MANIPAL UNIVERSITY
JAIPUR

List of Course Hand-outs
(Odd and Even Semester)

Department of Electrical Engineering
SEEC
Manipal University Jaipur (RJ)

MANIPAL UNIVERSITY
JAIPUR

School of Electrical, Electronics, and Communication Engineering Department of Electrical Engineering

Vision, Mission and PEOs of the Department

Vision

- Create globally competent automotive engineers having research aptitude with human values for societal development.

Mission

- Impart quality education with state-of-art academic environment to meet global industrial challenges.
- Provide conducive environment for interdisciplinary research through collaborations with industry and research organizations.
- Develop technical and managerial skills with ethical values contributing to societal development.

Program Educational Objectives

- Enable graduates to exhibit professional skills on global platform in Electrical Engineering and allied domains.
- Prepare graduates to pursue higher education and research in interdisciplinary area.
- Graduates shall exhibit teamwork and leadership quality with ethical behaviour.

PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Program Outcomes

[PO.1]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4]. Conduct investigations of complex problems: Use research- based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the

information to provide valid conclusions

[PO.5]. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Program Specific Outcomes

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics, and Communication Engineering

Department of Electrical Engineering

MANIPAL UNIVERSITY JAIPUR

Course Handout-(2020-21)

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1	BB0025	Value, Ethics & Governance	7
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4	EE2102	ELECTROMAGNETIC FIELD THEORY	27
5	EE2103	ELECTRICAL CIRCUIT ANALYSIS	34
6	EE2104	Electrical Machines-I	41
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8	MA2206	Engineering Mathematics-IV	56
9	EE2201	Electrical Machines-II	65
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11	EE2203	Microcontrollers	81
12	EE2080	SOLAR PHOTOVOLTAICS	89
13	EE2082	Fundamentals of Renewable Energy Sources (FRES)	93
14	EE2230	Electrical Machinery Lab – II	98
15	EE2231	Microcontroller Laboratory	107
16	EE2232	MATLAB & SYSTEM SIMULATION LAB	115
17	EE2233	PROJECT BASED LEARNING LAB	119
18	EE1501(N)	Control Theory	122
19	EE1502	Generation, Transmission & Distribution	128
20	EE1503(N)	Signals and Systems	137
21	EE1504(N)	Power Electronics	142
23	BB1540	Organization and Management	151
24	EE1601(N)	Microprocessor &	160

		Microcontroller	
25	EE1602(N)	Power System Analysis	170
26	EE1603(N)	COMMUNICATION SYSTEMS	180
27	EE1653	Renewable Energy Resources	186
28	EE1654(N)	DATA STRUCTURES AND ALGORITHMS	193
29	EE1663	Distributed Energy Resources	198
30	EE1661	Utilization of Electric Power	203
31	EE1691	Electrical Energy Systems	210
32	EE1632(N)	Power Electronics & Drives Lab	216
33	EE1701(N)	Power System Protection & Switchgear	230
34	EE1703(N)	Power System Operation & Control	238
35	EE1752	EHV AC/DC TRANSMISSION	248
36	EE1753	POWER QUALITY ISSUES	254
37	EE1763	Smart Grid Systems	260
38	EE1764	Object Oriented Programming	265
39	EE1792	Solar Photovoltaics Energy Conversion	271

HOD
Department of Electrical Engineering
School of Electrical,
Electronics & Communication (SEEC)
Manipal University Jaipur

Director, SEEC

PROGRAM ARTICULATION MATRIX

SEMESTER	COURSE CODE	PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
III	BB0025	2	0	0	1	2	1	3	0	0	0	1	1	2	2	1	0
	MA2103	3	3	2	3	3	0	0	0	3	0	3	1	0	0	0	0
	EE2101	3	0	0	2	0	0	0	0	0	0	0	0	0	3	3	0
	EE2102	3	3	2	3	3	0	1	1	1	0	2	2	3	3	3	0
	EE2103	3	3	2	2	2	1	0	0	0	0	0	0	3	2	3	0
	EE2104	2	3	3	3	3	2	2	1	2	1	1	0	2	3	2	0
IV	EO2001	0	2	2	3	2	1	2	0	2	0	2	3	0	0	0	0
	MA2206	3	3	3	3	3	0	0	0	3	0	3	1	0	0	0	0
	EE2201	2	3	3	3	3	2	2	1	2	1	1	0	2	3	2	0
	EE2202	3	3	3	3	1	2	3	0	0	0	0	1	3	2	3	0
	EE2203	2	3	3	3	2	2	1	0	0	0	0	2	2	3	3	0
	EE2080	3	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0
	EE2082	3	2	3	2	2	1	2	1	1	1	1	2	2	2	2	0
	EE2230	3	3	3	3	3	0	0	0	2	0	0	2	3	3	3	0
	EE2231	2	2	2	3	1	0	0	0	0	0	0	2	3	3	2	0
	EE2232	3	3	3	3	3	0	0	0	0	0	0	3	3	3	3	0
	EE2233	3	2	2	2	3	1	2	2	3	3	3	2	3	3	3	0
V	EE1501(N)	2	1	1	3	1	1	0	0	1	0	2	2	3	2	3	0
	EE1502	3	3	3	3	1	2	3	0	0	0	0	1	3	2	3	0
	EE1503(N)	3	3	2	3	3	0	1	1	1	0	2	2	3	3	3	0
	EE1504(N)	3	3	3	2	1	2	3	3	1	1	1	3	3	3	3	0
	EE1592	2	2	2	1	0	0	0	0	0	0	0	3	0	0	2	0
	BB1540	2	2	2	1	2	1	1	2	0	0	0	3	2	1	2	0
VI	EE1601(N)	2	3	3	3	2	2	1	0	0	0	0	2	3	3	3	0
	EE1602(N)	3	2	0	2	0	0	0	0	0	0	0	1	2	2	1	0
	EE1603(N)	3	1	1	2	2	1	1	1	1	1	1	1	1	1	1	0
	EE1653	3	2	0	2	0	0	0	0	0	0	0	1	2	2	1	0
	EE1654(N)	3	3	3	2	2	0	0	0	0	0	0	0	3	3	3	0
	EE1663	3	3	3	3	3	2	0	0	0	0	0	3	3	3	3	0
	EE1661	3	3	3	2	2	2	0	0	0	2	0	2	3	2	2	0
	EE1691	3	3	3	1	1	2	2	1	1	1	1	2	2	2	2	0
	EE1632(N)	2	3	2	2	0	0	1	0	2	0	0	1	2	0	1	0
VII	EE1701(N)	3	3	3	2	3	0	0	0	0	0	0	3	3	3	3	0
	EE1703(N)	3	2	0	2	0	0	0	0	0	0	0	1	2	2	2	0
	EE1752	3	2	0	2	0	0	0	0	0	0	0	1	2	2	1	0
	EE1753	3	3	3	3	2	2	3	0	0	0	0	3	3	2	3	0
	EE1763	3	3	1	1	2	2	1	1	0	0	0	2	2	2	2	0
	EE1764	3	2	2	3	1	1	0	2	1	0	1	2	2	2	3	0
	EE1792	2	2	2	1	0	0	0	0	0	0	0	3	0	0	2	0

MANIPAL UNIVERSITY JAIPUR

School of Business & Commerce

Department of Business Administration

Course Hand-out

Value, Ethics & Governance BB0025 [2 Credits] [2 0 0 2]

Session: July-Nov, 2020 | Faculty: Dr. Sonal Sidana | Class: B.Tech III Semester

Introduction: The course is offered to understand Moral Values and Ethics in personal as well as professional life. It is basic requirement of every human to be a good human being and a good citizen. It further imparts him basics of corporate governance so as to empower him to work technically and professionally in any organization with confidence and conviction and at the same time with honesty & integrity.

A. **Course Objectives:** At the end of the course, students will be able to

BB1101.1	Define the meaning and relevance of Value and Ethics and apply in personal & professional life.
BB1101.2	Describe the importance of three Gunas for self-development, lifelong learning & growth.
BB1101.3	Find issues and identify solutions related to Public & Private Governance systems.
BB1101.4	Explain the relevance of Company's Act 2013 with reference to corporate world.
BB1101.5	Explain the role and key objectives of organizational governance in relation to ethics and law.
BB1101.6	Demonstrate the social & environmental responsibilities of corporate for sustainability, harmony and growth.

B. **Program Outcomes and Program Specific Outcomes**

PROGRAM OUTCOMES

[PO.1]. **Engineering knowledge**: Demonstrate and apply knowledge of Mathematics, Science and Engineering to classical and recent problems of electronic design & communication system.

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. **Design/development of solutions**: Design a component system, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9]. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environment.

[PO.12]. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. An ability to understand the concepts of basic Electronics & Communication Engineering and to apply them to various areas like signal processing, VLSI, Embedded systems, Communication Systems, Digital & Analog Devices, etc.

[PSO.2]. An ability to solve complex Electronics Communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.

[PSO.3]. Wisdom of social and environmental awareness along with ethical responsibility to have a successful career and to sustain passion and zeal for real applications using optimal resources as an Entrepreneur.

C. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Mid Sem Exam I (Close Book)	15
	Mid Sem Exam II (Close Book)	15
	In class Quizzes/ Assignments Students' Presentations	20(Min 5 each) 10
End Term Exam (Summative)	End Term Exam (Close Book)	40

	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

D: **Syllabus:**

Values: Relevance of Value Education in day-to-day life. Mantra for success - Value, Moral and Ethics. Determinants of human nature (Three Gunas) and its impact on human life.

Relevance of traits like Personality, Attitude, Behaviour, Ego, Character, introspection, Motivation, Leadership and 4 Qs with relevant Case Studies*.

Governance: Understanding of Public and Private sector Governance systems; Courts & CAG.

Public Sector Governance: Need, relevance, stakeholders.

Private Sector Governance: Proprietary, Partnership, Company (Pvt Ltd & Ltd), Company' Act 2013, Board of Directors; its Roles and Responsivities. Regulatory bodies; its role in ethical governance.

Projects on PPP mode-relevance & prospects.

CSR: Relationship with Society, Philanthropy and Business strategy, CSR Policy, Triple Bottom Line

Text / Reference Books:

1. Professional Module of ICSI.
2. Ghosh B.N., Business Ethics & Corporate Governance, McGraw Hill.
3. Mandal S.K., Ethics in Business & Corporate Governance, McGraw Hill .
4. Ray C.K., Corporate Governance, Value & Ethics, Vaya Education of India
5. Chatterjee Abha, Professional Ethics, Oxford Publications.

***Suggestive Case Studies:**

1) Uphar Theatre Tragedy- Engineering Ethics
2) Bhopal Gas Tragedy- Operational Engineering Ethics
3) Satyam Case- Financial Reporting Ethics
4) Enron Case- Business Ethics
5) Neerav Modi Case- Financial Fraudulence *cases*

D. **Lecture Plan:**

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	**Introduction: Values:** Meaning & Relevance of value education	To acquaint and clear teacher's expectations and understand student expectations. Basics of	Lecture	BB 1101.1	In class Quiz Mid Term I End Term Exam

		Value Education			
2	Success: Meaning in perspective of morals & ethics	To understand the concept of success achieved with or without morals / ethics/ values	Lecture, case study	BB 1101.1	In class Quiz Mid Term I End Term Exam
3,4	Professional Ethics & ethical dilemmas	To understand the role of professional ethics in the life & deal with dilemmas	Lecture	BB 1101.1	In class Quiz, assignment Mid Term I End Term Exam
5	Three Gunas and their relevance, Nature and kinds of value with examples	Understand basic traits in one's personality, its causes and relevance with value based living.	Lecture	BB 1101.2	In Class Quiz, Mid Term I End Term
6,7	Relevance of traits of individual like Personality, Attitude, Behaviour	To acquaint & develop positive traits of personality in oneself	Short stories, Lecture	BB 1101.2	Class Quiz assignment Mid Term I End Term
8.9	Ego, Character, introspection, Motivation	*To acquaint & develop positive traits of personality in oneself and understand negative traits*	Lecture Short stories	BB 1101.2	In Class Quiz Mid Term I End Term
10,11	Leadership traits & 4Qs (PQ, IQ, EQ, SQ)	To realize importance of leadership and to imbibe in life	Lecture Short stories	BB 1101.2	In Class Quiz assignment Mid Term I End Term
12,13	Governance & its relevance	To acquaint with the concept of Governance	Lecture	BB 1101.3	In Class Quiz Mid Term II End Term
14	Public Sector Governance: Need, relevance, stakeholders	Understand various aspects of public sector governance	Lecture	BB 1101.3	Class Quiz, Mid Term II End Term
15	Public Finance, Audit & Control	Understand basics of Public Finance, Check & balance	Lecture Case study	BB 1101.3	Class Quiz, assignment Mid Term II End Term
16,17	Private Sector Governance, proprietary & partnership firms and corporate, PPP mode projects	Understand meaning of proprietary & partnership in a firm / company and perspective in PPP mode	Lecture Short stories	BB 1101.3 & 1101.4	Class Quiz Mid Term II End term
18, 19	Company' Act 2013 : Roles & Responsibilities of Directors & regulatory authorities	Explain various Regulations and practices of Corporate Governance internationally & understand key role of directors	Lecture	BB 1101.4	Class Quiz Mid Term II End Term
20,21	Role of Ethics in Governance	Recognize the necessity of ethics & transparency in Governance	Movie : Gandhi	BB 1101.5	Class Quiz, assignment Mid Term II End Term
22,23	CSR: Relationship with Society, Philanthropy and Business strategy	To understand the relevance of giving back to society by a corporate & its importance in society	Lecture, case study	BB 1101.6	Class Quiz, End Term
24	CSR Policy, Triple Bottom Line	Understand the concept of TBL in organizational frameworks	Lecture case study	BB 1101.6	Class Quiz assignment End Term

25,26	Students' Presentation	Recall contents and their importance through case studies.	Flipped Class	ALL	Class Quiz End Term

Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BB1101.1	Define the meaning and relevance of Value and Ethics and apply in personal & professional life.						1		2							
BB1101.2	Describe the importance of three Gunas for self-development, lifelong learning & growth.						1		2	1	1		2			1
BB1101.3	Find issues and identify solutions related to Public & Private Governance systems.						1	1		1	2					
BB1101.4	Explain the relevance of Company's Act 2013 with reference to corporate world.						1		1	1						
BB1101.5	Explain the role and key objectives of organizational governance in relation to ethics and law.						1		2	1			1			1
BB1101.6	Demonstrate the social & environmental responsibilities of corporate for sustainability, harmony and growth.						1	3				1	1			3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Engineering

Department of Mathematics & Statistics
Course Hand-out

Engineering Mathematics-III | MA 2103 | 3 Credits | 2 1 0 3

Session: August 20 – Dec 20 | Faculty: Dr. Giriraj Methi | Class: II Year (III Sem. EE)

A. Introduction: An engineering student needs to have some mathematical tools and techniques which emphasize the development of rigorous logical thinking and analytical skills. Based on this, the course aims at giving adequate exposure to the theory and applications. The course is aimed at developing the basic Mathematical skills of engineering students that are imperative for effective understanding of engineering

B. Course Outcomes: At the end of the course, students will be able to

[MA2103.1] Student will apply concepts of analytic functions and residue in solving the circuit equations

[MA2103.2] Student will be able to understand the computation in circuit analysis which involves complex numbers.

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[MA2103.3] Students will be able to decompose any periodic signal wave into sinusoids with the help of Fourier series

[MA2103.4] Student will understand and use the vector calculus in engineering problems related to heat & flow.

[MA2103.5] Fourier transform will develop the proper understanding of signal processing in electrical engineering.

Program Outcomes and Program Specific Outcomes

[PO.1]. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences**.**

[PO.3]. **Design/ Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

[PO.4]. **Conduct investigations** of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions**.**

[PO.5]. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an under- standing of the limitations.

[PO.6]. **The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

[PO.7]. **Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

[PO.8]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice**.**

[PO.9]. **Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

[PO.10]. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions**.**

[PO.11]. **Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to owners own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

[PSO.1]. An ability to understand the concepts of basic Electronics & Communication Engineering and to apply them to various areas like Signal processing, VLSI, Embedded systems, Communication Systems, Digital & Analog Devices, etc.

[PSO.2]. An ability to solve complex Electronics and Communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.

[PSO.3]. Wisdom of social and environmental awareness along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur

C. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	Quizzes (Open Book/Close Book) and Assignments	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. A student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

D. Syllabus

Functions of complex variable. Analytic function, C-R equations, differentiation, Integration of complex function, Cauchy's integral formula. Taylor's and Laurent Series, Singular points, Residues, Cauchy's residue theorem. Periodic function, Fourier series expansion. Even and odd functions, functions with arbitrary periods, half range expansions, Fourier transform, Parseval's identity, PDE-Solution by method of separation of variables and by indicated transformations. One dimensional wave equation, one dimensional heat equation and their solutions. Vector differential operator, gradient divergence and curl. Line, surface and volume integrals. Green's theorem, Divergence and Stoke's theorem

F. Textbook:

T1. Grewal B. S., Higher Engineering Mathematics, (42e), Khanna Publishers, 2013

T2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Eastern, 2006.

G. Reference Book:

R1 Iyengar S.R.K. and Jain, Rajendra K., *Advance Engineering Mathematics (3e)*, Narosa book distributors Pvt Ltd-New Delhi, 2007
R2 Ramana B. V., *Higher Engineering Mathematics* (6th reprint), Tata Mcgraw-Hill, New Delhi, 2008

H. Lecture Plan:

Lecture No.	Description of the Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction: Complex Variables	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.1	Quizzes, assignments, Two Sessional, End Term Examination
2	Analytic Function	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.1	Quizzes, assignments, Two Sessional, End Term Examination
3	Cauchy Riemann(C-R) Equations	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.1	Quizzes, assignments, Two Sessional, End Term Examination

4	differentiation,	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.1	Quizzes, assignments, Two Sessional, End Term Examination
5	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.1	Quizzes, assignments, Two Sessional, End Term Examination
6	Integration of complex function,	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.1	Quizzes, assignments, Two Sessional, End Term Examination
7	Cauchy's integral formula.	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.1	Quizzes, assignments, Two Sessional, End Term Examination
8	Taylor's series	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.2	Quizzes, assignments, Two Sessional, End Term Examination
9	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.2	Quizzes, assignments, Two Sessional, End Term Examination
10	Laurent Series	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.2	Quizzes, assignments, Two Sessional, End Term Examination
11	Singular points	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103..2	Quizzes, assignments, Two Sessional, End Term Examination
12	Residues	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.2	Quizzes, assignments, Two Sessional, End Term Examination
13	Cauchy's residue theorem	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.2	Quizzes, assignments, Two Sessional, End Term Examination

14	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.2	Quizzes, assignments, Two Sessional, End Term Examination
15	Periodic function, Fourier series expansion	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.3	Quizzes, assignments, Two Sessional, End Term Examination
16	Even and odd functions	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.3	Quizzes, assignments, Two Sessional, End Term Examination
17	functions with arbitrary periods	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.3	Quizzes, assignments, Two Sessional, End Term Examination
18	Half range expansions	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.3	Quizzes, assignments, Two Sessional, End Term Examination
19	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.3	Quizzes, assignments, Two Sessional, End Term Examination
20	Introduction: Scalar and vector field, differentiation & integration of vector function	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
21	Gradient & Directional derivatives	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
22	Divergence & Curl	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
23	Line Integrals Identify	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.4	Quizzes, assignments, Two Sessional, End Term Examination

24	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
25	Surface Integrals	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
26	Volume Integrals	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
27	**Tutorial**	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
28	Green's Theorem and its application	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
29	Gauss's Theorem and its Applications	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
30	Stoke's Theorem and its Applications	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
31	Fourier transform continued	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.5	Quizzes, assignments, Two Sessional, End Term Examination
32	Parseval's identity	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.5	Quizzes, assignments, Two Sessional, End Term Examination
33	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.5	Quizzes, assignments, Two Sessional, End Term Examination

34	PDE-Solution by method of separation of variables and by indicated transformations	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.5	Quizzes, assignments, Two Sessional, End Term Examination
35	PDE-Solution by method of separation of variables and by indicated transformations	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.5	Quizzes, assignments, Two Sessional, End Term Examination
36	One dimensional wave equation	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.5	Quizzes, assignments, Two Sessional, End Term Examination
37	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.5	Quizzes, assignments, Two Sessional, End Term Examination
38	One dimensional heat equation	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.5	Quizzes, assignments, Two Sessional, End Term Examination

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MA2103.1	Student will apply concepts of analytic functions and residue in solving the circuit equations	3	3	1	3	1				2		2	1			
MA2103.2	Student will be able to understand the computation in circuit analysis which involves complex numbers.	3	2	2	2	2				2		1	1			
MA2103.3	Students will be able to decompose any periodic signal wave into sinusoids with the help of Fourier series	3	2	2	2	2				3		3	1			
MA2103.4	Student will understand and use the vector calculus in engineering problems related to heat & flow.	3	3	2	3	2				1		2	1			
MA2103.5	Fourier transform will develop the proper understanding of signal processing in electrical engineering.	2	2	1	2	3				2		2	1			

MANIPAL UNIVERSITY JAIPUR

School of Electrical Electronics & Communication Engineering

Department of Electrical Engineering
Course Hand-out

ANALOG & DIGITAL SYSTEM DESIGN| EE 2101 | 4 Credits | 3 1 0 4

Session: Aug. 2020 – Dec.2020 | Faculty | Class: II Year | Course Coordinator: Mr. Satya Narayan Agarwal

A. Introduction: This course is designed as the introductory course on Analog & Digital System Design for undergraduate students. It covers the basic characteristics of MOSFET and its small signal analysis. This course covers fundamentals of OPAMPs, linear and non-linear OPAMPS based circuits. This course is to enable student to understand simple combinational & Sequential logic circuits. To understand this course students are expected to have background knowledge of Network Analysis and Basic.

