.1.	The state model of a system is given by $\dot{X} = AX + Bu$ $Y = CX$ Where $A = \begin{bmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix} B = \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} C = [1 \quad 0 \quad 0]$ Convert the state model to controllable canonical variable form	C306.5	1,2,3
T.5.2.	Show the following system is completely state controllable and observable $\dot{X} = \begin{bmatrix} -1 & -2 & -2 \\ 0 & -1 & 1 \\ 1 & 0 & -1 \end{bmatrix} X + \begin{bmatrix} 2 \\ 0 \\ 1 \end{bmatrix} u$ $Y = [1 \quad 1 \quad 0]X$	C306.5	1,2,3
T.5.3.	Obtain the state model of the system described by the following transfer function $\frac{y(s)}{u(s)} = \frac{5}{s^2+6s+7}$.	C306.5	1,2,3
T.5.4.	A LTI system is characterized by the state equation $\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U$ Where U is a unit step function. Compute the solution of this equation assuming initial condition $x_o = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$.	C306.5	1,2,3
T.5.5.	The state modal matrices are given below: $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u \; Y = [3 \quad 4 \quad 1] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$ Determine the observability property using Kalman's test.	C306.5	1,2,3
T.5.6.	Consider the system with state equation,	C306.5	1,2,3

	$\dot{X} = \begin{bmatrix} -1 & -1 \\ 2 & -1 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U$ Determine the controllability property of the system		
T.5.7.	Determine the transfer function of the system with state space model $\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & -1 & 1 \\ 0 & -1 & -10 \end{bmatrix} X + \begin{bmatrix} 0 \\ 0 \\ 10 \end{bmatrix} U \qquad Y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} X$	C306.5	1,2,3
T.5.8.	Obtain the state transition matrix for the state model whose system matrix A is given by $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$.	C306.5	1,2,3
T.5.9.	Consider a system with state space model given below $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 4 \end{bmatrix} u \quad y = \begin{bmatrix} 2 & -4 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$ Verify that the system is observable and controllable.	C306.5	1,2,3
	Seminar		
S.1.1	Synchros	C306.1	1
S.1.2	Effect of state feedback	C306.5	1, 3

Reg. No. | | | | | | | | | | | | |

Question Paper Code : 57320

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fifth Semester

Electrical and Electronics Engineering

EE6501 – POWER SYSTEM ANALYSIS

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Define per unit value of an electrical quantity and write the equation for base impedance for a three phase power system.
2. Write the equation for per unit impedance if change of base occurs.
3. What is the need for load flow analysis ?
4. Mention the various types of buses in power system with specified quantities for each bus.
5. State and explain symmetrical fault.
6. What is bolted fault or solid fault ?
7. What are the symmetrical components of a three phase system ?
8. Write down the equation to determine symmetrical currents from unbalanced current.
9. State Equal area criterion.
10. Define transient stability of a power system.

PART – B (5 × 16 = 80 Marks)

11. (a) The data for the system whose single line diagram shown in Fig.11(a) is as follows :

G1: 30 MVA, 10.5 kV, X" = 1.6 ohms

G2 : 15 MVA, 6.6 kV, X" = 1.2 ohms

G3 : 25 MVA, 6.6 kV, X" = 0.56 ohms

T1 : 15 MVA, 33/11 kV, X = 15.2 ohms/phase on H.T side

T2 : 15 MVA, 33/6.2 kV, X=16.0 ohms/phase on L.T side

Transmission line : X = 20.5 ohms/phase

Loads : A : 40 MW, 11 kV, 0.9 p.f lagging

B : 40 MW, 6.6 kV, 0.85 p.f lagging

Choose the base power as 30 MVA and approximate base voltages for different parts. Draw the reactance diagram. Indicate pu reactance on the diagram. **(16)**

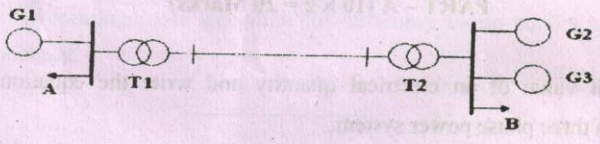


Fig. 11(a)

OR

(b) (i) Determine the Ybus matrix by inspection method for line specification as mentioned below. **(12)**

Line p-q	Impedance in p.u.	Half Line charging admittance in p.u.
1-2	0.04+j0.02	j0.05
1-4	0.05+j0.03	j0.07
1-3	0.025+j0.06	j0.08
2-4	0.08+j0.015	j0.05
3-4	0.035+j0.045	j0.02

(ii) Draw the π-model representation of a transformer with off nominal tap ratio 'α'. **(4)**

12. (a) With a neat flow chart, explain the computational procedure for load flow solution using Gauss Seidal load flow solution. **(16)**

OR

(b) Draw the flow chart and explain the algorithm of Newton-Raphson iterative method when the system contains all types of buses. **(16)**

13. (a) A generating station feeding a 132 kV system is shown in fig. 13(a). Determine the total fault current, fault level and fault current supplied by each alternator for a 3 phase fault at the receiving end bus. The line is 200 km long. **(16)**

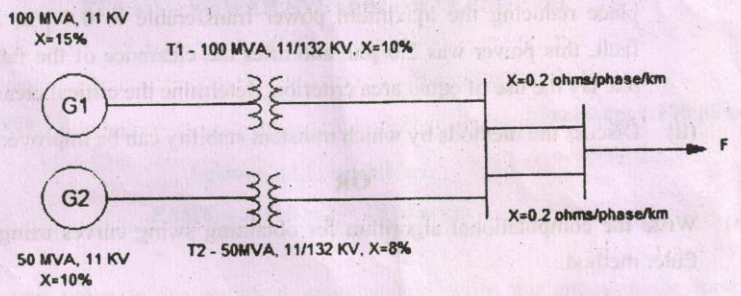


Fig.-13(a)

OR

(b) A Symmetrical fault occurs at bus 4 for the system shown in Fig 13.(b). Determine the fault current using Zbus Building algorithm. **(16)**

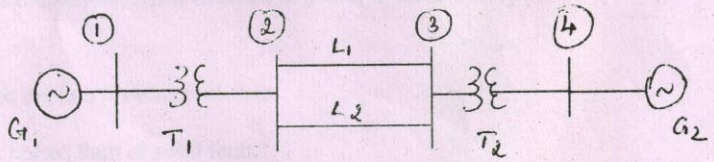


Fig.13(b)

G1, G2 : 100 MVA, 20 kV, $X^+ = 15\%$

Transformer : $X_{leakage} = 9\%$

L1, L2 : $X^+ = 10\%$

14. (a) (i) What are the assumptions to be made in short circuit studies ? (4)

(ii) Deduce and draw the sequence network for LLG fault at the terminals of unloaded generator. (12)

OR

(b) Derive the expression for fault current in line to line fault on unloaded generator. Draw an equivalent network showing the interconnection of networks to simulate line to ground fault. (16)

15. (a) (i) A generator is operating at 50 Hz, delivers 1.0 p.u. power to an infinite bus through a transmission circuit in which resistance is ignored. A fault takes place reducing the maximum power transferable to 0.5 p.u. Before the fault, this power was 2.0 p.u. and after the clearance of the fault it is 1.5 p.u. By the use of equal area criterion, determine the critical clearing angle. (10)

(ii) Discuss the methods by which transient stability can be improved. (6)

OR

(b) Write the computational algorithm for obtaining swing curves using Modified Euler method. (16)

Reg. No. | | | | | | | | | | | | |

Question Paper Code : 27218

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Fifth Semester

Electrical and Electronics Engineering

EE 6501 – POWER SYSTEM ANALYSIS

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is single line diagram?

2. Define per unit value.

3. What is the need for load flow study?

4. When is generator bus treated as load bus?

5. Why do faults occur in a power system?

6. What is direct axis reactance?

7. What are the symmetrical components of a three phase system?

8. What is the sequence operator?

9. How is the power system stability classified?

10. Write the power angle equation?

PART B — (5 × 16 = 80 marks)

11. (a) Draw the reactance diagram for the power system shown in fig. 1. Neglect resistance and use a base of 50MVA and 13.8KV on generator G_1

G_1 : 20MVA, 13.8KV, X" = 20%
G_2 : 30MVA, 18.0KV, X" = 20%
G_3 : 30MVA, 20.0KV, X" = 20%
T_1 : 25MVA, 220/13.8 KV, X = 10%
T_2 : 3 Single phase unit each rated 10MVA, 127/18 KV, X = 10%
T_3 : 35MVA, 220/22 KV, X = 10%

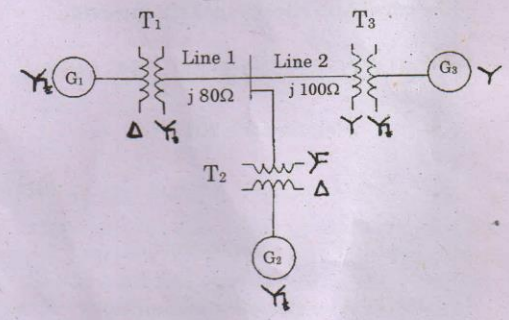


Fig. 1

Determine the new values of per unit reactance of G_1, T_1, Transmission line 1, Transmission line 2, G_2, T_2, G_3 and T_3.

Or

(b) Form Y_{bus} of the test system shown in fig.2 using singular transformation method. The impedance data is given in Table 1. Take (1) as reference node.

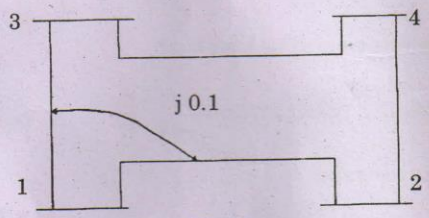


Fig. 2

Table 1

Element No	Self		Mutual	
	Bus code	Impedance	Bus code	Impedance
1	1 – 2	0.5	1 – 2	0.1
2	1 – 3	0.6		
3	3 – 4	0.4		
4	2 – 4	0.3		

12. (a) The system data for a load flow solution are given in Tables 2 and 3. Determine the voltages at the end of the first iteration using the Gauss-Seidel method. Take $\alpha = 1.6$.

Table 2 : Line admittances

Bus code	Admittance
1-2	2–j8.0
1-3	1–j4.0
2-3	0.666–j2.664
2-4	1–j4.0
3-4	2–j8.0

Table 3: Schedule of active and reactive powers

Bus Code	P in p.u	Q in p.u	V in p.u	Remarks
1	–	–	1.06	Slack
2	0.5	0.2	1+j0.0	PQ
3	0.4	0.3	1+j0.0	PQ
4	0.3	0.1	1+j0.0	PQ

Or

(b) Draw and explain the step by step procedure of load flow solution for the Gauss seidel method when PV buses are present.

13. (a) Generator G1 and G2 are identical and rated 11KV, 20MVA and have a transient reactance of 0.25 p.u at own MVA base. The transformers T1 and T2 are also identical and are rated 11/66KV, 5MVA and have a reactance of 0.06 p.u to their own MVA base. A 50km long transmission line is connected between the two generators. Calculate three phase fault current, when fault occurs at middle of the line as shown in fig. 3.

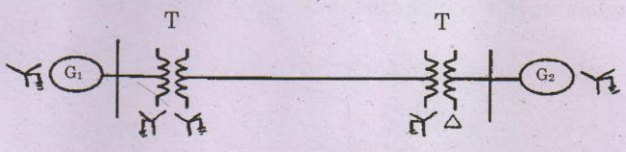


Fig. 3

Or

(b) A synchronous generator and synchronous motor each rated 30 MVA, 13.2 KV and both have subtransient reactance of 20% and the line reactance of 12% on a base of machine ratings. The motor is drawing 25 MW at 0.85 p.f leading. The terminal voltage is 12KV when a three phase short circuit fault occurs at motor terminals. Find the subtransient current in generator, motor and at the fault point.

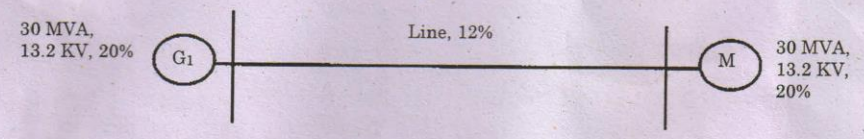


Fig.4

14. (a) Derive the expression for the three phase power in terms of symmetrical components.

Or

(b) A 30 MVA, 11 KV, 3ϕ synchronous generator has a direct subtransient reactance of 0.25 p.u. The negative and zero sequence reactance are 0.35 and 0.1 p.u respectively. The neutral of the generator is solidly grounded. Determine the subtransient current in the generator and the line to line voltages for subtransient conditions when a single line to ground fault occurs at the generator terminals with the generator operating unloaded at rated voltage.

15. (a) (i) Derive the expression for swing equation. (10)

(ii) The moment of inertia of a 4 pole, 100 MVA, 11 kV, $3-\phi$, 0.8 power factor, 50 HZ turbo alternator is 10000 kg-m^2. Calculate H and M. (6)

Or

(b) A synchronous motor is receiving 30% of the power that it is capable of receiving from an infinite bus. If the load on the motor is doubled, calculate the maximum value of δ during the swinging of the motor around its new equilibrium position.

Reg. No. | | | | | | | | | | | | |

Question Paper Code : 57322

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Sixth Semester

Manufacturing Engineering

EE6502 – MICROPROCESSORS AND MICROCONTROLLERS

(Common to Fifth semester Electronics and Instrumentation Engineering / Instrumentation and Control Engineering, Robotics and Automation Engineering and Electrical and Electronics Engineering)

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. What is the function of program counter in 8085 microporcessor ?
2. Mention the purpose of SID and SOD lines.
3. What is a recursive procedures ?
4. Define stack and stack related instructions.
5. Explain the operating mode 0 of 8051 ports.
6. List the features of 8051 microcontroller.
7. What are the internal devices of a typical DAC.
8. What are the features used mode 2 in 8255 ?
9. Write a program to find 2's complement using 8051.
10. How a keyboard matrix is formed in keyboard interface ?

PART – B (5 × 16 = 80 Marks)

11. (a) Explain with a neat block diagram the architecture of 8085 microprocessor. **(16)**

OR

(b) (i) Describe the interrupts of 8085 microprocessor. **(8)**

(ii) Explain the Timing diagram of STA $526A_H$. **(8)**

12. (a) (i) Compare memory mapping and I/O mapping technique in 8085. **(8)**

(ii) Write an assembly language program to sort numbers in ascending order. **(8)**

OR

(b) (i) Write a program to output square wave of 1 kHz frequency on the SOD pin of 8085 for 5 seconds. **(8)**

(ii) Describe the categories of instructions used for data manipulations in 8085 microprocessor. **(8)**

13. (a) (i) Explain the vectored interrupts in 8051 microcontroller. **(8)**

(ii) Explain the different addressing modes of 8051 microcontroller. **(8)**

OR

(b) Explain with a neat block diagram the architecture of 8051 microcontroller. **(16)**

14. (a) (i) Draw and explain the functional block diagram of 8254 timer. **(8)**

(ii) Draw and explain the functional block diagram of 8251. **(8)**

OR

(b) With neat diagram, explain the architecture and features of 8279 keyboard display controller. **(16)**

15. (a) Explain with a neat diagram the closed loop control of servo motor using microcontroller. **(16)**

OR

(b) A switch is connected to pin P2.7, write a ALP to monitor the status of switch and perform the following :

(i) if sw = 0 stepper motor moves clockwise

(ii) if sw = 1 stepper motor moves counter clockwise **(16)**

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 27219

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Fifth Semester

Electrical and Electronics Engineering

EE 6502 — MICROPROCESSOR AND MICROCONTROLLER

(Common to Electronics and Instrumentation Engineering/ Instrumentation and Control Engineering and Robotics and Automation Engineering)
(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is the use of stack pointer?

2. Mention the use of ALE.

3. How is time delay generated using subroutines?

4. Explain the functioning of CMP instruction.

5. List the interrupts of 8051 microcontroller.

6. Write the function of TMOD register in 8051 microcontroller.

7. Write the control word value for 8255 PPI when PORT A and PORT B are inputs in simple I/O mode.

8. What are the working modes of 8254 timer?

9. What is meant by PSW?

10. List out the difference between MOV and MOVX instructions.

PART B — (5 × 16 = 80 marks)

11. (a) Explain with a neat block diagram, the architecture of 8085 microprocessor. (16)

Or

(b) (i) Explain the interrupt structure of 8085 microprocessor. (8)

(ii) Draw the timing diagram of Opcode Fetch machine cycle. (8)

12. (a) (i) Explain the addressing modes of 8085 microprocessor with example for each. (8)

(ii) Write a 8085 assembly language program to divide a 8 bit number by another 8 bit number and store the remainder and quotient in memory locations 4252 and 4253 respectively. (8)

Or

(b) Write an 8085 assembly language program to solve the following equation:

Z = 2X+Y where X and Y are stored in memory locations 4200 and 4201 respectively. The value of Y should be stored in 4202(Lower byte) and 4203(higher byte). (16)

13. (a) Explain the Timers of 8051 microcontroller with appropriate diagrams. (16)

Or

(b) Explain the I/O ports and their functions of 8051 microcontroller. (16)

14. (a) Explain the block diagram, architecture and registers of the 8279 keyboard / display Controller. (16)

Or

(b) (i) Explain the block diagram and modes of the 8254 timer. (8)

(ii) Explain the architecture, functions and registers of the 8255 PPI. (8)

15. (a) Explain the working of a washing machine and how it is controlled by the 8051 Microcontroller. (16)

Or

(b) Explain how to control a stepper motor using 8051 microcontroller with a neat interfacing diagram and assembly program. (16)

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Reg. No. | | | | | | | | | | | | |

Question Paper Code : 57578

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fifth Semester

Electrical and Electronics Engineering

ME 6701 – POWER PLANT ENGINEERING

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. What are once through boilers ?
2. What are the functions of a draught system ?
3. Name the essential components of a diesel electric plant.
4. Give examples of combined cycle power plant.
5. What are fast nuclear reactors ?
6. What is a CANDU type reactor ?
7. Define the function of surge tank in hydro plants.
8. Why is a tall tower essential for mounting a horizontal axis wind turbine ?
9. Define load factor and capacity factor.
10. What are fixed costs in a power plant ?

PART – B (5 × 16 = 80 Marks)

11. (a) (i) Describe the working of FBC boiler with a neat diagram. **(8)**

(ii) Explain the arrangement and operation of a surface condenser. **(8)**

OR

(b) (i) Discuss the functions of air heater types. **(8)**

(ii) Describe with a sketch the working of a mercury-water binary cycle. **(8)**

12. (a) (i) With the help of a diagram, explain the functions of essential components of diesel power plant. **(10)**

(ii) What is IGCC system ? Brief. **(6)**

OR

(b) (i) Bring out the difference between closed cycle and open cycle gas turbine power plants. **(8)**

(ii) Discuss why combined cycle power generation is so important in present day energy scenario. **(8)**

13. (a) (i) Explain the functions of reflectors and cladding. **(8)**

(ii) Explain the necessity of pressurizer in a PWR power plant. **(8)**

OR

(b) (i) List and brief the characteristics features of a BWR. **(8)**

(ii) Write a note on India's three stage nuclear power programme. **(8)**

14. (a) (i) Write on the factors that should be considered while selecting a site for a hydroelectric plant. **(8)**

(ii) What is pumped storage plant ? Explain with a sketch. **(8)**

OR

(b) (i) Describe the functions of a solar PV electric plant. **(8)**

(ii) Enumerate the advantages of fuel cell power sources with specific reference to environment. **(8)**

13. (a) (i) List and discuss any 4 power tariff structure adopted by TANGEDCO ? **(8)**

(ii) Name the pollution control technologies adopted in thermal power plants and describe any one. **(8)**

OR

(b) (i) Name and elaborate on the elements that contribute to the total cost of electricity. **(6)**

(ii) Brief : Base Load, Peak Load and average load of a thermal power plant. **(6)**

(iii) Indicate the likely % cost of capital and operating cost of a thermal power plant take the like of the power plant as 25 years. **(4)**

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 27380

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Fifth Semester

Electrical and Electronics Engineering

ME 6701 — POWER PLANT ENGINEERING

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by super critical boiler?
2. What is pulveriser and why it is used?
3. Mention the major difference between otto cycle and diesel cycle.
4. Why power generation by gas turbine is more attractive than other turbines?
5. List the function of control rods.
6. How do you cater for safety of nuclear power plant?
7. Mention the various advantage of wind power.
8. What are the limitations of tidal power plant?
9. What is the significance of load curve?
10. What are the equipment used to control the particulates?

PART B — (5 × 16 = 80 marks)

11. (a) Write short notes on :
    (i) Ash handling system. (8)
    (ii) Different draught systems. (8)

Or

(b) Explain with a neat sketch the working of a thermal electric power plant station and discuss the function of major components in it. (16)

12. (a) Explain the working of open cycle and closed cycle gas turbine power plant and discuss its advantages and disadvantages. (16)

Or

(b) (i) Explain in detail about the construction and working of IGCC. (10)

(ii) Draw and explain PV and TS diagrams of Brayton cycle. (6)

13. (a) Explain with a neat diagram the various parts of nuclear power plant and mentioning the function of each part. (16)

Or

(b) (i) Explain CANDU reactor with neat sketch. Give its advantages and disadvantages. (8)

(ii) Explain what is chain reaction in connection with a nuclear reactor. (8)

14. (a) (i) Draw a schematic diagram of a hydro plant and explain the operation. (10)

(ii) Write a short note on Bio energy. (6)

Or

(b) (i) Briefly explain solar PV system. (8)

(ii) What are the various kinds of fuel cell and explain the working of anyone? (8)

15. (a) (i) Explain the analysis of pollution from thermal power plants. (10)

(ii) Elucidate the objectives and requirements to tariff and general form of tariff. (6)

Or

(b) (i) Write short note on Nuclear waste disposal. (8)

(ii) A central power station has annual factors as follows. Load factor = 60%, Capacity factor = 40% and use factor = 45%. Power station has a maximum demand of 15,000 KW. Determine the annual energy production, reserve capacity over and above peak load and hours per year not in service. (8)

Reg. No. | | | | | | | | | | | | |

Question Paper Code : 57323

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fifth Semester

Electronics and Instrumentation Engineering

EE 6503 – POWER ELECTRONICS

(Common to Mechatronics Engineering, Instrumentation and Control Engineering, Electrical and Electronics Engineering)

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Define Holding current and Latching current in SCR.
2. Draw the two transistor model of SCR.
3. What are the effects of source inductance ?
4. What are the functions of freewheeling diode ?
5. What is meant by PWM control in DC Chopper ?
6. Define Duty Cycle.
7. Compare CSI and VSI.
8. What are the applications of Inverter ?
9. What is integral cycle control ?
10. What are the different control techniques for AC regulator ?

PART – B (5 × 16 = 80 Marks)

11. (a) Explain the structure, different modes of operation and characteristics of Triac. **(16)**

OR

(b) Explain the operating principle of a thyristor in terms of the "two transistor analogy". **(16)**

12. (a) Explain the operating principle of a single phase full controlled bridge converter. **(16)**

OR

(b) Explain the operating principle of three phase dual converter with necessary waveforms. **(16)**

13. (a) Explain the working of Buck-Boost converter with a neat schematic diagram and waveforms and also derive the source voltage and current expression for the same. **(16)**

OR

(b) Discuss in detail, the voltage commutated chopper. **(16)**

14. (a) With the neat sketch and output waveforms, explain the operation of three phase bridge inverter in 120 degree mode of operation. **(16)**

OR

(b) Explain the single phase current source inverter. State the merits and demerits of them. **(16)**

15. (a) Explain the working of three phase to single phase cycloconverter with neat circuit diagram and necessary waveforms. **(16)**

OR

(b) Discuss in detail, the operation of single phase full wave A.C. voltage regulator with help of voltage and current waveform for various loads. **(16)**

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 27220

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Fifth Semester

Electronics and Instrumentation Engineering

EE 6503 — POWER ELECTRONICS

(Common to Mechatronics Engineering, Electrical and Electronics Engineering, Instrumentation and Control Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Holding current and Latching current in SCR.
2. What are the advantages of GTO over SCR?
3. What is overlap angle?
4. Mention some of the applications of converters.
5. What is meant by PWM control in DC Chopper?
6. What is Duty Cycle?
7. Compare CSI and VSI.
8. Give the use of resonant switching.
9. What is integral cycle control?
10. Write the output RMS voltage for single phase AC voltage controller with resistive load.

PART B — (5 × 16 = 80 marks)

11. (a) Explain the structure and different modes of operation with the characteristics of Traic. (16)

Or

(b) (i) Draw the turn-off characteristics of SCR and explain the mechanism of turn-off. (8)

(ii) Discuss in detail about the current commutation method of turn-off SCR. (8)

12. (a) Explain the operation of three phase 3-pulse converter with R-load. Derive for average output Voltage. (16)

Or

(b) (i) Explain the operating principle of single phase dual converter. (10)

(ii) A single phase full converter is connected with R-Load. The source voltage is 230 V, 50 Hz. The average load current is 10 A For R = 20 Ω. Find the firing angle. (6)

13. (a) Explain the working of Buck-Boost converter with sketch and waveforms and also derive the expression for 1 second. (16)

Or

(b) (i) Discuss the principle of operation of DC-DC step down chopper with suitable waveform. Derive an expression for its average DC output voltage. (8)

(ii) A step down dc chopper has resistive load of R=10 Ω and input voltage Vs=200 v. When the chopper remains ON its voltage drop is 2 for a duty cycle of 0.6 Calculate:

(1) Average and R.M.S value of output voltage

(2) Power delivered to load. (8)

14. (a) With the neat circuit and output waveforms, explain the operation of three phase bridge inverter in 120 degree mode of operation. (16)

Or

(b) Explain different methods of voltage control adopted in inverter with suitable waveforms. (16)

15. (a) Explain the working of three phase to single phase cycloconverter with neat circuit diagram and necessary waveforms. (16)

Or

(b) (i) Write a short notes on matrix converter. (6)

(ii) Explain the operation of single phase full wave A.C voltage regulator with help of voltage and current waveform. (10)

Reg. No. | | | | | | | | | | | | |

Question Paper Code : 57324

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fifth Semester

Electrical and Electronics Engineering

EE6504 – ELECTRICAL MACHINES – II

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. How can you distinguish between the two types of large synchronous generator from their appearance ?
2. Define voltage regulation.
3. List the inherent disadvantages of synchronous motor.
4. How can we change the operating speed of synchronous motor ?
5. Why are the slots on the cage rotor of induction motor usually skewed ?
6. Write down the condition to get maximum torque under running condition.
7. What is the effect of change in input voltage on starting torque of induction motor ?
8. How can the direction of a capacitor run motor be reversed ?
9. Name the motor being used in ceiling fans.
10. Why single phase induction motor is not self starting ? Mention any one method of starting.

PART – B (5 × 16 = 80 Marks)

11. (a) (i) Explain the concept of armature reaction and mention the methods to reduce this effect. **(8)**

(ii) In a 50-KVA, Y-connected, 440-V, 3-phase, 50 Hz alternator, the effective armature resistance is 0.25 Ω / phase. The synchronous reactance is 3.2 Ω/ phase and leakage reactance is 0.5 Ω / phase. Determine at rated load at unity power factor : (a) Internal e.m.f E_a, (b) no-load e.m.f, E_0, (c) percentage regulation on full load, (d) value of synchronous reactance which replaces armature reaction. **(8)**

OR

(b) The following data were obtained for the OCC of a 10 MVA, 13 KV, 3-phase, 50 Hz, Y-connected synchronous generator.

Field current (A) :	50	75	100	125	150	162.5	200	250	300
O.C. Voltage (KV) :	6.2	8.7	10.5	11.8	12.8	13.2	14.2	15.2	15.9

An excitation of 100 A causes the full-load current to flow during the short-circuit test. The excitation required to give the rated current at zero pf and rated voltage is 290 A.

(i) Calculate the adjusted synchronous reactance of the machine.

(ii) Calculate the leakage reactance of the machine assuming the resistance to be negligible.

(iii) Determine the excitation required when the machine supplies full-load at 0.8 pf lagging by using the leakage reactance and drawing the mmf phasor diagram. What is the voltage regulation of the machine ? Also calculate the voltage regulation for this loading using the adjusted synchronous reactance. Compare and comment upon the two results. **(16)**

12. (a) (i) Explain in detail V and inverted V curves of a synchronous motor. **(8)**

(ii) Explain in detail the method of starting of synchronous motor. **(8)**

OR

(b) (i) A 3300 V, delta connected motor has a synchronous reactance per phase of 18 Ω. It operates at a leading power factor of 0.707 when drawing 800 KW from the mains. Calculate its excitation emf. **(8)**

(ii) Enumerate in detail the effect of varying excitation on armature current and power factor of synchronous motor. **(8)**

13. (a) (i) Derive the expression for torque, slip and draw speed-torque characteristics of 3-phase induction motor. (8)

(ii) Explain in detail the construction of circle diagram of an induction motor. (8)

OR

(b) (i) Explain in detail the equivalent circuit of 3-phase induction motor. (8)

(ii) A 40 kW, 3-phase, slip-ring induction motor of negligible stator impedance runs at a speed of 0.96 times synchronous speed at rated torque. The slip at maximum torque is four times the full-load value. If the rotor resistance of the motor is increased by 5 times, determine :

(a) The speed, power output and rotor copper loss at rated torque.

(b) The speed corresponding to maximum torque. (8)

14. (a) (i) Explain in detail the speed control methods of induction motor. (8)

(ii) Explain in detail the scherbius system of speed control. (8)

OR

(b) (i) Describe a starter available for a 3-phase slip ring induction motor. (8)

(ii) A small squirrel-cage induction motor has a starting current of six times the full load current and a full-load slip of 0.05. Find in pu of full-load values, the current (line) and starting torque with the following methods of starting ((a) to (d)). (a) Direct switching, (b) Stator-resistance starting with motor current limited to 2p.u, (c) auto-transformer starting with motor current limited to 2p.u, and (d) Y-delta starting. (e) What auto transformer ratio would give 1pu starting torque ? (8)

15. (a) (i) Explain in detail the operation of capacitor start and run induction motor. (8)

(ii) Discuss in detail the operation of hysteresis motor. (8)

OR

(b) Write short notes on the following :

(i) Linear Induction motor and (8)

(ii) AC series motor (8)

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 27221

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Fifth Semester

Electrical and Electronics Engineering

EE 6504 — ELECTRICAL MACHINES – II

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by armature reaction in alternator?

2. Define Voltage regulation of an alternator.

3. When is synchronous motor is said to receive 100% excitation?

4. What are the causes of hunting?

5. State the condition for maximum torque of an induction motor under running condition.

6. Why the rotor slots are slightly skewed in squirrel cage induction motor?

7. What is the effect of change in supply voltage on starting torque of induction motor?

8. List out the methods of speed control of cage type 3 phase induction motor.

9. Why single phase induction motor is not self starting? Mention any one method of starting.

10. How can the direction of a capacitor run motor be reversed?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Define armature reaction and explain the effect of armature reaction on different power factor loads of synchronous generators. (8)

(ii) Derive the emf equation of an alternator. (8)

Or

(b) A 3 phase, Y-connected, 1000 KVA, 2000 V, 50 Hz alternator gave the following open-circuit and short circuit test readings:

Field current (A)	10	20	25	30	40	50
O.C. Voltage (V)	800	1500	1760	2000	2350	2600
S.C. armature current (A)	–	200	250	300	–	–

The armature effective resistance per phase is 0.2Ω Draw the characteristic curves and determine the full load percentage regulation at (i) 0.8 p.f lagging, (ii) 0.8 p.f leading by MMF method. (16)

12. (a) (i) Draw and explain the phasor diagram of a synchronous motor operating at lagging and leading power factor. (8)

(ii) Explain V and inverted V curves applied to synchronous motor. (8)

Or

(b) (i) A 1000 KVA, 11000 V, 3—phase star-connected synchronous motor has an armature resistance and reactance per phase of 3.5Ω and 40Ω respectively. Determine the induced emf and angular retardation of the rotor when fully loaded at 0.8 p.f. lagging and 0.8 p.f. leading. (8)

(ii) Derive the expression for power delivered by a synchronous motor in terms of load angle (α). (8)

13. (a) Sketch and explain the torque slip characteristics of the 3 phase cage and slip-ring induction motors. Show the stable region in the graph. (16)

Or

(b) (i) A 3 phase induction motor has a starting torque of 100% and a maximum torque of 200% of the full load torque. Determine:

(1) Slip at which maximum torque occurs;

(2) Full load slip;

(3) Rotor current at starting in per unit of full-load rotor current. (8)

(ii) Explain the working principle of 3 phase induction motor. (8)

14. (a) (i) Explain the method of starting of slip ring induction motor. (8)

(ii) Explain the speed control of a 3 phase induction motor using voltage control and frequency control. (8)

Or

(b) Explain the speed control of 3 phase induction motor with slip power recovery scheme. (16)

15. (a) (i) Explain the operating principle of hysteresis motor with neat diagram. (8)

(ii) Explain the operating principle of Linear Induction motor with neat diagram. (8)

Or

(b) Using double field revolving theory, explain why a single phase induction motor is not self starting. Also obtain the equivalent circuit of single phase induction motor with necessary equations. (16)

Reg. No. | | | | | | | | | | | | |

Question Paper Code : 57450

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fifth Semester

Electrical and Electronics Engineering

IC 6501 – CONTROL SYSTEMS

(Common to Electronic and Instrumentation Engineering & Instrumentation and Control Engineering)

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

(Use to Graph Sheet, Semi log sheet Polar sheet is Permissible)
Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. What are the basic elements in control systems ?
2. Define Synchros.
3. List the time domain specifications.
4. State the effect of PI-controller on the system performance.
5. Define phase and gain cross over frequencies.
6. What is Lag-Lead compensation ?
7. What is a characteristic equation ?
8. Define Nyquist stability criterion.
9. What is meant by state space ?
10. When a system is said to be completely observable ?

PART – B (5 × 16 = 80 Marks)

11. (a) (i) Compare open and closed loop control systems. **(4)**

(ii) Write the differential equations governing the mechanical rotational system as shown in Fig. 11(a). Draw the both electrical analogous circuits. **(12)**

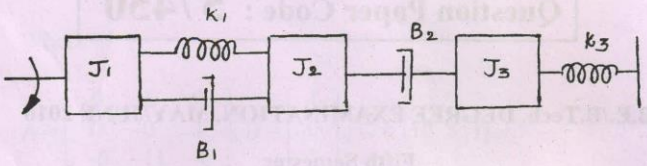

Fig. 11(a)

OR

(b) (i) Convert the given block diagram shown in Fig. 11(b) (i) to signal flow graph for and determine the closed loop transfer function C(s)/R(s). **(12)**

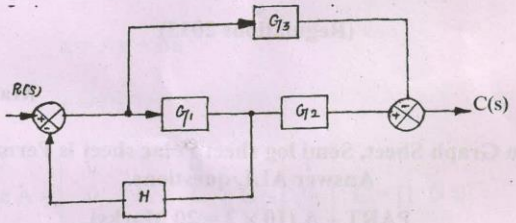

Fig. 11(b) (i)

(ii) Differentiate DC and AC servo motor. **(4)**

12. (a) Derive the time domain specifications of a second order system. **(16)**

OR

(b) (i) For a Unity feedback control system, the open loop transfer function is given by

$$G(S) = \frac{10\,(S+2)}{S^2\,(S+1)}$$

(1) Find the position, velocity and acceleration error co-efficients.

(2) Also find the steady state error when the input is

$$R(S) = \frac{3}{S} - \frac{2}{s^2} + \frac{1}{3\,s^3}$$ **(12)**

(ii) With a neat diagram explain the efect of PD controller in detail. **(4)**

13. (a) Plot the Bode diagram for the following transfer function and determine the Phase and gain cross over frequencies.

$$G(S) = \frac{10}{S\,(1 + 0.4\,S)\,(1 + 0.1S)}$$ **(16)**

OR

(b) The open loop transfer function of a unity feedback system is given by

$$G(S) = \frac{1}{S(1 + S)^2}$$

Sketch the polar plot and determine the gain and phase margin. **(16)**

14. (a) (i) Use R- H criterion to determine the location of the roots and stability for the system represented by Characteristic Equation

$$s^5 + 4s^4 + 8s^3 + 8s^2 + 7s + 4 = 0$$ **(8)**

(ii) Write the procedure for the design of Lag compensator using Bode plot. **(8)**

OR

(b) Draw the Nyquist plot for the system whose open loop transfer function

$$G(S)\,H(S) = \frac{K}{S(S + 2)\,(S + 10)}$$

Determine the range of K for which closed loop system is stable. **(16)**

15. (a) (i) With a neat block diagram, derive the state model and its equations of a Linear multi-input-multi-output system. **(10)**

(ii) Consider the system defined by (6)

$$X = Ax + BU$$

$$Y = Cx$$

Where

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}; B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}; C = [10\ 5\ 1]$$

Check the complete Controllability of the system.

OR

(b) (i) The state model of a system defined by

$$x = Ax + Bu$$

$$y = Cx$$

Where $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}; B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}; C = [1\ 0\ 0]$ (12)

Obtain the diagonal canonical form of the state model by a suitable transformation matrix.

(ii) Explain about the effect of state feedback. (4)

Reg. No. | | | | | | | | | | | | |

Question Paper Code : 27300

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Fifth Semester

Electrical and Electronics Engineering

IC 6501 – CONTROL SYSTEMS

(Common to Instrumentation and Control Engineering
and Electronics and Instrumentation Engineering)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Draw the electrical analog of a thermometer.

2. What is electrical zero position of a synchro transmitter?

3. For the system described by $\frac{C(s)}{R(s)} = \frac{16}{s^2 + 8s + 16}$; find the nature of the time response.

4. Why is the derivative control not used in control systems?

5. Draw the approximate polar plot for a Type 0 second order system.

6. What is the basis for the selection of a particular compensator for a system?

7. How are the roots of the characteristic equation of a system related to stability?

8. Draw the electric lag network and its pole-zero plot.

9. What is meant by 'State' of a dynamic system?

10. When do you say that a system is completely state controllable?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Explain open loop and closed loop control systems with examples. (8)

(ii) Derive the transfer function of an armature controlled DC servomotor. (8)

Or

(b) (i) For the mechanical system shown in Fig. Q 11(b)(i).

(1) Draw the mechanical network diagram and hence write the differential equations describing the behaviour of the system.

(2) Draw the force-voltage and force-current analogous electrical circuits. (6+4)

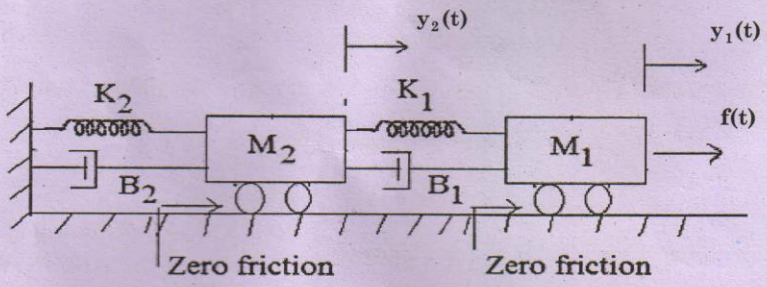

Fig. Q 11(b)(i)

(ii) For a nonunity negative feedback control system whose open loop transfer function is $G(s)$ and feedback path transfer function is $H(s)$, obtain the control ratio using Mason's gain formula. (6)

12. (a) (i) Derive the expressions for the unit step response of a second order

(1) underdamped, and

(2) undamped systems (8+4)

(ii) Explain briefly the PID controller action with block diagram and obtain its transfer function model. (4)

Or

(b) (i) The open loop transfer function of a unity feedback system is given by $G(s) = \frac{1}{s(1+s)}$. The input to the system is described by $r(t) = 4 + 6t$. Find the generalized error coefficients and steady state error. (6)

(ii) Explain the rules to construct root locus of a system. (10)

13. (a) Construct Bode plot for the system whose open loop transfer function is given below and determine (i) the gain margin, (ii) the phase margin, and (iii) closed-loop system stability.

$$G(s) = \frac{4}{s(1+0.5s)(1+0.08s)} \quad (16)$$

Or

(b) (i) Explain the use of Nichol's chart to obtain closed loop frequency response from open loop frequency response of a unity feedback system. (8)

(ii) Describe the correlation between time and frequency domain specifications. (8)

14. (a) (i) By use of the Nyquist stability criterion, determine whether the closed-loop system having the following open-loop transfer function is stable or not. If not, how many closed- loop poles lie in the right-half s-plane.

$$G(s)\,H(s) = \frac{s+2}{(s+1)(s-1)} \quad (6)$$

(ii) Explain the procedure for the design of a lead compensator using Bode plot. (10)

Or

(b) (i) The open loop transfer function of a unity feedback system is given by $G(s)H(s) = \frac{K}{(s+2)(s+4)(s^2+6s+25)}$. By applying the Routh criterion, find the range of values of K for which the closed loop system is stable. Determine the values of K which will cause sustained oscillations in the closed loop system. What are the corresponding oscillation frequencies? (10)

(ii) Derive the transfer function of the lag-lead compensator. (6)

15. (a) (i) Obtain the state model of the mechanical system shown in Fig.Q11(b)(i) in which $f(t)$ is the input and $y_2(t)$ is the output. (10)

(ii) State and prove the properties of State Transition Matrix. (6)

Or

(b) Check for controllability and observability of a system having following coefficient matrices. (8+8)

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}; \; B = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}; \; C^T = \begin{bmatrix} 10 \\ 5 \\ 1 \end{bmatrix};$$

ANNA UNIVERSITY, CHENNAI -25.
OFFICE OF THE CONTROLLER OF EXAMINATIONS

RULES OF THE EXAMINATIONS

A candidate is permitted to use geometric tools, non-programmable calculators and approved tables and data books only during the theory and the practical examinations. No other material/gadget (including cell phone) should be brought inside the examination hall.

A candidate should neither possess/refer any forbidden material in any form nor should seek/obtain assistance in any form from any person/source towards answering the questions during the examinations. He/she should not assist other candidates in any form towards answering the questions during the examinations. The candidate should not reveal his/her identity in any form in the answer scripts. The candidate should not indulge in canvassing either directly or indirectly to award more than deserving marks in the exanimations. The candidate should maintain discipline and decorum during the examinations.

Violation of the above rules in any form during the examinations will attract punishment ranging from levying fine to permanently debarring the candidate from continuing his/her studies as given below.

Sl.No.	Nature of Malpractice	Maximum Punishment
1	Appeal by the candidate in the answer script to show mercy by way of awarding more than deserving marks.	Fine of Rs. 1000/- per subject.
2	The candidate writing his/her name in the answer script.	
3	The candidate writing his/her registration number/college name in places other than specified in the answer script	
4	Any special marking in the answer script by the candidate.	
5	The candidate communicating with neighboring candidate orally or non-verbally; the candidate causing suspicious movement of his/her body.	
6	Irrelevant writing by the candidate in the answer script.	
7	The candidate marking on the question paper or writing answer on his/her question paper or making use of his/her question paper for rough work	
9	The Candidate facilitating the other candidate(s) to copy from his /her answer script	
10	The candidate possessing any incriminating material(s) (whether used or not). For example:-Written or printed materials, bits of papers containing written information,	Invalidating the examinations of the subject concerned and all the theory and the practical subjects of the current semester registered by the candidate.

	writings on scale, calculator, handkerchief, dress, part of the body, Hall Ticket, etc.	Further the candidate is not considered for revaluation of answer scripts of the arrears-subjects. If the candidate has registered for arrears – subjects only, invalidating the examinations of all the arrears – subjects registered by the candidate.
11	The candidate possessing cell phone(s)/programmable calculator(s)/any other electronic storage device(s) gadgets and containing incriminating materials (whether used or not).	
12	The Candidate possessing the question paper of another candidate with additional writing on it.	
13	The candidate passing his/her question paper to another candidate with additional writing on it	
14	The candidate passing incriminating materials brought into the examination hall in any medium (hard/soft) to other candidate(s).	
15	The candidate copying from neighbouring candidate.	
16	The candidate taking out of the examination hall answer booklet(s), used or unused	
17	Appeal by the candidate in the answer script coupled with a promise of any form of consideration.	
18	Candidate destroying evidence relating to an alleged irregularity.	Invalidating the examinations of the subject concerned and all the theory and the practical subjects of the current semester registered by the candidate. Further the candidate is not considered for revaluation of answer scripts of the arrears-subjects. If the candidate has registered for arrears – subjects only, invalidating the examinations of all the arrears – subjects registered by the candidate. Additional Punishment: if the candidate has not completed the programme, he/she is debarred from continuing his/her studies for one year i.e., for two subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects up to the last semester during the debarred period. if the candidate has completed the programme, he/she is prevented from writing the examinations of the arrears-subjects for two subsequent semesters.
19	Vulgar/offensive writings by the candidate in the answer script.	Invalidating the examinations of all the theory and practical subjects of the current semester and all the arrears –subjects registered by the candidate.
20	The candidate possessing the answering script of another candidate	
21	The candidate passing his /her answer script to another candidate	
22	Involved in any one or more of the malpractices of serial no. 8 to 21 for the second or subsequent times.	Invalidating the examinations of all the theory and practical subjects of the current semester and all the arrears –subjects registered by the candidate. Additional Punishment: If the candidate has not completed the programme, he/she is debarred from continuing his/her studies for one year i.e., for two subsequent semesters. However the student is permitted to appear for the examination
23	The candidate substituting an answer book let prepared outside the examination hall for the one already distributed to the candidate	

		in all the arrears-subjects up to the last semester during the debarred period. If the candidate has completed the programme, he/she is prevented from writing the examinations of the arrears-subjects for two subsequent semesters.
24	The candidate indulge in any disruptive conduct including, but not limited to, shouting, assault of invigilator, officials or students using abusive and /or threatening language, destruction of property.	Invalidating the examinations of all the theory and practical subjects of the current semester and all the arrears –subjects registered by the candidate. Additional Punishment: if the candidate has not completed the programme, he/she is debarred from continuing his/her studies for two years i.e., for four subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects up to the last semester during the debarred period. if the candidate has completed the programme, he/she is prevented from writing the examinations of the arrears-subjects for four subsequent semesters.
25	The candidate harass or engage others to harass on his/her behalf an invigilator, official, witnesses or any other person in relation to an irregularity by making telephone calls, visits, mails or by any other means.	
26	Candidate possessing any firearm/weapon inside the examination hall.	
27	Cases of Impersonation	(i)Handing over the impersonator to the police with a complaint to take appropriate action against the person involved in the impersonation by the Chief Supt. (ii)If a student of this University is found to impersonate a 'bonafide student', the impersonating student is debarred from continuing his/her studies and writing the examinations permanently. He/she is not eligible for any further admission to any programme of the University. (iii)Debarring the 'bonafide student' for whom the impersonation was done from continuing his/her studies and writing the examinations permanently. He/she is not eligible for any further admission to any programme of the University.

CONTROLLER OF EXAMINATIONS

K.L.N. COLLEGE OF ENGINEERING, Pottapalayam 630612
(11 km from Madurai City)

STUDENTS LEAVE APPLICATION FORM

Department of Electrical and Electronics Engineering

Date:

Name of the Student :

Roll No.: : Sem / Yr. / Sec.

No. of days, leave, already availed :

%of Attendance as on : _____ is _____

Date & Day :

Reason for Leave :

Signature of the Student **Name, Mobile No. & Signature of Parent / Guardian**

Recommended / Not Recommended

Class Tutor **Class Coordinator** **HOD/EEE**

K.L.N.COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

ON DUTY REQUISITION FORM – STUDENTS –

TO ATTEND SKILL DEVELOPMENT PROGRAMMES (Workshop / Seminar / Symposium etc.)

Date: _____

To,

The Principal,
KLNCE.
Pottapalayam.

Respected Sir,

Sub.: Request for OD to attend _____

As, I am going to attend _____ conducted by _____ from_____ to_____. Please permit me to attend the programme and also grant me O.D. for these days.

S. No	Roll No.	Name & Degree, Semester / Section)	No. of Programmes already attended & Days OD availed	No. of Arrears in AU Exam	No. of subjects failed in Class Test	No. of Subjects failed in CIT's	ATT % As on	Sign

Discipline / misbehavior, reported if any :

Clash with Internal test if any :

Recommended by		
Class co-ordinator	HOD	
	OD Permitted	OD Approved

K.L.N.COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
On duty (OD) norms for students – Reminder

1. Students who apply for OD should submit the filled in OD form, forwarded by class co-ordinator, to the Department office. Such OD should be applied, **atleast a day before** availing it. Only after getting permission from the HOD, students are permitted to avail OD.

2. Students are permitted to **apply** for OD for attending co-curricular and extra curricular activities, inside / outside the college, only after getting prior permission from the class co-ordinator and HOD. Permission will be granted, considering students port folio, (performance in the University examination, Class test / CITs and attendance). Also the relevance of the seminar / workshop / technical events / certificate courses etc. will be reviewed with the class co-ordinators to sanction OD.

3. On duty will be approved only after the submission of relevant certificates (Copies to submitted to the staff in-charge, Mr. S. Rajalingam, and to the college office).

4. Final year Students having more than 6 arrears, third year students having more than 4 arrears and Second year students having more than 3 arrears (cumulative) will not be permitted to attend the Co-curricular / extra curricular activities. This is to ensure them to concentrate more on academic subjects. However, this will be relaxed, at the request of parents and students, considering the students contribution in the co –curricular / extra curricular activities.

5. Students who failed in 3 and above subjects in class tests / CITs will not be permitted to participate in any inside / outside the college co curricular activities. This is to ensure them to concentrate on academic subjects.

6. Students with less than 90% of attendance will not be permitted to apply for OD.

7. Students with the history of indiscipline activities reported in the past in the class room / laboratories / campus etc. will not be permitted to apply for OD.

8. Status of Students who have applied for OD for attending Co-curricular / extra curricular activities inside / outside the college will be monitored. Their presence in the concerned venue will be constantly monitored. Non availability of students, in the concerned venue, is reported, if any, disciplinary action will be taken.

9. First and Second year students of B.E-EEE are not encouraged to participate in the Co-curricular / extra curricular activities, as subject content of first and second year is heavy and basics are to be studied in deep for successful career.

10. Curricular / co-curricular events, are planned and periodically conducted by the department. Also certificate / certification courses are regularly conducted by the department during summer / winter holidays. Students are encouraged to attend such courses / events organized by the department, as it will not affect the regular academics.

11. Students are encouraged to attend curricular / co-curricular events, inside / outside the college, after college working hours or during holidays, as it will not affect the regular academics.

12. Students will be selectively permitted to attend curricular / co-curricular events inside / outside the college, if it is highly recommended by the faculty. A maximum of 10% of the students from each class will be permitted for attending such events. Preference will be given for those students having no history of arrears and passed all the class test / CITs.

13. Students attending curricular / co-curricular events inside / outside the college should maintain highest order of discipline. Indiscipline reports received, if any, students will not be permitted for attending any events thereafter and suitable disciplinary action will be taken.

14. It was reported that students who involved in indiscipline activities, while participating in the curricular / co-curricular activities, outside the college, were not permitted to appear for the University Examinations, as such issues reported to the University. Hence students should be very cautious while attending events inside / outside the college.

Co-operation of the all the staff are solicited for better academic performance and successful career.

HOD / EEE

A Brief History of the College

K.L.N. College of Engineering is the first self-financing Co-educational Engineering College in Madurai, started in 1994 by Munificence of Philanthropist and well-wishers in Sourashtra Community which is a linguistic minority in Tamilnadu. This college is sponsored by the committee of eminent industrialists and academicians led by enthusiastic, educationalist and industrialist (Late) Thiru K.L.N. Krishnan. This college has the approval of All India Council for Technical Education, New Delhi and is affiliated to Anna University, Chennai.

Thiru. K.L.N. Krishnan, Founder President of this Engineering College has rendered Yeoman service to Sourashtra Arts & Science College and Sourashtra Girls Higher Secondary School, Madurai for the past several years. He also promoted a Polytechnic under the name of K.L. Nagaswamy Memorial Polytechnic College in Viraganur, Madurai in 1983. This Engineering College, functioned in the premises of the above polytechnic during the academic years 1994-95 & 1995-96 was shifted to its own premises in the year 1996.

(Late) Thiru K.L.N. Krishnan is the Founder President, and the college is now under the management of Dr. K.N.K. Ganesh as Secretary & Correspondent and other executive committee members.