B. Course Outcomes: At the end of the course, students will be able to

[EE2101.1] Explain the basic characteristics of MOSFET and be able to employ DC and AC analysis of circuits involving semiconductor devices.

[EE2101.2]. Explain frequency response MOSFET and application of current mirror circuit.

[EE2101.3] Design and analyse the OPAMPS based linear and non-linear circuit.

[EE2101.4] Develop and analyse the various combinational circuits for given set of specifications.

[EE2101.5] Apply the concept for design of various sequential circuits for given set of specifications.

C. Program Outcomes and Program Specific Outcomes

[PO.1].Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2].Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3].Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4].Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5].Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6].The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7].Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8].Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9].Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyze the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	Quizzes (03) and Assignment (02)	20
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Quizzes	3 Quizzes (Close Book)	

E. Syllabus

Semiconductor Devices MOSFET Characteristics, structure, biasing, current mirrors, basic amplifier configurations, CS, CD, CG configurations, small signal model, frequency response, OPAMP configuration, OPAMP in linear Mode, OPAMP with positive and negative feedback, Linear applications of OPAMP, Nonlinear applications of OPAMP, Overview of Algebraic simplification of Boolean expressions, realization using logic gates, minimization using Karnaugh map, Combinational circuit design, Arithmetic circuits, Sequential logic circuits: Overview of flip-flops, Counters, shift registers.

F. Text Book:

T1. Boylestad and Nashelsky, *Electronic Devices and Circuit Theory* (10e), Pearson Education 2009

G. Reference Book:

R1. D. S. William, *Operational Amplifiers with Linear Integrated Circuits*, Pearson Education, 2004

R2. R. A. Gayakwad, *Op-Amps and Linear Integrated Circuits* (4e), Pearson Education 2015.

H. Lecture Plan:

Lec No	Topics	Session Objective	Mode of Delivery (Online/Classroom)	Corresponding CO	Mode of Assessing the Outcome
1	Introduction, aims and objectives of the course and elementary fundamentals of Analog & Digital systems	Know the basics of the course and understand its applications	Lecture Online	EE2101.1	Assignments Class Quiz Mid-Term I End-Term
2	**MOSFET introduction, Threshold voltage, Characteristics, Operating Region**	Understand basic structure of MOSFET and its operation	Lecture Online	EE2101.1	
3	**MOSFET as amplifier, switch, resistor, capacitor**	Different modes of operation of MOSFET i.e amplifier, voltage controlled resistor and capacitor.	Lecture Online	EE2101.1	
4	**MOSFET as amplifier, switch, resistor, capacitor contd.**	Different modes of operation of MOSFET i.e amplifier, voltage controlled resistor and capacitor.	Lecture/Activity	EE2101.1	
5	**MOSFET biasing**	Numerical practice	Lecture Online	EE2101.1	
6	**MOSFET small signal model**	Small signal model of MOSFET, working as amplifier	Lecture Online	EE2101.1	
7	**MOSFET small signal model contd.**		Lecture Online	EE2101.1	
8	**Small signal analysis of MOSFET amplifier, Single Stage**		Lecture Online	EE2101.1	Assignments Class Quiz Mid-Term I End-Term
9	**Small signal analysis of MOSFET amplifier, CS, CD, CG amplifier configurations**		Lecture Online	EE2101.1	
10	**Input & Output resistance of CS, CD, CG configuration, Input Signal Swing Limits**	Input and output resistance of different configuration and limitation of input voltage swing, saturation and cut-off region Know the basics of the I.C. Engine and understand its applications	Lecture Online	EE2101.1	
11	**Input & Output resistance of CS, CD, CG configuration, Input Signal Swing Limits contd.**		Lecture Online	EE2101.1	
12	Current mirrors Circuit	Analysis of current mirror circuit and their application	Lecture Online	EE2101.2	

13	Frequency response of MOSFET	Parameter variation at various frequency level in MOSFET	Lecture Online	EE2101.2	
14	**Introduction to Operation amplifier and its characteristics**	Learn the basic property of operational amplifier, ideal amplifier and practical amplifier difference and their its numerical values	Lecture Online	EE2101.3	
15	**Parameter of Op-Amp and various type of feedback topologies**		Lecture Online	EE2101.3	
16	**Summer, scaling amplifier and various mathematical operations**	Able make basic circuit to perform addition, subtraction using Op-amp	Lecture Online	EE2101.3	
17 -23	Analysis of Op-Amp based linear circuit	Analysis of inverting and non inverting amplifier, filters, voltage follower, integrator, differentiator etc.	Lecture/Activity	EE2101.3	
24-29	Analysis of Op-Amp based non-linear circuit	Analysis of Schmitt trigger, zero crossing detector, voltage level detector etc.	Lecture Online	EE2101.3	Assignments Class Quiz Mid-Term II End-Term
30-31	Op-based positive feedback circuits	Analysis of oscillator circuit	Lecture Online	EE2101.3	
32	Introduction to logic gates	Introduction to logic gates, symbolic Representation, classification, truth tables and explanations	Lecture	EE2101.4	
33	Boolean Algebra	Boolean algebra, basic formulas and their verification and Utilization	Lecture	EE2101.4	
34		Implementation of Boolean expression with logic gates	Lecture	EE2101.4	Assignments Class Quiz Mid-Term II End-Term
35	Representation of Boolean expression	Representation of Boolean expression in SumOfProduct (SOP) , ProductOfSum (POS) forms	Lecture	EE2101.4	
36	Implementations of Boolean expressions using universal gate	Implementations of Boolean expressions using universal gate (NAND-NAND Logic)	Lecture	EE2101.4	
37	Implementations of Boolean expressions using universal	Implementations of Boolean expressions using universal	Lecture	EE2101.4	

	gate	gate.(NOR-NOR Logic)			
38	Minimization Techniques	Minimization Techniques: Introduction of Karnaugh Map, formation of Karnaugh Table	Lecture/Activity	EE2101.4	
39	Minimization Techniques	K-Map (2-3 variable) for minimization of Boolean Expressions	Lecture	EE2101.4	
40	Combinational Circuits	Introduction of Combinational Circuits, Design of arithmetic circuits – Half adder	Lecture	EE2101.4	
41	Arithmetic circuits	Design and explanation of Full adder, Substractor	Lecture	EE2101.4	Assignments Class Quiz End-Term
42	Arithmetic circuits	Design of 4 bit adder and 4 bit Substractor	Lecture	EE2101.4	
43	Multiplexer and Demultiplexer	Introduction of multiplexers and demultiplexers, Design and Explanation	Lecture	EE2101.4	
44	Latches and flip-flops	Latches and flip-flops: RS Flip-flop and explanation	Lecture	EE2101.5	
45	Latches and flip-flops	Latches and flip-flops: JK Flip-flop and explanation, Master-Slave JK	Lecture	EE2101.5	Assignments Class Quiz End-Term
46	Latches and flip-flops	Latches and flip-flops: D & T Flip-flop and explanation	Lecture	EE2101.5	
47	Flip-flip conversion	Flip-flip conversion	Lecture	EE2101.5	
48	Synchronous Sequential Circuit Design	**Synchronous Sequential Circuit Design**: Introduction to Synchronous Sequential circuits	Lecture	EE2101.5	
49	Counters	Design and explanation of Synchronous Counters	Lecture	EE2101.5	
50	Counter	Design and explanation of Asynchronous Counters	Lecture	EE2101.5	

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE2101.1	Explain the basic characteristics of MOSFET and be able to employ DC and AC analysis of circuits involving semiconductor devices	3													3	3
EE2101.2	Explain frequency response MOSFET and application of current mirror circuit	3			2										2	
EE2101.3	Design and analyse the OPAMPS based linear and non-linear circuit.	3			2										2	2
EE2101.4	Develop and analyse the various combinational circuits for given set of specifications.	3			2										1	
EE2101.5	Apply the concept for design of various sequential circuits for given set of specifications.	3													1	2

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and Communication Engineering

Department of Electrical Engineering
Course Hand-out

ELECTROMAGNETIC FIELD THEORY | EE 2102 | 3 Credits | 2 1 0 3

Session: August2020 – December2020| Faculty | Class: II Year | Course Coordinator: Himanshu Priyadarshi [MU - Jaipur]

A. Introduction: Electromagnetic field theory is a foundational course in Electrical Engineering, for it is necessary to develop sound understanding of other courses like Electrical Machinery, Power Systems, Communication Systems, to name a few. Apart from an academic perspective, all of us are surrounded by electromagnetic radiation and gadgets, and hence it becomes important for us as electrical engineers to engage responsibly in the developing engineering awareness for electromagnetic applications.

B. Course Outcomes: At the end of the course, students will be able to

[EE2102.1] DEVELOP sound fundamentals of electrostatics as well as magnetostatics along with their mathematical basis by utilizing the tools of vector calculus and algebra. APPRECIATE the utility of electrostatics as well as magnetostatics for problem solving leading to entrepreneurship and employment. (**Bloom's Level: knowledge, Analysis, Application)**

[EE2102.2] DERIVE electric and magnetic fields for simple configurations under time invariant(static)conditions**.(Bloom's Level: Comprehensive, Application)**

[EE2102.3] ANALYZE time-varying electric and magnetic fields, and APPRECIATE Maxwell's equation in different forms and different media (**Bloom's Level: Comprehensive, Analysis)**

[EE2102.4] APPRECIATE propagation of plane waves in different media (**Bloom's Level: Application, Analysis)**

[EE2102.5] CORRELATE the concepts of electromagnetism in different applications(**Bloom's Level: Application Analysis)**

C. Program Outcomes and Program Specific Outcomes

[PO.1]. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences**.**

[PO.3]. **Design/ Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

[PO.4]. **Conduct investigations** of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions**.**

[PO.5]. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an under- standing of the limitations.

[PO.6]. **The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

[PO.7]. **Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

[PO.8]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice**.**

[PO.9]. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

[PO.10]. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions**.**

[PO.11]. **Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to owners own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	Quizzes (03) and Assignment (03)	20
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Quizzes	3 Quizzes (Close Book)	

E. Syllabus

Vector analysis and calculus: Vector algebra, Rectangular, Cylindrical and Spherical Coordinates, Gradient, Divergence, Curl

Electrostatics: Field intensity, Flux density, Electric scalar potential, Potential gradient, Energy density in an electric field, Boundary conditions, Capacitance, Laplace's and Poisson's equations.

Magnetostatics: Field intensity, Flux density, Boundary conditions, Magnetic forces, Inductance,

Time varying fields: Maxwell's equations, Uniform Plane wave: Wave equation and its solution, Wave propagation in different media, Poynting's theorem.

F. Text Book:

1. M. Sadiku, *Elements of Electromagnetics*, Oxford University Press, 2014.

G. Reference Book:

1. W. Hayt, *Engineering Electromagnetics*, TMH, 2012.
2. N. Rao, *Elements of Engineering Electromagnetics*, Pearson Education, 2006.

H. Online Learning Material:

https://nptel.ac.in/courses/108/104/108104087/

I. Lecture Plan:

Lec No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
L1	Introduction to the practice of Electromagnetic Field Theory(EMFT)	APPRECIATION for the purposeful practice of AWARENESS about the impact of ELECTROMAGNETISM in our daily lives; the dangers of casual, unscientific approach towards ELECTROMAGNETIC RADIATION and gadgets	Lecture & Discussion	EE 2102.1, 5	Microsoft Forms Formative Quiz, CIA, ETE
L2-6	Vectors and Scalars, Concept of field and their physical interpretation; coordinate systems(with livescript-aided visualization and their relevance	IDENTIFY and DISCRIMINATE between *SCALARS* and **VECTORS** from the viewpoint of an engineer, and not just mathematical viewpoint; RATIONALIZE the CHOICE of ORTHONORMAL COORDINATE SYSTEMS in EMFT using results from vector algebra	Lecture & Discussion	EE 2102.1, 5	Microsoft Forms Formative Quiz, CIA, ETE
L7-8	Vector Calculus and its significance for EMFT	APPRECIATE length, area, and volume in relevant coordinate systems for EE 2102 with problem-solving	Lecture & embedded Tutorial	EE 2102.1, 5	Microsoft Forms Formative Quiz, CIA, ETE
L9-11	Utility, scope and relevance of concepts like gradient, divergence, and curl	Understanding through problem solving for the vector calculus operations like gradient, divergence and curl for EMFT	Lecture & embedded Tutorial	EE 2102.1, 5	Microsoft Forms Formative Quiz, CIA, ETE
L12 -15	Electrostatics: Coulomb's Law – Electric field intensity – problems on point charges, Field due to charge distribution, Straight line charge, Field due to circular disc	ACKNOWLEDGE Electric Field in its various applications and accuracy of Coulomb's law along with its limitations	Lecture & embedded Tutorial	EE 2102.1,2, 5	Microsoft Forms Formative Quiz, CIA quiz, ETE

L16-17	Electric Flux density – Gauss Law & Applications, Uniform line charge, Plane with surface charge density, Spherical Shell	APPRECIATE the effectiveness of GAUSS law in overcoming the limitations of COULOMB's law	Lecture & embedded Tutorial	EE 2102.1,2, 5	Microsoft Forms Formative Quiz, CIA, ETE
L18	Coaxial cable, Electric scalar potential, Potential gradient	APPLY the electrostatics concepts for electric potential calculations for co-axial cable	Lecture & embedded Tutorial	EE 2102.1,2, 5	Microsoft Forms Formative Quiz, CIA, ETE
L19-20	Electric potential due to ring, sphere, Divergence – Divergence theorem (Cartesian coordinates)	UTILIZE the divergence transformer for electric potential	Lecture & embedded Tutorial	EE 2102.1,2, 5	Microsoft Forms Formative Quiz, CIA, ETE
L21	Boundary conditions for dielectric materials	APPRECIATE & APPLY boundary conditions for electrostatic problems	Lecture & embedded Tutorial	EE 2102.1,2, 5	Microsoft Forms Formative Quiz, CIA, ETE
L22-23	Capacitance of parallel plate capacitor, Concentric spherical shell, co-axial cable,	UNDERSTAND capacitance from first principles of electrostatics	Lecture & embedded Tutorial	EE 2102.1,2, 5	Microsoft Forms Formative Quiz, CIA, ETE
L24	Energy density in an electric field, Laplace & Poisson's Equations	METRICIZE energy density for pertinent problems	Lecture & embedded Tutorial	EE 2102.1,2, 5	Microsoft Forms Formative Quiz, CIA, ETE
L25-26	Magnetostatics, Biot-Savart's law and Applications – Straight line conductor, circular ring	APPRECIATE the importance of static magnetic fields using Biot-Savart's law.	Lecture & embedded Tutorial	EE 2102.1,2, 5	Microsoft Forms Formative Quiz, CIA, ETE
L27-28	Ampere's circuital law & applications: co-axial cable Solenoid, Curl-Stoke's Theorem (Cartesian coordinates), Magnetic flux & flux density, scalar & vector magnetic potential	UTILIZE Ampere's circuital law for magnetic flux calculations	Lecture & embedded Tutorial	EE 2102.1,2, 5	Microsoft Forms Formative Quiz, CIA, ETE
L29	Lorenz force equation, force between differential current elements, Magnetic Boundary	COMPUTE Lorenz force for current carrying conductors	Lecture & embedded Tutorial	EE 2102.1,2, 3,5	Microsoft Forms Formative Quiz, CIA, ETE

	conditions				
L30	Inductance of Toroid, Solenoid, Two wire cable, Coaxial cable	CALCULATE inductance for salient configurations	Lecture & embedded Tutorial	EE 2102.1,2,3, 5	Microsoft Forms Formative Quiz, CIA, ETE
L31	Faraday's Law – Transformer emf, motional emf derivations and theory, Concept of displacement, Conduction current	APPRECIATE Faraday's Law and UTILIZE it for transformer emf calculations	Lecture & embedded Tutorial	EE 2102.1,2, 3,5	Microsoft Forms Formative Quiz, CIA, ETE
L32	Maxwell's equations in integral & point form, Wave equation and solution	EXPRESS Maxwell's equations in suitable forms	Lecture & embedded Tutorial	EE 2102.1,2, 3,5	Microsoft Forms Formative Quiz, CIA, ETE
L33-35	Characteristics of medium – attenuation constant, phase constant, propagation constant Wavelength, phase velocity, intrinsic impedance and power (Poynting's theorem), Wave motion in dielectrics Wave motion in lossy dielectrics, Wave motion in conductors – concept of skin depth	UNDERSTAND & METRICIZE medium characteristics FOR wave propagation in different media	Lecture & embedded Tutorial	EE 2102.1,2, 3,4,5	Microsoft Forms Formative Quiz, CIA, ETE
L36	Plane wave reflection: normal incidence reflection & transmission coefficients, Power calculation & standing wave ratio	UNDERSTAND plane waves and making relevant power calculation	Lecture & embedded Tutorial	EE 2102.1,2, 3,4,5	Microsoft Forms Formative Quiz, CIA, ETE
L37-39	Oblique incidence: perpendicular polarization, Parallel polarization, Total reflection: Brewster angle, Critical angle; Cross talk in transmission lines	UNDERSTANDING polarization and cross talk with relevant background	Lecture & embedded Tutorial	EE 2102.1,2, 3,4,5	Microsoft Forms Formative Quiz, CIA, ETE

L 40	Conclusion and Summary	RECAPITULATE the concepts taught in this course	Lecture & Discussion	EE 2102.1,2, 3,4,5	-------

J. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	Correlation with Program Outcomes												Correlation with Program Specific Outcomes		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
[EE2102.1]	DEVELOP sound fundamentals of electrostatics as well as magnetostatics along with their mathemtical basis by utilizing the tools of vector calculus and algebra. (**Bloom's Level: knowledge, Analysis)**		1	2				3					1		2	1
[EE2102.2]	DERIVE electric and magnetic fields for simple configurations under time invariant(static)conditions**.(Bloom's Level: Comprehensive, Application)**	1	1		3											3
[EE2102.3]	ANALYZE time-varying electric and magnetic fields, and APPRECIATE Maxwell's equation in different forms and different media (**Bloom's Level: Comprehensive, Analysis)**	3	2			1							1	3		1
[EE2102.4]	APPRECIATE propagation of plane waves in different media (**Bloom's Level: Application, Analysis)**		3	1			2								2	1
[EE2102.5]	CORRELATE the concepts of electromagnetism in different applications(**Bloom's Level: Application Analysis)**			3		1		2					1	2	1	1

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and Communication Engineering

Department of Electrical Engineering
Course Hand-out

ELECTRICAL CIRCUIT ANALYSIS | EE 2103 | 4 Credits | 3 1 0 4

Session: Aug. 2020 – Nov.2020 | Faculty | Class: 2nd Year | Course Coordinator: Mr. Ritesh Singh

A. **Introduction:** The course is offered by Department of Electrical Engineering as a Electrical Engineering Core Course, targeting Electrical & Electronics Engineering students of III Semester, B. Tech. (EEE). The course offers an in-depth understanding of various fundamentals of Electrical Network Analysis. The topics covered include the Electrical Network analysis theorems for Circuit Analysis with application of nodal and mesh analysis. The Signals and Waveforms, Time Domain and Frequency Domain Analysis of the Electrical Circuit is covered with Laplace Domain Analysis. Network functions with concepts of Poles-Zeros, Two-Port Network and application of Graph theoretical methods to Network Analysis is also included in the course.