Campus :

This college is situated on the South Eastern outskirts of Madurai, 11th Km on Madurai – Nedungulam Road. It is built in an area of 53.8 acres. The Campus has multistoried buildings consisting of well provided class rooms, drawing halls, seminar halls, conference hall, library, Air-Conditioned Computer centres, staff rooms and student rest rooms. The infrastructure also consists of five double storeyed laboratory buildings and three single storeyed workshops and Machine shop, and an automobile workshop.

The Administrative block (2 storeyed) of 1,185 sq. metre with office in the ground floor, I.T. laboratory in the first floor & class rooms in the second floor has been constructed on the eastern side. A two storeyed block of 1,185 sq. metre consisting class room has been constructed on the southern side of the administrative block. A two storeyed block of 1,185 sq. metre with EIE laboratory in the ground floor, DSP laboratory in the first floor & class rooms in the second floor has been constructed on the western side of the administrative block. A two storeyed block of 2,122 sq. metre with spacious library, video library & Electronic resource section in the ground floor, class rooms in the first floor & CSE laboratory in the second floor has been constructed near the administrative block.

A single storeyed block of 1,193 sq. metre with S.M. laboratory in the ground floor CAD, CAM laboratories in the first floor & class rooms in the second floor has been constructed on the north western side of the administrative block.

Three Mechanical sheds (occupied by three Mech. Engg. Laboratory) of 2460 sq. metre have been constructed on the northern side of the mechanical block.An automobile work shop of 2304 sq. metre has been constructed on the north western side of the administrative block.

An Indoor stadium cum Auditorium of 2,221 sq. metre has been constructed on the northern side of the administrative block.

A separate double storeyed post-Graduate block of 4,020 square metre for M.B.A. and M.C.A. departments has been constructed on the South Western side of the administrative Block.

A single storeyed block of two canteens with 2,485 square metre in the ground floor and ladies rest room in the first floor has been contructed on the south western side of the Administrative Block.

A single storeyed block of 1,289 square metre for Electrical & Electronics Engg., Laboratories & class rooms in the ground floor and Electronics & Communication Laboratory and Class rooms in the first floor has been constructed on the western side of the Administrative Block.

A two-storeyed block with an area of 2,956 sq. metre has been constructed as an extension to Block III Opposite the U.G. library Block. This block comprised Physics lab, Chemistry lab and EIE Lab. D.S.P. Lab & Class rooms.

A two-storeyed block with an area of 2076 squremetre for the use of EEE Dept. in the ground floor & ECE Dept. in the first & 2nd floors is now under construction as an extension to the existing EEE & ECE block on the western side of the administrative block.

A two storeyed block with an area of 2,977 sq. metre for the use of Mechanical & Automobile depts. is now under construction, as an extension to the existing Mechanical block on the North-Western side of the administrative block.

A separate building with ground floor of area of 170 sq. metre for the installation of Generator on the South-estern side (Opposite to the Vinayagar temple) of the administrative block is under construction & (nearing completion)

In order to facilitate the easy accessibility for the students, in all, 950 numbers of computers have been installed so far. This sounds the management's conviction in providing essential infrastructure for the learning purpose in our college.

An overhead Tank of 20,000 Litre Capacity at a height of 40 feet has been constructed at a cost of Rs.4 lakhs, donated by Rotary international, Rotary District-1240, Rotary club of LEIGH-ON-SEA. Treated drinking water plant at a cost of Rs.2 lakhs has been installed near the overhead tank.

Well-furnished Men's Hostel, Mess block and canteen block are also inside the campus. The college is a quiet retreat, ideal for concentrated study, away from distractions and disturbances of a large city.

A single storeyed block of 1,330 square metre with a spacious dining hall in the ground floor and 13 rooms in the first floor for men students has been constructed on the northern side of the administrative block and is already in use. A two storeyed hostel block of 2,034 square metre adjacent to the existing hostel for men students has been constructed.

Total expenditure incurred so far towards the cost of equipments& buildings & other assets is about Rs.22.50 crores.

A VINAYAGAR Temple on the eastern side of the administrative Block has been constructed Eight class rooms for I year B.E. / B.Tech 2 class room for M.E. (P.S.) students, and two staff rooms have been constructed in the ECE/EEE block.

A Ladies Hostel of 1460 sq.m. which can accommodate about 150 students in under construction within the campus.

SALIENT FEATURES OF THE DEPARTMENT

1. GENERAL

- Started offering B.E. in Electrical and Electronics Engineering in the year 1994 with an intake of 40 (No.-732-50-8/RC/94, dated 11th August 1994, AICTE) with the latest intake of 120 in 2011 (F.No.Southern/1-400215781/2011/EOA, dated 01.09.2011, AICTE).
- Started offering M.E. in Power Systems Engineering in the year 2005 with an intake of 20 and increased intake to 24 in 2012 (F.No.Southern/1-687512981/2012/EOA, dated 10.05.2012, AICTE).
- Accredited in March 2004 (First time – F.No.NBA/ACCR-242/2003, dated 24/03/04) and Re-accredited (Second time – F.No.NBA/ACCR-242/2003, dated July 19, 2008) by National Board Accreditation, New Delhi.
  Re-accredited (Third time - For 2 years w.e.f. 28-08-2012) by National Board Accreditation, New Delhi.
- Recognized Research Centre No.4490408, Approved by Anna University, Chennai with effect from December 2012, offering guidance for M.S &Ph.D.(Full time/Part time).
- Both UG and PG programs are permanently affiliated to Anna University, Chennai with effect from December 2012.
- MODROB fund of Rs.5 lakhs was allotted for the year 2011-2012 for the Power Electronics laboratory (No.8024/RIFD/MOD-131(pvt)/Policy-III/2011-2012, dated 06.03.2012).

2. INFRASTRUCTURE

- Electrical machines laboratory, Control, Measurement and Instrumentation laboratory, Power Electronics laboratory, Electric circuits and Electronic devices laboratory, Research and Development laboratory and Power System Simulation Laboratory are equipped with machineries, components, signal generating, power supply measuring, recording instruments and computer systems costing Rs.2 crores. The total built up area of laboratories is 1208.21 sq.m.
- Latest softwares on Power system analysis, Power system stability, Power world simulator and Power electronics are available to study, solve, design and simulate research on Power system and Power Electronics problems to experience the real time results.
- All the class rooms are equipped with computer systems, LCD and OHP to promote the Teaching-Learning process more effectively.
- Separate library facility for EEE students with more than two thousand books on core subjects and hard copies of IEEE Journals and magazines from 1999 are available for reference. Staff and students

can access the softcopy of Journals, proceedings published by IEEE, Elsevier, ASME, Springer, Mc Graw Hill.

- All laboratories are provided with sufficient computing facilities, printing facility with internet connection to simulate laboratory experiments.

3. STAFF

- Teams of well qualified, and experienced 32 faculties with cadre ratio as per AICTE, are guiding the students to attain the best educational objectives.
- Excellent research environment promotes the staff and students to participate, present and publish their research works in the National/International Journals and National/International conferences.
- Facility and experienced faculty available for guiding Ph.D.scholars.
- Staff development Programme / Faculty development programme / Workshop/ Seminar are organized regularly to share the knowledge of our experienced faculty with parent institution and other colleges staff and students and Industrial persons.

4. RESEARCH AND DEVELOPMENT

- The Research and Development section is doing research on Industrial Power Harmonics and mitigation and interact with industries in measuring, recording, analyzing and designing of filters for reducing harmonics with the help of Power Quality analyzer, as per IEEE standard.

5. STUDENTS

- Students secured 95 University Ranks in UG and 15 University Ranks in PG from 1998 to 2015 with **Gold medal** in 2000 (UG - EEE) and in 2011 (PG – Power Systems Engineering). Sweety Jain of 2009 batch student secured 2nd rank in Anna University Examination in 2009 among 8500 students who completed degree and out of 240 Engineering colleges all over Tamil Nadu.
- IEEE student's chapter which was started in the year 1999, continuously conducting number of student technical programme. Guest lecturers from industries have been arranged periodically to promote Industry-Institute Interaction and to bridge the gap between curriculum and latest trend in industry.
- To promote innovation, latest trends in industry and employability skills, student's professional activities are conducted every year in the name of symposium and conferences.
- Workshop/Seminar is regularly conducted for students to meet out the curriculum objectives.
- Inplant trainings are arranged for second and third year students to have hands on training with industry. Industrial visits are arranged every semester to know about the various process taking places in industry.
- Placement oriented training programme were conducted every semester right from the first year to develop soft skills, attitude, aptitude, self-confidence, communication skills, interview skills etc, so as to face the campus placement programme organized by the college. Professional Trainers from software companies, Bangalore, Chennai are being invited for such training programme.

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM – 630 612

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

S.No.	Name of the Faculty	Designation	Mobile No.	Email id
1.	Dr.S.M.Kannan	Professor & Head	9442035859	smkeeeklnce@gmail.com
2.	Dr.S.Venkatesan	Professor	9790672188	vensenn@yahoo.com
3.	Dr.K.Gnanambal	Professor	-	gnans_balu@rediffmail.com
4.	Dr. S.Parthasarathy	Professor	9443402901	sarathy_sps@yahoo.co.in
5.	Dr. S.Venkatanarayanan	Professor	9677320576	venjey@yahoo.co.uk
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31.	J.Sangeetha	Assistant Professor	-	geetha_maniraj@yahoo.com
32.	M.Maha Lakshmi	Assistant Professor	-	mmahalakshmi36@gmail.com
33.	Dr. C.Vimala Rani	Assistant Professor	-	jaysanjayvim@gmail.com

Placement Activity – Remainder

1. In the month of October every first year students must fill forms online in TATA CONSULTANCY SERVICES (TCS) campus recruitment using **nextsteptcs.com** website and must submit the following documents in the department.
   a. SSLC and HSC mark sheet photo copy at least 5.
   b. Latest passport size Photo at least 5.
   c. Current address proof with parent contact cell numbers.
   d. Create your own two E-mail id using Gmail.
   e. Resume with Scanned copy of passport size Photo.
   f. CT number registered in the TCS website.
2. Every semester end update CGPA in your resume and TCS profile.
3. An Engineering student from Electrical and Electronics Engineering should complete the following courses in order to enhance their software skills. This will be most helpful during their successful completion in Curriculum during 4th Semester and in the software company campus recruitment.
   a. Should complete **C Programming** before joining**2nd Semester**.
   b. Should complete **C++ Programming** before joining**3rd Semester**.
   c. Should complete **JAVA Programming** before joining**4th Semester**. (for the successful completion of object oriented Programming theory paper and laboratory during 4th Semester)
4. An Engineering student from Electrical and Electronics Engineering should complete the **Micro Processor, Micro Controller and Embedded Systems** courses before joining **5th Semester** in order to enhance their Hardware skills. This will be most helpful during their successful completion in Curriculum from 5th to 6th Semester and in the Core company campus recruitment. (for the successful completion of Micro Processor and Micro Controller theory as well as laboratory during 5th Semester and Embedded Systems during 6th Semester)
5. From 6th Semester Summer vacation onwards all should prepare for GATE Examination because all Engineering students from Electrical and Electronics Engineering should appear GATE Examination in order to settle in their life by pursuing higher education in the reputed colleges like IIT, NIT and Anna University or else to join as a Graduate Engineer trainee in a public sector companies like IOC, BHEL, PGCI etc.,
6. Before joining 7th Semester all should get any international certification programme course like OCJP, CCNA, etc., and upload the certification details in TCS campus commune website. This will be most helpful during the TCS campus and other MNC company recruitment.

Activity	Semester							
	1	2	3	4	5	6	7	8
TCS Online form Filling in nextsteptcs.com	In the month of October							
Documents to be submitted in the EEE Department/ Placement Coordinator	a. SSLC and HSC mark sheet photo copy at least 5. b. Latest passport size Photo at least 5. c. Current address proof with parent contact cell numbers. d. Create your own two E-mail id using Gmail. e. Resume with Scanned copy of passport size Photo. f. CT number registered in the TCS website.							
Updating CGPA in resume and TCS online profile	✓	✓	✓	✓	✓	✓	✓	✓
C Programming	✓	✓						
C++ Programming		✓						
JAVA Programming			✓					
Micro Processor & Micro Controller				✓				
Embedded Systems					✓			
GATE / UPSC/ TNPSC Preparation			✓	✓	✓	✓	✓	
International Certification – OCJP / CCNA						✓	✓	

K.L.N. COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

All India Installed Capacity (in MW) of Power Stations

This is a **list of states and territories of India by installed capacity of power utilities** with electricity generation mode break-up as on **31 March 2016** with figures in Megawatts.

REVISED

INSTALLED CAPACITY (IN MW) OF POWER UTILITIES IN THE STATES/UTS LOCATED IN

SOUTHERN REGION

INCLUDING ALLOCATED SHARES IN JOINT & CENTRAL SECTOR UTILITIES

(As on 31.03.2016)

State	Ownership/ Sector	Modewise breakup							Grand Total
		Thermal				Nuclear	Hydro (Renewable)	RES (MNRE)	
		Coal	Gas	Diesel	Total				
Andhra Pradesh	State	3085.91	0.00	0.00	3085.91	0.00	1758.87	89.50	4934.28
	Private	2990.00	3182.65	16.97	6189.62	0.00	0.00	2586.80	8776.42
	Central	1473.30	0.00	0.00	1473.30	127.16	0.00	0.00	1600.46
	Sub-Total	**7549.21**	**3182.65**	**16.97**	**10748.83**	**127.16**	**1758.87**	**2676.30**	**15311.17**
Telangana	State	4806.59	0.00	0.00	4806.59	0.00	2135.66	0.00	6942.25
	Private	270.00	1697.75	19.83	1987.58	0.00	0.00	605.54	2593.12
	Central	1721.88	0.00	0.00	1721.88	148.62	0.00	0.00	1870.50
	Sub-Total	**6798.47**	**1697.75**	**19.83**	**8516.05**	**148.62**	**2135.66**	**605.54**	11405.87
Karnataka	State	4220.00	0.00	127.92	4347.92	0.00	3599.80	155.33	8103.05
	Private	2060.00	0.00	106.50	2166.50	0.00	0.00	4950.19	7116.69
	Central	1628.46	0.00	0.00	1628.46	475.86	0.00	0.00	2104.32
	Sub-Total	**7908.46**	**0.00**	**234.42**	**8142.88**	**475.86**	**3599.80**	**5105.52**	**17324.06**
Kerala	State	0.00	0.00	234.60	234.60	0.00	1881.50	138.92	2255.02
	Private	0.00	174.00	0.00	174.00	0.00	0.00	116.55	290.55
	Central	1038.69	359.58	0.00	1398.27	228.60	0.00	0.00	1626.87
	Sub-Total	**1038.69**	**533.58**	**234.60**	**1806.87**	**228.60**	**1881.50**	**255.47**	**4172.44**
Tamil Nadu	State	4770.00	524.08	0.00	5294.08	0.00	2182.20	122.70	7598.98
	Private	2350.00	503.10	411.66	3264.76	0.00	0.00	9388.56	12653.32
	Central	4155.10	0.00	0.00	4155.10	986.50	0.00	0.00	5141.60
	Sub-Total	**11275.10**	**1027.18**	**411.66**	**12713.94**	**986.50**	**2182.20**	**9511.26**	**25393.90**
NLC	State	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Private	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Central	100.17	0.00	0.00	100.17	0.00	0.00	0.00	100.17
	Sub-Total	**100.17**	**0.00**	**0.00**	**100.17**	**0.00**	**0.00**	**0.00**	**100.17**
Puducherry	State	0.00	32.50	0.00	32.50	0.00	0.00	0.00	32.50
	Private	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
	Central	249.32	0.00	0.00	249.32	52.78	0.00	0.00	302.10
	Sub-Total	**249.32**	**32.50**	**0.00**	**281.82**	**52.78**	**0.00**	**0.03**	**334.63**
Central - Unallocated		1523.08	0.00	0.00	1523.08	300.48	0.00	0.00	1823.56
Total (Southern Region)	State	16882.50	556.58	362.52	17801.60	0.00	11558.03	506.45	29866.08
	Private	7670.00	5557.50	554.96	13782.46	0.00	0.00	17647.67	31430.13
	Central	11890.00	359.58	0.00	12249.58	2320.00	0.00	0.00	14569.58
	Grand Tota	**36442.50**	**6473.66**	**917.48**	**43833.64**	**2320.00**	**11558.03**	**18154.12**	**75865.79**

'*'Renewable Energy Sources (RES) includes small hydro projects, wind, solar, tidal, biomass and urban & industrial waste power.

ADVANCED TRAINING INSTITUTE

Guindy, CHENNAI, Tamilnadu

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Annual Training calendar 2016 – 2017

(Short Term Skill Training Programme)

	Course Code	Course Title	Duration (Week)	Date	
				From	To
GROUP:1		**ELECTRICAL CONTROL MAINTENANCE**			
	01.01	Protective Relays , Circuit Breakers, & Switch Gear Protection	01	04-04-2016	06-04-2016
				09-05-2016	13-06-2016
				20-06-2016	24-06-2016
				06-06-2016	12-06-2016
				12-09-2016	16-09-2016
				24-10-2016	28-10-2016
				19-12-2016	23-12-2016
				06-02-2017	10-02-2017
				13-03-2017	17-03-2017
	01.02	Operation and Maint. Of Power Transformers	01	11-04-2016	15-04-2016
				16-05-2016	20-06-2016
				27-06-2016	01-07-2016
				01-06-2016	05-06-2016
				29-08-2016	02-09-2016
				31-10-2016	04-11-2016
				05-12-2016	09-12-2016
				26-12-2016	30-12-2016
				13-02-2017	17-02-2017
				20-03-2017	24-03-2017
	01.03	Trouble shooting & Maintenance of Electric Motors	01	25-04-2016	29-04-2016
				23-05-2016	27-06-2016
				11-07-2016	15-07-2016
				19-09-2016	23-09-2016
				17-10-2016	21-10-2016
				07-11-2016	11-11-2016
				02-01-2017	06-01-2017
				20-02-2017	24-02-2017
	01.04	Operation & Control of Industrial AC/DC Motors	01	2-05-2016	5-05-2016
				30-05-2016	3-06-2016
				13-06-2016	17-06-2016
				15-07-2016	22-07-2016
				25-09-2016	30-09-2016
				21-11-2016	25-11-2016
				09-01-2017	13-01-2017
				27-02-2017	03-03-2017
	01.05	Electrical Safety at Work Place and First Aid	01	2-05-2016	6-05-2016
				5-05-2016	10-06-2016
				25-07-2016	29-07-2016
				3-10-2016	7-10-2016
				25-11-2016	02-12-2016
				16-01-2017	20-01-2017
				06-03-2017	10-03-2017
GROUP:1		**ELECTRONIC CONTROL MAINTENANCE**			
	02.01	Maintenance and Servicing of SMPS Inverter & UPS	02	11-07-2016	22-07-2016
				2-1-2017	13-1-2017
	02.02	Power Electronics and its Industrial Applications	02	4-04-2016	15-04-2016
				26-9-2016	7-10-2016
				27-2-2017	10-3-2017
	02.03	Industrial Drives & Automation using Siemens PLC	02	16-05-2016	27-05-2016
				6-5-2016	19-5-2016
				23-1-2017	3-2-2017
	02.04	Siemens S 7 400 PLC Step 7 (Level 1)	01	25-04-2016	29-04-2016
				29-5-2016	2-9-2016
				6-2-2017	10-2-2017
	02.05	Siemens S 7 400 PLC Win CC SCADA (Level 2)	01	2-05-2016	5-05-2016
				5-09-2016	9-09-2016
				13-02-2017	17-02-2017
	02.06	Siemens S 7 400 PLC TIA portal (Level 1)	01	16-05-2016	20-05-2016
				27-05-2016	1-07-2016
				3-05-2016	12-08-2016
				23-1-2017	27-1-2017
				28-11-2016	2-12-2016

'*'Renewable Energy Sources (RES) includes small hydro projects, wind, solar, tidal, biomass and urban & industrial waste power.

List of PSUs through GATE Exam

Name of PSU	Eligible Branches	Name of PSU	Eligible Branches	Name of PSU	Eligible Branches
ONGC Ltd.	XE, GG	MDL	ME, EE	NLC	ME, EE, EC, IN, MN, CE
NHPC Limited	EE	PSPCL Ltd	ME, EE, EC, IN, CE, CS	NALCO	ME, EE, EC, IN, MT, CE, MN, CS, CH
BPCL Limited	ME, EE, CH, IN, CE	OPGC Ltd	ME, EE, CE, C & I	RITES	CE, ME
CEL	EC, ME, EE, XE	IRCON International Ltd	EC, EE, IN	NPCCL	CE
Coal India Ltd.	ME, EE, MN, GG	BNPM	ME, EE, EC, CH	MECL	ME, CY, GG
POWERGRID	EE, CE, CS	AAI	EC, EE	NBCC Ltd.	CE
Indian Oil	CH, CE, CS, EE, EC, GG, IN, ME, MT, MN	BBNL	EC, EE, CS	PAPCL	EE, EC, ME, IN, CS
THDC India Ltd	ME, EE, CE	NFL	EE, CS, CH, IN, XE		
HPCL	ME, EE, CE, IN, CH, EC	GSECL	EE, ME, MT, C& I		
NTPC Limited	ME, EC, EE, IN	GAIL	ME, EE, IN, CH		

Lists of TPO 10 software companies to offer jobs in India

S. No.	Name of the Company	About the company	Head quarters	Revenue	No. of Employees	Website
1.	**Tata Consultancy Services**	TCS was established in 1968 and is spread across 47 countries.	Mumbai, India	US$ 13.44 billion	300,464	www.tcs.com
2.	**Cognizant Technology Solutions**	CTS was founded in year 1994 by Srilankan American Kumar Mahadeva.	Teaneck, New Jersey, United States	US$ 8.84 billion	178,000	www.cognizant.com
3.	**Infosys**	Infosys was founded in year 1981.	Bangalore, Karnataka	US$ 8.4 billion	160,405	www.infosys.com
4.	**Wipro**	Azim Premji is the Chairman & TK Kurien is the CEO of Wipro.	Mumbai, India	US$7.3 billion	146,053	www.wipro.com
5.	**Tech Mahindra**	Tech Mahindra was founded in year 1986	Mumbai	$4.09 billion	89,500	www.techmahindra.com
6.	**HCL Technologies**	HCL was founded by Shiv Nadar in year 1991.	Noida, Uttar Pradesh	US$335 million	90,190	www.hcltech.com
7.	**iGate**	iGate was earlier known as Patni Computer Systems and was founded by Narendra Patni and his wife.	Bridgewater, New Jersey, U.S	US$ 1.15 billion	31,000 +	www.igate.com
8.	**Mphasis**	MPhasis was founded by Jaithirth Rao in year 2000	Bangalore, India	US$1.0 billion	45,426 +	www.MphasiS.com
9.	**Larsen &Toubro Infotech**	L & T Infotech was founded in year 1997	Mumbai	US$ 650 million	16,000+	www.lntinfotech.com
10.	**Oracle Financial Services Software Limited**	Oracle Financial Services Software Limited was earlier know as i-Flex Solutions Limited. It is spread across 130 countries around the globe and provides the IT solutions to the financial companies.	Mumbai, India	US$610 million	9,682	www.oracle.com

Lists of TOP 10 core companies to offer Electrical jobs

1 | Bharat Heavy Electricals Ltd.
Corporate office – New Delhi, India | **Establishment** – 1964 |
Business – Electrical equipments | **Website** – *www.bhel.com* |
Bharat Heavy Electricals Ltd established in the year 1964 is a leading power plant equipment manufacturer and has expertise in engineering, manufacture, construction, testing, designing and servicing of various products of the core sectors such as defense, power, industries etc. BHEL is among the top electrical companies in India and which has total 16 manufacturing divisions and four regional offices. It is currently operating more than 150 project sites across India and abroad.

2 | Alstom
Corporate office – Levallois-Perret, France | **Establishment** – 1928 |
Business – Power generation and transmission | **Website** – *www.alstom.com* |

Alstom a multinational corporation is one of the best electrical companies in India and world, operating in hydroelectric power transportation and generation and it is active in many core industry sector. Company has a workforce of 9000+ employees in India and over 85000+ worldwide.

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3 | ABB
Corporate office – Zürich, Switzerland | **Establishment** – 1988 |
Business – Electrical equipments | **Website** – *www.abb.com* |

ABB holds interests in robotics and mainly in the automation and power areas. ABB is active in the field of electricity grids manufacturing and other technologies in the field of automation and power. ABB is one of the few giant electrical player at global level and among the largest engineering company in the world.

4| Siemens
Corporate office – Erlangen, Germany | **Establishment** – 1847 |
Business – Renewable energy, Power generation &
transmission| **Website** – *www.energy.siemens.com* |

Siemens a German conglomerate is rated one the finest electrical company in India. Company's product line includes generators, steam turbines, compressors, high-voltage switching products and many more. Siemens employees more than 86000 people worldwide and it is a leading supplier of energy related products worldwide.

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5 | Crompton Greaves
Corporate office – Mumbai, Maharashtra | **Establishment** – 1878 |
Business – Electrical | **Website** – *www.cgglobal.com* |

Crompton Greaves is a part of Avantha Group which is headquartered in Mumbai. CGL deals in manufacturing, marketing and designing of power transmission and generation related products. CGL has manufacturing units in Canada, France, Hungary, UK, US, Indonesia, Ireland, India and Belgium.

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6 |Bajaj Electricals Ltd.
Corporate office – Mumbai, Mharashtra | **Establishment** – 1938 |
Business – Electrical Appliances | **Website** – *www.bajajelectricals.com* |

Bajaj Electricals is a leader in the field of electrical equipment and headquartered in Mumbai. It is one of the top 5 electrical companies in India having 19 branch offices across India. Bajaj Electricals provides complete range of consumer durable such as fan, electrical appliances, lighting which includes tubes, lamps etc.

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7 | Eason Reyrolle
Corporate office – Bangalore, Karnataka | **Establishment** – 1986 |
Business – Electric Equipments& Industrial Consumables | **Website** – *www.easunreyrolle.com* |

Established in 1980 EasunReyrolle is a Power Management Products, Transmission, Distribution & Industrial Application, Systems, Solutions and Services provider having significant presence in global market as reputed electrical products manufacturer.

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8 | Schneider Electrical
Corporate office – RueilMalmaison, France | **Establishment** – 1981 |
Business – Electric Equipment | **Website** – *www.schneider-electric.co.in* |

Schneider Electric a French company established in the year 2000 is among the top electrical companies in India which is involved in energy management. Company has a workforce of more than 17000 employees and has 31 global manufacturing Plants.

9| Wipro Lighting
Corporate office – Pune, Maharashtra | **Establishment** – |
Business – Lamps, Luminaires and Accessories | **Website** – *www.wiprolighting.com* |

Wipro lightings a part of Wipro group and a leading electrical company in India producing Lamps, luminaries and accessories. Company's product portfolio comprises of high end lighting control and architectural dimming system, high intensity discharge lamp Luminaries, brightness management lighting products etc.

10| Kelvin Electrical
Corporate office – Al-Ain, U.A.E | **Establishment** – 2005 |
Business – | **Website** – *www.kelvin-electrical.com* |

Kelvin Electrical LLC founded in 2005 is based in United Arab Emirates (UAE). Kelvin Electrical deals in Cable Management Systems, Interior, Architectural, Exterior and Special lighting, Cable Support Systems, Raised Floor, Wiring Accessories etc.

List of Core Companies to offer Electrical Jobs in India

Types of Electrical Core Companies

1. Electrical motors and Generators
2. Consultancy (Electrical Engineering)
3. Electrical appliances
4. Electrical components companies
5. Lighting & luminaries
6. Power Generation
7. Electric wires & Cables
8. Electrical exporters
9. Measurements & Instrumentation
10. Power Distribution
11. Transformers
12. Green Energy Companies in India
13. Internationally renowned MNC'S
14. Top 20 core companies in India to offer electrical jobs
15. Exclusive Government jobs for Electrical Engineers

Electrical motors and Generators

1. Ajay Engineers http://www.ajayengineers.com
2. All India Electric Motor Manufacturers' Association http://www.aiemma.com/
3. Aqua Brand Submersible Sewage Pump http://www.aquapumps.com
4. Compact http://www.compactlighting.net
5. Crown Electric Company http://www.crown-gear.com
6. Lawkim http://lawkimindia.com/
7. MMC Electric Company http://www.dynafluxindia.com
8. MS Enterprises and Trimega Power Corporation http://www.msein.com
9. National Electrical Industries - Ahmedabad. http://www.elmomachines.com/
10. Numeric Power Systems http://www.numericups.com
11. Pranshu Electricals http://www.pranshuelec.com/
12. Reva Industries http://www.reva.com/
13. Rotomag Motors & Controls Pvt. Ltd. http://www.rotomag.com
14. Rudrashakti Electronics http://www.rudrashakti.com
15. Sanjay Diesels - Diesel Generating Sets. http://www.dgsets.com/
16. Venus Industrial Corporation http://www.venusind.com/
17. A-One Industries. http://www.aoneindustries.com/contactus.html

Consultancy (Electrical Engineering)

1. APJ Projects http://www.apjprojects.com
2. Consolidated Consultants and Engineers Pvt. Ltd http://www.consolidatedconsultants.com
3. DSON Enterprises http://www.dsonenterprises.com
4. Eltech Engineers http://www.eltechindia.com/
5. John Mech-El Technologies (P) Ltd http://www.johnmech-el.com/
6. Mandvi Electric Works http://www.bicserve.com/
7. Miraj Instrumentation Services http://www.mirajinstrumentation.com
8. PG Associates http://www.engineeringconsultant.in
9. Power Gem Engineers - Consultants in Power Generation. http://www.powergem.com/
10. Secon Engineers http://www.seconindia.com
11. Shanti Enterprises Electricals Limited http://www.shantielectricals.com
12. Shashi Electricals http://www.shashielectricals.com
13. SK Systems http://www.sksystem.com
14. Tata Consulting Engineers http://www.tce.co.in
15. Nutronics India http://www.nutronicsindia.com/

Electrical appliances

1. Ajay Industrial Corporation http://www.ajayindustrial.com/
2. Ankit Electricals http://www.ankitelectricals.com
3. A.P.C. System & Products Pvt. Ltd http://www.apcsp.com
4. Arka Trading & Services http://www.mfdplaza.in
5. Bajaj Electricals Ltd - Part of Bajaj Group. http://www.bajajelectricals.com/
6. Electroil http://www.electroil.com/
7. Eveready Industries India Ltd http://www.evereadyindustries.com/
8. Graftecindia http://graftec.trade-india.com
9. Indexelectronics http://www.indexelectronics.com
10. Khaitan Group http://www.khaitan.com/
11. Lloyd Electric & Engineering Limited http://www.lloydengg.com/
12. Modern Electrical Stores http://www.modernelectricalsindia.com/
13. Needo electronics and electricals pvt. Ltd. http://www.needoindia.com

14. Picasso home products http://www.picassoappliances.com/
15. Polor Industries Ltd http://www.polarinc.com/
16. Rajshree India Ltd. http://www.rajshreefans.com
17. Shilpa Electricals http://www.shilpaelectricals.com/
18. Super Impex http://www.superimpex.com
19. Tri Star Engineering Industries http://www.tristarengg.com
20. Vijay Electricals http://www.vijayelectricalspune.com/
21. Vxl Technologies Ltd. http://www.vxldesign.com
22. XtremeWorx http://www.xtremeworx.net

Electrical components companies

1. Ace Bimetalliks India Pvt. Ltd. http:// www.aceelectricals.com
2. Aditron India Pvt. Ltd. (Engineering Division) http://www.aiplen.com
3. Admir Ovens http://www.admir.com
4. Arvind Anticor Ltd http://www.picklingplant.com
5. Asiatic Electronic Industries. http://www.asiatic-india.com/
6. Axis Electrical Components India Pvt. Ltd. http://www.axis-india.com
7. Balar Marketing Pvt. Ltd http://www.allelectricalproducts.com/
8. Bhartia Industries Limited http://www.bchindia.com
9. Brass Copper & Alloy (I) Ltd. http://www.hexworldwide.com
10. Brightech Valves and Controls Pvt. Ltd. http://www.brightechvalves.com
11. Caltech Engineering Services http://www.caltechindia.com
12. Color Design India http://www.colordesigntech.com/
13. Consult Techniques (I) Pvt. Ltd http://www.consulttechnique.com/
14. Deki Electronics Ltd. http://www.dekielectronics.com
15. Elpro International Limited http://www.elproindia.com/
16. Elymer http://www.elymer.com
17. E S Electronics (India) Pvt. Ltd http://www.energysaversindia.com/
18. Finetech Engineering Corporation http://www.finetechindia.com
19. Gayatri Control, Ahmedabad http://www.gayatricontrol.com/
20. Gemscab Industries Ltd http://www.gemscab.com/
21. Hallmark Electronics http://www.hallmarkelect.com/
22. India International House Ltd http://www.builderhardware.com/
23. Jaykrishna magnetics pvt.ltd http://www.jkmagnetics.com
24. Leotech Group http://www.leotechindia.com/
25. Maxx Mobile Phone Accessories Pvt. Ltd http://www.maxmobile.co.in
26. Mehta Engineering Enterprise http://www.mehtaswitch.com
27. Mehta Tubes Ltd http://www.mehta-group.com/
28. Mellcon Engineers http://www.mellcon.com
29. Micromot Controls http://www.micromotcontrols.com
30. Muskaan Engineers http://www.electricitysaver.com/
31. Neelam Import Pvt. Ltd. http://www.cellking.org
32. Onload Gears http://www.onloadgears.com/
33. Orton Engineering Pvt. Ltd, Thane http://www.ortonengineering.com/
34. Persang Alloy Industries http://www.webmasterindia.com/persangalloy
35. PMT Engineers http://www.pmtengineers.com
36. Powercap Systems (Madras) Pvt. Ltd http://www.transformersindia.com/
37. Powertek Equipment Company http://www.powertekindia.com/
38. PragatiElectrocom Pvt. Ltd http://www.pragatielectrocom.com/

39. Pran Electronics Pvt. Ltd. http://www.pranelectronics.com
40. Precicraft Components India Pvt. Ltd http://www.precicraft.com/
41. Prima Automation India Pvt. Ltd http://www.prima-automation.com/
42. Rittal India Pvt Ltd http://www.rittal-india.com
43. SanghiYantraUdyog http://www.skyuindia.com/
44. SKN - Bentex Group of Companies. http://www.sknbentex.com/
45. South India Industrial Suppliers http://siis-india.com/bus_bar_support.html
46. Square Automation Pvt. Ltd http://www.squareautomation.com/
47. Sudhir Switchgears http://www.sudhirswitchgears.com
48. Syntron Controls http://www.syntron-controls.com
49. Torque Master Tools Pvt. Ltd http://www.torquemasterindia.com/
50. United Core http://www.unitedcores.com/
51. Utiliti Controls http://www.utiliticontrols.com/
52. valrack modular systems pvt.ltd http://www.valrack.com
53. Wavetronics http://www.wavetronicsindia.com
54. Rane Holdings Limited http://www.rane.co.in

Lighting & luminaries

1. A.K. Electricals http://www.akelectricals.com/
2. APCO India http://www.indiabizclub.net/Electrical/APCO_INDIA.html
3. Aquascape engineers http://www.fountainsnozzles.com
4. ArihantEnterprises : http://www.arihantsecurityindia.com/
5. Atlas Electricals www.indiabizclub.net/Electrical/ATLAS_ELECTRICALS.html
6. Baliga Lighting http://www.baliga.com/
7. Crompton Greaves Limited. http://www.cglonline.com/
8. Decon Lighting http://deconlighting.com
9. GE Lighting India http://www.gelighting.com/india/index.html
10. Jain Industrial Lighting Corporation http://www.indiamart.com/jilco/
11. Jayanta Lamp Industries Pvt.Ltd : http://www.jayantagroup.com
12. Kuber Lighting Pvt Ltd http://www.kuber.biz
13. LitrayLighting : http://www.litraylighting.com/
14. Mindscreen Pvt. Ltd. http://www.mindscreenfilms.com/
15. Peralites http://www.indiabizclub.net/Electrical/PEARLITES.html
16. Sam International http://www.indiamart.com/
17. Shyam Electricals - http://www.shyamelectricals.com/
18. Hpl Electric & Power Pvt.Ltd http://www.hplindia.com

Power Generation

1. Advance Engineering Company - http://www.advanceengineering.com/
2. APGENCO http://www.apgenco.com/
3. Birla Power Solutions Limited http://www.birlapower.com
4. Dyna Hitech Power Systems Ltd http://www.dynahitech.com
5. Essar Group http://www.essar.com/Group/group.asp
6. Essar Power Ltd. http://www.essar.com/
7. Jindal Steel & Power Ltd. http://www.jindalsteelpower.com
8. Kaiga Atomic Power Station http://www.npcil.org/docs/kaigaps.htm
9. Kakrapar Atomic Power Station http://www.npcil.org/docs/kaps.htm
10. Kirloskar Electric Co http://www.kirloskar-electric.com/
11. Lanco Industries http://www.lancogroup.com/groups/kpower/kpower.html
12. Madras Atomic Power Station (MAPS) http://www.npcil.org/

13. Magnum Power Generation Ltd http://www.magnumgrouponline.com/power/
14. Narora Atomic Power Station http://www.npcil.org/docs/naps.htm
15. National Thermal Power Corporation (NTPC) http://www.ntpc.co.in
16. NEPC India Ltd http://www.nepcindia.com
17. PTC India http://www.ptcindia.com
18. Rajasthan Atomic Power Station (RAPS) http://www.npcilraps.com/
19. Rajasthan Renewable Energy Corporation Limited (RRECL) http://www.rrecl.com/
20. Reliance Energy http://www.rel.co.in
21. Tarapur Atomic Power Station http://www.npcil.org/docs/taps.htm
22. Tata Electric Companies http://www.tata.com
23. Tata Power http://www.tatapower.com/
24. Techno Instrument India Pvt.Ltd web site url: http://www.tiiindia.com/
25. Torrent Power web site url: http://www.torrentpower.com/
26. Uttar Pradesh Power Corporation Ltd http://www.uppcl.org/
27. ABB Ltd www.abb.co.in/
28. Adani Power Ltd www.adanipower.com/
29. Aplab Ltd www.aplab.com/
30. BF Utilities Ltd www.bfutilities.com/
31. CESC Ltd. www.cescltd.com/
32. CMI Ltd. www.cmilimited.com.au/
33. DLF Power Limited www.eipowertech.com/dlf_power_limited.htm
34. DPSC Ltd www.dpscl.com/
35. Energy Development Company Ltd www.energy.com.ph/
36. Entegra Ltd www.entegra.co.in/
37. GMR Infrastructure Ltd www.gmrgroup.in/
38. Gujarat Industries Power Company Ltd www.gipcl.com/
39. GVK Power & Infrastructure Ltd www.gvk.com/
40. HBL Power Systems Ltd www.hbl.in/
41. Indowind Energy Ltd www.indowind.com/
42. Indo power projects Ltd www.indopowerprojects.in/
43. Jaiprakash Power Ventures Ltd www.jppowerventures.com/
44. Kalpataru Power Transmission Ltd www.kalpatarupower.com/
45. KSK Energy Ventures Ltd www.ksk.co.in/
46. National Wind & Power Corpn. Ltd www.nationalwind.com/
47. Neyveli Lignite Corpn. Ltd www.nlcindia.com/
48. NHPC Ltd. www.nhpcindia.com/
49. NTPC Limited www.ntpc.co.in/
50. Power Grid Corpn. Of India Ltd www.powergridindia.com/
51. PTC India Ltd www.ptcindia.com/
52. Reliance Power Ltd www.reliancepower.co.in/
53. Savant Infocomm Ltd www.savant-infocomm.com/
54. Sun Source (India) Ltd www.sunsource.in/about_us.htm
55. Suryachakra Power Corpn. Ltd www.suryachakra.in/
56. Suzlon Energy Limited www.suzlon.com/

Electric wires & Cables

1. AkshOptifibre Limited http://www.akshoptifibre.com/
2. Anant Distributors Private Ltd. http://www.proflexcable.com/

3. Brimson Cables Private Ltd http://www.brimsoncable.com/
4. Capital Cables India Limited - http://www.indiantrade.com/cci/
5. Colt Cables Private Limited http://www.coltcables.com/
6. Cords Cable Industries Ltd http://www.cordscable.com/
7. Delton Cables Limited - http://www.deltoncables.com/
8. Fort Gloster Industries Limited http://www.glostercables.com/
9. Kaydour Cables India http://www.kaydourcables.com
10. KEI Industries Limited http://www.kei-ind.com/
11. Lapp India http://www.lappindia.com/
12. National Cable Industries http://www.nationalcables.com/
13. Navinbhai Cables Private Ltd http://www.ncplindia.com/
14. Neolex Cables http://www.neolexcable.com/
15. North Eastern Cables Private Ltd //www.khetangroup.com/
16. Novoflex Marketing Private Limited. http://www.novoflexgroup.com/
17. Polycab Wires Private Limited http://www.polycab.com/
18. Q-Flex Cables Limited http://www.qflexcable.com/
19. Ravin Cables limited - Primecab brand of cables. http://www.primecab.com/
20. Relemac India http://www.relemacindia.com
21. RollRing Industries - Calicut, Kerala. http://www.rollring.com/
22. Samdaria Electricals http://www.samdariaelectricals.co.in/
23. Satish Enterprises http://www.satishenterprise.com/
24. Shree Nakoda Cables Private Limited. http://www.nakodacables.com/
25. Skytone Electricals (India) http://www.skytonecables.com/
26. Surbhi Cables Industries Private Limited. http://www.indiamart.com/surbhi/
27. SurbhiTelelink Pvt. Ltd http://www.surbhiindia.com/
28. Torrent Cables Ltd http://www.torrentcables.com/
29. Universal Cables http://www.universalcablesltd.com
30. Usha Martin http://www.ushamartin.com
31. Weather Crafts Ltd http://www.weathercraft.com/
32. Finolex Cables Limited http://www.finolex.com

Electrical exporters

1. Arbariya steels http://www.arbariya.com/
2. Bajaj International Pvt. Ltd. http://www.bajajinternational.com/
3. Biax http://www.biaxmetals.com/
4. Brightech Valves and Controls Pvt Ltd http://www.brightechvalves.com
5. Dynamic Scaffolding & Equipment Co http://www.dynamicscaffolding.com/
6. Excel Metal And Engg. Industries http://www.excelmetal.net
7. Impex Trading Company http://www.impextradingco.com
8. Miltop Trading Company http://www.miltop.com/
9. Om(India)Exports http://omindiaexpo.com
10. Oriental Export Corporation http://www.indialinks.com/oriental/
11. Sevana Electrical Group http://www.sevana.com/
12. Veejay Lakshmi Engineering Works Limited http://www.veejaylakshmi.com
13. Vishal Electromag Industries http://www.vishalmotor.com
14. Vaibhav Electricals http://www.vaibhavelectricals.com
15. Industrial Forging Industries http://www.ifi-india.net/
16. Imperial Brass Component http://electronics-electrical.exportersindia.com

17. M/s Horizon Exports http://www.horizonexport.net
18. Golden Crest Marketing Network Pvt. Ltd. http://www.aceenergy.co.in/
19. Shree Krishna Enterprises http://www.shreekrishnaenterprises.co.in/
20. Sahiba International Trading Company http://www.sahibainternational.com
21. Pushpak Metals web site url: http://www.pushpakmetals.com/
22. IEEMA http://www.ieema.org
23. ELSTER METERING (P) LTD http://www.elstermetering.com/
24. Shivam Electronics http://www.shivamelectronics.com
25. SUBRTO http://www.subrtoburnishing.com/
26. Unitek Engineers http://www.unitekengineers.com
27. Euro Technologies http://www.eurotapes.in/

Measurements & Instrumentation

1. Active Control Pvt Ltd http://www.indiamart.com/activecontrols/
2. Autometers Alliance Limited. http://www.autometers.com/
3. EIP Bulk Control Pvt Ltd http://www.eipbulkcontrols.com/
4. IMP Power Limited http://www.imp-power.com/
5. Instruments International http://www.indorecity.com/ii/index.html
6. Kanji Precision Works http://www.kanjimeters.com
7. Mittal Enterprises http://www.indiamart.com/mittalenterprises/
8. Modsonic http://www.modsonic.com/
9. Nippon Instruments http://www.nipponinstruments.com/
10. Poonawala Electro Weigh http://www.peweigh.com
11. Prok Devices http://www.prokdvs.com
12. Shanti Instruments http://www.shanti-instruments.com
13. Texlab Industries http://www.texlabindia.com
14. Vasavi Electronics http://www.vasavi.com
15. VPL Infotech http://vplinf.com

Power Distribution

1. Areva T&D India http://www.areva-td.co.in/
2. BSES Yamuna Power Ltd and BSES Rajdhani Power Ltd. http://www.bsesdelhi.com/
3. Central Power Distribution Company of Andhra Pradesh Limited http://www.apcentralpower.com/
4. CESC Limited http://www.cescltd.com
5. Eastern Power Distribution Company of Andhra Pradesh Limited http://www.apeasternpower.com/
6. Elpro International Limited http://www.elproindia.com/
7. Gujarat Electricity Board http://www.gseb.com
8. Haryana Power Utilities http://www.haryanaelectricity.com/
9. Hubli Electricity Supply Company Limited (HESCOM) http://www.hescom.org/
10. Maharashtra State Electricity Distribution Company Limited http://www.mahadiscom.in
11. Natinal Hydroelectric Power Corporation of India http://www.nhpcindia.com
12. Noida Power Company Ltd http://www.noidapower.com
13. North Delhi Power Limited http://www.ndplonline.com/
14. Power Grid Corporation Of India http://www.powergridindia.com
15. Southern Power Distribution of Andhra Pradesh http://www.apspdcl.in
16. Transmission Corporation of Andhra Pradesh (AP TRANSO) http://www.aptranscorp.com/

Transformers

1. Emco Limited http://www.emcoindia.com
2. Golecha Electro Stampings. http://www.golecha.com/

3. Intaf India http://www.intafindia.com/
4. Kappa Electricals Private Ltd http://www.kappaelectricals.com/
5. Kotsons Transformers http://www.kotsons.com/
6. Mahindra Electrical Works http://www.mewindia.com
7. Marson's Electricals http://www.marsonselectricals.com/
8. P.M. Electronics Limited. http://www.indiamart.com/pme/
9. Prismatic India http://www.wind-it.com/
10. Raksan Transformers Private Ltd http://www.raksantransformers.com/
11. Roland Electronics and devices Private Ltd. http://www.redpl.com/
12. Sai Electricals http://www.saielectricals.com/
13. Tesla Transformers Limited http://www.teslatransformers.com/
14. Transformers and Electricals Kerala Limited. http://www.telk.com/
15. Transformers and Rectifiers (India) Ltd. http://www.jmtril.com
16. T.S. International http://www.transformers-reactors.com

Green Energy Companies in India

1. **Suzlon Energy:** Suzlon is of course the first company that comes to mind. They are one of the leading wind energy companies in India are one of the better known alternative energy companies in India. Here are some details from their website.

Conceived in 1995 with just 20 people, Suzlon is now a leading wind power company with:

- Over 16,000 people in 25 countries
- Operations across the Americas, Asia, Australia and Europe
- Fully integrated supply chain with manufacturing facilities in three continents
- Sophisticated R&D capabilities in Belgium, Denmark, Germany, India and The Netherlands
- Market leader in Asia, Suzlon Market Share (Combined with REpower) rose to 9.8% thereby making Suzlon 3rd * largest wind turbine manufacturing company in the world.

2. **Orient Green Power Limited:** Primarily engaged in the Wind and Biomass energy space. Currently wind constitutes the majority of their energy portfolio, so this is another one of India's wind energy companies. As of March 31, 2010, their total portfolio of operating projects included 193.1 MW of aggregate installed capacity, which comprised 152.6 MW of wind energy projects and 40.5 MW of biomass projects. Their portfolio of committed and development projects included approximately 815.5 MW of prospective capacity, which comprised an estimated 622.0 MW of wind energy projects, 178.5 MW of biomass projects and a 15.0 MW small hydroelectric project.

3. **Indowind Energy Limited:** Indowind Energy Limited is also a wind energy company that develops wind farms for sale, manages the wind assets, and generates green power for sale to utilities and corporates. Turnkey implementation of Wind Power Projects, from concept to commissioning. Wind Asset Management Solution for installed assets, including operations, billing, collection of revenue to project customers. Supply of Green Power to Customers. CERs (Carbon Credit) Sales and Trading.

4. **Suryachakra Power Corporation Limited:** SPCL is the flagship company of Suryachakra Group with interests in Power generation – renewable energy (biomass, Solar, hydro, Wind) and Clean Technology / Ultra Super Critical Thermal Power Plants (coal, Gas), Engineering Consultancy and Urban infrastructure development activities. Suryachakra Power Corporation Limited has established 3 wholly owned subsidiaries for setting up of renewable energy (biomass) power projects and also acquired stake in Sri Panchajanya Power Private limited, which was setting up a 10 MW Biomass Power Plant at Hingoli, Maharashtra.

5. **NEPC India:** This is a Public Limited Company promoted by the Khemka Group with the primary objective of promoting wind energy. This successful Group has a multi crore turnover from diversified activities in the field of Power Generation from Wind Energy and manufacture and marketing of Wind Turbine Generator (a renewable energy device).

6. **Azure Power:** Azure Power is the green energy space as it is one of the solar energy companies in India. It is a solar power company, and they are supplying power to 20,000 people in 32 villages in Punjab.

7. **AuroMira Energy:** Auro Mira is also a green technology energy company that is private, and present in the Biomass, Small Hydel and Wind Sectors. It plans to develop over 1000 MW capacity by 2012. AME is presently focusing in Biomass, Small Hydro and Wind Sectors. AME plans to invest $ 900 Million to develop, own and operate over 1000 MW in clean energy in addition to WTG manufacture and to develop over 15000 acres of energy plantation in the next five years. AME intends to foray into other clean energy technologies, solar, bio-diesel etc. in the future.
8. **Husk Power Systems:** This is truly an alternate energy company which owns and operates 35-100 kW "mini power-plants" that use discarded rice husks to deliver electricity to off-grid villages in the Indian "Rice Belt
9. **RRB Energy Limited:** This company is in the field of Wind Power Generation, and is an ISO 9001:2008 and ISO 14001:2004 certified Company. RRBEL is also an Independent Power Producer having established wind farms of aggregate megawatt capacity.
10. **Moser Baer Solar Limited:** This is a subsidiary of Moser Baer that is one of the solar energy companies as well. The Group's photovoltaic manufacturing business was established between 2005 and 2007 with the primary objective of providing reliable solar power as a competitive non-subsidized source of energy.

Internationally renowned MNC's to offer electrical jobs

Cisco, Hewlett Packard, Intel, AMD, IBM, Ford, General Electric, General Motors, Lockheed Martin, Lucent Technologies, Moog, Micron, Motorola, Nokia, Qualcomm, Rockwell, Sun Microsystems, Atto Technology, MTI and Texas Instruments.

Top core companies in India to offer electrical jobs

1. Bharat Sanchar Nigam Limited
2. Tata Consultancy Services
3. Bharti Airtel Limited
4. Wipro Ltd
5. Infosys Technologies Limited
6. Hewlett-Packard India
7. HCL Infosystems Limited
8. Reliance Communications Ltd
9. LG Electronics India Pvt Ltd
10. IBM India Pvt Ltd
11. Videocon Industries Ltd
12. HCL Technologies Limited
13. Satyam Computer Services Ltd
14. Siemens Ltd.
15. Samsung India Electronics Pvt. Ltd.
16. Mahanagar Telephone Nigam Ltd
17. Redington (India) Limited
18. Cognizant Technology Solutions
19. Idea Cellular Ltd
20. Videsh Sanchar Nigam Limited

Exclusive Government jobs for Electrical Engineers

1. ISRO
2. DRDO
3. BEL
4. BHEL
5. GAIL
6. SAIL

7. HAL
8. HPCL
9. NTPC
10. ONGC
11. IOCL
12. RRB
13. ECIL
14. APGENCO
15. APTRANSCO

MOCK EMAIL WRITING QUESTIONS

Directions:

1. Use all the phrases given
2. Minimum words should be 50 otherwise your email cannot be validated
3. Addressing and signing should be done as in the question given.
4. Common grammatical rules, punctuation should be according to standard English.
5. You can use your own phrases along with the phrases given.