B. **Course Outcomes:** Upon successful completion of the course, the student will be able to:

[EE2103.1]. Describe the fundamental concepts of Graph Theory and demonstrate the Skills to apply it to analyse Electrical Networks. **(Bloom's Level: Knowledge, Comprehensive)**

[EE2103.2]. Apply the basic Circuital Law and different Network Theorems to analyse Electrical Circuits. **(Bloom's Level: Analysis, Application)**

[EE2103.3]. Analyse the Electrical Networks using Time Domain analysis, and evaluate transient response and steady state response of electrical circuit using elementary signals. **(Bloom's Level: Knowledge, Application)**

[EE2103.4]. Analyse the Electrical Network using Frequency Domain approach and Laplace Transforms to enhance Employability. **(Bloom's Level: Analysis, Application)**

[EE2103.5] Analyse complex Electrical Network by matrix formulation of network and solve it by Two – Port Network concept. **(Bloom's Level: Knowledge, Application)**

C. **PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

[PO.1] **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2] **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3] **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4] **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5] **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

[PO.6] **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

[PO.7] **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8] **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

[PO.9] **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10] **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11] **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12] **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1] To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2] To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3] Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Plan

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments (Accumulated and Averaged)	20 (Assignments – 10 & Quiz's - 10)
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who miss a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. These assignments are limited to a maximum of 5 throughout the entire semester.	

E. SYLLABUS

EE 2103 ELECTRICAL CIRCUIT ANALYSIS [3 1 0 4]

Introduction to Graph Theory, Graph of a network, Matrix representation of a graph, Cut- set and Tie set Matrix. Network Theorems with controlled sources: Superposition, Thevenin's, Norton's, Maximum power transfer, Reciprocity, Substitution, Compensation, Millman's, Tellegen's theorems. Signals and waveforms: Classification of Signals, elementary signals, characteristics, representation of waveforms. Time domain analysis: Initial and final conditions, Transients analysis of RL, RC and RLC circuits. Frequency domain analysis: Laplace domain analysis, Laplace Transforms of signals, Transformed circuits, Analysis of networks using Laplace Transforms, Frequency domain analysis: Network Function, poles and zeros, convolution integral. Two port networks: Z, Y, T and h parameters, Relation between parameters, Series, parallel and cascade connections.

F. TEXT BOOK:

T1. R. R. Singh, *Network Analysis and Synthesis*, McGraw Hill Education 2013.

G. REFERENCE BOOKS

R1. W. H. Hayt, J. E. Kemmerly & S. M. Durbin, *Engineering Circuit Analysis* (7e), TMH, 2010.

R2. V. Valkenberg, *Network Analysis* (3e), PHI, 2009.

R3. J. W. Nilsson & S. A. Reidel, *Electric Circuits* (9e), PHI, 2011.

H. ONLINE LEARNING MATERIAL

Video Lectures:

1. **https://nptel.ac.in/courses/108/104/108104139/**
2. **https://nptel.ac.in/courses/117/106/117106108/**
3. **https://www.coursera.org/learn/linear-circuits-dcanalysis#about**
4. **https://www.edx.org/course/principles-of-electric-circuits-2**

Further Reading

5. **https://www.coursera.org/learn/linear-circuits-ac-analysis**

I. Lecture Plan:

Lecture No.	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
	Introduction to the Course	To acquaint students with the subject and outcomes of the course. Students will be introduced with outcome based education (OBE) and Course outcome (CO) and program outcome (PO) assessment process	Lecture Online		NA
Lecture – 1	Introduction to the subject	Discuss the subject and its importance in modern engineering education.	Lecture Online	[2103.1]	Class Quiz / Mid Term Exam / End Term Exam
Lecture – 2	Introduction to Graph Theory, Graph of a Network, Matrix representation of a Graph	Introduction to graph theory concepts. Explain Trees and related concepts in the graph theory	Lecture Online	[2103.1]	Class Quiz / Assignment / Mid Term Exam/ End Term Exam
Lecture – 3	Cut-set Matrix	Analyze and solve different problems using cut-set and cut set matrix	Lecture Online	[2103.1]	Class Quiz / Mid Term Exam/ End Term Exam
Lecture – 4	Tie-set Matrix	Analyze and solve different problems using tie-set and tie set matrix	Lecture Online	[2103.1]	Class Quiz / Mid Term Exam / End Term Exam
Lecture – 5	Tutorial – 1	To solve graph theory problems based on Lecture 1-4	Tutorial Online	[2103.1]	Mid Term Exam / End Term Exam
Lecture – 6	Network Theorems Introduction	Learning computation of electrical quantities using Nodal and Mesh Analysis	Lecture Online	[2103.2]	Class Quiz / Assignment / Mid Term Exam / End Term Exam
Lecture – 7	Superposition Theorems	Describe apply different Network Theorems.	Lecture Online	[2103.2]	Class Quiz / Mid Term Exam/ End Term Exam
Lecture – 8	Thevenin's Theorems	Describe apply different Network Theorems.	Lecture Online	[2103.2]	Class Quiz / Mid Term Exam / End Term Exam
Lecture – 9	Norton's Theorems	Describe apply different Network Theorems.	Lecture Online	[2103.2]	Class Quiz / Mid Term Exam / End Term Exam
Lecture – 10	Tutorial – 2	Numerical problem solving exercises based on Lecture 6-9	Tutorial Online	[2103.2]	Mid Term Exam / End Term Exam
Lecture – 11	Maximum Power Transfer Theorems	Describe apply different Network Theorems.	Lecture Online	[2103.2]	Class Quiz / Mid Term Exam / End Term Exam
Lecture – 12	Reciprocity, Substitution, Compensation	Describe apply different Network Theorems.	Lecture Online	[2103.2]	Class Quiz / Mid Term Exam / End Term Exam
Lecture – 13	Tutorial – 3	Numerical problem solving exercises based on Lecture 11-12	Tutorial Online	[2103.2]	Mid Term Exam / End Term Exam

Lecture – 14	Millman's Theorems	Describe apply different Network Theorems.	Lecture Online	[2103.2]	Class Quiz / Mid Term Exam / End Term Exam
Lecture – 15	Tellegen's Theorems	Describe apply different Network Theorems.	Lecture Online	[2103.2]	Class Quiz / Mid Term Exam / End Term Exam
Lecture – 16	Tutorial – 4	Numerical problem solving exercises based on Lecture 14-15	Tutorial Online	[2103.2]	Mid Term Exam / End Term Exam
Lecture – 17	Signals and Waveforms, Classification of Signals	Introduction to Signals	Lecture Online	[2103.3]	Class Quiz / Assignment / Mid Term Exam / End Term Exam
Lecture – 18	Elementary Signals, Characteristics	Signals Characteristics	Lecture Online	[2103.3]	Class Quiz / Mid Term Exam / End Term Exam
Lecture – 19	Representation of Waveforms	Describe different mathematical representation of the periodic waveforms	Lecture Online	[2103.3]	Class Quiz / Mid Term Exam / End Term Exam
Lecture – 20	Tutorial – 5	Numerical problem solving exercises based on Lecture 17-19	Tutorial Online	[2103.3]	Mid Term Exam/ End Term Exam
Lecture – 21	Time Domain Analysis: Initial and Final conditions	Introduction to Time Domain Analysis	Lecture Online	[2103.3]	Class Quiz / Mid Term Exam/ End Term Exam
Lecture – 22-23	Transients analysis of RL circuits	Learn about the transient analysis of R-L circuits	Lecture Online	[2103.3]	Class Quiz / Mid Term Exam/ End Term Exam
Lecture – 24	Tutorial – 6	Numerical problem solving exercises based on Lecture 21-23	Tutorial Online	[2103.3]	Mid Term Exam/ End Term Exam
Lecture – 25-26	Transients analysis of RC circuits	Learn about the transient analysis of R-C circuits	Lecture Online	[2103.3]	Class Quiz / Mid Term Exam/ End Term Exam
Lecture – 27-28	Transients analysis of RLC circuits	Learn about the transient analysis of RLC circuits	Lecture Online	[2103.3]	Class Quiz / Mid Term Exam/ End Term Exam
Lecture – 29	Tutorial – 7	Numerical problem solving exercises based on Lecture 25-28	Tutorial Online	[2103.3]	Mid Term Exam/ End Term Exam
Lecture – 30	Frequency Domain Analysis	Learn analysing the electrical network using Frequency Domain	Lecture Online	[2103.4]	Class Quiz / Assignment / Mid Term Exam/ End Term Exam
Lecture – 31	Laplace Domain Analysis	Review of fundamentals of Laplace Transformation	Lecture Online	[2103.4]	Class Quiz / Mid Term Exam/ End Term Exam
Lecture – 32	Laplace Transforms of Signals and Transformed Circuits	Learn analysing the electrical network using Laplace Transform	Lecture Online	[2103.4]	Class Quiz / Mid Term Exam / End Term Exam
Lecture – 33	Tutorial – 8	Numerical problem solving exercises based on Lecture 30-32	Tutorial Online	[2103.4]	Mid Term Exam/ End Term Exam
Lecture – 34-35	Analysis of Networks using Laplace Transforms	Learn analysing the electrical network using Laplace Transform	Lecture Online	[2103.4]	Class Quiz / Mid Term Exam/ End Term Exam

Lecture – 36	Network Function, Poles and Zeros, Convolution Integral	Computation of Poles and Zeros and interpretation of its placement on graph, Convolution Integral	Lecture Online	[2103.4]	Class Quiz / Mid Term Exam / End Term Exam
Lecture – 37	Tutorial – 9	Numerical problem solving exercises based on Lecture 34-36	Tutorial Online	[2103.4]	Mid Term Exam/ End Term Exam
Lecture – 38	Two Port Networks	Learn the fundamental of 2 port network	Lecture Online	[2103.5]	Class Quiz / Assignment / Mid Term Exam/ End Term Exam
Lecture – 39-40	Z and Y Parameters	Computing different parameters of 2 port Network	Lecture Online	[2103.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lecture – 41	Tutorial – 10	Numerical problem solving exercises based on Lecture 38-40	Tutorial Online	[2103.5]	Mid Term Exam/ End Term Exam
Lecture – 42-43	T and h Parameters	Computing different parameters of 2 port Network	Lecture Online	[2103.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lecture – 44	Relation between Parameters	Describe the relationship between different 2 port Network parameters	Lecture Online	[2103.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lecture – 45	Tutorial – 11	Numerical problem solving exercises based on Lecture 42-44	Tutorial Online	[2103.5]	Mid Term Exam/ End Term Exam
Lecture – 46	Series and Parallel connections	Describe the Serial and Parallel connection of 2 port networks	Lecture Online	[2103.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lecture – 47	Cascade connections	Describe the cascade connection of 2 port networks	Lecture Online	[2103.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lecture – 48	Tutorial – 12	Numerical problem solving exercises based on Lecture 46-47	Tutorial Online	[2103.5]	Mid Term Exam/ End Term Exam

J. Course Articulation Matrix: (Mapping of COs with POs)

CO No.	CO STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE2103.1	Describe the fundamental concepts of Graph Theory and demonstrate the skill to apply it to analyse Electrical Networks.	3	3		2	2	1							3	2	3
EE2103.2	Apply the basic Circuital Law and different Network Theorems to analyse Electrical Circuits.	3	2			1								3	2	3
EE2103.3	Analyse the Electrical Networks using Time Domain analysis, and evaluate transient response and steady state response of electrical circuit using elementary signals.	3	2		2	2								3	2	3
EE2103.4	Analyse the Electrical Network using Frequency Domain approach and Laplace Transforms.	3	2		2	2								3	2	3
EE2103.5	Analyse complex Electrical Network by matrix formulation of network and solve it by Two – Port Network concept.	2	2	2										3	2	3

1- **Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronic Communication Engineering

Department of Electrical Engineering
Course Hand-out

Electrical Machines-I | EE2104 | 4 Credits | 3 1 0 4

Session: Jul 20 – Dec. 20 | Faculty: Vinay Gupta | Class: III Semester, B. Tech. (EEE)

A. **Introduction:** The objective of this course provides a basic understanding of AC & DC machinery fundamentals, constructional features, operational analysis through phasor diagrams, equivalent circuits, determination of performance parameters, testing and applications.

B. **Course Outcomes:** At the end of the course, students will be able to

[EE2104.1] Know the basic fundamentals of electrical machines.

[EE2104.2] Constructional details, principle of operation of single-phase Transformers.

[EE2104.3] Comprehend the operation and performance of three phase transformer.

[EE2104.4] Constructional details, principle of operation of Induction Machines.

[EE2104.5] Comprehend the working of DC & BLDC machines and testing.

C. **PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics_and responsibilities and norms of the engineering practices

[PO.9]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	15
	Sessional Exam II (Close Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Transformers: Types of transformers; Single phase transformers - working principle, construction, phasor diagram, equivalent circuit, voltage regulation, losses and efficiency, All day efficiency, testing, parallel operation, inrush current, harmonics, tap changing, auto transformer. Three phase transformers: Connections: star-star, star-delta, delta-star, delta-delta, zigzag, open delta; three winding transformer. DC Machines: DC generators- working principle, construction, types, armature winding, Magnetization characteristics, armature reaction, commutation, load characteristics, DC Motors – working principle, types,

torque-speed characteristics, starting, braking, speed control, losses, efficiency, and testing. BLDC motors – working principle and control.

F. REFERENCE BOOK

1. M. G. Say, *Alternating Current Machines* (5e), ELBS, 1994.
2. E. H. Langsdorf, *Theory of Alternating Current Machine* (2e), TMH, 1994.
3. A. E. Clayton, *Performance and Design of DC Machines* (3e), O& IBH, 1978

G. TEXT BOOKS

1. P. S. Bhimbra, “Electrical Machinery”, Seventh Edition, 1995,Khanna Publishers.
2. I. J. Nagrath, , D. P.Kothari, “Electric Machines”, Third Edition, Tata McGraw-Hill Publishing Company Ltd.
3. A. E.Fitzgerald, Charles Kingsley, Jr. Stephen D. Umans, “Electric Machinery”, Fifth Edition, Tata McGraw-Hill.

H. ON-LINE LEARNING MATERIAL

Video link:

https://nptel.ac.in/courses/108/105/108105155/

https://nptel.ac.in/courses/108/105/108105017/

https://nptel.ac.in/courses/108/102/108102146/

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I. Lecture Plan:

Lec No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	Introduction	To acquaint students with the outcome based education (OBE) and Course outcome (CO) and program outcome (PO) assessment process	Lecture		
2-3	Introduction of Basic Rules of Electromagnetic Induction, Principle of Transformer, EMF Equation of Single phase Transformer, Construction and Type of Single phase Transformer.	Recall the basic Rules Electromagnetic Induction	Lecture	2104.1 2104.2	In Class Quiz
4-5	Equivalent circuit of single phase Transformer, Open circuit test and Short circuit test of single phase Transformer	Identify different testing and their implementation	Lecture	2104.1 2104.2	In Class Quiz End Term
T-1	L1-L5	Numerical problems based on L1-L5	Tutorial		
6,7	Various Losses in Single Phase Transformer, Efficiency, Condition of Maximum Efficiency in Single Phase Transformer.	Explain various losses and the effects of various losses and its effects	Lecture	2104.1 2104.2	Home Assignment End Term
8,9	Voltage Regulation of Single phase Transformer, All day Efficiency of single Phase Transformer	Explain voltage regulation and its effects	Lecture	2104.1 2104.2	In Class Quiz End Term
T-2,T-3	L6-L9	Numerical problems based on L6-L9	Tutorial		
10,11	Polarity Test, Sumpner's Test, Cooling ,inrush current phenomenon	Identify the polarity and in rush current phenomenon	Lecture	2104.1 2104.2	Class Quiz Mid Term I End Term
12,13	Parallel operation of Two Transformers-conditions, Unequal and equal voltage ratio.	Identify the conditions of parallel operation.	Lecture	2104.2	Class Quiz Mid Term 1 End term
14,15	Auto Transformer, Tap changers	Describe the concept of auto transformer and tapping	Lecture	2104.1 2104.2	Home Assignment Class Quiz Mid Term 1 End Term
T-4	L10-L15	Numerical problems based on L19-	Tutorial		

		L15			
16,17	Connection of single phase transformer for three phase operation, Open delta connection.	Describe the concept of 3-phase transformer and its connections	Lecture	2104.1 2104.3	Class Quiz Mid Term 1 End Term
18,19,20	Scott connection, Harmo nics	Describe the concept of 3-phase to 2-phase transformation and its applications	Lecture	2104.1 2014.3	Class Quiz Mid Term I End Term
FIRST SESSIONAL EXAM					
21,22,23	Three winding transformer, different type of connections, Vector groups	Describe the concept of harmonics and Vector groups	Lecture	2104.1 2104.3	Class Quiz Mid Term II End Term
T-5-T6	L16-L23	Numerical problems based on L19-L15	Tutorial		
24,25	Principle of Three phase induction motor, construction, Type, Equivalent circuit	Describe the construction of Induction motor and its working, types.	Lecture	2104.1 2104.4	Class Quiz Mid Term II End Term
26,27	Torque equation ,Torque/slip characteristic	Describe the Torque equation ,Torque/slip characteristic	Lecture	2104.1 2104.4	Class Quiz Mid Term II End Term
T-7	L24-L27	Numerical problems based on L24-L27	Tutorial		
28,29	NO Load and Blocked Rotor Test, Circle diagram	Identify different testing and their implementation.	Lecture	2104.4	Class Quiz Mid Term II End Term
30,31	Starting Methods of three phase Induction motor- DOL, Star-Delta Starter, Auto Transformer Starter	Describe working of Star/Delta, auto transformer Starter.	Lecture	2104.4	Class Quiz Mid Term II End Term
32,33,34	Speed control Method of three phase induction motor	Describe working of various speed control methods.	Lecture	2104.4	Class Quiz Mid Term II End Term
T-8-T9	L28-L34	Numerical problems based on L28-L34.	Tutorial		
35,36	Cogging, Crawling, Deep bar and double cage induction motors , Induction generators	Describe the Cogging and crawling phenomena and working of induction generator.	Lecture	2104.1 2104.4	Class Quiz Mid Term II End Term
37,38,	DC generator- Construction, type, operation, Emf equation. Characteristics	Describe the construction and working of DC generator and its characteristics	Lecture	2104.1 2104.5	Class Quiz Mid Term II End Term
39	Armature reaction and Commutation of DC generator	Describe the armature reaction and commutation process.	Lecture	2104.5	Class Quiz Mid Term II End Term

SECOND SESSIONAL EXAM					
40-41	DC Motor:- Principle, Types , Torque Equation , Back Emf	Describe the construction and working of DC motors and its characteristics	Lecture	2104.1 2104.5	Class Quiz End Term
42	Characteristics of DC shunt, series compound Motors	Identify the characteristics of different motors.	Lecture	2104.1 2104.5	Class Quiz End Term
43	Speed Control Methods of DC shunt Series motors & testing.	Describe the speed control methods of DC motors	Lecture	2104.5	Class Quiz End term
T-10-T12	L35-L43	Numerical problems based on L35-L43.	Tutorial		
44-46	Working and control of BLDC	Describe the working & control of BLDC	Lecture	2104.1 2104.5	Class Quiz
END TERM EXAM					

J. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE2104.1	Know the basic fundamentals of electrical machines.	2		3		3		1	1					2		2
EE 2104.2	Constructional details, principle of operation of single phase Transformers.	2	1	3	3		2				1	1		2	2	
EE2104.3	Comprehend the operation and performance of three phase transformer.	1	3	2	1			2	1	1		1			3	2
EE2104.4	Constructional details, principle of operation of Induction Machines.	1	2			2		1		2	1			2		2
EE2104.5	Understand the working of DC & BLDC machines and constructions.	1			2			2			1			2		2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY
JAIPUR

School of Humanities and Social Sciences
Department of Economics
Course Handout

Economics | EO 2001 | 3 Credits | 3003

Session: Jan 21 – May 21 | Faculty: Dr Manas Roy | Class: B. Tech | Semester IV

A. Introduction: This course is offered by Dept. of Economics to the Engineering departments, targeting students to give basic understanding in the concept of economics. It mainly deals with economic issues related to consumer behaviour, firms, industries and business organizations to make aware the students regarding economic environment. This course also discusses the preliminary concepts associated with macroeconomic variable like GDP inflation, balance of payments etc. It explores various possibilities emerging in an economy and the role of economic policy in this context.

B. Course Outcomes: At the end of the course, students will be able to

[2001.1] Describe the basic principles of micro and macroeconomic analysis.
[2001.2] Aware of the tools and techniques of economics and be able to prepare projects.
[2001.3] Recognize the problems and give solutions which in turn will create employability.
[2001.4] Interpret and illustrate decision making process in practical life and hence enhance employability.
[2001.5] Apply the learning of economic concepts in their life.