Question : 1

As a member of your residential society, write an email to inspector of local Police station, Mr.Sharma, informing him about miscreants who ride their bikes rashly every evening outside your society. Sign the email as william.

residential area - ride - rashly - children - play - elderly - walk - grocery shop - across the road - dangerous - accidents - nuisance - action - immediately.

Sample Answer:

Dear Mr.Sharma,

We are the residents of Siddartha Nagar. We would like to bring to your notice that a few guys are riding their bikes very rashly in the evening hours in the main road of the colony. As you know that this is the time when children play on the road and elderly go for an evening walk. Also there is a grocery shop across the road and many housewife's used to cross the road to buy any groceries. In the recent times we observed that due this rash driving many accidents were happened and several injured. This is creating a constant nuisance for all. So we would like to request you to take necessary action to curb these activities.

Thanking you
Yours sincerely,
William.

Question 2:

As a recent buyer of their car, write an email to the Manager of Smart Automotive company, Mr.Ahmed, regarding the poor quality of service facility available in the city. Sign the email as Chopra.

Outline:

very few - service centers - complaints - pending problems - maintenance - cost - time - delivery - increase - customer satisfaction

Dear Mr. Ahmed

I recently bought Fiat palio from "Sridhar Fiat show room" in Nagole. Recently I faced small problem with car AC and bought the car for maintenance. But to my utter surprise, the how room staff told me that service is not available in their showroom and they asked me to take the car to nearby service center. I found that there are very few service centers available compared to sales showrooms, and there are many complaints regarding this. This in turn is causing many pending problems and increased maintenance cost, time and delivery time. I would like to suggest you that if more service centers are opened in the city, customer satisfaction also goes up which finally converts into more sales.
Thanks and Regards
Chopra

Question 3:

As a former student, write an email to your professor, Mr.Matt, thanking her for teaching and guidance that contributed to your overall development. Sign the email as peter.

Outline:
Successful - Placed - grateful - help - advice - grooming - values - shaping my future - sincere - professional

Dear Mr.Matt
I am very happy to tell you that I got successful in the recently conducted campus placement drive at my college. I am placed with TCS. I am extremely grateful for your help regarding my preparation. More over your advice regarding personality development helped for my personal grooming. In addition to that, your style of teaching inculcates not only those skills related to professional success but also for developing values which I believe helps for shaping my career. Once again I would like to thanks for your sincere and professional help.
with warm regards
Peter.

Question 4:
As an intern at ABC consulting Pvt.Ltd, write an email to your internship Project Manager, Mr.Ramesh, informing about the progress that you are making and some difficulties that you are encountering. Sign the email as Ben.

Outline:
Thank - challenging - progress - tight schedule - support - report - analytics - guidance - access - doubt - requirements - design.

Dear Mr.Ramesh
Thank you for allotting a challenging project for my internship. I am making steady progress and learning many new things. The project is due next month and we are on tight schedule. I need some additional support with regard to the reporting of Analytics. Your guidance helped me access the database with ease but I have several doubts regard to the requirements of the design. But I am facing little problem in reporting.

Thanks and regards
Ben

Latest Placement Paper

Aptitude Test consists of 35 questions and here we have been given Negative Marking of 0.33 per wrong answer. At the selection the bench mark was 22marks.It's an easy test where more than 25 questions can be cleared easily Coming to questions first search for the numerical data in the questions and just
the logic how the questions can be solved

1. Two bowls are taken, one contains water and another contains tea.one spoon of water is added to second bowl and mixed well, and a spoon of mixture is taken from second bowl and added to the second bowl. which statement will hold good for the above?
(Ans: second liquid in first bowl is smaller than the first mixture in second bowl)
2. Which is the smallest no divides 2880 and gives a perfect square?
a.1 b.2 c.5 d.6
Ans: c
3. Form 8 digit numbers from by using 1, 2,3,4,5 with repetition is allowed and must be divisible by4?
a.31250 b.97656 c.78125 d.97657
Ans: c
4. One problem on (a3-b3)/(a2+ab+b2)
Ans: 'a-b'
5. Rearrange and categorize the word 'RAPETEKA'?
Ans: bird
6. In school there are some bicycles and 4wheeler wagons.one Tuesday there are190 wheels in the campus. How many bicycles are there?
Ans: 15
7. Key words in question (Fibonacci series, infinite series, in the middle of thequestion one number series is there….I got the series 3 12 7 26b 15?
Ans:54
(Logic: 3*2+1=7 12*2+2=26
7*2+1=15 26*2+2=54)
8. A father has 7 penny's with him and 1 water melon is for 1p, 2chickoos for 1p, 3grapes foe 1p. he has three sons. How can he share the fruits equally?
Ans: 1 watermelon,2chickoos,1grape
9. A lies on mon, tues, wed and speak truths on other days, B lies on thur, fri, sat and speaks truths on other days.. one day a said I lied today and B said I too lied today. What is the day?
10. Man, Bear, North, South, walks.
Ans: White
11. (1/2) of a number is 3 times more than the (1/6) of the same number?
Ans: 9
12. There are two pipes A and B. If A filled 10 liters in hour B can fills 20 liters in same time. Likewise B can fill 10, 20, 40, 80,160….if B filled in (1/16) th of a tank in 3 hours, how much time will it take to fill completely?
Ans:7 hours
13. KEYWORDS: T.Nagar,Chennai,1-100,prime numbers b/n 140-180,How many 2's are there?
Ans: 20 (Not only 2's ,1's,3's,4's,5's,6's,7's,8's,9's,0's also 20)
14. One question has last part like difference between two terms is 9 and product of two numbers is 14, what is the squares of sum of numbers?
Ans:109
15. A man is standing before a painting of a man and he says I have no bro and sis and his father is my father's son?

Ans: His son

16. What is the value of [(3x+8Y)/(x-2Y)]; if x/2y=2?

Ans:10 {the numerical may change)

17. A pizza shop made pizzas with to flavours.in home there are 'N' different flavors, in that 'M' flavors are taken to made pizza.in how many ways they can arrange?

(Logic: NcM)

18. One grandfather has three grandchildren, two of their age difference is 3,eldest child age is 3 times youngest child's age and eldest child's age is two times of sum of other two children. What is the age of eldest child?

Ans:15

19. In a market 4 man are standing. the average age of the four before 4years is45, after some days one man is added and his age is 49. what is the average weight of all?

Ans: 49

20. KEYWORDS: one organization, material labor and maintenance are in the ratio of 4:6:7, the material cost is:100, what is the total cost?

Ans: 425

21. KEYWORDS: density, reluctance, sensitivity, voltage, current, what is the resistance Formula is "R=V/I"

22. KEYWORDS: Sports readers,10 tables,4chairs per table, each table has different number of people then how many tables will left without at least one person?

Ans : 6

23. KEYWORDS: Die, card, coin, b/n 2 to 12
24. Ans: All are equal

24. In a school for a student out of a 100 he got 74 of average for 7 subjects and he got 79 marks in 8th subject. what is the average of all the subjects?

Ans: 74.625

25. In a question, last part has, the ages of two people has the ratio of 6:6 and by adding the numbers we get 44, after how many years the ratio would be 8:7?

Ans: 8

26. Two years before Paul's age is 2times the Alice age and the present age of Paul is 6times the Alice. what is the presents Paul's age?

Ans (3years)

27. One train travels 200m from A to B with 70 km/ph. and returns to A with80kmph, what is the average of their speed?

Q1) Given a collection of points P in the plane, a 1-set is a point in P that can be separated from the rest by a line, .i.e the point lies on one side of the line while the others lie on the other side. The number of 1-sets of P is denoted by n1(P). The minimum value of n1(P) over all configurations P of 5 points in the plane in general position (i.e. no three points in P lie on a line) is

a) 3

b) 5

c) 2

Q2) Paul the octopus who has been forecasting the outcome of FIFA world cup matches with tremendous accuracy has now been invited to predict ICC world cup matches in 2011. We will assume that the world cup contenders have been divided into 2 groups of 9 teams each. Each team in a group plays the other teams in the group. The top two teams from each group enter the semifinals (after which the winner is decided by knockout). However, Paul has a soft spot for India and when India plays any team, Paul always backs India. Alas, his predictions on matches involving India are right only 2 out of 3 times. In order to qualify for the semifinals, it is sufficient for India to win 7 of its group matches. What is the probability that India will win the ICC world cup?

a) (2/3)^10

b) (2/3)^9 + 8/3 * (2/3)^9

c) 8/3 * (2/3)^9

d) (2/3)^10 + 8/3*(2/3)^9

Q3) A toy train produces at least 10 different tunes when it moves around a circular toy track of radius 5 meters at 10 meters per minute. However, the toy train is defective and it now produces only two different tunes at random. What are the odds that the toy train produces 4 consecutive music tunes of the same type?

a) 1 in 16

b) 1 in 4

c) 1 in 8

Q4) A number when divided by D leaves a remainder of 8 and when divided by 3D leaves a remainder of 21. What is the remainder left, when twice the number is divided by 3D?

a) 13

b) cannot be determined

c) 3

d) 42 **(solution: c)**

Q5) Six friends decide to share a big cake. Since all of them like the cake, they begin quarreling who gets to first cut and have a piece of the cake. One friend suggests that they have a blindfold friend choose from well shuffled set of cards numbered one to six. You check and find that this method works as it should be simulating a fair throw of a die. You check by performing multiple simultaneous trials of picking the cards blindfold and throwing a die. You note that the number shown by the method of picking up a card and throwing a real world die, sums to a number between 2 and 12. Which total would be likely to appear more often – 8,9 or 10?

a) 8

b) All are equally likely

c) 9

d) 10

Q6) One day Alice meets pal and byte in fairyland. She knows that pal lies on Mondays, Tuesdays and Wednesdays and tells the truth on the other days of the week byte, on the other hand, lies on Thursdays, Fridays and Saturdays, but tells the truth on the other days of the week. Now they make the following statements to Alice – pal. Yesterday was one of those days when I lie byte. Yesterday was one of those days when I lie too. What day is it?

a) Thursday

b) Tuesday

c) Monday

d) Sunday **(solution: a)**

Q7) A car manufacturer produces only red and blue models which come out of the final testing area completely at random. What are the odds that 5 consecutive cars of the same color will come through the test area at any one time?

a) 1 in 16

b) 1 in 125

c) 1 in 32

d) 1 in 25

Q8) Alok is attending a workshop “How to do more with less” and today's theme is *Working with fewer digits.* The speakers discuss how a lot of miraculous mathematics can be achieved if mankind(as well as womankind) had only worked with fewer digits. The problem posed at the end of the workshop is How many four digit numbers can be formed using the digits 1, 2,3,4 ,5 (but with repetition) that are divisible by 4?

Can you help Alok find the answer?

a) 100 b) 125 c) 75 d) 85

Q9) Rearrange the following letters to make a word and choose the category in which it Ms RAPETEKA

a) Bird

b) Vegetable

c) City

d) Fruit

Q10) On planet korba, a solar blast has melted the ice caps on its equator. 9 years after the ice melts, tiny planetoids called echina start growing on the rocks. Echina grows in the form of circle, and the relationship between the diameter of this circle and the age of echina is given by the formula $d = 4*\sqrt{(t-9)}$ for $t \geq 9$where d represents the diameter in mm and t the number of years since the solar blast. Jagan recorded the radius of some echina at a particular spot as 7mm. How many years back did the solar blast occur?
a) 17
b) 21.25
c) 12.25
d) 12.06 **(solution:b)**
Q11) In the reading room of a library, there are23 reading spots. Each reading spot consists of a round table with 9 chairs placed around it. There are some readers such that in each occupied reading spot there are different numbers of readers. If in all there are 36 readers, how many reading spots do not have even a single reader?
a) 8
b) None
c) 16
d)15 **(solution:d)**
Q12) Ferrari S.P.A is an Italian sports car manufacturer based in Maranello, Italy. Founded by Enzo Ferrari in1928 as Scuderia Ferrari , the company sponsored drivers and manufactured race cars before moving intoproduction of street-legal vehicles in 1947 as Feraari S.P.A. Throughout its history, the company has been noted for its continued participation in racing, especially in Formula One where it has employed great success .Rohit once bought a Ferrari . It could go 4 times as fast as Mohan's old Mercedes. If the speed of Mohan's Mercedes is 46 km/hr and the distance traveled by the Ferrari is 953 km, find the total time taken for Rohit to drive that distance.
a) 20.72
b) 5.18
c) 238.25
d) 6.18 **(solution:b)**
Q13) A sheet of paper has statements numbered from 1 to 70. For all values of n from 1 to 70. Statement n says ' At least n of the statements on this sheet are false. ' Which statements are true and which are false?
a) The even numbered statements are true and the odd numbered are false.
b) The odd numbered statements are true and the even numbered are false.
c) The first 35 statements are true and the last 35 are false.
d) The first 35 statements are false and the last 35 are false.
(solution:d)
Q14) Middle – earth is a fictional land inhabited by Hobbits, Elves, dwarves and men. The Hobbits and theElves are peaceful creatures who prefer slow, silent lives and appreciate nature and art. The dwarves and the men engage in physical games. The game is as follows . A tournol is one where out of the two teams that play a match, the one that loses get eliminated. The matches are played in different rounds where in every round , half of the teams get eliminated from the tournament. If there are 8 rounds played in a knock-out tournol how many matches were played?
a) 257
b) 256
c) 72
d) 255 **(solution:d)**
Q15) A research lab in Chennai requires 100 mice and 75 sterilized cages for a certain set of laboratory experiments . To identify the mice, the lab has prepared labels with numbers 1 to 100 , by combining tags numbered 0 to 9. The SPCA requires that the tags be made of toxin-free material and that the temperature of the cages be maintained at 27 degree Celsius. Also , not more than 2 mice can be caged together and each cage must be at least 2 sq.ft in area. The 5 experiments to be conducted by lab are to be thoroughly

documented and performed only after a round of approval by authorities. The approval procedure takes around 48 hours. How many times is the tag numbered '4' used by the lab in numbering these mice?
a) 9
b) 19
c) 20
d)21 **(solution:b)**
Q16) There are two water tanks A and B, A is much smaller than B. While water fills at the rate of one litre every hour in A, it gets filled up like 10, 20, 40, 80, 160... in tank B.(At the end of first hour, B has 10 litres ,second hour it has 20, and so on). If tank B is 1/32 filled after 21 hours, what is the total duration required to fill it completely?
a) 26 hrs
b) 25 hrs
c) 5 hrs
d)27 hrs**(solution:a)**
Q17) Consider two tumblers, the first containing one litre of coffee. Suppose you take one spoon of water out of the first tumbler and pour it into the second tumbler. After moving you take one spoon of the mixture from the second tumbler and pour it back into the first tumbler. Which one of the following statement holds now?
a) There is less coffee in the first tumbler than water in the second tumbler.
b) There is more coffee in the firs tumbler than water in the second tumbler
c) There is as much coffee in the first tumbler as there is water in the second tumbler
d) None of the statements holds true.
Q18) Francois Pachet , a researcher at Sony Computer Science laboratories is also a jazz musician. He decided to build a robot able to improvise like a pro. Named Continuator, the robot can duet with a live musician in real- time. It listens to a musical phrase and then computes a complementary phrase with the same playing style. If the cost of making the robot is divided between and then computes a complementary phrase with the same playing style. If the cost of making the robot is divided between materials, labour and overheads in the ratio of 4:6:2. If the materials cost $108. the cost of the robot is
a) $270
b) $324
c) $216
d) $ 648 **(solution:b)**
Q19) A lady has fine gloves and hats in her closet- 18 blue- 32 red and 25 yellow. The lights are out and it is totally dark inspite of the darkness. She can make out the difference between a hat and a glove. She takes out anitem out of the closet only if she is sure that if it is a glove. How many gloves must she take out to make sure she has a pair of each colour?
a) 50
b) 8
c) 60
d) 42
Q20) A man jogs at 6 mph over a certain journey and walks over the same route at 4 mph. What is his averagespeed for the journey?
a) 2.4 mph
b) 4 mph
c) 4.8 mph
d) 5 mph **(solution:d)**
Q21) Spores of a fungus, called late blight, grow and spread infection rapidly. These pathogens were responsible for the Irish potato famine of the mid-19th century. These seem to have attacked the tomato crops in England this year. The tomato crops have reduced and the price of the crop has risen up. The price has already gone up to $45 a box from $27 a box a month ago. How much more would a vegetable vendor need to pay to buy 27 boxes this month over what he would have paid last month?
a) $27

b) $ 18
c) $45
d) $ 486

Q22) Given a collection of 36 points P in the plane and a point equidistant from all points in P, which of the following are necessarily true?

A. The points in P lie on a circle.

B. The distance between any pair of points in P is larger than the distance between X and a point in P

a) A and B
b) Neither A nor B
c) B only
d) A only

Q23) In the year 2002, Britain was reported to have had 4.3m closed – circuit television (CCTV) cameras – one for every 14 people in the country. This scrutiny is supposed to deter and detect crime. In one criminal case, thepolice interrogates two suspects. The ratio between the ages of the two suspects is 6:5 and the sum of their ages is 6:5 and the sum of their ages is 55 years. After how many years will the ratio be 8:7.?

a) 11
b) 6
c) 10
d) 5

Q24) Susan made a block with small cubes of 8 cubic cm volume to make a block 3 small cubes long, 9 small cubes wide and 5 small cubes deep. She realizes that she has used more small cubes than she really needed. She realized that she could have glued a fewer number of cubes together to lock like a block with same dimensions, if it were made hollow. What is the minimum number of cubes that she needs to make the block?

a) 114
b) 135
c) 21
d) 71

Q25) Alok and Bhanu play the following coins in a circle game. 99 coins are arranged in a circle with each coin touching two other coin. Two of the coins are special and the rest are ordinary. Alok starts and the players take turns removing an ordinary coin of their choice from the circle and bringing the other coins closer until they again form a (smaller) circle. The goal is to bring the special coins adjacent to each other and the first player to do so wins the game. Initially the special coins are separated by two ordinary coins O1 and O2. Which of the following is true ?

a) In order to win, Alok should remove O1 on his first turn.
b) In order to win, Alok should remove one of the coins different from O1 and O2 on his first turn.
c) In order to win, Alok should remove O2 on his first turn.
d) Alok has no winning strategy.

Tips for Effective Communication Have courage to say what you think.

Be confident in knowing that you can make worthwhile contributions to conversation. Take time each day to be aware of your opinions and feelings so you can adequately convey them to others. Individuals who are hesitant to speak because they do not feel their input would be worthwhile need not fear. What is important or worthwhile to one person may not be to another and may be more so to someone else.

Practice. Developing advanced communication skills begins with simple interactions. Communication skills can be practiced every day in settings that range from the social to the professional. New skills take time to refine, but each time you use your communication skills, you open yourself to opportunities and future partnerships.

Make eye contact. Whether you are speaking or listening, looking into the eyes of the person with whom you are conversing can make the interaction more successful. Eye contact conveys interest and encourages your partner to be interested in you in return.

- Use gestures. These include gestures with your hands and face. Make your whole body talk. Use smaller gestures for individuals and small groups. The gestures should get larger as the group that one is addressing increases in size.
- Manifest constructive attitudes and beliefs. The attitudes you bring to communication will have a huge impact on the way you compose yourself and interact with others. Choose to honest, patient, optimistic , sincere, respectful, and accepting of others. Be sensitive to other people's feelings, and believe in others' competence.

Develop effective **listening** skills: Not only should one be able to speak effectively, one must listen to the other person's words and engage in communication on what the other person is speaking about. Avoid the impulse to listen only for the end of their sentence so that you can blurt out the ideas or memories your mind while the other person is speaking.

- Enunciate your words. Speak clearly and don't mumble. If people are always asking you to repeat yourself, try to do a better job of articulating yourself in a better manner.
- Pronounce your words correctly. People will judge your competency through your vocabulary. If you aren't sure of how to say a word, don't use it.
- Use the right words. If you're not sure of the meaning of a word, don't use it. Grab a dictionary and start a daily habit of learning one new word per day. Use it sometime in your conversations during the day.
- Slow your speech down. People will perceive you as nervous and unsure of yourself if you talk fast. However, be careful not to slow down to the point where people begin to finish your sentences just to help you finish.

Developing Leadership Skills

No one is a born leader; everyone can develop leadership skills and everyone can benefit from using them. First, take time to honestly analyze yourself. Learn to understand yourself.
It's the first step to understanding others. Consider these important questions:
What kind of leader am I? One who helps to solve problems? A leader who helps people get along? How do others see me as a leader?
What are my goals, purposes, and expectations in working with this particular group? Identify areas for improvement.
Ask yourself these questions:
1. Do I try to be aware of how others think and feel?
2. Do I try to help others perform to the best of their abilities?
3. Am I willing to accept responsibility?
4. Am I willing to try new ideas and new ways of doing things?
5. Am I able to communicate with others effectively?
6. Am I a good problem solver?
7. Do I accept and appreciate other perspectives and opinions?
8. Am I aware of current issues and concerns on campus or in my community?
Then after analyzing your strengths and weaknesses -- take action

Devise a strategy for upgrading your skills. Here are a few strategies to consider:
1) Communicate effectively:
Effective communication is dialogue. Barriers are created by speaking down to people, asking closed questions that elicit yes or no answers, using excessive authority, and promoting a culture that depends on unanimity. If your focus is winning the argument or if you react defensively to criticism, you'll create fear of openness and hinder the organization's growth.
Try these steps to effective communication:
• Listen actively - ask open questions. Be genuinely interested in what other's say.

• Thank people for their openness -- stress how much you value it -- even if you don't like specifically what is being said.
• Point to areas of agreement before jumping on areas of disagreement - this reduces defensiveness; members wont fear being "attacked."
• Set aside your authority to create an atmosphere of partnership to reduce fear in group members.
• Promote a culture of constructive dissent - though not to the point of paralysis.
• Portray disagreement as simply a difference of opinion. Get rid of the "I'm right, you're wrong" attitude.
2) Encourage enthusiasm and a sense of belonging. Show:
• Friendliness: others will be more willing to share ideas if you're interested in them as people too.
• Understanding: everyone makes mistakes. Try to be constructive, tolerant and tactful when offering criticism.
• Fairness: equal treatment and equal opportunity lead to an equally good effort from all group members.
• Integrity: members will take tasks more seriously if you show that you're more interested in group goals than your own personal gain.
3) Keep everyone working toward agreed upon goals:
• Remind everyone of the group's purposes from time to time. It's easy to become too narrowly focused and lose sight of the larger goals.
• Provide encouragement and motivation, by showing your appreciation for good ideas and extra effort.
• Harmonize differences and disagreements between group members by stressing compromise and cooperation.
• Involve everyone in discussions and decisions, even if asking for opinions and ideas means a longer discussion.
4) Get to know the people around you Everyone has different abilities, wants, needs, and purpose in life.
To get along with others and get results, you need to get to know them.
• Interact with group members as often as possible. The only way to get to know someone is through direct personal contact.
• Become familiar with every member of your group. Take note of each person's unique qualities and characteristics.

5) Treat others as individuals
Put your knowledge and understanding of each group member to work!
• Be aware of expectations. Everyone expects something different: recognition, a chance to learn, a chance to work with other people, etc.
• Be creative. A repetitious routine can cause boredom. A successful leader thinks of new and better approaches to old ways of doing things.
• Provide rewards. Recognition by the group is a source of personal satisfaction and positive reinforcement for a job well done.
• Delegate responsibilities. If everyone shares the work, everyone can share pride in the group's accomplishments. Let each member know what's expected of him/her, available resources, deadlines, etc.
6) Accept responsibility for getting things done
• Take the initiative. Why stand around and wait for someone else to get things started? Set an example.
• Offer help and information. Your unique knowledge and skills may be just what's needed.
• Seek help and information. Ask for advice if you need it. This will encourage group involvement and help accomplish group goals.
• Make things happen. By being decisive, energetic, and enthusiastic, you can and will help get things done!
• Know when and how to say "no."
If your time and resources are already committed, turn down extra tasks, but do it nicely.
7) Problem solve in a step - by-step way
Whether you are faced with a decision to make or a conflict to resolve, following a logical approach will help.
1. State the problem as simply and clearly as possible.
2. Gather all relevant information and available resources.

3. Brainstorm as many ideas or solutions as you can think of (with others if possible).
4. Evaluate each idea or solution and choose the best one.
5. Design a plan for using your idea or solution. Include a timetable, assigned roles, and resources to be used.
6. Follow up on your plan by asking if your idea worked and why or why not.

K.L.N. College of Engineering.

How to prepare for Anna University Examinations.

Don't study just for passing the tests/exams. Ensure that you understood the concepts and you can explain/ demonstrate/justify/analyze/ answer/ argue/ design /implement/draw/develop any mathematical model, based on what you have learnt. If you are confident enough, you can successfully solve any question papers/technical interviews/competitive examinations at any time without fear/confusion/ delay. Remember that, you will be working in an environment, after graduation, where all the process/operation of machineries/equipment's are based on the basic scientific and engineering concepts what you have studied from first year to final year of your Engineering programme, where you are the only person to solve any problems aroused. You can't get away/escape from these. Hence, it is a lifelong learning, a wonderful experience.

Syllabus, books (at least 2-one Text books as prescribed in the syllabus, -one local author book) previous year question papers(atleast10), class notes, are your God/religion/food/ destiny/light. Ensure that you have studied all the contents of the syllabus, prepared correct answers for all questions in the AU question paper. Remember that ignoring any one word in the syllabus means you are losing 5 to 10 marks in each unit in the AU exams. Similarly, ignoring any one questions in the previous year question paper means you are losing 10 marks in each unit of AU exams. Don't expect that your Professor would cover 100% of the syllabus. Even if he/she has covered 100% of the syllabus don't think that he/she has covered 100% of each line in the syllabus. It is your responsibility to prepare 10% in excess of each lines in each units of the syllabus in addition to the contents taught by your Professors. This is possible by referring the books and the questions asked in the competitive exam books like GATE/TANCET/IES.

Plan your studies –right from the second week of the commencement of the classes till the semester examination is over. In a year, you will be attending the college only for 200 days(including theory/practical exams-8hours /day). You have 165 days (24 hours /day) away from the college. Prepare a time table from Monday-Friday. Take a rest on Saturday and Sunday. Allocate 3-4 hours in the evening for study.1-2 hours for completing assignments/observation/record note work. Remaining 2-3 hours for studying subjects A,B.(Mon),C,D(Tue)E,F(Wed), A,B(Thu),C,D(Fri),E,F(Sat or Sun).Each day, in addition to studying subjects for the current syllabus, you should refer competitive exam books (GATE/TANCET/IES/ Objective type questions –technical) corresponding to the current syllabus. This parallel preparation will ensure that you have prepared for state level and National level examinations there by you will be meeting the expectations of the Engineering Educational Objectives. Your preparation for AU examination should be vigorous (minimum), 15 days from the commencement of the exam and it should be maximum 2 days before the exam. You need to allocate for 8 hours per day during minimum days (early morning-6AM-10AM with a break for an hour,10AM-12 Noon-sleep/rest,12 noon-2PM-study,2PM-5PM-sleep/rest,6PM-10PM –study). Repetition/memorizing is required to retain certain contents to improve confidence on the subject. During rest time you can have group discussion with your friends or you can teach slow learners, thereby you will gain more knowledge and also help others.

Presentation – AU Exam-General complaints by students that the valuation is not fair or poor valuation. Remarks of examiners that there is nothing in the answer paper. Parents may say that either "college is not good" or "it is a fate". Public may say "poor quality" and the experts may comment that " only 20% are employable". These statements will go on for centuries. Many students believes that they have written right answers mostly (but many of them actually wrong) and few examiners assumed certain answers by students are wrong(but many of them are actually correct). It is 70% true that students are not presenting the answers well and it is 30% true that the valuation is not fair. But it is 95% true that the deserved students are getting expected results in most of the papers. This is because of good presentation. Good presentation involves many factors such as legible writing, good handwriting. answering correctly (100% correct),all answers with mathematical modeling/pictorial representation/drawing/layout/sketches with different colors, writing 7 pages for 16 mark questions with valid points and sketches, 4 pages for 8 marks with valid points and sketches/drawings/equations, characterizes,. Such students will solve problems correctly without any overwriting/ strikeouts. Simply, they do not cheat. These are the in-born qualities or developed over the years due to good habits, friendship, good character, obedience, hard work, well brought up by parents and blessing by God. Everyone can become like them if their attitude is good. Fear of God is the beginning of Wisdom. The examiners will know about your quality,

just by referring the way you have answered Part-A- questions. A well prepared student would get a maximum of 18 out of 20. This impresses the examiner so that they will award a maximum of 14-16 for each part-B-questions. Most of the students would answer wrongly in the Part-A-questions. This is due to their poor preparation during Class tests/internal tests, frequently taking leave, lot of diversion, skipping the classes for attending Co-Curricular/ /extra-curricular activities etc inside or outside the college.. Attending the classes is more important than attending college. Students are expected to attend 98%classes to maintain the continuity of the subjects learnt. One-day absence means it will take a week to study on his/her own. If he/she fails to study on his/her own to review the classes not attended means a loss of 10 marks in the exams.

Know well about Why one should apply for revaluation without /with Photocopy, schedule and fees to be paid. Sometimes a well-deserved students get low CGPA than he/she expected or even may fail. This may be due to error in valuation/data entry. Hence such students should not hesitate to apply for revaluation with/without photocopy. The parents should also be informed, all about these unfortunates (the misunderstanding between parents /sons/daughter/faculty may lead to unnecessary things).90% of those deserved students who applied for revaluation with photo copy benefitted after revaluation. Ignorance/communication failure of these formalities, by deserved students, may damage their life. Some students failed in revaluation secured "S"grade in the REVIEW, shows some hope in the examination system and the better prospect of the students.

Need to maintain high CGPA in every semester. :This is possible only when one gets "S" grade in all practical's (from first to eighth semester).Those who are regular in attending the lab classes, submitting the observation and record note in time, disciplined behavior with staff and students in the class room/laboratory/campus etc. will impress the faculty in-charge of practical's, so that he/she will help such students during regular lab classes. This will improve the students to do the lab experiments with confidence and fetch them to get more marks. This will reflect in internal assessment marks also. Classification of degree-First class with distinction-More than 8.5CGPA (passed all subjects in first attempt),First class-More than 6.5CGPA at the end of eighth semester, less than this would be second class.

Q. 1 – Q. 5 carry one mark each.

Q.1 The man who is now Municipal Commissioner worked as _____.

(A) the security guard at a university

(B) a security guard at the university

(C) a security guard at university

(D) the security guard at the university

Q.2 Nobody knows how the Indian cricket team is going to cope with the difficult and seamer-friendly wickets in Australia.

Choose the option which is closest in meaning to the underlined phrase in the above sentence.

(A) put up with (B) put in with (C) put down to (D) put up against

Q.3 Find the odd one in the following group of words.

mock, deride, praise, jeer

(A) mock (B) deride (C) praise (D) jeer

Q.4 Pick the odd one from the following options.

(A) CADBE (B) JHKIL (C) XVYWZ (D) ONPMQ

Q.5 In a quadratic function, the value of the product of the roots (α, β) is 4. Find the value of

$$\frac{\alpha^n + \beta^n}{\alpha^{-n} + \beta^{-n}}$$

(A) n^4 (B) 4^n (C) 2^{2n-1} (D) 4^{n-1}

Q. 6 – Q. 10 carry two marks each.

Q.6 Among 150 faculty members in an institute, 55 are connected with each other through Facebook® and 85 are connected through WhatsApp®. 30 faculty members do not have Facebook® or WhatsApp® accounts. The number of faculty members connected only through Facebook® accounts is _____.

(A) 35 (B) 45 (C) 65 (D) 90

Q.7 Computers were invented for performing only high-end useful computations. However, it is no understatement that they have taken over our world today. The internet, for example, is ubiquitous. Many believe that the internet itself is an unintended consequence of the original invention. With the advent of mobile computing on our phones, a whole new dimension is now enabled. One is left wondering if all these developments are good or, more importantly, required.

Which of the statement(s) below is/are logically valid and can be inferred from the above paragraph?

(i) The author believes that computers are not good for us.
(ii) Mobile computers and the internet are both intended inventions

(A) (i) only (B) (ii) only (C) both (i) and (ii) (D) neither (i) nor (ii)

Q.8 All hill-stations have a lake. Ooty has two lakes.

Which of the statement(s) below is/are logically valid and can be inferred from the above sentences?

(i) Ooty is not a hill-station.
(ii) No hill-station can have more than one lake.

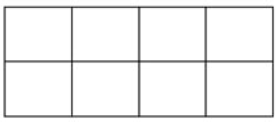
(A) (i) only

(B) (ii) only

(C) both (i) and (ii)

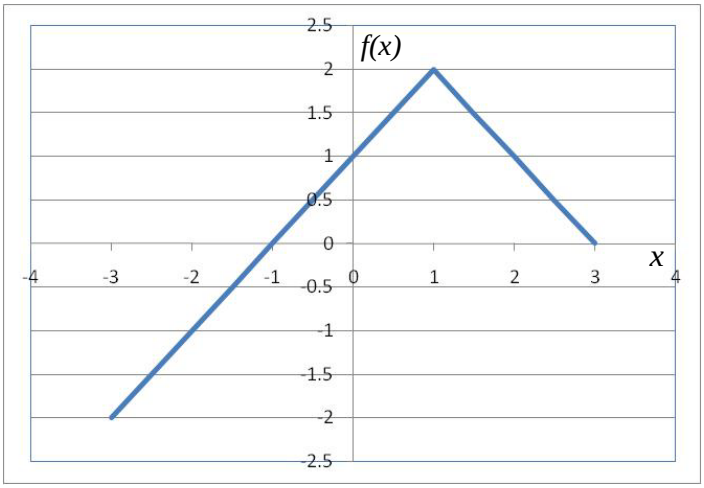
(D) neither (i) nor (ii)

Q.9 In a 2 × 4 rectangle grid shown below, each cell is a rectangle. How many rectangles can be observed in the grid?



(A) 21 (B) 27 (C) 30 (D) 36

Q.10



Choose the correct expression for *f(x)* given in the graph.

(A) $f(x) = 1 - |x - 1|$

(B) $f(x) = 1 + |x - 1|$

(C) $f(x) = 2 - |x - 1|$

(D) $f(x) = 2 + |x - 1|$

END OF THE QUESTION PAPER

Q. 1 – Q. 25 carry one mark each.

Q.1 The maximum value attained by the function $f(x) = x(x-1)(x-2)$ in the interval [1, 2] is _____.

Q.2 Consider a 3×3 matrix with every element being equal to 1. Its only non-zero eigenvalue is ____.

Q.3 The Laplace Transform of $f(t) = e^{2t}\sin(5t)\,u(t)$ is

(A) $\frac{5}{s^2-4s+29}$ (B) $\frac{5}{s^2+5}$ (C) $\frac{s-2}{s^2-4s+29}$ (D) $\frac{5}{s+5}$

Q.4 A function $y(t)$, such that $y(0) = 1$ and $y(1) = 3e^{-1}$, is a solution of the differential equation $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + y = 0$. Then $y(2)$ is

(A) $5e^{-1}$ (B) $5e^{-2}$ (C) $7e^{-1}$ (D) $7e^{-2}$

Q.5 The value of the integral

$$\oint_C \frac{2z+5}{\left(z-\frac{1}{2}\right)(z^2-4z+5)}dz$$

over the contour $|z| = 1$, taken in the anti-clockwise direction, would be

(A) $\frac{24\pi i}{13}$ (B) $\frac{48\pi i}{13}$ (C) $\frac{24}{13}$ (D) $\frac{12}{13}$

Q.6 The transfer function of a system is $\frac{Y(s)}{R(s)} = \frac{s}{s+2}$. The steady state output $y(t)$ is $A\cos(2t+\varphi)$ for the input $\cos(2t)$. The values of A and φ, respectively are

(A) $\frac{1}{\sqrt{2}}, -45^\circ$ (B) $\frac{1}{\sqrt{2}}, +45^\circ$ (C) $\sqrt{2}, -45^\circ$ (D) $\sqrt{2}, +45^\circ$

Q.7 The phase cross-over frequency of the transfer function $G(s) = \frac{100}{(s+1)^3}$ in rad/s is

(A) $\sqrt{3}$ (B) $\frac{1}{\sqrt{3}}$ (C) 3 (D) $3\sqrt{3}$

Q.8 Consider a continuous-time system with input $x(t)$ and output $y(t)$ given by

$$y(t) = x(t)\cos(t)$$

This system is

(A) linear and time-invariant
(B) non-linear and time-invariant
(C) linear and time-varying
(D) non-linear and time-varying

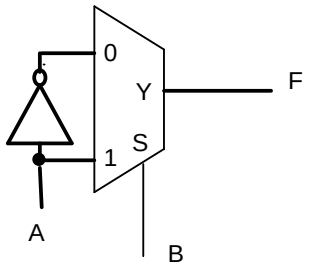
Q.9 The value of $\int_{-\infty}^{+\infty} e^{-t}\,\delta(2t-2)\,dt$, where $\delta(t)$ is the Dirac delta function, is

(A) $\frac{1}{2e}$ (B) $\frac{2}{e}$ (C) $\frac{1}{e^2}$ (D) $\frac{1}{2e^2}$

Q.10 A temperature in the range of -40° C to 55° C is to be measured with a resolution of 0.1° C. The minimum number of ADC bits required to get a matching dynamic range of the temperature sensor is

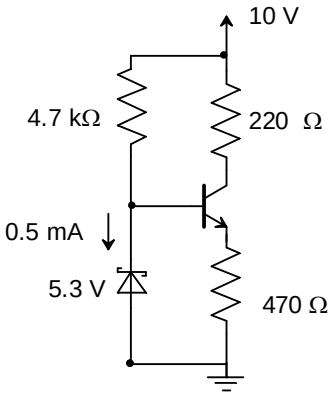
(A) 8 (B) 10 (C) 12 (D) 14

Q.11 Consider the following circuit which uses a 2-to-1 multiplexer as shown in the figure below. The Boolean expression for output F in terms of A and B is



(A) $A \oplus B$ (B) $\overline{A+B}$ (C) $A+B$ (D) $\overline{A \oplus B}$

Q.12 A transistor circuit is given below. The Zener diode breakdown voltage is 5.3 V as shown. Take base to emitter voltage drop to be 0.6 V. The value of the current gain β is _____.

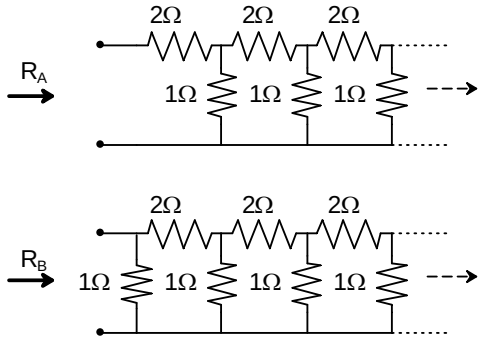


Q.13 In cylindrical coordinate system, the potential produced by a uniform ring charge is given by $\varphi = f(r, z)$, where f is a continuous function of r and z. Let $\vec{E}$ be the resulting electric field. Then the magnitude of $\nabla \times \vec{E}$

(A) increases with r. (B) is 0. (C) is 3. (D) decreases with z.

Q.14 A soft-iron toroid is concentric with a long straight conductor carrying a direct current I. If the relative permeability μ_r of soft-iron is 100, the ratio of the magnetic flux densities at two adjacent points located just inside and just outside the toroid, is _____.

Q.15 R_A and R_B are the input resistances of circuits as shown below. The circuits extend infinitely in the direction shown. Which one of the following statements is TRUE?

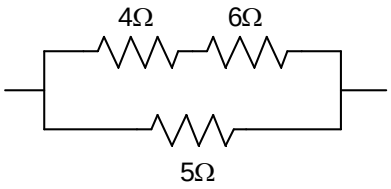


(A) $R_A=R_B$ (B) $R_A=R_B=0$ (C) $R_A< R_B$ (D) $R_B= R_A /(1+R_A)$

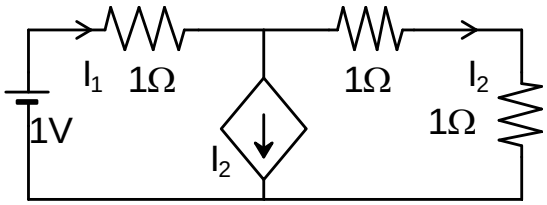
Q.16 In a constant V/f induction motor drive, the slip at the maximum torque

(A) is directly proportional to the synchronous speed.
(B) remains constant with respect to the synchronous speed.
(C) has an inverse relation with the synchronous speed.
(D) has no relation with the synchronous speed.

Q.17 In the portion of a circuit shown, if the heat generated in 5 Ω resistance is 10 calories per second, then heat generated by the 4 Ω resistance, in calories per second, is _____.



Q.18 In the given circuit, the current supplied by the battery, in ampere, is _____.



Q.19 In a 100 bus power system, there are 10 generators. In a particular iteration of Newton Raphson load flow technique (in polar coordinates), two of the PV buses are converted to PQ type. In this iteration,

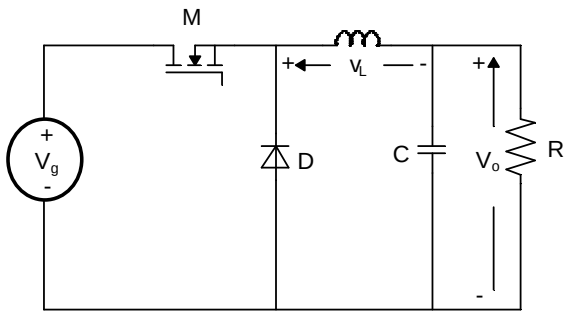
(A) the number of unknown voltage angles increases by two and the number of unknown voltage magnitudes increases by two.
(B) the number of unknown voltage angles remains unchanged and the number of unknown voltage magnitudes increases by two.
(C) the number of unknown voltage angles increases by two and the number of unknown voltage magnitudes decreases by two.
(D) the number of unknown voltage angles remains unchanged and the number of unknown voltage magnitudes decreases by two.

Q.20 The magnitude of three-phase fault currents at buses A and B of a power system are 10 pu and 8 pu, respectively. Neglect all resistances in the system and consider the pre-fault system to be unloaded. The pre-fault voltage at all buses in the system is 1.0 pu. The voltage magnitude at bus B during a three-phase fault at bus A is 0.8 pu. The voltage magnitude at bus A during a three-phase fault at bus B, in pu, is _____.

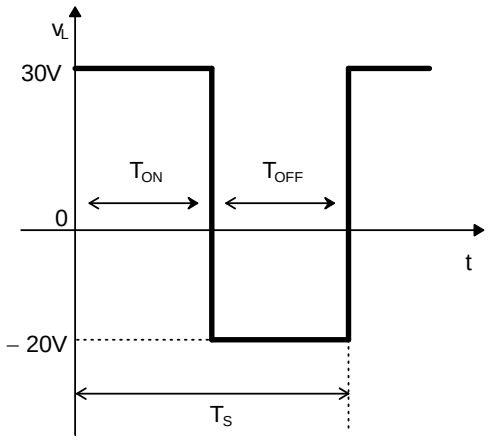
Q.21 Consider a system consisting of a synchronous generator working at a lagging power factor, a synchronous motor working at an overexcited condition and a directly grid-connected induction generator. Consider capacitive VAr to be a source and inductive VAr to be a sink of reactive power. Which one of the following statements is TRUE?

(A) Synchronous motor and synchronous generator are sources and induction generator is a sink of reactive power.
(B) Synchronous motor and induction generator are sources and synchronous generator is a sink of reactive power.
(C) Synchronous motor is a source and induction generator and synchronous generator are sinks of reactive power.
(D) All are sources of reactive power.

Q.22 A buck converter, as shown in Figure (a) below, is working in steady state. The output voltage and the inductor current can be assumed to be ripple free. Figure (b) shows the inductor voltage v_L during a complete switching interval. Assuming all devices are ideal, the duty cycle of the buck converter is _____.

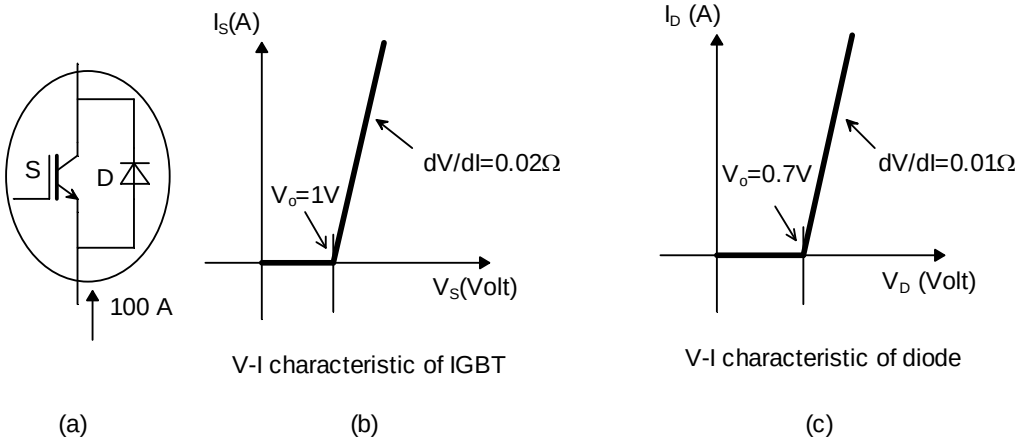


(a)



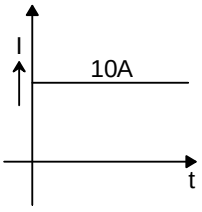
(b)

Q.23 A steady dc current of 100 A is flowing through a power module (S, D) as shown in Figure (a). The V-I characteristics of the IGBT (S) and the diode (D) are shown in Figures (b) and (c), respectively. The conduction power loss in the power module (S, D), in watts, is _____.

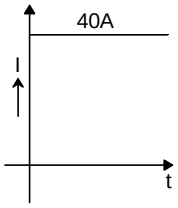


Q.24 A 4-pole, lap-connected, separately excited dc motor is drawing a steady current of 40 A while running at 600 rpm. A good approximation for the waveshape of the current in an armature conductor of the motor is given by

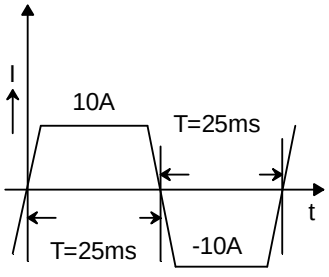
(A)



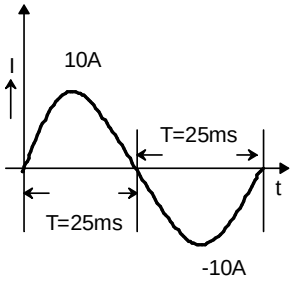
(B)



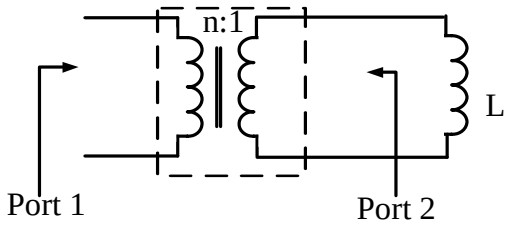
(C)



(D)



Q.25 If an ideal transformer has an inductive load element at port 2 as shown in the figure below, the equivalent inductance at port 1 is



(A) nL (B) n^2L (C) $\frac{n}{L}$ (D) $\frac{n^2}{L}$

Q. 26 – Q. 55 carry two marks each.

Q.26 Candidates were asked to come to an interview with 3 pens each. Black, blue, green and red were the permitted pen colours that the candidate could bring. The probability that a candidate comes with all 3 pens having the same colour is _____.

Q.27 Let $S = \sum_{n=0}^{\infty} n\alpha^n$ where $|\alpha| < 1$. The value of α in the range $0 < \alpha < 1$, such that $S = 2\alpha$ is _____.

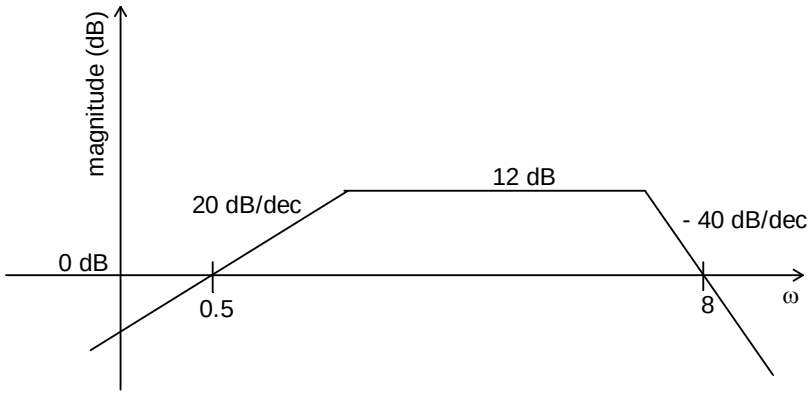
Q.28 Let the eigenvalues of a 2 x 2 matrix A be 1, -2 with eigenvectors x_1 and x_2 respectively. Then the eigenvalues and eigenvectors of the matrix $A^2 - 3A + 4I$ would, respectively, be

(A) 2, 14; x_1, x_2
(B) 2, 14; $x_1 + x_2, x_1 - x_2$
(C) 2, 0; x_1, x_2
(D) 2, 0; $x_1 + x_2, x_1 - x_2$

Q.29 Let A be a 4×3 real matrix with rank 2. Which one of the following statement is TRUE?

(A) Rank of A^TA is less than 2.
(B) Rank of A^TA is equal to 2.
(C) Rank of A^TA is greater than 2.
(D) Rank of A^TA can be any number between 1 and 3.

Q.30 Consider the following asymptotic Bode magnitude plot (ω is in rad/s).



Which one of the following transfer functions is best represented by the above Bode magnitude plot?

(A) $\frac{2s}{(1+0.5s)(1+0.25s)^2}$

(B) $\frac{4(1+0.5s)}{s(1+0.25s)}$

(C) $\frac{2s}{(1+2s)(1+4s)}$

(D) $\frac{4s}{(1+2s)(1+4s)^2}$

Q.31 Consider the following state-space representation of a linear time-invariant system.

$$\dot{\boldsymbol{x}}(t) = \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix} \boldsymbol{x}(t),\ y(t) = \boldsymbol{c}^{\mathrm{T}}\boldsymbol{x}(t),\ \boldsymbol{c} = \begin{bmatrix} 1 \\ 1 \end{bmatrix} \text{ and } \boldsymbol{x}(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

The value of $y(t)$ for $t = \log_e 2$ is _____.

Q.32 Loop transfer function of a feedback system is $G(s)H(s) = \frac{s+3}{s^2(s-3)}$. Take the Nyquist contour in the clockwise direction. Then, the Nyquist plot of $G(s)H(s)$ encircles $-1+j0$

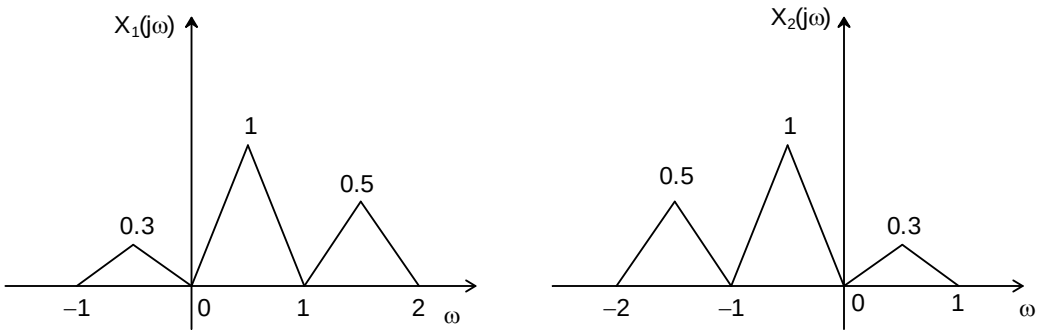
(A) once in clockwise direction
(B) twice in clockwise direction
(C) once in anticlockwise direction
(D) twice in anticlockwise direction

Q.33 Given the following polynomial equation

$$s^3 + 5.5\,s^2 + 8.5\,s + 3 = 0,$$

the number of roots of the polynomial, which have real parts strictly less than -1, is _____ .