C. Program outcomes and program specific outcomes

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

[PO2]. Problem analysis: The sophisticated curriculum would enable a graduate to identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using basic principles of mathematics, computing techniques and communication engineering principles.

[PO3]. Design/development of solutions: Upon analysing, the B Tech graduate should be able to devise solutions for complex engineering problems and design system components or processes that meet the specified requirements with appropriate consideration for law, safety, cultural & societal obligations with environmental considerations.

[PO4]. Conduct investigations of complex problems: To imbibe the inquisitive practices to have thrust for innovation and excellence that leads to 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 modelling to complex engineering activities with an understanding of the limitations.

[PO6]. **The engineer and society**: The engineers are called society builders and transformers. B. Tech graduate should be able to 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**: The zero effect and zero defect are not just a slogan; it is to be practised in each action. Thus, a B Tech should 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**: Protection of IPR, staying away from plagiarism are important. Student should be able to apply ethical principles and commit to professional ethics, responsibilities and norms of the engineering practice.

[PO9]. **Individual and team - work**: United we grow, divided we fall is a culture at MUJ. Thus, an outgoing student should be able to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO10]. **Communication**: Communicate effectively for all engineering processes & activities with the peer engineering team, community and with society at large. Clarity of thoughts, being able to comprehend and formulate 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 varied 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.

Program specific outcomes (PSOs)

At the end of the B Tech program, the student:

[PSO1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems

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D. Assessment rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I	20
	Sessional Exam II	20
	Assignments, Activity, etc.	20
End Term Exam (Summative)	End Term Exam	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

E. Syllabus

Introduction; Microeconomics: Consumer behaviour, cardinal and ordinal approaches of utility, law of diminishing marginal utility, theory of demand and supply, law of demand, exceptions to the law of demand, change in demand and change in quantity demanded, elasticity of demand and supply, consumer surplus and producer; Indifference curve, properties, consumer equilibrium, Price and income effect; **Production:** Law of production, production function, SR and LR production function, law of returns and returns to scale, Isoquant curve, characteristics, Iso-cost, producer's equilibrium; **Cost and revenue analysis:** Cost concepts, Opportunity cost, Incremental and sunk cost, Recurring and non-recurring cost, fixed and variable cost, short run and long- run cost and revenue curves**; Introduction to markets:** Characteristics and types, **Introduction to Macro Economics:** National Income, Monetary Policy, Fiscal Policy, Inflation and Business Cycle; **Economic decision making:** Cash flow and rate of return analysis, Pay - back period, Internal rate of return(IRR), Net present value(NPV), Time value of money.

F. Text- books

T1. H.L Ahuja, Macroeconomics Theory and Policy, (20e) S. Chand Publication.
T2. Peterson H C et.al., Managerial Economics, (9e), Pearson, 2012
T3. P L Mehta, Managerial Economics, Sultan Chand & Sons, New Delhi, 2012.
T4. G J Tuesen & H G Tuesen, Engineering Economics, PHI, New Delhi, 2008.
T5. James L Riggs, David D Bedworth, Sabah U Randhawa, Engineering Economics, Tata - McGraw Hill, 2018.

G. Lecture plan:

Lec. No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Overview of the course structure, Introduction to Economics	To acquaint and clear the overview of the course	Lecture	NA	NA
2	Objective and scope of the course	Discussion of the objective of the course for the engineers, its scope, differences between micro and macro economics	Lecture	NA	NA
3,4,5,6	Introduction to Consumer Behaviour, Cardinal approaches of utility	Describe the concept of cardinal approach of utility, Law of DMU and equi-marginal utility	Lecture	2001.1	Class Test Mid Term I
7,8	Law of demand and supply	Describe the concept of demand, supply,	Lecture	2001.1	Class Test Mid Term I
9,10,11,12	Elasticity of demand and supply	Elasticity of demand and supply with examples, conceptual questions	Lecture	2001.1	Class Test Mid Term I
13,14,15,	Ordinal approaches of utility, Consumer and producer's surplus	Recall of the differences between the concept of the cardinal approach and ordinal approach of utility , IC analysis, Consumers equilibrium, IE,SE,PE, Consumer and Producer surplus	Lecture	2001.5	Class Test Mid Term I End Term
16	Revision of previous lectures	Recall all the concepts discussed in previous classes	Lecture, Activity		Home Assignment Mid Term I End term
17	Discussion of the topics related to assignment	Discussion about the assignment topics	Lecture	2001.5	Class Test Mid Term I End Term
18,19	Production, laws of	Discussion of the	Lecture	2001.4	Class Test

	production and return to scale	concept of production, recognize production function, producers equilibrium, RTS			Mid Term II End Term
20,21	Cost and revenue analysis	Discussion of the concept of different types of cost and cost function, recognize SR and LR cost curves, revenues	Lecture	2001.4	Class Test Mid Term II End Term
22,23	Types of Market Competition	Aware of market morphology with examples, Interpret the forms of market situations	Lecture	2001.3	Class Test Mid Term II End Term
24	Revision of previous lectures	Recall all the concepts discussed in previous classes	Lecture	2001.5	Class Test Mid Term II End Term
25	Discussion of the topics related to assignment	Recall the discussion about the assignment topics	Lecture, Activity	2001.5	Home Assignment Mid Term II End term
26,27	Macro Economics: National income and its concepts	Interpret and illustrate the concept of CB and various tools	Lecture	2001.2	Home Assignment Class Test End Term
28,29	Monetary and fiscal policies	Interpret and illustrate the concept of NI,GDP,GNI,PI etc., circular flow	Lecture	2001.2	Home Assignment Class Test End Term
30	Inflation	Concept of monetary and fiscal policies, Aware of its instruments, importance and limitations	Lecture	2001.3	Home Assignment Class Test End Term
31	Business Cycle	Concept of Business Cycles, Role of monetary and fiscal policy to counter business cycles	Lecture	2001.3	Home Assignment Class Test End Term
32, 33,34	Economic Decision Making	Cash flow and rate of return analysis, payback period, IRR, NPV and Time value of money	Lecture	2001.3	Home Assignment Class Test End Term
35	Revision of	Recall the	Lecture	2001.5	End Term

	Previous Lectures	discussion about the assignment topics			
36	Conclusion and Course Summarization	Recall all the concepts discussed in previous classes	Lecture	2001.5	End Term
37	Quiz-I	Microeconomics	Quiz	NA	Internal Assessment
38	Quiz-II	Macroeconomics	Quiz	NA	Internal Assessment
39	Quiz-III	Microeconomics Macroeconomics Economic Decision Making	Quiz	NA	Internal Assessment

H. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

CO	Statement	Correlation with program outcomes												Correlation with program specific outcomes			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
EO 2001.1	Describe the basic principles of micro and macroeconomic analysis		2	2													
EO 2001.2	Aware of the tools and techniques of economics and be able to prepare projects				2			2		1		2					
EO 2001.3	Recognize the problems and give solutions which in turn will create employability			2	3	2						2					
EO 2001.4	Interpret and illustrate decision making process in practical life and hence enhance employability						1			2		1	2				
EO 2001.5	Apply the learning of economic concepts in their life						1	2					3				

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Engineering

Department of Mathematics & Statistics

Course Hand-out

Engineering Mathematics-IV | MA 2206 | 3 Credits | 2 1 0 3

Session: February 21 – May 21 Faculty: Dr. Giriraj Methi | Class: II Year (IV Sem. EE)

A. Introduction: An engineering student needs to have some mathematical tools and techniques which emphasize the development of rigorous logical thinking and analytical skills. Based on this, the course aims at giving adequate exposure to the theory and applications. The course is aimed at developing the basic Mathematical skills of engineering students that are imperative for effective understanding of engineering.

B. Course Outcomes: At the end of the course, students will be able to

[MA2206.1] Student will apply concepts of measures of central tendency and dispersion in real life problems.

[MA2206.2] Student will be able to understand the one dimensional and two-dimensional random variables.

[MA2206.3] Students will examine various probability distributions in mathematical problems.

[MA2206.4] Student will understand and use the Z transform in solving difference equations.

[MA2206.5] Students will apply finite difference scheme to Laplace and Poisson equations

Program Outcomes and Program Specific Outcomes

[PO.1]. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences**.**

[PO.3]. **Design/ Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

[PO.4]. **Conduct investigations** of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions**.**

[PO.5]. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an under- standing of the limitations.

[PO.6]. **The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

[PO.7]. **Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

[PO.8]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice**.**

[PO.9]. **Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

[PO.10]. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions**.**

[PO.11]. **Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to owners own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

[PSO.1]. An ability to understand the concepts of basic Electronics & Communication Engineering and to apply them to various areas like Signal processing, VLSI, Embedded systems, Communication Systems, Digital & Analog Devices, etc.

[PSO.2]. An ability to solve complex Electronics and Communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.

[PSO.3]. Wisdom of social and environmental awareness along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur

C. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	Quizzes (Open Book/Close Book) and Assignments	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. A student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

D. Syllabus

Statistics: Mean, Median, Mode measures of dispersion. Finite sample spaces, conditional probability and independence, Bayes' theorem, one dimensional random variable, mean, variance, Chebyshev's inequality. Two and higher dimensional random variables, covariance, correlation coefficient, curve fitting. Binomial, Poisson, uniform, normal, gamma, Chi-square and exponential distributions. Moment generating function, Functions of one and two dimensional random variables, Sampling theory, Central limit theorem. Difference equations with constant coefficients, solutions. Z- Transforms and Inverse Z-transforms. Solutions of Difference equations using Z-transforms. Solution of boundary value problems, Numerical solutions of Laplace and Poisson equations, heat and wave equations by explicit methods

E. Textbook:

T1. Grewal B. S., Higher Engineering Mathematics, (42e), Khanna Publishers, 2013

T2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Eastern, 2006.

F. Reference Book:

R1 Iyengar S.R.K. and Jain, Rajendra K., *Advance Engineering Mathematics (3e)*, Narosa book distributors Pvt Ltd-New Delhi, 2007
R2 Ramana B. V., *Higher Engineering Mathematics* (6th reprint), Tata Mcgraw-Hill, New Delhi, 2008

G. Lecture Plan:

Lecture No.	Description of the Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Measures of central tendency Mean	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2206.1	Quizzes, assignments, Two Sessional, End Term Examination
2	Mode	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2206.1	Quizzes, assignments, Two Sessional, End Term Examination
3	Median	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2206.1	Quizzes, assignments, Two Sessional, End Term Examination

4	Range and Standard deviation	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2206.1	Quizzes, assignments, Two Sessional, End Term Examination
5	Mean deviation	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2206.1	Quizzes, assignments, Two Sessional, End Term Examination
6	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2206.1	Quizzes, assignments, Two Sessional, End Term Examination
7	Conditional probability and Independent	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2206.1	Quizzes, assignments, Two Sessional, End Term Examination
8	Bayes theorem	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2206.1	Quizzes, assignments, Two Sessional, End Term Examination
9	One dimensional random variable Mean and Variance	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples		Quizzes, assignments, Two Sessional, End Term Examination
10	Two and Higher dimensional random variable	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.2	Quizzes, assignments, Two Sessional, End Term Examination
11	Joint pmf and joint pdf	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103..2	Quizzes, assignments, Two Sessional, End Term Examination
12	Probability distributions Binomial distribution	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.2	Quizzes, assignments, Two Sessional, End Term Examination
13	Poisson distribution	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.2	Quizzes, assignments, Two Sessional, End Term Examination

14	Normal distribution	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.2	Quizzes, assignments, Two Sessional, End Term Examination
15	Uniform distribution	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.3	Quizzes, assignments, Two Sessional, End Term Examination
16	Gamma distribution	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.3	Quizzes, assignments, Two Sessional, End Term Examination
17	Chi square distribution	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.3	Quizzes, assignments, Two Sessional, End Term Examination
18	Exponential distribution	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.3	Quizzes, assignments, Two Sessional, End Term Examination
19	Chebyshev's inequality	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.3	Quizzes, assignments, Two Sessional, End Term Examination
20	Moment generating function	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
21	Correlation coefficient	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
22	Rank correlation coefficient	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
23	Functions of one and two dimensional random variables	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.4	Quizzes, assignments, Two Sessional, End Term Examination

24	Sampling theory	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
25	Central limit theorem	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
26	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
27	Difference equations with constant coefficients	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
28	Z transform	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
29	Inverse Z transform	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
30	Solutions of Difference equations using Z-transforms	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.4	Quizzes, assignments, Two Sessional, End Term Examination
31	Applications of Solution of Z transform	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.5	Quizzes, assignments, Two Sessional, End Term Examination
32	Solution of boundary value problems	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.5	Quizzes, assignments, Two Sessional, End Term Examination
33	Numerical solution of Laplace equation	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.5	Quizzes, assignments, Two Sessional, End Term Examination

34	Numerical solution of Poisson equation	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.5	Quizzes, assignments, Two Sessional, End Term Examination
35	Numerical Solution of Heat equation	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.5	Quizzes, assignments, Two Sessional, End Term Examination
36	Numerical solution of Wave equation	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Lecture, Discussion & Examples	2103.5	Quizzes, assignments, Two Sessional, End Term Examination
37	Tutorial	Identify, formulate, apply appropriate techniques, professional ethics, Communicate effectively & life-long learning	Problem solving	2103.5	Quizzes, assignments, Two Sessional, End Term Examination

H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MA2206.1	Student will apply concepts of measures of central tendency and dispersion in real life problems.	3	3	1	3	1				2		2	1			
MA2206.2	Student will be able to understand the one dimensional and two-dimensional random variables	3	2	2	2	2				2		1	1			
MA2206.3	Students will examine various probability distributions in mathematical problems	3	2	2	2	2				3		3	1			
MA2206.4	Student will understand and use the Z transform in solving difference equations	3	3	2	3	2				1		2	1			

MA2206.5	Students will apply finite difference scheme to Laplace and Poisson equations	2	2	1	2	3				2		2	1			

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronic Communication Engineering

Department of Electrical Engineering
Course Hand-out

Electrical Machines-II | EE2201 | 4 Credits | 3 1 0 4

Session: Jan 21 – May. 21 | Faculty: Vinay Gupta | Class: IV Semester, B. Tech. (EEE)

A. **Introduction:** The objective of this course provides a basic understanding of AC & DC machinery fundamentals, constructional features, operational analysis through phasor diagrams, equivalent circuits, determination of performance parameters, testing and applications.

B. **Course Outcomes:** At the end of the course, students will be able to

C. **PROGRAM**

[EE2201.1] Know the fundamentals of AC machines. (**Bloom's Level: knowledge, Comprehensive)**
[EE2201.2] Constructional details, principle of operation of Three-phase and single-phase Induction Motor. (**Bloom's Level: knowledge, Comprehensive)**
[EE2201.3] Comprehend the operation and performance of three phase and single-phase Induction Motor. (**Bloom's Level: Analysis, Application)**
[EE2201.4] Constructional details, principle of operation of synchronous generators. (**Bloom's Level: knowledge, Comprehensive)**
[EE2201.5] Comprehend the working of synchronous motor and its different phenomena. (**Bloom's Level: Analysis, Application)**

OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics_and responsibilities and norms of the engineering practices

[PO.9]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmentally friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

C. **Assessment Plan:**

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	15
	Sessional Exam II (Close Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

D. SYLLABUS

Induction Machines: Three phase Induction motor- construction and working principle, equivalent circuit and phasor diagram, losses and efficiency, torque-slip characteristics, no load & blocked rotor tests, starting, braking, speed control, Induction generator, Single phase induction motor - types, double field revolving theory, torque-slip characteristics.
Synchronous Machines: Alternators– construction and working principle, EMF equation, Equivalent circuit of non-salient

pole alternator, Phasor diagrams, voltage regulation, Synchronization, Synchronizing power and torque, power angle characteristics, Load sharing, Alternator connected to infinite bus, Equivalent circuit of salient pole alternator - Two reaction theory, Phasor diagrams, slip test. Synchronizing power and torque, power angle characteristics. Synchronous motors: working principle, Starting methods, Synchronizing power and torque, Performance characteristics, Hunting, Synchronous condenser.

E. **REFERENCE BOOK**

R1. E. H. Langsdorf, Theory of Alternating Current Machinery (2e), TMH, 2004.
R2. A. E. Clayton & N. N. Hancock, Performance and Design of Direct Current Machines, CBS, 2004.
R3. D. P. Kothari & I. J. Nagrath, Electric Machines (4e), TMH, 2013.
R4. Fitzarald & Kingslay, Electric Machinery, TMH, 2011
R5. P. S. Bhimbra, Electrical Machinery, Khanna Publication, 2011

1. TEXT BOOKS

T1. P. S. Bhimbra, “Electrical Machinery”, Seventh Edition, 1995,Khanna Publishers.
T2. I. J. Nagrath, , D. P.Kothari, “Electric Machines”, Third Edition, Tata McGraw-Hill Publishing Company Ltd.
T3. A. E.Fitzgerald, Charles Kingsley, Jr. Stephen D. Umans, “Electric Machinery”, Fifth Edition, Tata McGraw-Hill.

I. Lecture Plan:

Lec No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	Introduction	To acquaint students with the outcome based education (OBE) and Course outcome (CO) and program outcome (PO) assessment process	Lecture		
2-3	Principle of Three phase induction motor, construction, Type, Equivalent circuit	Describe the construction of Induction motor and its working, types.	Lecture	2201.1 2201.2	In Class Quiz
4-5	Torque equation ,Torque/slip characteristic	Describe the Torque equation ,Torque/slip characteristic	Lecture	2201.1 2201.2	In Class Quiz End Term
T-1	L1-L5	Numerical problems based on L1-L5	Tutorial		
6,7	NO Load and Blocked Rotor Test	Identify different testing and their implementation.	Lecture	2201.1 2201.2	Home Assignment End Term
8,9	Starting Methods of three phase Induction motor- DOL, Star-Delta Starter, Auto Transformer Starter	Describe working of Star/Delta, auto transformer Starter.	Lecture	2201.1 2201.2	In Class Quiz End Term
T-2,T-3	L6-L9	Numerical problems based on L6-L9	Tutorial		
10,11	Speed control Method of three phase induction motor	Describe working of various speed control methods.	Lecture	2201.2 2201.3	Class Quiz Mid Term I End Term
12,13	Plugging, dynamic, regenerative Braking Methods of induction motor	Describe the different braking methods of Induction motor	Lecture	2201.3	Class Quiz Mid Term 1 End term
14,15	Induction generators	Describe the working of induction generator.	Lecture	2201.3	Home Assignment Class Quiz Mid Term 1 End Term
T-4	L10-L15	Numerical problems based on L19-L15	Tutorial		
16,17	single phase Induction motor	Describe the concept of 1-phase induction motor and its construction and working	Lecture	2201.1 2201.3	Class Quiz Mid Term 1 End Term

18,19,20	double field revolving theory, torque-slip characteristics	Describe the concept of double field revolving theory, torque-slip characteristics.	Lecture	2201.1 2201.3	Class Quiz Mid Term I End Term
FIRST SESSIONAL EXAM					
21,22,23	Introduction of generation of Electricity. Synchronous Generator- Construction features, Types, Excitation system Emf Equation.	Recall the basic Rules of Electromagnetic Induction & induced emf	Lecture	2201.1 2201.3	Class Quiz Mid Term II End Term
24-25	Concentrated winding & Distribution Winding, Suppression of Harmonics- Full Pitch coil, short Pitch Coil, Distribution Factor, Pitch Factor, Winding Factor.	Identify different winding and their implementation & harmonics reduction methods	Lecture	2201.1 2201.2	In Class Quiz Mid Term I End Term
T-5-T6	L21-L25	Numerical problems based on L19-L15	Tutorial		
26,27	Armature Reaction, effect of power factor on armature reaction	Explain armature reaction and its effects	Lecture	2201.1 2201.4	Class Quiz Mid Term II End Term
28-29	Open circuit, Short Circuit Characteristics of synchronous generator, Synchronous impedance,	Explain Open circuit, Short Circuit Characteristics	Lecture	2201.1 2201.4	Class Quiz Mid Term II End Term
T-7	L26-L29	Numerical problems based on L26-L29	Tutorial		
30,32	Voltage Regulation, Various Method of determine the Voltage Regulation EMF, MMF, ZPFC Method	Explain voltage regulation and various methods.	Lecture	2201.1 2201.4	Class Quiz Mid Term II End Term
T-8	L30-L32	Numerical problems based on L30-L32.	Tutorial		
33	Power equation of Non salient pole Alternator	Derive the power equation	Lecture	2201.1 2201.4	Class Quiz Mid Term II End Term
34,35,36	Salient pole alternator- Two Reaction Theory, Phasor diagram, Power angle Characteristics	Describe the concept of Two reaction Theory	Lecture	2201.1 2201.4	Class Quiz Mid Term II End Term
T-9	L34-L36	Numerical problems based on L32-L36.	Tutorial		
37,38	Parallel operation of Two alternators-conditions, governor characteristics, synchronization method, alternator connected to infinite bus	Describe the concept of Synchronization.	Lecture	2201.1 2201.4	Class Quiz Mid Term II End Term
T-9	L37-L38	Numerical problems based on L37-L38.	Tutorial	2201.1 2201.4	Class Quiz Mid Term II End Term

SECOND SESSIONAL EXAM					
39	Synchronous motor- Construction, principle of Operation, Armature Reaction, power Input & power Output Developed	Describe the working of synchronous motor and its applications	Lecture	2201.1 2201.5	Class Quiz End Term
40	Performance Characteristics, V-Curve, Inverted V-Curve, synchronous Condenser	Describe the V & inverted V curve	Lecture	2201.1 2201.5	Class Quiz End Term
41	Methods Of Starting, synchronizing power, Synchronizing Torque	Describe the starting methods of synchronous motor.	Lecture	2201.1 2201.5	Class Quiz End term
42	Hunting, Method of Reducing Hunting, Damping Winding, periodicity	Describe the hunting phenomena	Lecture	2201.1 2201.5	
T-10	L39-L42	Numerical problems based on L39-L42.	Tutorial		
END TERM EXAM					

J. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE2201.1	Know the fundamentals of AC machines. (**Bloom's Level: knowledge, Comprehensive)**	2		3		3								2		2
EE 2201.2	Constructional details, principle of operation of Three-phase and single-phase Induction Motor. (**Bloom's Level: knowledge, Comprehensive)**	2		3	3		2							2	2	
EE2201.3	Comprehend the operation and performance of three phase and single-phase Induction Motor. (**Bloom's Level: Analysis, Application)**		3	2				2							3	2
EE2201.4	Constructional details, principle & Analysis of synchronous generators. (**Bloom's Level: knowledge, Comprehensive, Analysis)**		2			2				2				2		2
EE2201.5	Comprehend the working of synchronous motor and its different phenomena (**Bloom's Level: Analysis, Application)**				2			2						2		2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and Communication

Department of Electrical Engineering
Course Hand-out

Generation, Transmission & Distribution | EE2202 | 4 Credits | 3 1 0 4

Session: Jan. 21 – May 21 | Faculty: Dr. Sunil Kumar Goyal | Class: IV Sem. Electrical & Electronics Engineering

A. Introduction: A fundamental course of Electrical Engineering which provides systematic understanding related to operation, working, significance of different conventional generating plants, transmission line parameters, concepts of transmission and distribution of electricity. This will help to provide students knowledge of the modern electricity network operation under balanced steady-state and fault conditions. This course is designed to develop the concepts of the students who are looking for career in the electricity supply industry, electrical maintenance or any large industrial network. The basic familiarity of line parameters and concepts of electricity generation is desired from the students for a better learning.

B. Course Outcomes: At the end of the course, students will be able to

[1502.1]	Describe the basic operation and working of different conventional generation plants and their relative technical comparison.
[1502.2]	Interpret and illustrate the fundamental importance and develop the skills for working on various transmission and distribution systems.
[1502.3]	Recognize transmission line parameters and understand characteristics / performance of short, medium and long transmission lines used for complex electrical power network.
[1502.4]	Analyze and formulate the tasks of reactive power control, power factor improvement and voltage control.
[1502.5]	Identify the characteristics of overhead transmission lines, Corona effect, different Insulators and underground cables.

A. Program Outcomes and Program Specific Outcomes

[PO.1].Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2].Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3].Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4].Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5].Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6].The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7].Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8].Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9].Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

B. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	**15**
	Sessional Exam II (Open Book)	**15**
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	**30**
End Term Exam (Summative)	End Term Exam (Open Book)	**40**
	Total	**100**
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

C. Syllabus

Generation of Electric Power: Hydro Electric Power Plants, Thermal and Nuclear Power Plants, Diesel Power Plant, Typical AC transmission and distribution scheme: Effect of system voltage and regulation, Distribution network elements, distribution schemes, Transmission Line Parameter Calculations, Transmission Line Performance, Ferranti effect, receiving end power circle diagram, regulated system of transmission by reactive power control, Power Factor Improvement, Mechanical characteristics of Overhead lines, Line Insulators, Corona , Underground cables.

D. TEXT BOOKS

1. B. R. Gupta, *Power System Analysis and Design (7e),* S. Chand Publications, 2014.
2. C. L. Wadhwa, *Electrical Power System (3e)*, New Age Intl., 2013.
3. D. P. Kothari & I. J. Nagrath, Power System Engineering (2e), TMH, 2010.

E. REFERENCE BOOKS

1. S. N. Singh*, Electric Power Generation, Transmission and Distribution (6e)*, PHI, 2014.

F. Lecture Plan:

Lec No	**Topics**	**Session Objective**	**Mode of Delivery**	**Correspon-ding CO**	**Mode of Assessing the Outcome**
L1	Course objective and overview of the contents	To acquaint students with the outcome based education (OBE) and Course outcome (CO) and program outcome (PO) assessment process	Lecture		NA
L2 – L4	Introduction to Electric Power System, Overview of Generation, Transmission & Distribution, Types of Load, Plant Economics, Important Terms and Factors.	Basic knowledge of different types of loads, economic aspects of power plants.	Lecture	[1502.1]	Class Quiz
T1 – T2	L1 – L4	Numerical problems based on L1 - L4	Tutorial	[1502.1]	Mid Term Exam
L5 – L6	Schematic diagram explanation, different parts of thermal plants, Operation and working of Thermal Electric Power plants	Understanding of Thermal power plant and its different component. Steam, water, flue gases	Lecture	[1502.1]	Home Assignment Class Quiz Mid Term Exam
L7 – L8	Schematic diagram explanation and Operation & working of Hydro Electric Power plants	Basic understanding of construction and working of Hydro Power Plant	Lecture	[1502.1]	Home Assignment Class Quiz Mid Term Exam
L9 – L10	Requirements, construction and operation of nuclear power plants	Basic understanding of construction and working of Nuclear Power Plant	Lecture	[1502.1]	Home Assignment Class Quiz Mid Term Exam
L11	Diesel Power Plants: Plant equipment, layout of the plants and its operation	Basic understanding of construction and working of Diesel Power Plant			Home Assignment Class Quiz
T3	L5 – L11	Numerical problems based on L5-L11	Tutorial	[1502.1]	Mid Term Exam
L12	Effect of the system voltage and regulation	Calculation of Economic Voltage and voltage regulation	Lecture	[1502.2]	Home Assignment Class Quiz Mid Term Exam
L13	Voltage drop in AC and DC distribution system, Comparison of various distribution system	Comparison of different DC and AC distribution system based on equal power loss	Lecture	[1502.2]	Home Assignment Class Quiz Mid Term Exam
L14	AC-3 phase 4-wire distribution system	Calculation of conductor size for same power transfer and power loss for 3-phase	Lecture	[1502.2]	Class Quiz Mid Term Exam
L15	Types of primary and secondary distribution systems	Calculation of size of conductor for same power transfer and power loss for 1-phase	Lecture	[1502.2]	Class Quiz Mid Term Exam
L16	Kelvin's Law and flickering of Lamps	Calculation of economic cost of conductor based on installation cost and operating cost	Lecture	[1502.2]	Class Quiz Mid Term Exam
T4 – T5	L12– L16	Numerical problems based on L12-L16	Tutorial	[1502.2]	Mid Term Exam
L17 - L18	Flux linkages within and outside the conductor producing fluxes, Inductance of single phase two wire line and of composite conductor lines	Derivation of basic relation of inductance of single phase transmission line for single, two wire and stranded conductors.	Lecture	[1502.3]	Home Assignment Class Quiz Mid Term Exam

L19 – L20	Inductance of three phase line with equilateral and unsymmetrical spacing, inductance of bundled conductors	Estimation of inductance of three phase transmission line in different configuration including bundle conductors and double circuit	Lecture	[1502.3]	Home Assignment Class Quiz Mid Term Exam
L21 - L22	Electric field and potential difference, capacitance of two-wire line, Capacitance of 3-phase line with equilateral spacing and unsymmetrical spacing	Derivation of basic relation of capacitance of single phase transmission line for single, two wire and stranded conductors.	Lecture	[1502.3]	Home Assignment Class Quiz Mid Term Exam
L23 – L24	Capacitance of Bundled conductor lines and double circuit three phase lines	Estimation of inductance of three phase transmission line including bundle conductors and double circuit	Lecture	[1502.3]	Home Assignment Class Quiz Mid Term Exam
T6 – T7	L17 – L24	Numerical problems based on L17-L24	Tutorial	[1502.3]	Mid Term Exam
L25	Representation of transmission lines, per unit method and advantages of per unit method	Per unit calculation of different transmission line parameters	Lecture	[1502.3]	Home Assignment Class Quiz Mid Term Exam
L26 – L27	Short and medium transmission lines	Representation and calculation of transmission line parameters	Tutorial	[1502.3]	Class Quiz Mid Term Exam
L28 – L29	Long transmission lines, ABCD parameters and equivalent T and pi networks.	Representation and calculation of transmission line parameters in equivalent T and π networks	Lecture	[1502.3]	Home Assignment Class Quiz Mid Term Exam
L30	Ferranti effect, power formulae for transmission lines	Analysis of Ferranti effect and its significance in power system	Lecture	[1502.3]	Home Assignment Class Quiz Mid Term Exam
T8 – T9	L29 – L33	Numerical problems based on L25-L30	Tutorial	[1502.3]	Mid Term Exam
L31 – L32	Natural loads and power circle diagrams	Calculation of sending end and receiving end power	Lecture	[1502.4]	Class Quiz Mid Term Exam
L33 – L34	Line voltage regulation and its control through reactive power regulation, power factor improvement	Formation of sending end and receiving end power circle diagram and power factor improvement	Lecture	[1502.4]	Home Assignment Class Quiz Mid Term Exam
T10	L31-L34	Numerical problems based on L31-L34	Tutorial	[1502.4]	Mid Term Exam
L35 – L37	Insulators, Voltage distribution in insulator string and improvement of string efficiency	Voltage distribution in different discs and calculation of string efficiency	Lecture	[1502.5]	Class Quiz Mid Term Exam
L38 – L39	Corona phenomenon, Corona loss, factors and conditions affecting corona loss	Process of Corona, calculation of disruptive voltage and factors affecting corona losses	Lecture	[1502.5]	Home Assignment Class Quiz Mid Term Exam
L40	Radio interference due to corona and corona in bundled conductors	Impact of corona including RI and factors reducing corona losses	Lecture	[1502.5]	Class Quiz Mid Term Exam
T11 – T12	L35-L40	Numerical problems based on L35-L40	Tutorial	[1502.5]	Mid Term Exam
L41	Underground cables: Insulation, sheath, armour and covering, Classification of cables, effective conductor resistance	Basic construction of cables and its classification and different parameters	Lecture	[1502.5]	Home Assignment Class Quiz Mid Term Exam
42	Grading of cables, capacitance of three core belted cable, Breakdown of cables, current rating of cables	Categorization of cables based on capacitance grading	Lecture	[1502.5]	Home Assignment Class Quiz Mid Term Exam

Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 1502.1	Describe the basic operation and working of different conventional generation plants and their relative technical comparison.		1	2				3					1		2	1
EE 1502.2	Interpret and illustrate the fundamental importance and develop the skills for working on various transmission and distribution systems.	1	1		3											3
EE 1502.3	Recognize transmission line parameters and understand characteristics / performance of short, medium and long transmission lines used for complex electrical power network.	3	2			1							1	3		1
EE 1502.4	Analyze and formulate the tasks of reactive power control, power factor improvement and voltage control.		3	1			2								2	1
EE 1502.5	Identify the characteristics of overhead transmission lines, Corona effect, different Insulators and underground cables.			3		1		2					1	2	1	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Course Outcome Attainment Level Matrix:

CO	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES **THRESHOLD VALUE: 40%**											ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 1502.1	Describe the basic operation and working of different conventional generation plants and their relative technical comparison.		1	2				3					1		2	1
EE 1502.2	Interpret and illustrate the fundamental importance and develop the skills for working on various transmission and distribution systems.	1	1		3											3
EE 1502.3	Recognize transmission line parameters and understand characteristics / performance of short, medium and long transmission lines used for complex electrical power network.	3	2			1							1	3		1
EE 1502.4	Analyze and formulate the tasks of reactive power control, power factor improvement and voltage control.		3	1			2								2	1
EE 1502.5	Identify the characteristics of overhead transmission lines, Corona effect, different Insulators and underground cables.			3		1		2					1	2	1	1

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and Communication Engineering

Department of Electrical Engineering
Course Hand-out

Microcontrollers | EE 2203 | 3 Credits | 2 1 0 3

Session: JAN2021 – MAY2021 | Faculty: Abhishek Kumar | Class: IV Sem B Tech (E&E)

A. Introduction: This course is offered by Dept. of Electrical Engineering as a core course, targeting students who wish to work in the area of embedded systems and automation. This course provides an understanding about the concepts and basic architecture of 8051,8085 and AMR microcontroller, an overview of difference between microprocessor and micro controller, background knowledge and core expertise in microcontroller, study the architecture and addressing modes of 8051, knowledge about assembly language programs of 8051, knowledge of different types of external interfaces including LEDS, LCD, Keypad Matrix, Switches & Seven segment display, motors etc. The course also build up the basic understanding of the importance of different peripheral devices & their interfacing to 8051 and give an overview of recent growth and trends of ARM controllers & processors.

B. Course Outcomes: At the end of the course, students will be able to

[EE2203.1] Acquire the **knowledge** of Microcontroller types and variants, its features, specifications and architecture. **Bloom's Level: Cognitive level Knowledge.**

[EE2203.2] Simulate**, Analyze** and **develop** Microcontroller 8051 based programs using assembly language and high level language (**'**C**'**) in simulation software like Keil. **Bloom's Level: Cognitive level Analysis, Synthesis.**

[EE2203.3] Analyze and simulate the working of on-chip features of 8051 like timers, interrupts of 8051 **Bloom's Level: Cognitive level Analysis**.

[EE2203.4] Design, analyze and simulate circuits to interface stepper motor and LCD to 8051 microcontroller Kit. **Bloom's Level: Cognitive level Synthesis, Analysis.**

[EE2203.5] Ability to **analyze** a problem and **formulate** appropriate computing solution for microcontroller and microprocessor based applications and hence **enhancing skill development** in the area. **Bloom's Level: Cognitive level Analysis, Synthesis, Evaluation.**

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4]. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Plan:

Criteria	Description	Maximum Marks
	Sessional Exam I	20

Internal Assessment (Summative)	Sessional Exam II	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Introduction to microprocessors and microcontrollers, general purpose and embedded systems, CISC and RISC architectures, AT89C51 (8051) microcontroller: Architecture, pin diagram, addressing modes, instruction set, programming, stack, subroutines, GPIO, timers, serial port, interrupts. Interfacing keyboard, LCD, ADC and DAC to 8051. Embedded software development in 'C'. Programming 8051 in 'C'. ARM7 based NXPLPC21XX microcontroller: architecture, programming and interfacing.

F. TEXT BOOKS

T1. M. A. Mazidi and G. Mazidi, *The 8051 Microcontroller and embedded systems, using assembly and 'C'*, Pearson education, 2013.

T2. K. Ayala, *The 8051 Microcontroller and embedded systems, using assembly and 'C'*, Cengage Learning, 2009.

T3. S. Furber, *ARM System - on – Chip Architecture* (2e), Pearson, 2015.

T4. W. Hohl and H. Christopher, *ARM Assembly Language*, CRC Press, 2016.

H. Lecture Plan:

Lec No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Revision : Introduction of number system, Digital system, Adder, MUX, DeMUX, Decoder, Encoder	Recall of concepts of digital electronics	Lecture	[EE2203.1].	Class Quiz Home Assignment END TERM EXAM MID TERM 1
2	Memory : Flip flop, Register, Definitions of Bit, nibble, byte, word, Memory Organization, Memory size & address line, data lines	Recall of concepts of digital electronics and memory managements	Lecture	[EE2203.1].	
3	Introduction of Keil Software, Creating the new project, Create, translate, build and debug of Assembly program	Introduce the concepts of simulation software and its features	Lecture, Hands on Practice Session	[EE2203.2].	
4	Computer system: Organization, Block diagram; Introduction of Embedded system, History of ICs, Difference b/w Microprocessor & Microcontroller	Introduce the basic computer systems and its components	Lecture	[EE2203.1].	
5	Introduction of Microcontroller 8051,8085 microprocessor, Various flavors of uC 8051: 8031, 8052, features & specification	Introduce the Microcontroller 8051 and its various variant	Lecture	[EE2203.1.	
6	Assembly programing, Working of CPU, Various blocks available in 8051: CPU registers, register bank, SFRs	Introduce the assembly programming concepts and its functioning	Lecture, Hands on Practice Session	[EE2203.2].	
7	8051 blocks: Internal registers, Program Counter, Instruction Decoder and their role and	Describe the execution functional blocks of Mc 8051	Lecture, Hands on Practice Session	[EE2203.2].	
8	8051 Memory, ROM addressing, RAM architectures: , Various special function registers, Register bank & their selections, bit addressable area, Scratch Pad RAM	Describe the Memory architecture of Mc 8051	Lecture	[EE2203.2].	
9	Memory: ROM, PROM, UVPROM, EEPROM, Flash memory: Descriptions and Role in Computer system	Describe various types of Memory units	Lecture	[EE2203.2].	
10	PSW & its bits, Concept of Carry, Auxiliary Carry, Parity & examples	Introduce the functioning of PSW register	Lecture, Practice Session	[EE2203.2].	
11	Concept of Overflow, Signed & unsigned Number presentation, Concept of overflow in signed operations.	Introduce the signed and unsigned operations and the concept of overflow.	Lecture, Practice Session	[EE2203.2].	
12	Architecture of 8051 : Diagram, Description	Describe the architecture of Mc 8051	Lecture	[EE2203.1].	
13	Pin Diagram of 8051: Discussion on Pins & Signals (1): Supply Pins, Oscillator Pins, Pull up registers, Port P0,	Describe the Pin Diagram of Mc 8051 and its signal functioning	Lecture	[EE2203.3].	

	P1, P2 & P3, their specifications, functions and uses				
14	Instructions: Definitions, general format, Classification: (Bit wise & Byte wise), (1 Byte, 2 bytes & 3 Bytes Instructions)	Describe the various classifications of assembly language instructions	Lecture	[EE2203.2].	
15	Process flow chart of program execution, Concept of list file, absolute file & OH file, Hex file, Assembler Directives, Data Directives	Describe the systematic execution of assembly language instruction	Lecture	[EE2203.2].	
16	Addressing Mode: Definition, Types, explanation of each types with examples	Introduce the Addressing Modes and its types	Practice Session, Activities	[EE2203.1].	
17	Instructions (1): Data transfer operations (inside the RAM): MOV , XCH and XCHD ; formats, explanation, specifications and Assembly Programs	Explain the utilisation of instructions in various applications	Lecture, Practice Session	[EE2203.2].	
18	Instructions (2): Data transfer operations (From internal ROM to RAM): MOVC ; formats, explanation, specifications and Assembly Programs	Explain the utilisation of instructions in various applications	Lecture, Practice Session	[EE2203.2].	
19	Instructions (3): Data transfer instructions((B/w external Memory & RAM): MOVX ; formats, explanation, specifications and Assembly Programs	Explain the utilisation of instructions in various applications	Practice Session, Activities	[EE2203.2].	
20	Instructions (4): Arithmetic operations: ADD, ADDC, INC, DEC: formats, explanation, specifications and Assembly Programs	Explain the utilisation of instructions in various applications	Lecture, Practice Session	[EE2203.2].	
21	Instructions (5): Arithmetic operations: SUBB, MUL, DIV, DA : formats, explanation, specifications and Assembly Programs, BCD operations	Explain the utilisation of instructions in various applications	Lecture, Practice Session	[EE2203.2].	
22	Instructions (6): Logical operations: ANL, ORL, XRL, CLR, CPL : formats, explanation, specifications and Assembly Programs	Explain the utilisation of instructions in various applications	Practice Session, Activities	[EE2203.2].	
23	Instructions (7): Rotate Operations: RR, RRC, RL, RLC : formats, explanation, specifications and Assembly Programs; Stepper motor Programming	Explain the utilisation of instructions in various applications	Lecture, Practice Session	[EE2203.2].	Class Quiz Home Assignment END TERM EXAM MID TERM 1
24	Instructions (8): Boolean Manipulation operation: CLR,	Explain the utilisation of instructions in	Lecture, Practice	[EE2203.2].	