Q.34 Suppose $x_1(t)$ and $x_2(t)$ have the Fourier transforms as shown below.



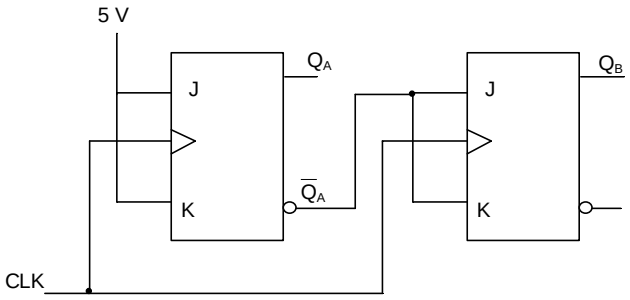
Which one of the following statements is TRUE?

(A) $x_1(t)$ and $x_2(t)$ are complex and $x_1(t)x_2(t)$ is also complex with nonzero imaginary part
(B) $x_1(t)$ and $x_2(t)$ are real and $x_1(t)x_2(t)$ is also real
(C) $x_1(t)$ and $x_2(t)$ are complex but $x_1(t)x_2(t)$ is real
(D) $x_1(t)$ and $x_2(t)$ are imaginary but $x_1(t)x_2(t)$ is real

Q.35 The output of a continuous-time, linear time-invariant system is denoted by $\boldsymbol{T}\{x(t)\}$ where $x(t)$ is the input signal. A signal $z(t)$ is called eigen-signal of the system $\boldsymbol{T}$, when $\boldsymbol{T}\{z(t)\} = \gamma\, z(t)$, where γ is a complex number, in general, and is called an eigenvalue of $\boldsymbol{T}$. Suppose the impulse response of the system $\boldsymbol{T}$ is real and even. Which of the following statements is TRUE?

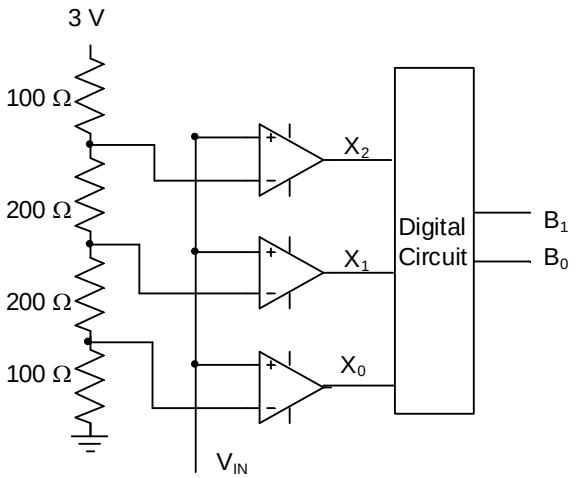
(A) $\cos(t)$ is an eigen-signal but $\sin(t)$ is not
(B) $\cos(t)$ and $\sin(t)$ are both eigen-signals but with different eigenvalues
(C) $\sin(t)$ is an eigen-signal but $\cos(t)$ is not
(D) $\cos(t)$ and $\sin(t)$ are both eigen-signals with identical eigenvalues

Q.36 The current state $Q_A\,Q_B$ of a two JK flip-flop system is 00. Assume that the clock rise-time is much smaller than the delay of the JK flip-flop. The next state of the system is



(A) 00 (B) 01 (C) 11 (D) 10

Q.37 A 2-bit flash Analog to Digital Converter (ADC) is given below. The input is $0 \le V_{IN} \le 3$ Volts. The expression for the LSB of the output B_0 as a Boolean function of X_2, X_1, and X_0 is

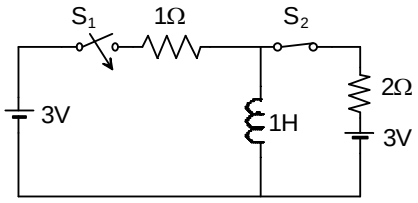


(A) $X_0[\overline{X_2 \oplus X_1}]$ (B) $\bar{X}_0[\overline{X_2 \oplus X_1}]$ (C) $X_0[X_2 \oplus X_1]$ (D) $\bar{X}_0[X_2 \oplus X_1]$

Q.38 Two electric charges q and $-2q$ are placed at (0,0) and (6,0) on the *x-y* plane. The equation of the zero equipotential curve in the *x-y* plane is

(A) $x = -2$ (B) $y = 2$ (C) $x^2 + y^2 = 2$ (D) $(x + 2)^2 + y^2 = 16$

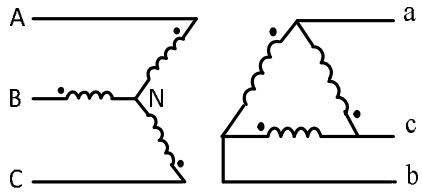
Q.39 In the circuit shown, switch S_2 has been closed for a long time. At time $t = 0$ switch S_1 is closed. At $t = 0^+$, the rate of change of current through the inductor, in amperes per second, is _____.



Q.40 A three-phase cable is supplying 800 kW and 600 kVAr to an inductive load. It is intended to supply an additional resistive load of 100 kW through the same cable without increasing the heat dissipation in the cable, by providing a three-phase bank of capacitors connected in star across the load. Given the line voltage is 3.3 kV, 50 Hz, the capacitance per phase of the bank, expressed in microfarads, is _____.

Q.41 A 30 MVA, 3-phase, 50 Hz, 13.8 kV, star-connected synchronous generator has positive, negative and zero sequence reactances, 15%, 15% and 5% respectively. A reactance (X_n) is connected between the neutral of the generator and ground. A double line to ground fault takes place involving phases 'b' and 'c', with a fault impedance of j0.1 p.u. The value of X_n (in p.u.) that will limit the positive sequence generator current to 4270 A is _____.

Q.42 If the star side of the star-delta transformer shown in the figure is excited by a negative sequence voltage, then

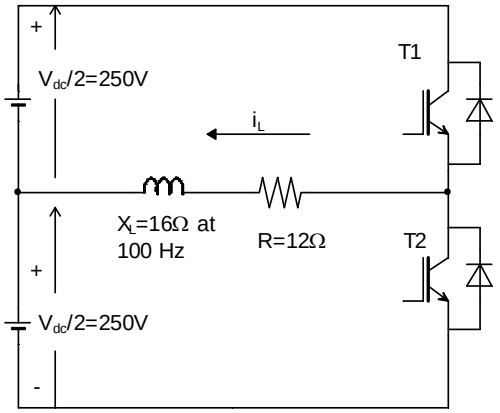


(A) V_{AB} leads V_{ab} by 60°
(B) V_{AB} lags V_{ab} by 60°
(C) V_{AB} leads V_{ab} by 30°
(D) V_{AB} lags V_{ab} by 30°

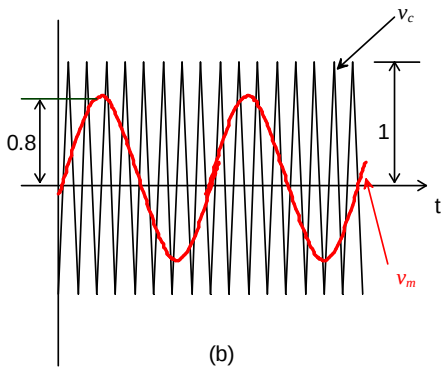
Q.43 A single-phase thyristor-bridge rectifier is fed from a 230 V, 50 Hz, single-phase AC mains. If it is delivering a constant DC current of 10 A, at firing angle of 30°, then value of the power factor at AC mains is

(A) 0.87 (B) 0.9 (C) 0.78 (D) 0.45

Q.44 The switches T1 and T2 in Figure (a) are switched in a complementary fashion with sinusoidal pulse width modulation technique. The modulating voltage $v_m(t) = 0.8 \sin(200\pi t)$ V and the triangular carrier voltage (v_c) are as shown in Figure (b). The carrier frequency is 5 kHz. The peak value of the 100 Hz component of the load current (i_L), in ampere, is _____ .

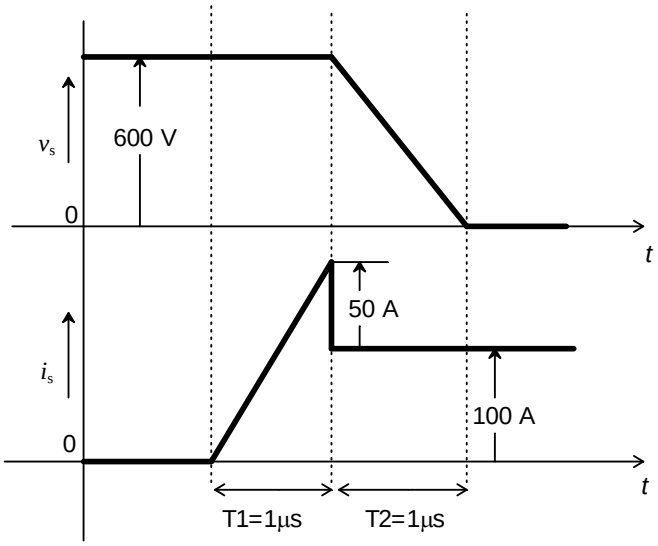


(a)



(b)

Q.45 The voltage (v_s) across and the current (i_s) through a semiconductor switch during a turn-ON transition are shown in figure. The energy dissipated during the turn-ON transition, in mJ, is _____.



Q.46 A single-phase 400 V, 50 Hz transformer has an iron loss of 5000 W at the rated condition. When operated at 200 V, 25 Hz, the iron loss is 2000 W. When operated at 416 V, 52 Hz, the value of the hysteresis loss divided by the eddy current loss is _____.

Q.47 A DC shunt generator delivers 45 A at a terminal voltage of 220 V. The armature and the shunt field resistances are 0.01 Ω and 44 Ω respectively. The stray losses are 375 W. The percentage efficiency of the DC generator is _____.

Q.48 A three-phase, 50 Hz salient-pole synchronous motor has a per-phase direct-axis reactance (X_d) of 0.8 pu and a per-phase quadrature-axis reactance (X_q) of 0.6 pu. Resistance of the machine is negligible. It is drawing full-load current at 0.8 pf (leading). When the terminal voltage is 1 pu, per-phase induced voltage, in pu, is _____.

Q.49 A single-phase, 22 kVA, 2200 V/ 220 V, 50 Hz, distribution transformer is to be connected as an auto-transformer to get an output voltage of 2420 V. Its maximum kVA rating as an auto-transformer is

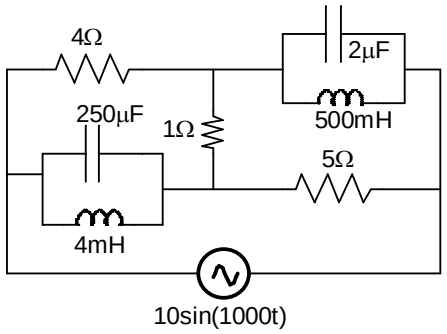
(A) 22 (B) 24.2 (C) 242 (D) 2420

Q.50 A single-phase full-bridge voltage source inverter (VSI) is fed from a 300 V battery. A pulse of 120^o duration is used to trigger the appropriate devices in each half-cycle. The rms value of the fundamental component of the output voltage, in volts, is

(A) 234 (B) 245 (C) 300 (D) 331

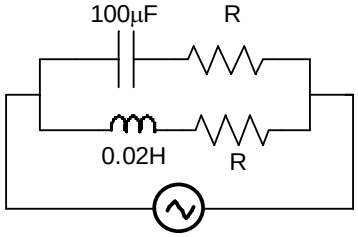
Q.51 A single-phase transmission line has two conductors each of 10 mm radius. These are fixed at a center-to-center distance of 1 m in a horizontal plane. This is now converted to a three-phase transmission line by introducing a third conductor of the same radius. This conductor is fixed at an equal distance D from the two single-phase conductors. The three-phase line is fully transposed. The positive sequence inductance per phase of the three-phase system is to be 5% more than that of the inductance per conductor of the single-phase system. The distance D, in meters, is _____.

Q.52 In the circuit shown below, the supply voltage is $10\sin(1000t)$ volts. The peak value of the steady state current through the 1 Ω resistor, in amperes, is _____.

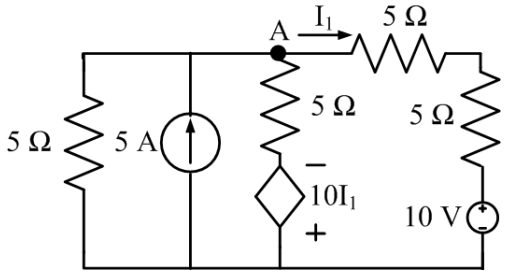


Q.53 A dc voltage with ripple is given by $v(t) = [100 + 10\sin(\omega t) - 5\sin(3\omega t)]$ volts. Measurements of this voltage $v(t)$, made by moving-coil and moving-iron voltmeters, show readings of V_1 and V_2 respectively. The value of $V_2 - V_1$, in volts, is _____.

Q.54 The circuit below is excited by a sinusoidal source. The value of R, in Ω, for which the admittance of the circuit becomes a pure conductance at all frequencies is _____.



Q.55 In the circuit shown below, the node voltage V_A is _____ V.



END OF THE QUESTION PAPER

Q. No	Type	Section	Key	Marks
1	MCQ	GA	B	1
2	MCQ	GA	A	1
3	MCQ	GA	C	1
4	MCQ	GA	D	1
5	MCQ	GA	B	1
6	MCQ	GA	A	2
7	MCQ	GA	D	2
8	MCQ	GA	D	2
9	MCQ	GA	C	2
10	MCQ	GA	C	2
1	NAT	EE-1	0.0 : 0.0	1
2	NAT	EE-1	3.0 : 3.0	1
3	MCQ	EE-1	A	1
4	MCQ	EE-1	B	1
5	MCQ	EE-1	B	1
6	MCQ	EE-1	B	1
7	MCQ	EE-1	A	1
8	MCQ	EE-1	C	1
9	MCQ	EE-1	A	1
10	MCQ	EE-1	B	1
11	MCQ	EE-1	D	1
12	NAT	EE-1	18.0 : 20.0	1
13	MCQ	EE-1	B	1
14	NAT	EE-1	99.0 : 101.0	1
15	MCQ	EE-1	D	1
16	MCQ	EE-1	C	1
17	NAT	EE-1	1.9 : 2.1	1
18	NAT	EE-1	0.5 : 0.5	1
19	MCQ	EE-1	B	1
20	NAT	EE-1	0.83 : 0.85	1
21	MCQ	EE-1	A	1
22	NAT	EE-1	0.39 : 0.41	1
23	NAT	EE-1	169.0 : 171.0	1
24	MCQ	EE-1	C	1
25	MCQ	EE-1	B	1
26	NAT	EE-1	0.2 : 0.2	2
27	NAT	EE-1	0.28 : 0.31	2
28	MCQ	EE-1	A	2
29	MCQ	EE-1	B	2
30	MCQ	EE-1	A	2
31	NAT	EE-1	5.9 : 6.1	2
32	MCQ	EE-1	A	2
33	NAT	EE-1	2.0 : 2.0	2
34	MCQ	EE-1	C	2
35	MCQ	EE-1	D	2
36	MCQ	EE-1	C	2
37	MCQ	EE-1	A	2
38	MCQ	EE-1	D	2
39	NAT	EE-1	1.9 : 2.1	2

40	NAT	EE-1	47.0 : 49.0	2
41	NAT	EE-1	1.05 : 1.15	2
42	MCQ	EE-1	D	2
43	MCQ	EE-1	C	2
44	NAT	EE-1	9.9 : 10.1	2
45	NAT	EE-1	74.0 : 76.0	2
46	NAT	EE-1	1.4 : 1.5	2
47	NAT	EE-1	86.0 : 88.0	2
48	NAT	EE-1	1.58 : 1.62	2
49	MCQ	EE-1	C	2
50	MCQ	EE-1	A	2
51	NAT	EE-1	1.41 : 1.47	2
52	NAT	EE-1	1.0 : 1.0	2
53	NAT	EE-1	0.30 : 0.33	2
54	NAT	EE-1	14.0 : 14.2	2
55	NAT	EE-1	11.25 : 11.50	2

Q. 1 – Q. 5 carry one mark each.

Q.1 The chairman requested the aggrieved shareholders to _____ him.

(A) bare with (B) bore with (C) bear with (D) bare

Q.2 Identify the correct spelling out of the given options:

(A) Managable (B) Manageable (C) Mangaeble (D) Managible

Q.3 Pick the odd one out in the following:

13, 23, 33, 43, 53

(A) 23 (B) 33 (C) 43 (D) 53

Q.4 R2D2 is a robot. R2D2 can repair aeroplanes. No other robot can repair aeroplanes.

Which of the following can be logically inferred from the above statements?

(A) R2D2 is a robot which can only repair aeroplanes.

(B) R2D2 is the only robot which can repair aeroplanes.

(C) R2D2 is a robot which can repair only aeroplanes.

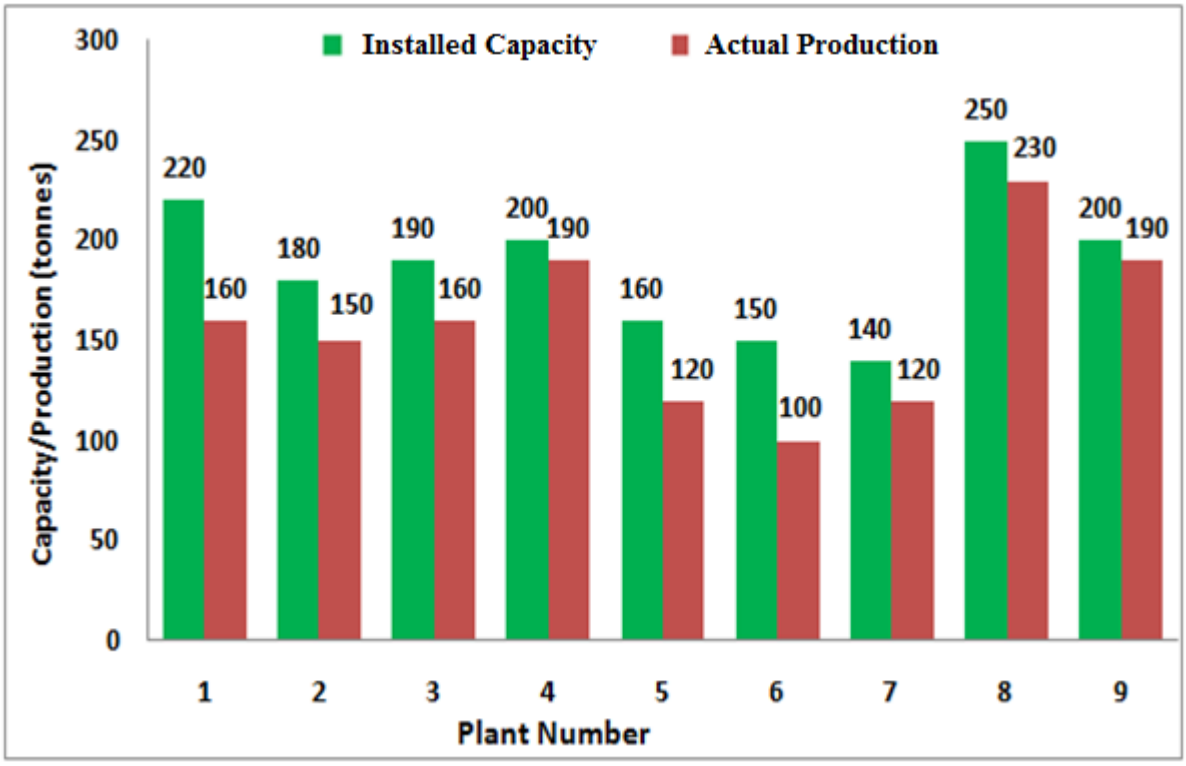
(D) Only R2D2 is a robot.

Q.5 If $|9y-6| = 3$, then $y^2 - 4y/3$ is _____.

(A) 0 (B) +1/3 (C) −1/3 (D) undefined

Q. 6 – Q. 10 carry two marks each.

Q.6 The following graph represents the installed capacity for cement production (in tonnes) and the actual production (in tonnes) of nine cement plants of a cement company. Capacity utilization of a plant is defined as ratio of actual production of cement to installed capacity. A plant with installed capacity of at least 200 tonnes is called a large plant and a plant with lesser capacity is called a small plant. The difference between total production of large plants and small plants, in tonnes is ____.



Q.7 A poll of students appearing for masters in engineering indicated that 60 % of the students believed that mechanical engineering is a profession unsuitable for women. A research study on women with masters or higher degrees in mechanical engineering found that 99 % of such women were successful in their professions.

Which of the following can be logically inferred from the above paragraph?

(A) Many students have misconceptions regarding various engineering disciplines.

(B) Men with advanced degrees in mechanical engineering believe women are well suited to be mechanical engineers.

(C) Mechanical engineering is a profession well suited for women with masters or higher degrees in mechanical engineering.

(D) The number of women pursuing higher degrees in mechanical engineering is small.

Q.8 Sourya committee had proposed the establishment of Sourya Institutes of Technology (SITs) in line with Indian Institutes of Technology (IITs) to cater to the technological and industrial needs of a developing country.

Which of the following can be logically inferred from the above sentence?

Based on the proposal,

(i) In the initial years, SIT students will get degrees from IIT.
(ii) SITs will have a distinct national objective.
(iii) SIT like institutions can only be established in consultation with IIT.
(iv) SITs will serve technological needs of a developing country.

(A) (iii) and (iv) only.
(B) (i) and (iv) only.
(C) (ii) and (iv) only.
(D) (ii) and (iii) only.

Q.9 Shaquille O' Neal is a 60% career free throw shooter, meaning that he successfully makes 60 free throws out of 100 attempts on average. What is the probability that he will successfully make exactly 6 free throws in 10 attempts?

(A) 0.2508 (B) 0.2816 (C) 0.2934 (D) 0.6000

Q.10 The numeral in the units position of $211^{870} + 146^{127} \times 3^{424}$ is _____.

END OF THE QUESTION PAPER

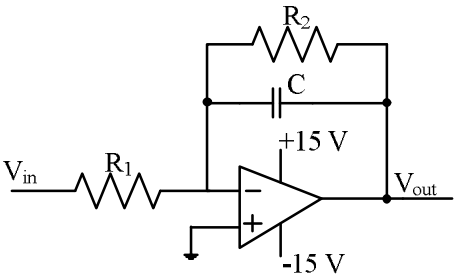
Q. 1 – Q. 25 carry one mark each.

Q.1 The output expression for the Karnaugh map shown below is

A \ BC	00	01	11	10
0	1	0	0	1
1	1	1	1	1

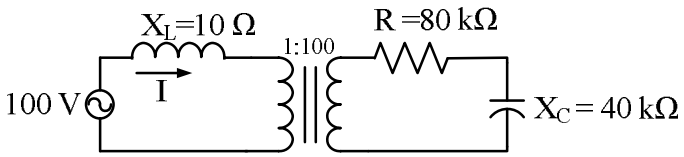
(A) $A + \bar{B}$ (B) $A + \bar{C}$ (C) $\bar{A} + \bar{C}$ (D) $\bar{A} + C$

Q.2 The circuit shown below is an example of a



(A) low pass filter.
(B) band pass filter.
(C) high pass filter.
(D) notch filter.

Q.3 The following figure shows the connection of an ideal transformer with primary to secondary turns ratio of 1:100. The applied primary voltage is 100 V (rms), 50 Hz, AC. The rms value of the current *I*, in ampere, is _____.



Q.4 Consider a causal LTI system characterized by differential equation $\frac{dy(t)}{dt} + \frac{1}{6}y(t) = 3x(t)$. The response of the system to the input $x(t) = 3e^{-\frac{t}{3}}u(t)$, where $u(t)$ denotes the unit step function, is

(A) $9e^{-\frac{t}{3}}u(t)$.
(B) $9e^{-\frac{t}{6}}u(t)$.
(C) $9e^{-\frac{t}{3}}u(t) - 6e^{-\frac{t}{6}}u(t)$.
(D) $54e^{-\frac{t}{6}}u(t) - 54e^{-\frac{t}{3}}u(t)$.

Q.5 Suppose the maximum frequency in a band-limited signal $x(t)$ is 5 kHz. Then, the maximum frequency in $x(t)\cos(2000\pi t)$, in kHz, is _____.

Q.6 Consider the function $f(z) = z + z^*$ where z is a complex variable and z^* denotes its complex conjugate. Which one of the following is TRUE?

(A) $f(z)$ is both continuous and analytic
(B) $f(z)$ is continuous but not analytic
(C) $f(z)$ is not continuous but is analytic
(D) $f(z)$ is neither continuous nor analytic

Q.7 A 3×3 matrix P is such that, $P^3 = P$. Then the eigenvalues of P are

(A) $1, 1, -1$
(B) $1, 0.5 + j0.866, 0.5 - j0.866$
(C) $1, -0.5 + j0.866, -0.5 - j0.866$
(D) $0, 1, -1$

Q.8 The solution of the differential equation, for $t > 0$, $y''(t) + 2y'(t) + y(t) = 0$ with initial conditions $y(0) = 0$ and $y'(0) = 1$, is ($u(t)$ denotes the unit step function),

(A) $te^{-t}u(t)$ (B) $(e^{-t} - te^{-t})u(t)$
(C) $(-e^{-t} + te^{-t})u(t)$ (D) $e^{-t}\,u(t)$

Q.9 The value of the line integral

$$\int_C (2xy^2dx + 2x^2y\,dy + dz)$$

along a path joining the origin (0, 0, 0) and the point (1, 1, 1) is

(A) 0 (B) 2 (C) 4 (D) 6

Q.10 Let *f(x)* be a real, periodic function satisfying $f(-x) = -f(x)$. The general form of its Fourier series representation would be

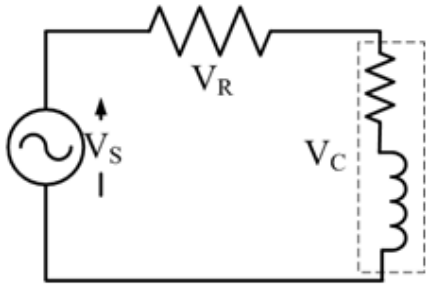
(A) $f(x) = a_0 + \sum_{k=1}^{\infty} a_k \cos(kx)$

(B) $f(x) = \sum_{k=1}^{\infty} b_k \sin(kx)$

(C) $f(x) = a_0 + \sum_{k=1}^{\infty} a_{2k} \cos(kx)$

(D) $f(x) = \sum_{k=0}^{\infty} a_{2k+1} \sin(2k+1)x$

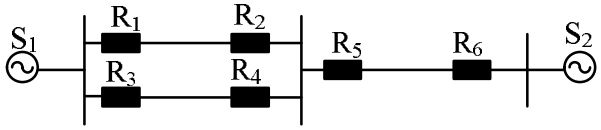
Q.11 A resistance and a coil are connected in series and supplied from a single phase, 100 V, 50 Hz ac source as shown in the figure below. The rms values of plausible voltages across the resistance (V_R) and coil (V_C) respectively, in volts, are



(A) 65, 35
(B) 50, 50
(C) 60, 90
(D) 60, 80

Q.12 The voltage (V) and current (A) across a load are as follows.
$v(t) = 100\sin(\omega t)$,
$i(t) = 10\sin(\omega t - 60°) + 2\sin(3\omega t) + 5\sin(5\omega t)$.
The average power consumed by the load, in W, is_____.