	SETB, CPL, ANL, ORL : formats, explanation, specifications and Assembly Programs	various applications	Session		
25	Instructions (9): Conditional Branching operation: DJNZ, CJNE : formats, explanation, specifications and Assembly Programs, Concept of Looping and Pointers	Explain the utilisation of instructions in various applications	Practice Session, Activities	[EE2203.2].	
26	Instructions (10): Conditional Branching operation: JZ, JNZ, JC, JNC : formats, explanation, specifications and Assembly Programs, Concept of Looping and Pointers	Explain the utilisation of instructions in various applications	Lecture, Practice Session	[EE2203.2].	
27	Instructions (11): Unconditional Branching operation: SJMP, LJMP, AJMP: formats, size, range, explanation, Hex code Calculations and Assembly Programs, Concept & calculation of relative address, absolute address.	Explain the utilisation of instructions in various applications	Practice Session, Activities	[EE2203.2].	
28	Instructions (12): Unconditional Branching operation: ACALL, LCALL, RET: formats, size, range, explanation, Hex code Calculations and Assembly Programs, Role of stack in calling instructions	Explain the utilisation of instructions in various applications	Lecture, Practice Session	[EE2203.2].	
29	Time delay calculation, Generation using 8051 instructions, Programming using 8051 instructions	Explain the utilisation of instructions for delay generations	Lecture, Practice Session	[EE2203.3].	
30	8051 timers: Introductions, Timer Registers, TMOD & TCON Registers: Presentations and explanations	Introduce the Timer registers and Timer control registers of Microcontroller	Practice Session, Activities	[EE2203.3].	
31	8051 Timers, Programming timers, timer modes : Mode 0 and Mode 1 Programming for particular delay generations	Explain the Timer Modes of Timer and its utilisations	Lecture, Practice Session	[EE2203.3]. [EE2203.5].	
32	Counter programming, Programming using 8051 instructions, parallel I/O ports of 8051, Alternate functions	Explain the Counter Modes of Timer and its utilisations	Practice Session, Activities	[EE2203.3].	
33	Enabling/Disabling interrupts, IE Register and IP Register: Presentations, explanations and uses	Explain the use of Interrupt in Microcontroller	Lecture, Practice Session	[EE2203.3].	
34	Interrupt Programming: timer interrupts T0 and T1: programming and application Programs, External hardware interrupt.	Explain the use of Interrupt in Microcontroller	Lecture, Practice Session	[EE2203.3].	Class Quiz Home Assignment END TERM EXAM MID TERM 2

35	LCD Interfacing with 8051: LCD Basics, Pin descriptions, Command Code, Busy flag concept, Programming	Explain the use of LCD and its interface with Microcontroller using ALP and Embedded C.	Practice Session, Activities	[EE2203.4]. [EE2203.5].	
36	LCD Interfacing with 8051 (2): Busy flag concept, LCD Read concept, Application Programs	Explain the use of LCD and its interface with Microcontroller and hence enhancing skill development in the area.	Lecture, Practice Session	[EE2203.4]. [EE2203.5].	
37	Stepper motor Interfacing with 8051: Stepper motor Basics, Pin descriptions, Rotate sequence, Programming, Speed Control using delay	Explain the use of Stepper Motor and its interface with Microcontroller and hence enhancing skill development in the area.	Lecture, Practice Session	[EE2203.4]. [EE2203.5].	
38	Keyboard, ADC and DAC interfacing with 8051 microcontroller.	Programming in Embedded C and ALP for interfacing keyboard , ADC and DAC with 8051.	Practice Session, Activities	[EE2203.4]. [EE2203.5].	
39	ARM7 based NXPLPC21XX microcontroller: architecture,	Explain the architecture and use of ARM microcontroller.	Lecture, Practice Session	[EE2203.5]	
40	ARM7 based NXPLPC21XX microcontroller: architecture, programming and interfacing.	Interfacing programming concept of ARM microcontroller.	Lecture, Practice Session	[EE2203.5].	Class Quiz Home Assignment END TERM EXAM

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 2203.1	Acquire the knowledge of Microcontroller types and variants, its features, specifications and architecture	2			3								2	2		
EE 2203.2	Simulate, Analyze and develop Microcontroller 8051 based programs using assembly language and high level language ('C') in simulation software like Keil.	2	2	1	2	1							1		3	2
EE 2203.3	Analyze and simulate the working of on-chip features of 8051 like timers, interrupts of 8051.	2	2	1	2	1							1		3	2
EE 2203.4	Design, analyze and simulate circuits to interface stepper motor and LCD to 8051 microcontroller Kit.	2	2	2	2	1							1		3	2
EE 2203.5	Ability to analyze a problem and formulate appropriate computing solution for microcontroller and microprocessor based Applications and hence enhancing skill development in the area.	2	3	3	2	2	2	1					2	2	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and communication Engineering (SEEC)

Department of Electrical Engineering
Course Hand-out

SOLAR PHOTOVOLTAICS | EE 2080| 3 Credits | 3 0 0 3

Session: August 20 – Dec 20 | Faculty: Mahipal Bukya | Class: Open-Elective

A. INTRODUCTION: This course is offered by Dept. of Electrical Engineering as an open-Elective subject, targeting students who wish to pursue researchand development in solar photo-voltaicsystem or higher studies in field of solar energy including solar radiations, PN junction diode & its characteristics, solar cell, solar PV modules, balance of solar PV systems, etc. Students are expected to have background knowledge on semiconductors, charge carriers and their motion in semiconductors, p-type and n-type of semiconductors, etc. for a better learning.

B. COURSE OUTCOMES: At the end of the course, students will be able to

[EE 2080.1]. To understand the basics of Solar Radiations, their measurement and tracking
[EE 2080.2]. Comprehend the PN Junction Diode & Characteristics
[EE 2080.3]. Interpret and explain the Solar Cell and its application in SPV System
[EE 2080.4]. Understand and develop skills for Solar PV Modules
[EE 2080.5]. Acquire knowledge about Balance of System (BOS) and Batteries

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9]. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. ASSESSMENT PLAN:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	15
	Sessional Exam II (Close Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Solar Radiation: Spectrum, Terminologies, Measurement, Estimation; Sun-Earth Movement & Angles, Sun Tracking, PN Junction Diode & Characteristics, Solar Cell, Photovoltage, Light Generated Current, I-V equation & Characteristics: Short Circuit Current, Open Circuit Voltage, Maximum Power Point, Fill Factor, Efficiency, Losses, Equivalent Circuit, Effect of Series & Shunt Resistance, Solar Radiation, Temperature on Efficiency, Solar PV Modules: Series & Parallel connection, Hotspots, Bypass & Blocking Diodes, Power Output, Ratings, I-V & Power Curve, Effect of Solar Irradiation & Temperature, Balance of System (BOS): Batteries: Classification, Capacity, Voltage, Depth of Discharge, Life Cycle, Factors affecting Battery Performance; Charge Controllers, DC to DC Converters, DC to AC converters, Maximum Power Point Tracking (MPPT).

F. TEXT BOOKS:

1. C. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Application, PHI New Delhi, 2009.
2. G. N. Tiwari, Solar Energy: Fundamentals, Design, Modeling and Applications, Narosa Publications New Delhi, 2013.

G. REFERENCE BOOKS

1. S. Deambi, Photovoltaic System Design, CRC Press USA, 2016.
2. F. Kreith and D. Y. Goswami, Energy Management and Conservation Handbook (2e), CRC Press USA, Fairmont Press, USA, 2017.
3. J. Balfour, M. Shaw and N. B. Nash, Advanced Photovoltaic Installations, Jones &Barlett Learning USA, 2013.
4. B.H. Khan, Non-conventional Energy Resources, TMH, 2006.
5. G.D. Rai, Non-conventional Energy Resources, Khanna Publishers.

H. LECTURE PLAN:

Lecture no.	Topic to be covered
L1	Introduction of course
L2	Introduction Non-renewable and Renewable Energy sources
L3	Solar Energy, applications, & advantages.
L4	Extra-terrestrial Solar radiation
L5	Solar spectrum at the earth surface
L6	Terminologies
L7	Sun-Earth Movement & Angles
L8	Angles of Sunrays on Solar collector
L9	Sun Tracking
L10	Estimation of solar radiation
L11	Measurement of solar radiation
L12	Numericals on Solar radiations
L13	Fundamentals of Semiconductors
L14	Energy bands
L15	Charge carriers, their concentration and distribution, motion,
L16	Electric field and Energy band bending, generation and recombination of carriers
L17	Introduction to P-N junction in equilibrium and non-equilibrium condition
L18	Numericals on PN Junction Diode & Characteristics
L19	Numericals on PN Junction Characteristics
L20	Photovoltage, Light Generated Current
L21	I-V equation and characteristics
L22	Short Circuit Current, Open Circuit Voltage
L23	Maximum Power Point, Fill Factor, Efficiency, Losses
L24	Equivalent Circuit of Solar cell
L25	Effect of Series & Shunt Resistance
L26	Solar Radiation, Temperature on Efficiency
L27	Numericals on Solar Cell
L28	Solar PV modules from Solar cells
L29	Series & Parallel connection
L30	Mismatch in Series connection: Hotspots, Bypass & Blocking Diodes
L31	Mismatch in Parallel connection
L32	Design and Structure of PV modules
L33	PV module Power Output, Ratings, I-V & Power Curve
L34	Effect of Solar Irradiation & Temperature
L35	Numericals on Solar PV Modules
L36	Introduction to Batteries
L37	Factors affecting battery performance
L38	Battery Parameters: Capacity, Voltage, Depth of Discharge, Life Cycle
L39	Batteries for PV systems, comparison
L40	DC to DC Converters
L41	Charge controllers
L42	DC to AC converters
L43	Maximum Power Point Tracking (MPPT)
L44	Numericals on Balance of Solar PV systems

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and communication Engineering (SEEC)

Department of Electrical Engineering

Course Hand-out

Fundamentals of Renewable Energy Sources (FRES)| EE 2082| 3 Credits | 3 0 0 3

Session: Jan. 2021 – May 2021 | Faculty: Mr. Divya Rishi Shrivastava | Class: IV Semester (Open Elective)

A. **Introduction:** This course is offered by Dept. of Electrical Engineering as an Open Elective, targeting students who wish to pursue research & development in industries or higher studies in the field of renewable energy sources and the related electrical engineering practices. Worldwide attention to environmental issues combined with the energy crisis has forced us to increase the use of renewable energy sources which are freely available in the nature and are environment friendly. Energy found in the renewable resources is converted into a form, we can use as heat or electricity. To understand this course students are expected to have background knowledge of electricity and mathematics.

B. **Course Outcomes:** At the end of the course, students will be able to

[2082.1]. Discuss the utilization of renewable sources and their pattern in the past, present and future projections of consumption.

[2082.2]. State the fundamentals of power systems and explain the operation and working of various kinds of power generation sources.

[2082.3]. Recognize the need and advancements in the renewable energy sources, analyse the problems and their possible solutions in harnessing energy from renewable sources.

C. **PROGRAM OUTCOMES (PO)**

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9]. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

D. PROGRAM SPECIFIC OUTCOMES (PSO)

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

E. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15/20
	Sessional Exam II (Closed Book)	15/20
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	30/20
End Term Exam (Summative)	End Term Exam (Closed Book)	40/40

	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

F. SYLLABUS

Energy sources and their availability, **Solar Energy -** Solar radiation and measurements, solar energy storage, Solar Photo-Voltaic systems design, **Wind Energy-** Estimation, Maximum power and power coefficient, wind energy conversion systems, design considerations and applications. **Energy from Bio-Mass-** Sources of bio-mass, Biomass conversion technologies, Thermo-chemical conversion and Biochemical conversions, Anaerobic digestion and Fermentation, Bio-gas generation Pyrolysis and Liquefaction, Classification of Gasifiers, **Geo-Thermal Energy**, **Energy plantation**- Energy from the Oceans, Ocean Thermal Energy Conversion, Open and Closed Cycle plants, Site selection considerations, **Origin of tides**, Tidal energy conversion systems, Wave energy conversion systems, **Hybrid Energy Systems**.

G. REFERENCE BOOKS

1. B. H. Khan, *Non-conventional Energy Resources*, TMH, 2009.
2. J. W. Twidell & A. D. Weir , *Renewable Energy Resources*, ELBS, 2005.
3. D. Mukherjee & S. Chakrabarti, *Fundamentals of Renewable Energy Systems*, New Age Intl., 2004.
4. G. D. Rai, *Non-Conventional Energy Sour*ces, Khanna Publishers, 2004.

H. Lecture Plan:

Lecture No.	TOPICS
1	Course objective and overview of the contents
2-4	Brief Introduction of the energy sources and their availability
5-13	Solar Energy - Solar radiation and measurements, solar energy storage, Solar Photo-Voltaic systems design
14-20	Wind Energy- Estimation, Maximum power and power coefficient, wind energy conversion systems, design considerations and applications
21-24	Energy from Bio-Mass- Sources of bio-mass, Biomass conversion technologies, Thermo-chemical conversion and Biochemical conversions
25-27	Anaerobic digestion and Fermentation, Bio-gas generation Pyrolysis and Liquefaction, Classification of Gasifiers
28-30	Geo-Thermal Energy
31-34	Energy plantation- Energy from the Oceans, Ocean Thermal Energy Conversion, Open and Closed Cycle plants, Site selection considerations
35-37	Origin of tides, Tidal energy conversion systems
38-39	Wave energy conversion systems
40-42	Hybrid Energy Systems

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 2082.1	Discuss the utilization of renewable sources and their pattern in the past, present and future projections of consumption.	3	2	3	2	1	1	2	0	0	0	1	2	1	2	0
EE 2082.2	State the fundamentals of power systems and explain the operation and working of various kinds of power generation sources.	3	2	0	1	1	0	2	0	0	1	0	0	2	1	2
EE 2082.3	Recognize the need and advancements in the renewable energy sources, analyse the problems and their possible solutions in harnessing energy from renewable sources.	3	2	2	2	2	1	2	1	1	1	1	2	2	1	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and Communication

Department of Electrical Engineering
Course Hand-out

Electrical Machinery Lab – II | EE2230 | 1 Credits | 0 0 2 1

Session: Jan. 21 – May 21 | Faculty: Dr. Sunil Kumar Goyal | Class: IV Sem. Electrical & Electronics Engineering

A. Introduction: A fundamental course of Electrical Engineering which provides systematic understanding related to operation, working, significance of different electrical machines. The operational characteristics of single-phase induction machines i.e. no-load & blocked rotor test, load test etc. are discussed. Different characteristics of synchronous machines which includes OC/SC test, voltage regulation by EMF, MMF and ZPF methods. The V-Curves and Inverted V-Curves has also been plotted and determination of different reactance are also performed in this lab. Design of different electrical machines i.e. single and three phase transformers, DC machines, Induction machines and synchronous machine on MATLAB platform is also included. It improves the student's understanding of various basic electrical machines and their working in different operating conditions. This course is designed to develop the concepts of the students who are looking for career in the core electrical machine design, electricity supply industry, electrical maintenance or any large industrial network.

B. Course Outcomes: At the end of the course, students will be able to

[EE2230.1]	Understand the working principle and different characteristics of Induction Machines.
[EE2230.2]	Understand the working principle and different characteristics of Synchronous Machines.
[EE2230.3]	Designing of various Electrical Machines i.e. Transformers, D.C. Machines, Induction and Synchronous Machines.

A. Program Outcomes and Program Specific Outcomes

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

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[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9]. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

B. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Internal Assessment	**60**
End Term Exam (Summative)	End Term Exam	**40**
	Total	**100**
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	

Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.

C. Syllabus

Induction Machine: No load and blocked rotor tests, load test on three phase squirrel cage & Slip ring induction motor, load test on induction generator. Load test on Single Phase Induction Motor. Synchronous Machines: V- and inverted V-curves of synchronous machines, Measurement of X_d and X_q of a salient pole synchronous machine, Predetermination of regulation of alternator. Synchronization of alternator, Design of Electrical Machines.

D. REFERENCE BOOKS

1. E. H. Langsdorf, Theory of Alternating Current Machinery (2e), TMH, 2004.
2. A. E. Clayton & N. N. Hancock, Performance and Design of Direct Current Machines, CBS, 2004.
3. Fitzarald & Kingslay, Electrical Machinery, TMH, 2011.
4. P. S. Bhimbra, Electrical Machinery, Khanna Publication, 2011.
5. D. P. Kothari & I. J. Nagrath, Electrical Machines (4e), TMH, 2013.

E. Lecture Plan:

Exp No	Experiment Description	Lab Objective	Mode of Delivery	Corresponding COs	Mode of Assessing Outcome
1	Conduct the no load test & blocked-rotor test on single phase induction motor	Student will learn to perform OC test & Short circuit test on single phase induction motor	Laboratory Tutorial and Experiments	EE2230.1	Continuous Lab Evaluation and End Term Practical exam
2	To conduct load test on single phase induction motor	Student will learn to perform the load test & draw the different characteristic	Laboratory Tutorial and Experiments	EE2230.1	Continuous Lab Evaluation and End Term Practical exam
3	To conduct the open circuit and short circuit tests on the given 3-phase Alternator.	Student will learn to apply OC & SC test to get the OCC & SCC characteristic of Three phase Alternator	Laboratory Tutorial and Experiments	EE2230.2	Continuous Lab Evaluation and End Term Practical exam
4	To determine the Voltage Regulation of 3- Phase alternator by E.M.F. Method.	Student will learn to determine the Voltage Regulation of Alternator by EMF Method & Understand the Concept of EMF	Laboratory Tutorial and Experiments	EE2230.2	Continuous Lab Evaluation and End Term Practical exam
5	To determine the Voltage Regulation of 3- Phase alternator by M.M.F. Method.	Student will learn to determine the Voltage Regulation of Alternator by MMF Method & Understand the Concept of MMF	Laboratory Tutorial and Experiments	EE2230.2	Continuous Lab Evaluation and End Term Practical exam
6	To determine the Voltage Regulation of 3- Phase alternator by Z.P.F.C. Method.	Student will learn to determine the Voltage Regulation of Alternator by Z.P.F.C Method & Understand the Concept of Z.P.F.C	Laboratory Tutorial and Experiments	EE2230.2	Continuous Lab Evaluation and End Term Practical exam
7	To determine the direct axis and quadrature axis reactance of a salient pole alternator by slip test.	Student will learn to apply Slip test & how to find X_d & X_q of salient pole alternator.	Laboratory Tutorial and Experiments	EE2230.2	Continuous Lab Evaluation and End Term Practical exam

8	To determine the V-curve of synchronous machine.	Student will learn and draw the V-curve of synchronous machine	Laboratory Tutorial and Experiments	EE2230.2	Continuous Lab Evaluation and End Term Practical exam
9	To Synchronize a 3- phase Alternator with incoming grid supply.	Student will learn how to operate the alternator parallel with incoming bus-bar & what conditions should be fulfilled for this operation	Laboratory Tutorial and Experiments	EE2230.2	Continuous Lab Evaluation and End Term Practical exam
10	Design the 1-phase core type transformer of given specifications.	Student will learn designing of 1-phase core type transformer of given specifications	Laboratory Tutorial and Experiments	EE2230.3	Continuous Lab Evaluation and End Term Practical exam
11	Design the 3-phase core type transformer of given specifications.	Student will learn designing of 3-phase core type transformer of given specifications	Laboratory Tutorial and Experiments	EE2230.3	Continuous Lab Evaluation and End Term Practical exam
12	Design the DC machine of given specifications.	Student will learn designing DC machine of given specifications.	Laboratory Tutorial and Experiments	EE2230.3	Continuous Lab Evaluation and End Term Practical exam
13	Design the 3-phase induction machine of given specifications.	Student will learn designing 3-phase induction machine of given specifications	Laboratory Tutorial and Experiments	EE2230.3	Continuous Lab Evaluation and End Term Practical exam
14	Design the 3-phase Synchronous machine of given specifications.	Student will learn designing the 3-phase Synchronous machine of given specifications	Laboratory Tutorial and Experiments	EE2230.3	Continuous Lab Evaluation and End Term Practical exam

Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
[EE2230.1]	Understand the working principle and different characteristics of Induction Machines.	3	3	2	3	2				1			2	3	2	3
[EE2230.2]	Understand the working principle and different characteristics of Synchronous Machines.	3	3	2	3	2				2			2	3	2	3
[EE2230.3]	Designing of various Electrical Machines i.e. Transformers, D.C. Machines, Induction and Synchronous Machines.	3	3	3	1	3				1				2	3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Course Outcome Attainment Level Matrix:

CO	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES **THRESHOLD VALUE: 40%**											ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
[EE2230.1]	Understand the working principle and different characteristics of Induction Machines.	3	3	2	3	2				1			2	3	2	3
[EE2230.2]	Understand the working principle and different characteristics of Synchronous Machines.	3	3	2	3	2				2			2	3	2	3
[EE2230.3]	Designing of various Electrical Machines i.e. Transformers, D.C. Machines, Induction and Synchronous Machines.	3	3	3	1	3				1				2	3	2

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and Communication Engineering

Department of Electrical Engineering
Course Hand-out

Microcontroller Laboratory | EE 2231 | 1 Credits | 0 0 2 1

Session: JAN2021 – MAY2021 | Faculty: Abhishek Kumar | Class: IV Sem B Tech (EEE)

A. Introduction: This course is offered by Dept. of Electrical Engineering as a Laboratory course, targeting students who wish to work in the area of embedded systems and automation. This course provides an understanding about the concepts and basic architecture of 8051, background knowledge of Keil Software in microcontroller, knowledge about assembly language programs of 8051 and ARM7 based microcontroller, knowledge of different types of external interfaces including LEDS, LCD, Switches, stepper motor etc. The course also build up the basic understanding of the importance of different peripheral devices & their interfacing to 8051 and give an overview of recent growth and trends of controllers & processors.