Q.13 A power system with two generators is shown in the figure below. The system (generators, buses and transmission lines) is protected by six overcurrent relays R_1 to R_6. Assuming a mix of directional and nondirectional relays at appropriate locations, the remote backup relays for R_4 are



(A) R_1, R_2
(B) R_2, R_6
(C) R_2, R_5
(D) R_1, R_6

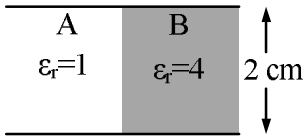
Q.14 A power system has 100 buses including 10 generator buses. For the load flow analysis using Newton-Raphson method in polar coordinates, the size of the Jacobian is

(A) 189 x 189
(B) 100 x 100
(C) 90 x 90
(D) 180 x 180

Q.15 The inductance and capacitance of a 400 kV, three-phase, 50 Hz lossless transmission line are 1.6 mH/km/phase and 10 nF/km/phase respectively. The sending end voltage is maintained at 400 kV. To maintain a voltage of 400 kV at the receiving end, when the line is delivering 300 MW load, the shunt compensation required is

(A) capacitive
(B) inductive
(C) resistive
(D) zero

Q.16 A parallel plate capacitor filled with two dielectrics is shown in the figure below. If the electric field in the region A is 4 kV/cm, the electric field in the region B, in kV/cm, is



(A) 1 (B) 2 (C) 4 (D) 16

Q.17 A 50 MVA, 10 kV, 50 Hz, star-connected, unloaded three-phase alternator has a synchronous reactance of 1 p.u. and a sub-transient reactance of 0.2 p.u. If a 3-phase short circuit occurs close to the generator terminals, the ratio of initial and final values of the sinusoidal component of the short circuit current is _____.

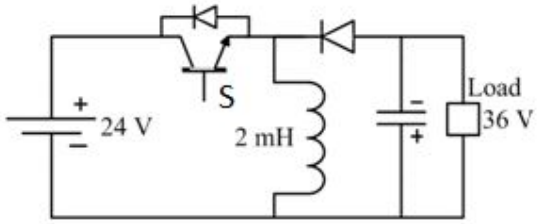
Q.18 Consider a linear time-invariant system with transfer function

$$H(s) = \frac{1}{(s+1)}$$

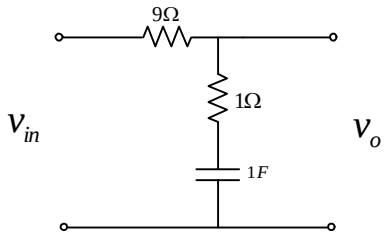
If the input is $\cos(t)$ and the steady state output is $A\cos(t+\alpha)$, then the value of A is _____.

Q.19 A three-phase diode bridge rectifier is feeding a constant DC current of 100 A to a highly inductive load. If three-phase, 415 V, 50 Hz AC source is supplying to this bridge rectifier then the rms value of the current in each diode, in ampere, is _____.

Q.20 A buck-boost DC-DC converter, shown in the figure below, is used to convert 24 V battery voltage to 36 V DC voltage to feed a load of 72 W. It is operated at 20 kHz with an inductor of 2 mH and output capacitor of 1000 μF. All devices are considered to be ideal. The peak voltage across the solid-state switch (S), in volt, is _____.



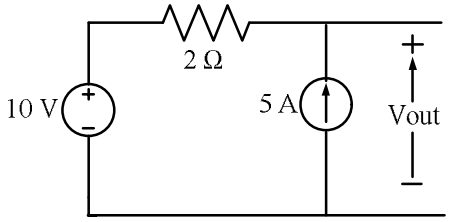
Q.21 For the network shown in the figure below, the frequency (in rad/s) at which the maximum phase lag occurs is, _____.



Q.22 The direction of rotation of a single-phase capacitor run induction motor is reversed by

(A) interchanging the terminals of the AC supply.
(B) interchanging the terminals of the capacitor.
(C) interchanging the terminals of the auxiliary winding.
(D) interchanging the terminals of both the windings.

Q.23 In the circuit shown below, the voltage and current sources are ideal. The voltage (V_{out}) across the current source, in volts, is

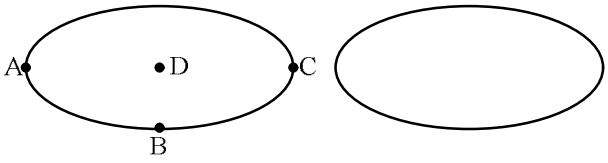


(A) 0 (B) 5 (C) 10 (D) 20

Q.24 The graph associated with an electrical network has 7 branches and 5 nodes. The number of independent KCL equations and the number of independent KVL equations, respectively, are

(A) 2 and 5 (B) 5 and 2 (C) 3 and 4 (D) 4 and 3

Q.25 Two electrodes, whose cross-sectional view is shown in the figure below, are at the same potential. The maximum electric field will be at the point



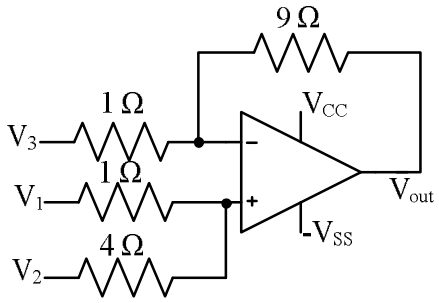
(A) A (B) B (C) C (D) D

Q. 26 – Q. 55 carry two marks each.

Q.26 The Boolean expression $\overline{(a + \bar{b} + c + \bar{d}) + (b + \bar{c})}$ simplifies to

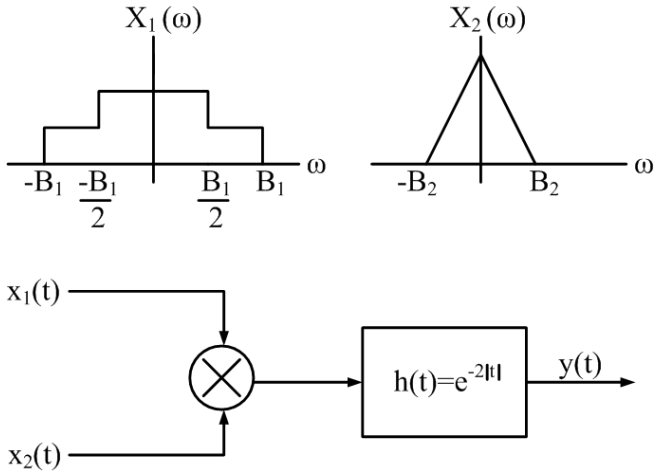
(A) 1 (B) $\overline{a.b}$ (C) $a.b$ (D) 0

Q.27 For the circuit shown below, taking the opamp as ideal, the output voltage V_{out} in terms of the input voltages V_1 , V_2 and V_3 is



(A)$1.8V_1 + 7.2V_2 - V_3$ (B) $2V_1 + 8V_2 - 9V_3$ (C) $7.2V_1 + 1.8V_2 - V_3$ (D) $8V_1 + 2V_2 - 9V_3$

Q.28 Let $x_1(t) \leftrightarrow X_1(\omega)$ and $x_2(t) \leftrightarrow X_2(\omega)$ be two signals whose Fourier Transforms are as shown in the figure below. In the figure, $h(t) = e^{-2|t|}$ denotes the impulse response.



For the system shown above, the minimum sampling rate required to sample y(t), so that y(t) can be uniquely reconstructed from its samples, is

(A) $2B_1$ (B) $2(B_1+B_2)$ (C) $4(B_1+B_2)$ (D) ∞

Q.29 The value of the integral $2\int_{-\infty}^{\infty}\left(\frac{sin2\pi t}{\pi t}\right)dt$ is equal to

(A) 0 (B) 0.5 (C) 1 (D) 2

Q.30 Let $y(x)$ be the solution of the differential equation $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 0$ with initial conditions $y(0) = 0$ and $\left.\frac{dy}{dx}\right|_{x=0} = 1$. Then the value of $y(1)$ is _____.

Q.31 The line integral of the vector field $F = 5xz\,\hat{\imath} + (3x^2 + 2y)\,\hat{\jmath} + x^2z\,\hat{k}$ along a path from (0,0,0) to (1,1,1) parametrized by (t, t^2, t) is _____.

Q.32 Let $P = \begin{bmatrix} 3 & 1 \\ 1 & 3 \end{bmatrix}$. Consider the set S of all vectors $\begin{pmatrix} x \\ y \end{pmatrix}$ such that $a^2 + b^2 = 1$ where $\begin{pmatrix} a \\ b \end{pmatrix} = P\begin{pmatrix} x \\ y \end{pmatrix}$. Then S is

(A) a circle of radius $\sqrt{10}$
(B) a circle of radius $\frac{1}{\sqrt{10}}$
(C) an ellipse with major axis along $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$
(D) an ellipse with minor axis along $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$

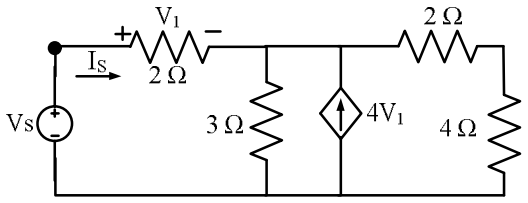
Q.33 Let the probability density function of a random variable, X, be given as:

$$f_X(x) = \frac{3}{2}e^{-3x}u(x) + ae^{4x}u(-x)$$

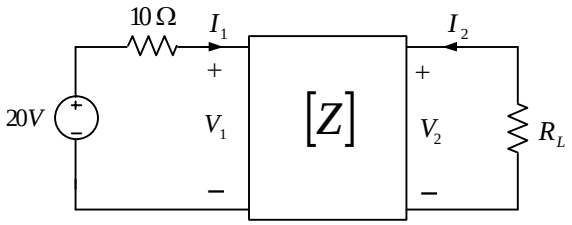
where $u(x)$ is the unit step function.
Then the value of 'a' and $Prob\{X \leq 0\}$, respectively, are

(A) $2, \frac{1}{2}$ (B) $4, \frac{1}{2}$ (C) $2, \frac{1}{4}$ (D) $4, \frac{1}{4}$

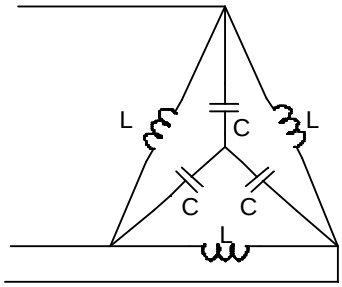
Q.34 The driving point input impedance seen from the source V_S of the circuit shown below, in Ω, is _____.



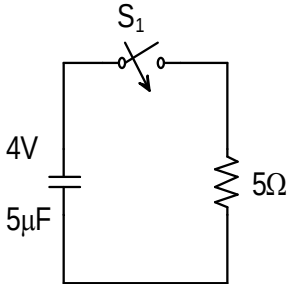
Q.35 The *z*-parameters of the two port network shown in the figure are $z_{11} = 40\ \Omega$, $z_{12} = 60\ \Omega$, $z_{21} = 80\ \Omega$ and $z_{22} = 100\ \Omega$.. The average power delivered to $R_L = 20\ \Omega$, in watts, is _____.



Q.36 In the balanced 3-phase, 50 Hz, circuit shown below, the value of inductance (L) is 10 mH. The value of the capacitance (C) for which all the line currents are zero, in millifarads, is _____.

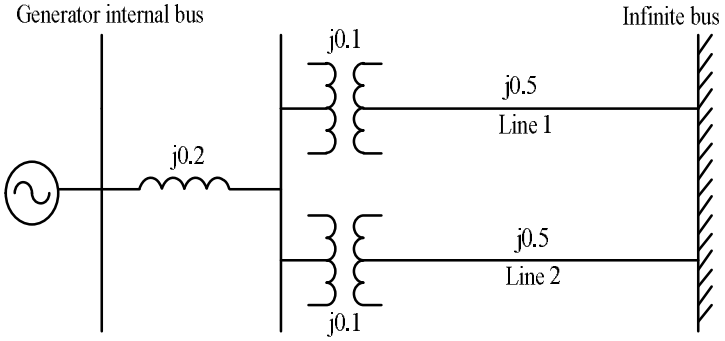


Q.37 In the circuit shown below, the initial capacitor voltage is 4 V. Switch S_1 is closed at $t = 0$. The charge (in μC) lost by the capacitor from $t = 25\ \mu s$ to $t = 100\ \mu s$ is _____.



Q.38 The single line diagram of a balanced power system is shown in the figure. The voltage magnitude at the generator internal bus is constant and 1.0 p.u. The p.u. reactances of different components in the system are also shown in the figure. The infinite bus voltage magnitude is 1.0 p.u. A three phase fault occurs at the middle of line 2.

The ratio of the maximum real power that can be transferred during the pre-fault condition to the maximum real power that can be transferred under the faulted condition is _____.



Q.39 The open loop transfer function of a unity feedback control system is given by

$$G(s) = \frac{K(s+1)}{s(1+Ts)(1+2s)}, \qquad K > 0, T > 0.$$

The closed loop system will be stable if,

(A) $0 < T < \frac{4(K+1)}{K-1}$ (B) $0 < K < \frac{4(T+2)}{T-2}$

(C) $0 < K < \frac{T+2}{T-2}$ (D) $0 < T < \frac{8(K+1)}{K-1}$

Q.40 At no load condition, a 3-phase, 50 Hz, lossless power transmission line has sending-end and receiving-end voltages of 400 kV and 420 kV respectively. Assuming the velocity of traveling wave to be the velocity of light, the length of the line, in km, is _____.

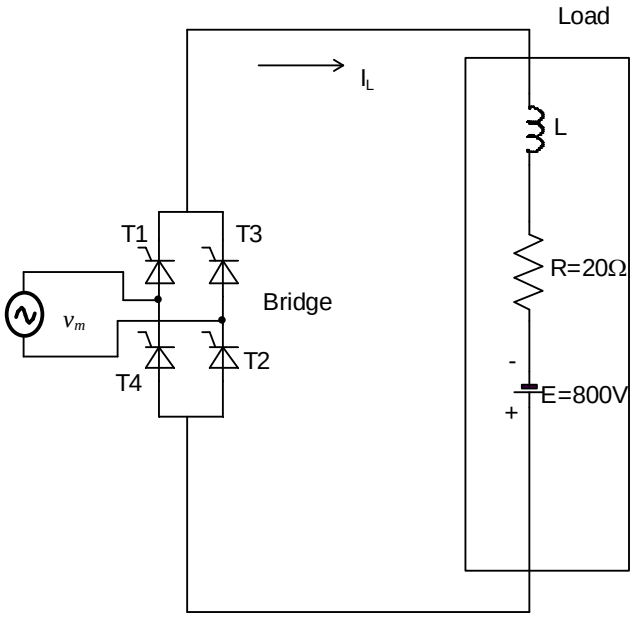
Q.41 The power consumption of an industry is 500 kVA, at 0.8 p.f. lagging. A synchronous motor is added to raise the power factor of the industry to unity. If the power intake of the motor is 100 kW, the p.f. of the motor is _____

Q.42 The flux linkage (λ) and current (i) relation for an electromagnetic system is $\lambda = (\sqrt{i})/g$. When i = 2A and g (air-gap length) = 10 cm, the magnitude of mechanical force on the moving part, in N, is _____.

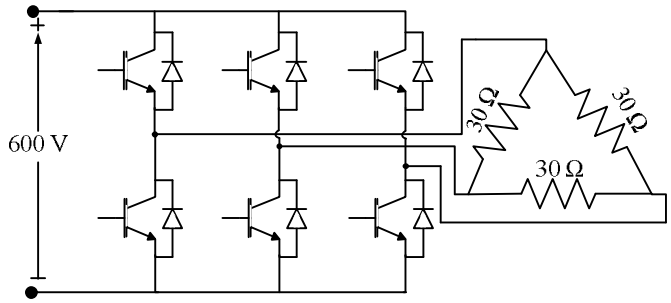
Q.43 The starting line current of a 415 V, 3-phase, delta connected induction motor is 120 A, when the rated voltage is applied to its stator winding. The starting line current at a reduced voltage of 110 V, in ampere, is _____.

Q.44 A single-phase, 2 kVA, 100/200 V transformer is reconnected as an auto-transformer such that its kVA rating is maximum. The new rating, in kVA, is _____.

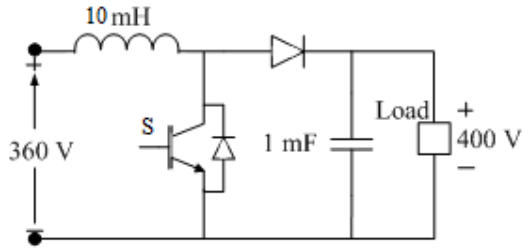
Q.45 A full-bridge converter supplying an RLE load is shown in figure. The firing angle of the bridge converter is 120°. The supply voltage $v_m(t) = 200\pi \sin(100\pi t)$ V, R=20 Ω, E=800 V. The inductor L is large enough to make the output current I_L a smooth dc current. Switches are lossless. The real power fed back to the source, in kW, is _____.



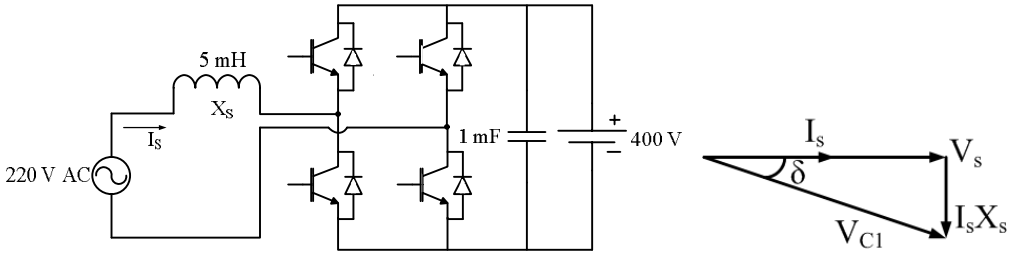
Q.46 A three-phase Voltage Source Inverter (VSI) as shown in the figure is feeding a delta connected resistive load of 30 Ω/phase. If it is fed from a 600 V battery, with 180° conduction of solid-state devices, the power consumed by the load, in kW, is _____.



Q.47 A DC-DC boost converter, as shown in the figure below, is used to boost 360V to 400 V, at a power of 4 kW. All devices are ideal. Considering continuous inductor current, the rms current in the solid state switch (S), in ampere, is _____.



Q.48 A single-phase bi-directional voltage source converter (VSC) is shown in the figure below. All devices are ideal. It is used to charge a battery at 400 V with power of 5 kW from a source V_s = 220 V (rms), 50 Hz sinusoidal AC mains at unity p.f. If its AC side interfacing inductor is 5 mH and the switches are operated at 20 kHz, then the phase shift (δ) between AC mains voltage (V_s) and fundamental AC rms VSC voltage (V_{C1}), in degree, is _____.



Q.49 Consider a linear time invariant system $\dot{x} = Ax$, with initial condition $x(0)$ at $t = 0$. Suppose α and β are eigenvectors of (2 x 2) matrix A corresponding to distinct eigenvalues λ_1 and λ_2 respectively. Then the response $x(t)$ of the system due to initial condition $x(0) = \alpha$ is

(A) $e^{\lambda_1 t}\alpha$ (B) $e^{\lambda_2 t}\beta$ (C) $e^{\lambda_2 t}\alpha$ (D) $e^{\lambda_1 t}\alpha + e^{\lambda_2 t}\beta$

Q.50 A second-order real system has the following properties:
a) the damping ratio $\zeta = 0.5$ and undamped natural frequency ω_n=10 rad/s,
b) the steady state value of the output, to a unit step input, is 1.02.
The transfer function of the system is

(A) $\frac{1.02}{s^2+5s+100}$ (B) $\frac{102}{s^2+10s+100}$

(C) $\frac{100}{s^2+10s+100}$ (D) $\frac{102}{s^2+5s+100}$

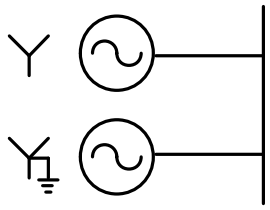
Q.51 Three single-phase transformers are connected to form a delta-star three-phase transformer of 110 kV/ 11 kV. The transformer supplies at 11 kV a load of 8 MW at 0.8 p.f. lagging to a nearby plant. Neglect the transformer losses. The ratio of phase currents in delta side to star side is

(A) $1 : 10\sqrt{3}$ (B) $10\sqrt{3} : 1$ (C) $1 : 10$ (D) $\sqrt{3} : 10$

Q.52 The gain at the breakaway point of the root locus of a unity feedback system with open loop transfer function $G(s) = \dfrac{Ks}{(s-1)(s-4)}$ is

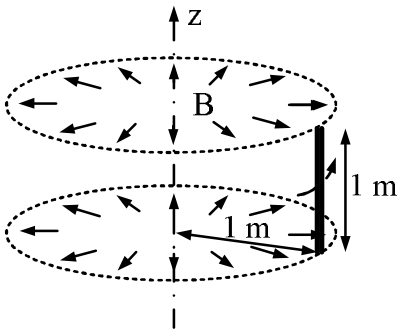
(A) 1 (B) 2 (C) 5 (D) 9

Q.53 Two identical unloaded generators are connected in parallel as shown in the figure. Both the generators are having positive, negative and zero sequence impedances of j0.4 p.u., j0.3 p.u. and j0.15 p.u., respectively. If the pre-fault voltage is 1 p.u., for a line-to-ground (L-G) fault at the terminals of the generators, the fault current, in p.u., is _____.



Q.54 An energy meter, having meter constant of 1200 revolutions/kWh, makes 20 revolutions in 30 seconds for a constant load. The load, in kW, is _____.

Q.55 A rotating conductor of 1 m length is placed in a radially outward (about the z-axis) magnetic flux density (B) of 1 Tesla as shown in figure below. Conductor is parallel to and at 1 m distance from the z-axis. The speed of the conductor in r.p.m. required to induce a voltage of 1 V across it, should be _____.



END OF THE QUESTION PAPER

Q. No	Type	Section	Key	Marks
1	MCQ	GA	C	1
2	MCQ	GA	B	1
3	MCQ	GA	B	1
4	MCQ	GA	B	1
5	MCQ	GA	C	1
6	NAT	GA	120.0 : 120.0	2
7	MCQ	GA	C	2
8	MCQ	GA	C	2
9	MCQ	GA	A	2
10	NAT	GA	7.0 : 7.0	2
1	MCQ	EE-2	B	1
2	MCQ	EE-2	A	1
3	NAT	EE-2	9.5 : 10.5	1
4	MCQ	EE-2	D	1
5	NAT	EE-2	6.0 : 6.0	1
6	MCQ	EE-2	B	1
7	MCQ	EE-2	A ; D	1
8	MCQ	EE-2	A	1
9	MCQ	EE-2	B	1
10	MCQ	EE-2	B	1
11	MCQ	EE-2	MTA	1
12	NAT	EE-2	249.0 : 251.0	1
13	MCQ	EE-2	D	1
14	MCQ	EE-2	A	1
15	MCQ	EE-2	B	1
16	MCQ	EE-2	C	1
17	NAT	EE-2	4.9 : 5.1	1
18	NAT	EE-2	0.69 : 0.72	1
19	NAT	EE-2	57.0 : 58.0	1
20	NAT	EE-2	59.5 : 60.5	1
21	NAT	EE-2	0.30 : 0.33	1
22	MCQ	EE-2	C	1
23	MCQ	EE-2	D	1
24	MCQ	EE-2	D	1
25	MCQ	EE-2	A	1
26	MCQ	EE-2	D	2
27	MCQ	EE-2	D	2
28	MCQ	EE-2	B	2
29	MCQ	EE-2	D	2
30	NAT	EE-2	7.0 : 7.5	2
31	NAT	EE-2	4.40 : 4.45	2
32	MCQ	EE-2	D	2
33	MCQ	EE-2	A	2
34	NAT	EE-2	19.5 : 20.5	2
35	NAT	EE-2	34.0 : 36.0	2
36	NAT	EE-2	2.9 : 3.1	2
37	NAT	EE-2	6.8 : 7.2	2
38	NAT	EE-2	2.20 : 2.35	2
39	MCQ	EE-2	C	2

40	NAT	EE-2	294.0 : 298.0	2
41	NAT	EE-2	0.31 : 0.33	2
42	NAT	EE-2	186.0 : 190.0	2
43	NAT	EE-2	31.0 : 33.0	2
44	NAT	EE-2	5.9 : 6.1	2
45	NAT	EE-2	5.9 : 6.1	2
46	NAT	EE-2	23.0 : 25.0	2
47	NAT	EE-2	3.0 : 4.0	2
48	NAT	EE-2	9.1 : 9.3	2
49	MCQ	EE-2	A	2
50	MCQ	EE-2	B	2
51	MCQ	EE-2	A	2
52	MCQ	EE-2	A	2
53	NAT	EE-2	5.5 : 6.5	2
54	NAT	EE-2	1.9 : 2.1	2
55	NAT	EE-2	9.4 : 9.7	2

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