B. Course Outcomes: At the end of the course, students will be able to

[EE2231.1] Explain the features of Microcontroller ESA MCB51 Kit, ARM7 kit and Keil Software. **(Bloom's Level: Cognitive level Knowledge).**

[EE2231.2] Introduce Assembly Language Program (ALP) concepts and features. **(Bloom's Level: Cognitive level Knowledge).**

[EE2231.3] Write ALP for Data block operations, arithmetic and logical operations, Code Conversion operations in 8051 and ARM7 **(Bloom's Level: Cognitive level Synthesis, Analysis).**

[EE2231.4] Analyze the working of on-chip features of 8051 and ARM7 like timers, counter and interrupts of Microcontroller 8051 and ARM7 processor based microcontroller. **(Bloom's Level: Cognitive level Analysis, Synthesis).**

[EE2231 .5] Simulate various interface kits (LCD, stepper motor, elevator, traffic light control). **(Bloom's Level: Cognitive level Analysis, Synthesis).**

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified

needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4]. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmentally friendly and feasible solutions.

[PSO.3]. Develop, investigate, and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Plan:

Criteria	Description	Maximum Marks

Internal Assessment (60 Marks)	Documentation Preparation and Observation Regularity and Performance : Assignment Submission : Internal Viva :	Total 60 15 10 15 10 10
End Term Exam	Procedure with logic, flowchart Experiment Conduction : Calculations : Viva Voce :	40 15 10 5 10
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Module I: Experiments using 8051 Microcontroller simulator. Module II: Interfacing exercises using 8051 microcontroller, Module III: Experiments using ARM7 processor based microcontroller.

F. TEXT BOOKS

T1. M.A. Mazidi and G. Mazidi, The 8051 microcontroller & Embedded Systems using Assembly & **'**C**'**, Pearson, 2011

T2. Rajkamal, Microcontrollers, Architecture, Programming, Interfacing & System Design, Pearson, 2005.**T3.** Ramesh S. Gaonkar, *Microprocessor architecture, programming, and applications with the 8085 (5e)*, Prentice Hall, 2002.

G. REFERENCE BOOKS

R1. K.J. Ayala, The 8051 Microcontroller & Embedded Systems using Assembly & **'**C**'**, Cengage, 2009

R2. Predko, Programming & Customizing the 8051 Microcontroller, Tata McGraw Hill

R3. S. Furber, *ARM System - on -Chip Architecture* (2e), Pearson, 2016.

H. Lecture Plan:

ExpNo	Experiment Description	Lab Objective	Mode of Delivery	Corresponding COs	Mode of Assessing Outcome
1	Study of 8051 based Microcontroller Kit (ESA MCB51 Kit) and Keil Software.	Student will learn to write an ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE2231.1 EE2231.2	Continuous Lab Evaluation and End Term Practical exam
2	Write assembly language programs to transfer the data from one memory location to another memory location using different addressing mode.	Student will learn to develop a logic of data block transfer among different memories for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE2231.1 EE2231.2 EE2231.3	Continuous Lab Evaluation and End Term Practical exam
3	Write assembly language programs to transfer a data block from one place to another place in the memory of Microcontroller 8051.	Student will learn to apply the logic of exchanging the data for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE2231.1 EE2231.2 EE2231.3	Continuous Lab Evaluation and End Term Practical exam
4	Write assembly language programs to search a number in block available in memory of Microcontroller 8051.	Student will learn to develop a logic for searching algorithms in ALP for 8051.	Laboratory Tutorial and Experiments	EE2231.1 EE2231.2 EE2231.3	Continuous Lab Evaluation and End Term Practical exam
5	Write assembly language programs to sort a data block available in memory of Microcontroller 8051.	Student will learn to develop a logic for sorting algorithms in ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE2231.1 EE2231.2 EE2231.3	Continuous Lab Evaluation and End Term Practical exam

6	Write assembly language programs for mathematical operation (addition and subtraction) using Microcontroller 8051.	Student will learn to develop a logic for addition and subtraction in ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE2231.1 EE2231.2 EE2231.3	Continuous Lab Evaluation and End Term Practical exam
7	Write and perform programs for mathematical operation (multiplication and division) using Microcontroller 8051.	Student will learn to develop a logic for multiplication and division in ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE2231.1 EE2231.2 EE2231.3	Continuous Lab Evaluation and End Term Practical exam
8	Write and perform programs of mathematical operations on BCD Numbers.	Student will learn to develop a logic for BCD addition in ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE2231.1 EE2231.2 EE2231.3	Continuous Lab Evaluation and End Term Practical exam
9	Write and perform programs of the various number system based code conversion operation.	Student will learn to develop a logic for code conversion in ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE2231.1 EE2231.2 EE2231.3	Continuous Lab Evaluation and End Term Practical exam
10	Write and simulate programs for Delay Generation, Timer & Counter operations.	Student will learn to develop a logic for timer and counter in ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE2231.1 EE2231.2 EE2231.4	Continuous Lab Evaluation and End Term Practical exam
11	Write and simulate programs for interrupt operation on ESA51 Microcontroller Kit.	Student will learn to develop a logic for interrupt operation in ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE2231.1 EE2231.2 EE2231.4	Continuous Lab Evaluation and End Term Practical

					exam
12	Write and perform programs to display the data on LCD Screen interfaced with ESA51 Microcontroller	Student will learn to develop a logic for LCD interface to 8051 microcontroller.	Laboratory Tutorial and Experiments	EE2231.1 EE2231.2 EE2231.5	Continuous Lab Evaluation and End Term Practical exam
13	Write and perform an arithmetic program on ARM 7 processor based microcontroller.	Student will learn to develop a logic for arithmetic operations interface to ARM 7 processor based microcontroller.	Laboratory Tutorial and Experiments	EE2231.1 EE2231.3 EE2231.4	Continuous Lab Evaluation and End Term Practical exam
14	Write assembly language programs to interface & run a stepper motor at various speed using ESA51 Microcontroller Kit.	Student will learn to develop a logic for stepper motor control interface to 8051 microcontroller.	Laboratory Tutorial and Experiments	EE2231.1 EE2231.2 EE2231.5	Continuous Lab Evaluation and End Term Practical exam

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 2231.1	Explain the features of Microcontroller ESA MCB51 Kit, ARM7 kit and Keil Software.	2			3								2	2		
EE 2231.2	Introduce Assembly Language Program (ALP) concepts and features.	2												3	2	1
EE 2231.3	Write ALP for Data block operations, arithmetic and logical operations, Code Conversion operations in 8051 and ARM7.	2	2	1	2	1							1		3	2
EE 2231.4	Analyze the working of on-chip features of 8051 like timers, counter and interrupts of Microcontroller 8051 and ARM7 processor based microcontroller.	2	2	1	2	1							1		3	2
EE 2231.5	Simulate various interface kits (LCD, stepper motor, elevator, traffic light control).	2	2	2	2	1							1		3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronic Communication Engineering

Department of Electrical Engineering
Course Hand-out

MATLAB & SYSTEM SIMULATION LAB | EE 2232 | 1 Credit | 0 0 2 1

Session: Jan 2020 – June 2021 | Faculty: Engineering | Class: II Year | Course Coordinator: Dr. Neeraj Kanwar

A. Introduction: This Lab is offered by Dept. of Electrical Engineering targeting students from the department who wish to pursue a career in system simulation, coding, etc. It offers an understanding of basic programming skill of circuit solving languages using MATLAB. This course offers design and simulation of basic electrical & electronics circuit and their theoretical analysis. Students are expected to have background knowledge on basic of C, C++ for a better learning.

B. Course Outcomes: At the end of the course, students will be able to:

[EE 2232.1] Understand basics of MATLAB and application of different commands. (**Bloom's Level: knowledge)**

[EE 2232.2] Ability to express programming skills for engineering problems. (**Bloom's Level: Application**)

[EE 2232.3] Study steady state and transient analysis of electrical circuits using MATLAB. (**Bloom's Level: Analysis, Application**)

[EE 2232.4] Ability to simulate basic electrical circuit in Simulink. (**Bloom's Level: knowledge, Application)**

[EE 2232.5] Understand Circuit simulation using Simscape. (**Bloom's Level: Application**)

C. Program Outcomes and Program Specific Outcomes

[PO.1]. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences**.**

[PO.3]. **Design/ Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

[PO.4]. **Conduct investigations** of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions**.**

[PO.5]. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an under- standing of the limitations.

[PO.6]. **The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

[PO.7]. **Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

[PO.8]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice**.**

[PO.9]. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

[PO.10]. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions**.**

[PO.11]. **Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to owners own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Continuous Evaluation (Summative)	Student Lab Record	30
	Viva-voce	10
	Quiz Tests / Assignments / Projects	20
	Total	60
End Term Exam (Summative)	Quiz Tests	20
	Viva-voce	20
	Total	40
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

E. Syllabus

Introduction to MATLAB, Basics of MATLAB matrices and vectors, matrix and array operations, Saving and loading data, plotting simple graphs, scripts and functions, Script files, Function files, Global Variables, Loops, Branches, Control flow, Advanced data objects, Multi-dimensional matrices, Structures, Electric circuit simulation using MATLAB, data visualization, functions, file I/O and GUI, Introduction to SIMULINK, Steady state analysis of circuits, Transient analysis of RL, RC, and RLC circuits, Circuit simulation using Simscape. Simulation of basic electrical systems: PV System, Distribution System, Electrical vehicle system.

F. Text Books

T1. Gilat, A.: MATLAB® An Introduction with Applications, John Wiley & Sons, Inc., 3rd Ed., 2007.

T2. S. J. Chapman, Essentials of MATLAB Programming, BAE Systems (3e), Cengage Learning, 2008.

T3. S. L. Eshkavilov, MATLAB & Simulink Essentials: MATLAB & Simulink for Engineering Problem Solving and Numerical Analysis, Lulu Publishing, 2017.

G. Reference Books

R1. Hanselman, D.: Mastering MATLAB 7, Pearson Education, 2005.

R2. Rashid, M. H.: SPICE for circuits and Electronics using PSPICE, PHI Learning publications, 1995.

H. Lecture Plan:

Lec. No	Topics	Session Objective	Mode of Delivery (Online/Classroom)	Corresponding CO	Mode of Assessing the Outcome
1	Introduction to MATLAB	Knowledge about basics of MATLAB	Online Lab	EE2232.1	Quiz, Lab Exam and Viva
2	Basic Data Visualization, MATLAB Script files, creating functions, working with files, flow control and introduction to GUIs in MATLAB	Knowledge to write MATLAB programmes	Online Lab	EE2232.1 EE2232.2	Quiz, Lab Exam and Viva

3	Solving Systems of Linear Algebraic Equations using MATLAB, DC Analysis of electrical circuits using MATLAB (Nodal and Mesh Analysis)	Understand to analyse electrical circuits	Online Lab	EE2232.1 EE2232.2	Quiz, Lab Exam and Viva
4	Perform different operations on polynomials	Understand solving a polynomial in MATLAB	Online Lab	EE2232.1 EE2232.2	Quiz, Lab Exam and Viva
5	Basic features of plotting a graph using MATLAB	Learn MATLAB graphics	Online Lab	EE2232.1 EE2232.2	Quiz, Lab Exam and Viva
6	Draw multiple plots using plot, hold and line functions	MATLAB Graphics-Multiple & Sub-Plots	Online Lab	EE2232.1 EE2232.2	Quiz, Lab Exam and Viva
7	MATLAB Programs using For and While loops	Understand looping and branching structures	Online Lab	EE2232.1 EE2232.2	Quiz, Lab Exam and Viva
8	MATLAB Programs using if, if-else loops	Understand looping and branching structures	Online Lab	EE2232.1 EE2232.2	Quiz, Lab Exam and Viva
9	Transient analysis of R-C Circuit	Knowledge of Transient analysis of R-C Circuit	Online Lab	EE2232.2 EE2232.3	Quiz, Lab Exam and Viva
10	Transient analysis of R-L Circuit	Knowledge of Transient analysis of R-L Circuit	Online Lab	EE2232.2 EE2232.3	Quiz, Lab Exam and Viva
11	Introduction to SIMULINK in MATLAB	Acquire knowledge about SIMULINK in MATLAB	Online Lab	EE2232.4	Quiz, Lab Exam and Viva
12	Simulation of RLC Circuits on SIMULINK	Know about simulation of RLC circuit	Online Lab	EE2232.4	Quiz, Lab Exam and Viva
13	Simulation of PV system on Simscape	Learn about simulation of PV system	Online Lab	EE2232.5	Quiz, Lab Exam and Viva
14	Simulation of Electrical vehicle system on Simscape	Learn about simulation of electrical vehicle system	Online Lab	EE2232.5	Quiz, Lab Exam and Viva

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 2232.1	Understand basics of MATLAB and application of different commands	1				2							2	1	1	1
EE 2232.2	Ability to express programming skills for engineering problems	3	2	3		2							2	2	2	2
EE 2232.3	Study steady state and transient analysis of electrical circuits using MATLAB	3	3	2		3							2	3	2	3
EE 2232.4	Ability to simulate basic electrical circuit in Simulink	2	2	2	2	2							2	2	2	2
EE 2232.5	Understand Circuit simulation using Simscape	3	3	2	3	3							3	3	3	3

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronic Communication Engineering

Department of Electrical Engineering
Course Hand-out

PROJECT BASED LEARNING LAB | EE 2233 | 1 Credit | 0 0 2 1

Session: Jan 2020 – June 2021 | Faculty: Engineering | Class: II Year | Course Coordinator: Vikash Kumar Boradak

A. Introduction: This course is offered by the Dept. of Electrical Engineering to improve the understanding of the technical subjects through faculty guided project activity.

B. Course Objectives: At the end of the course, students shall be able to

[EE 2233.1] To acquire knowledge on hardware and/or software for project implementation
[EE 2233.2] Analyse the theoretical concepts into practical/simulated environment.
[EE 2233.3] Demonstrate skills related to technical presentation and preparation of technical report.
[EE 2233.4] Learn to coordinate in a team project or individual specific projects.

C. Program Outcomes and Program Specific Outcomes

[PO.1]. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences**.**

[PO.3]. **Design/ Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

[PO.4]. **Conduct investigations** of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions**.**

[PO.5]. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an under- standing of the limitations.

[PO.6]. **The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

[PO.7]. **Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

[PO.8]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice**.**

[PO.9]. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

[PO.10]. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions**.**

[PO.11]. **Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to owners own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Mid-Term Evaluation (Literature Review, Project Report, Project Execution, and Viva)	60
End Term Exam (Summative)	End Term Evaluation (Literature Review, Project Completion Report, Project Execution, and Viva)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ Activity Assignment (Formative)	A student is expected to participate and perform these assignments with full zeal and should regularly coordinate with faculty advisor.	

E. Syllabus

Project based learning aims to build students' creative capacity to work through difficult or complex problems. It encompasses student's involvement in designing, developing, and constructing hands-on solutions to a problem, commonly in small teams. Typically, Project based learning takes students through the following phases or steps: Identifying a problem, agreeing on or devising a solution and potential solution path to the problem (i.e., how to achieve the solution), Designing and developing a prototype of the solution, refining the solution based on feedback from experts, instructors, and/or peers. Depending on the goals of the instructor, the size and scope of the project can vary greatly.

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 2233.1	To acquire knowledge on hardware and/or software implementation	1		**2**		**3**						**3**	**2**	3	2	3
EE 2233.2	Analyse the theoretical concepts into practical/simulated environment	**3**	**2**		2		**1**							2	1	3
EE 2233.3	Demonstrate skills related to technical presentation and preparation of technical report		2			**3**			**2**		**3**		**2**	1	2	1
EE 2233.4	Learn to coordinate in a team project or individual specific projects.	1		1	2					**3**		**2**		2	3	2

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics & Communication Engineering

Department of Electrical Engineering
Course Hand-out

Control Theory| EE 1501(N) | 4 Credits | 3 1 0 4

Session: Aug 20– Dec 20 | Faculty: Abhishek Kumar | Class: V Sem B Tech. (EE)

A. Introduction: This course is offered by Department of Electrical Engineering as a Core Subject, targeting students who wish to pursue research & development in industries or higher studies in field of Control Engineering. This course is to explore the modeling of linear dynamic systems via differential equations and transfer functions utilizing state-space and input-output representations. It involves, the study of principles of system modeling, system analysis and feedback control, and use them to design and evaluate feedback control systems with desired performance; specifically, to acquire the related knowledge and techniques. Students are expected to have background knowledge on Basics of Electrical Science, Basic Mathematics, Signal Systems for a better learning.

B. Course Objectives: At the end of the course, students will be able to

[EE1501(N).1] To identify, formulate and solve engineering problems using transfer function approach and differential equation approach.

[EE1501(N).2] Mathematical modelling of electrical, mechanical and electromechanical systems, using differential equations, transfer functions, block diagrams, and signal flow graphs.

[EE1501(N).3] Analyze the classical stability tests of a first order and second order system in time domain.

[EE1501(N).4] Analyze the design methods and finding the stability of a system using poles zeros location on s domain Routh Hurwitz criterions, Polar plot, Nyquist plots, Root-locus plots and Bode plots.

[EE1501(N).5] Determine and analyze the performance specifications of control systems, such as sensitivity, stability, controllability, tracking, in Time and Frequency domains.

[EE1501(N).6] Design feedback controllers, such as PID, lead and lag compensators, to meet desired system performance specifications and hence foster design skills.

C. Program Outcomes and Program Specific Outcomes

[PO.1]. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.2]. 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

[PO.3]. 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

[PO.4]. 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

[PO.5]. 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

[PO.6]. 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

[PO.7]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.8]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.9]. 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

[PO.10]. 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

[PO.11]. 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.

[PO.12]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments. Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. Syllabus

Mathematical Models of Electrical: Mechanical and electro-mechanical systems block diagram - signal flow graphs, Mason's gain formula. **Time Response:** Transient response specifications of second order systems, system response with additional pole & zero, Steady state error non- unity feedback systems. **Sensitivity Stability:** Routh - Hurwitz criterion, frequency domain specifications, Root locus plot transient response design by gain adjustment. **Frequency Response Plots:** Polar plots, Nyquist stability criterion, stability analysis, Bode plots. **Controller Design:** Proportional, Derivative and Integral controllers, PI, PD & PID controller, State Model, electrical, mechanical and electromechanical systems, physical variable form and phase variable form.

F. Text Books

T1. K. Ogata, *Modern Control Engineering (4th Ed.)*, Prentice Hall, 2001.

T2. S.N. Norman, *Control Systems Engineering (3rd Ed)*, John Wiley & Sons, Inc, 2000.

T3. K.R. Varmah, *Control Systems*, Tata Mc-Graw Hill, 2010.

G. Reference Books

R1. Benjamin Kuo, *Automatic Control Systems (8th Ed.),* Prentice-Hall 2002.

H. Lecture Plan:

Lec No	**Topics**	**Session Objective**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	Course overview, Introduction to Control Systems	To acquaint and clear teachers expectations and understand student expectations	Lecture		NA
2,3,4,5,6	**Mathematical Models of Electrical Systems**: Mechanical and electro-mechanical systems	To Understand basic physics and mathematics involved in Electricla, mechanical and electro-mechanical Systems	Lecture	**[EE1501(N).1]**	In Class Quiz (Not Accounted)
7,8,9,10	Block diagram	Identify different block diagram reduction steps and use it to determine transfer function of the system	Lecture	**[EE1501(N).2]**	In Class Quiz
11,12,13	Signal flow graphs	Identify Signal flow graphs and use them to determine transfer function of the system	Lecture	**[EE1501(N).2]**	In Class Quiz
14,15	Mason's gain formula	Able to determine transfer function of the system using Mason's gain formula	Lecture	**[EE1501(N).2]**	Home Assignment
16,17,18,19	**Time Response:** Transient response specifications of second order systems	Analyze system response of second order systems	Lecture	**[EE1501(N).4]**	Class Quiz
20	System response with additional pole &zero	Analyze System response with addition of pole & zero	Lecture, Activity	**[EE1501(N).3]** **[EE1501(N).4]**	Class Quiz
21	Steady state error non-unity feedback systems	Analyze Steady state error for non-unity feedback systems	Lecture	**[EE1501(N).3]**	Class Quiz
22,23,24	**Sensitivity Stability:** Routh- Hurwitz criterion	Able to determine and comment on stability using Routh- Hurwitz	Lecture	**[EE1501(N).3]**	Class Quiz
25	Frequency domain specifications	Understand the Frequency domain specifications	Lecture	**[EE1501(N).3]** **[EE1501(N).4]**	Class Quiz
26,27,28,29,30	Root locus plot	Able to determine and plot the root locus for a given sysytem	Lecture	**[EE1501(N).3]**	Class Quiz
31,	Transient response design by gain adjustment	Analyse and able to design the system response by gain adjustment	Lecture	**[EE1501(N).4]**	Home Assignment Class Quiz
32,33,34	**Frequency Response plots:** Polar plots	Able to determine and plot the polar plot for a given sysytem	Lecture	**[EE1501(N).4]**	Class Quiz
35,36,37	Nyquist stability criterion, stability analysis	Able to determine and comment on the system stability using Nyquist stability criterion	Lecture	**[EE1501(N).3]**	Class Quiz

38,39,40,41	Bode plots	Able to determine and plot the bode plot for a given sysytem	Lecture	**[EE1501(N).3]**	Class Quiz
42	**Controller design:** Proportional, Derivative and Integral controllers	Understand the controller design steps	Lecture	**[EE1501(N).4]** **[EE1501(N).6]**	Class Quiz
43	PI, PD & PID controller	Able to design PI, PD & PID controller and hence foster design skills.	Lecture	**[EE1501(N).5]** **[EE1501(N).6]**	Home Assignment Class Quiz
44	**State Space Analysis**	Able to analyze and determine the state space design for a given system	Lecture	**[EE1501(N).5]**	Class Quiz
45,46	State Model, electrical, mechanical and electromechanical systems	Able to analyze and determine the state model for a given electrical, mechanical and electromechanical system and hence foster design skills.	Lecture, Activity	**[EE1501(N).5]**	Class Quiz
47	Physical variable form	Able to analyze and determine the physical variable form for a given system	Lecture	**[EE1501(N).5]**	Class Quiz
48	Phase variable form	Able to analyze and determine the phase variable form for a given system	Lecture	**[EE1501(N).5]**	Class Quiz

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
[EE1501(N).1]	To identify, formulate and solve engineering problems using transfer function approach and differential equation approach.	2		1	3								1	2	2	1
[EE1501(N).2]	Mathematical modelling of electrical, mechanical and electromechanical systems, using differential equations, transfer functions, block diagrams, and signal flow graphs.	2		1	3								2	3	2	1
[EE1501(N).3]	Analyze the classical stability tests of a first order and second order system in time domain.	2		1									1	2	1	2
[EE1501(N).4]	Analyze the design methods and finding the stability of a system using poles zeros location on s domain Routh Hurwitz criterions, Polar plot, Nyquist plots, Root-locus plots and Bode plots.	1	1			1				1		2	1	2	2	3
[EE1501(N).5]	Determine and analyze the performance specifications of control systems, such as sensitivity, stability, controllability, tracking, in Time and Frequency domains.	1		1			1						2	2	1	3
[EE1501(N).6]	Design feedback controllers, such as PID, lead and lag compensators, to meet desired system performance specifications and hence foster design skills.		1		3								1	1	2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and Communication

Department of Electrical Engineering
Course Hand-out

Generation, Transmission & Distribution | EE 1502(N) | 4 Credits | 3 1 0 4

Session: Aug. 20 – Dec. 20 | Faculty: Dr. Neeraj Kanwar | Class: V Sem. Electrical Engineering

A. Introduction: A fundamental course of Electrical Engineering which provides systematic understanding related to operation, working, significance of different conventional generating plants, transmission line parameters, concepts of transmission and distribution of electricity. This will help to provide students knowledge of the modern electricity network operation under balanced steady-state and fault conditions. This course is designed to develop the concepts of the students who are looking for career in the electricity supply industry, electrical maintenance or any large industrial network. The basic familiarity of line parameters and concepts of electricity generation is desired from the students for a better learning.

B. Course Outcomes: At the end of the course, students will be able to

[1502.1]	Describe the basic operation and working of different conventional generation plants and their relative technical comparison.
[1502.2]	Interpret and illustrate the fundamental importance and develop the skills for working on various transmission and distribution systems.
[1502.3]	Recognize transmission line parameters and understand characteristics / performance of short, medium and long transmission lines used for complex electrical power network.
[1502.4]	Analyze and formulate the tasks of reactive power control, power factor improvement and voltage control.
[1502.5]	Identify the characteristics of overhead transmission lines, Corona effect, different Insulators and underground cables.

A. Program Outcomes and Program Specific Outcomes

[PO.1].Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2].Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3].Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4].Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5].Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6].The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7].Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8].Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9].Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

B. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I	**15**
	Sessional Exam II	**15**
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	**30**
End Term Exam (Summative)	End Term Exam	**40**
	Total	**100**
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

C. Syllabus

Generation of Electric Power: Hydro Electric Power Plants, Thermal and Nuclear Power Plants, Diesel Power Plant, Typical AC transmission and distribution scheme: Effect of system voltage and regulation, Distribution network elements, Transmission Line Parameter Calculations, Transmission Line Performance, Ferranti effect, receiving end power circle diagram, regulated system of transmission by reactive power control, Mechanical design of Overhead lines, Line Insulators, Corona , Underground cables.

D. TEXT BOOKS

1. B. R. Gupta, *Power System Analysis and Design (7e),* S. Chand Publications, 2014.
2. C. L. Wadhwa, *Electrical Power System (3e)*, New Age Intl., 2000.

E. REFERENCE BOOKS

1. S. N. Singh*, Electric Power Generation, Transmission and Distribution (2e)*, PHI Learning, 2004.

F. Lecture Plan:

Lec No	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
L1	Course objective and overview of the contents	To acquaint students with the outcome based education (OBE) and Course outcome (CO) and program outcome (PO) assessment process	Lecture		NA
L2 – L4	Introduction to Electric Power System, Overview of Generation, Transmission & Distribution, Types of Load, Plant Economics, Important Terms and Factors.	Basic knowledge of different types of loads, economic aspects of power plants.	Lecture	[1502.1]	Class Quiz
T1 – T2	L1 – L4	Numerical problems based on L1 - L4	Tutorial	[1502.1]	Mid Term Exam
L5 – L6	Schematic diagram explanation, different parts of thermal plants, Operation and working of Thermal Electric Power plants	Understanding of Thermal power plant and its different component. Steam, water, flue gases	Lecture	[1502.1]	Home Assignment Class Quiz Mid Term Exam
L7 – L8	Schematic diagram explanation and Operation & working of Hydro Electric Power plants	Basic understanding of construction and working of Hydro Power Plant	Lecture	[1502.1]	Home Assignment Class Quiz Mid Term Exam
L9 – L10	Requirements, construction and operation of nuclear power plants	Basic understanding of construction and working of Nuclear Power Plant	Lecture	[1502.1]	Home Assignment Class Quiz Mid Term Exam
L11	Diesel Power Plants: Plant equipment, layout of the plants and its operation	Basic understanding of construction and working of Diesel Power Plant			Home Assignment Class Quiz
T3	L5 – L11	Numerical problems based on L5-L11	Tutorial	[1502.1]	Mid Term Exam
L12	Effect of the system voltage and regulation	Calculation of Economic Voltage and voltage regulation	Lecture	[1502.2]	Home Assignment Class Quiz Mid Term Exam
L13	Voltage drop in AC and DC distribution system, Comparison of various distribution system	Comparison of different DC and AC distribution system based on equal power loss	Lecture	[1502.2]	Home Assignment Class Quiz Mid Term Exam
L14	AC-3 phase 4-wire distribution system	Calculation of conductor size for same power transfer and power loss for 3-phase	Lecture	[1502.2]	Home Assignment Class Quiz Mid Term Exam
L15	Types of primary and secondary distribution systems	Calculation of size of conductor for same power transfer and power loss for 1-phase	Lecture	[1502.2]	Home Assignment Class Quiz Mid Term Exam
L16	Kelvin's Law and flickering of Lamps	Calculation of economic cost of conductor based on installation cost and operating cost	Lecture	[1502.2]	Home Assignment Class Quiz Mid Term Exam
T4 – T5	L12– L16	Numerical problems based on L12-L16	Tutorial	[1502.2]	Mid Term Exam

L17 - L18	Flux linkages within and outside the conductor producing fluxes, Inductance of single phase two wire line and of composite conductor lines	Derivation of basic relation of inductance of single phase transmission line for single, two wire and stranded conductors.	Lecture	[1502.3]	Home Assignment Class Quiz Mid Term Exam
L19 – L20	Inductance of three phase line with equilateral and unsymmetrical spacing, inductance of bundled conductors	Estimation of inductance of three phase transmission line in different configuration including bundle conductors and double circuit	Lecture	[1502.3]	Home Assignment Class Quiz Mid Term Exam
L21 - L22	Electric field and potential difference, capacitance of two-wire line, Capacitance of 3-phase line with equilateral spacing and unsymmetrical spacing	Derivation of basic relation of capacitance of single phase transmission line for single, two wire and stranded conductors.	Lecture	[1502.3]	Home Assignment Class Quiz Mid Term Exam
L23 – L24	Capacitance of Bundled conductor lines and double circuit three phase lines	Estimation of inductance of three phase transmission line including bundle conductors and double circuit	Lecture	[1502.3]	Home Assignment Class Quiz Mid Term Exam
T6 – T7	L17 – L24	Numerical problems based on L17-L24	Tutorial	[1502.3]	Mid Term Exam
L25	Representation of transmission lines, per unit method and advantages of per unit method	Per unit calculation of different transmission line parameters	Lecture	[1502.3]	Home Assignment Class Quiz Mid Term Exam
L26 – L27	Short and medium transmission lines	Representation and calculation of transmission line parameters	Tutorial	[1502.3]	Home Assignment Class Quiz Mid Term Exam
L28 – L29	Long transmission lines, ABCD parameters and equivalent T and pi networks.	Representation and calculation of transmission line parameters in equivalent T and π networks	Lecture	[1502.3]	Home Assignment Class Quiz Mid Term Exam
L30	Ferranti effect, power formulae for transmission lines	Analysis of Ferranti effect and its significance in power system	Lecture	[1502.3]	Home Assignment Class Quiz Mid Term Exam
T8 – T9	L29 – L33	Numerical problems based on L25-L30	Tutorial	[1502.3]	Mid Term Exam
L31 – L32	Natural loads and power circle diagrams	Calculation of sending end and receiving end power	Lecture	[1502.4]	Home Assignment Class Quiz Mid Term Exam
L33 – L34	Line voltage regulation and its control through reactive power regulation, power factor improvement	Formation of sending end and receiving end power circle diagram and power factor improvement	Lecture	[1502.4]	Home Assignment Class Quiz Mid Term Exam
T10	L31-L34	Numerical problems based on L31-L34	Tutorial	[1502.4]	Mid Term Exam
L35 – L37	Insulators, Voltage distribution in insulator string and improvement of string efficiency	Voltage distribution in different discs and calculation of string efficiency	Lecture	[1502.5]	Home Assignment Class Quiz Mid Term Exam
L38 – L39	Corona phenomenon, Corona loss, factors and conditions affecting corona loss	Process of Corona, calculation of disruptive voltage and factors affecting corona losses	Lecture	[1502.5]	Home Assignment Class Quiz Mid Term Exam

L40	Radio interference due to corona and corona in bundled conductors	Impact of corona including RI and factors reducing corona losses	Lecture	[1502.5]	Home Assignment Class Quiz Mid Term Exam
T11 – T12	L35-L40	Numerical problems based on L35-L40	Tutorial	[1502.5]	Mid Term Exam
L41	Underground cables: Insulation, sheath, armour and covering, Classification of cables, effective conductor resistance	Basic construction of cables and its classification and different parameters	Lecture	[1502.5]	Home Assignment Class Quiz Mid Term Exam
L42	Grading of cables, capacitance of three core belted cable, Breakdown of cables, current rating of cables	Categorization of cables based on capacitance grading	Lecture	[1502.5]	Home Assignment Class Quiz Mid Term Exam

C. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 1502.1	Describe the basic operation and working of different conventional generation plants and their relative technical comparison.		1	2				3					1		2	1
EE 1502.2	Interpret and illustrate the fundamental importance and develop the skills for working on various transmission and distribution systems.	1	1		3											3
EE 1502.3	Recognize transmission line parameters and understand characteristics / performance of short, medium and long transmission lines used for complex electrical power network.	3	2			1							1	3		1
EE 1502.4	Analyze and formulate the tasks of reactive power control, power factor improvement and voltage control.		3	1			2								2	1
EE 1502.5	Identify the characteristics of overhead transmission lines, Corona effect, different Insulators and underground cables.			3		1		2					1	2	1	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Course Outcome Attainment Level Matrix:

CO	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES **THRESHOLD VALUE: 40%**											ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 1502.1	Describe the basic operation and working of different conventional generation plants and their relative technical comparison.		1	2				3					1		2	1
EE 1502.2	Interpret and illustrate the fundamental importance and develop the skills for working on various transmission and distribution systems.	1	1		3											3
EE 1502.3	Recognize transmission line parameters and understand characteristics / performance of short, medium and long transmission lines used for complex electrical power network.	3	2			1							1	3		1
EE 1502.4	Analyze and formulate the tasks of reactive power control, power factor improvement and voltage control.		3	1			2								2	1
EE 1502.5	Identify the characteristics of overhead transmission lines, Corona effect, different Insulators and underground cables.			3		1		2					1	2	1	1

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

MANIPAL UNIVERSITY JAIPUR

School of Electrical Electronics and Communication Engineering

Department of Electrical Engineering
Course Hand-out

Signals and Systems| EE 1503(N) | 4 Credits | 3 1 0 4

Session: Aug 20 –Dec 20 | Faculty: Divya Rishi Shrivastava | Class: Program Core

A. Introduction: This course is offered by Dept. of Electrical Engineering as a Program core. The course will help students to pursue research & development in industries or higher studies in field of Electrical Engineering, including robotics, power systems, control theory, signal processing and its applications. The course familiarizes with the detailed understanding of signals and systems, their mathematical foundations and practical applicability. Students are expected to have background knowledge on Engineering Mathematics for a better learning.

B. Course Outcomes: At the end of the course, students will be able to

[EE 1503(N).1]. Development of skill set for the classification and mathematical operation on signals and LTI system.

[EE 1503(N).2]. Formulate the response of the LTI system to any input signal.

[EE 1503(N).3]. Implement the transform techniques in continuous – time and discrete – time domain such as Laplace Transform, Fourier analysis and Z transform

[EE 1503(N).4]. Determine the stability of the CT and DT systems

[EE 1503(N).5]. Apply signals and systems in circuit theory and power systems

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9]. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who miss a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	

E. SYLLABUS

Basic Introduction: Basic definitions, classification, Properties, Sampling and quantization, **Time domain analysis of continuous-time and discrete-time signals & systems**: linear-time invariant systems, impulse response, convolution, correlation, causality and stability, representation of LTI systems, **Frequency domain analysis of continuous time signals and systems**: Fourier series, Fourier transform, applications, **Frequency domain analysis of discrete-time signals and systems**: Discrete-time Fourier series, Discrete-time Fourier transform, **Sampling in time domain**: reconstruction, discrete-time processing of continuous-time signals, Relation between frequency domain representation in continuous and discrete-domain, Sampling in frequency domain, **Discrete Fourier transform**: Transform domain analysis of systems, **Laplace and Z transform**, Representation of systems.

F. TEXT BOOKS

1. Haykin S, *Signals and Systems*, (2e) Wiley, 2007

G. REFERENCE BOOKS

1. Oppenheium, Willisky and Nawab, *Signals and Systems (2e)*, PHI, 1997
2. R. E. Ziemer; *Signals and Systems*, (4e), Pearson, 2002

1. Lecture Plan:

Class Number	Topics	Session Outcome	Mode of Delivery	Corresponding Course Outcome	Mode of Assessing the Outcome
L1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture Interaction	-	NA
2 - 3	Signals and systems: classification of signals- continuous and discrete- time signals, even and odd signals, periodic signal and aperiodic signals, Energy and power signals.	To acquaint students signals and its classification	Lecture Interaction	EE 1503(N).1	Class Quiz Assignment Mid Term I End Term
4 – 5	Basic signals: unit impulse, unit step, unit ramp signals. Basic operations on signals: Operations on dependent variable: amplitude scaling, addition, multiplication, differentiation, integration.	To acquaint students operation on independent variable	Lecture Interaction	EE 1503(N).1	
1,2	Tutorial 1,2 (L1 – L5)	To acquaint students examples and numerical	Lecture Interaction	EE 1503(N).1	
6 – 7	Operations on independent variable: time scaling, time reflection, time shifting; Properties of systems: stability, memory, causality, time-invariance, linearity	To acquaint students operation on dependent variable and systems	Lecture Interaction	EE 1503(N).1	
8 - 10	Convolution of discrete-time signals: convolution sum. Convolution of continuous-time signals: convolution integral. Properties of convolution	To acquaint students convolution and correlation	Lecture Interaction	EE 1503(N).1 EE 1503(N).2	
3,4	Tutorial 3,4 (L6 – L10)	To acquaint students examples and numerical	Lecture Interaction	EE 1503(N).1 EE 1503(N).2	
11	Properties of LTI systems with respect to impulse response: memory, causality, stability and step response.	To acquaint students LTI systems and operation	Lecture Interaction	EE 1503(N).1 EE 1503(N).2 EE 1503(N).4	
12	Representation of LTI systems: parallel connection, cascade connection.	To acquaint students LTI systems and operation	Lecture Interaction	EE 1503(N).1 EE 1503(N).2	
13 – 16	Differential equations, difference equations, solution of differential and difference equations, zero-input response and zero-state response.	To acquaint students LTI systems and operation	Lecture Interaction	EE 1503(N).1 EE 1503(N).2 EE 1503(N).4 EE 1503(N).5	
5,6	Tutorial 5,6 (L11 – L16)	To acquaint students examples and numerical	Lecture Interaction	EE 1503(N).1 EE 1503(N).2 EE 1503(N).4	
FIRST MID TERM EXAM					
17 – 21	Continuous time Fourier series, properties of CTFS; Continuous-time Fourier transforms, properties, inverse CTFT	To acquaint students continuous time Fourier series and transform	Lecture Interaction	EE 1503(N).3	
7,8	Tutorial 7,8 (L17 – L21)	To acquaint students examples and numerical	Lecture Interaction	EE 1503(N).3	

22 – 25	Discrete time Fourier series, properties of DTFS; Discrete-time Fourier transforms, properties, inverse DTFT	To acquaint students discrete time Fourier series and transform	Lecture Interaction	EE 1503(N).3	Class Quiz Assignment Mid Term II End Term
25 – 27	Applications of DTFT representation, Fourier transform representation of periodic signals.	To acquaint students discrete time Fourier series and transform	Lecture Interaction	EE 1503(N).3	
28 – 29	Discrete Fourier transform	To acquaint students discrete transform	Lecture Interaction	EE 1503(N).3	
9,10	Tutorial 9,10 (L22 – L29)	To acquaint students examples and numerical	Lecture Interaction	EE 1503(N).3	
30 – 34	Laplace Transform: Review, poles and zeros, stability.	To acquaint students Laplace transform	Lecture Interaction	EE 1503(N).3 EE 1503(N).4 EE 1503(N).5	
SECOND MID TERM EXAM					
35,36	Z transform: definition, relation with Laplace transform, region of convergence, properties of z transform.	To acquaint students Z transform	Lecture Interaction	EE 1503(N).2 EE 1503(N).4 EE 1503(N).5	Assignment Class Quiz End Term
11,12	Tutorial 11,12 (L30 – L36)	To acquaint students examples and numerical	Lecture Interaction	EE 1503(N).3 EE 1503(N).4	
37,38	Poles and zeros, stability, causality; Inverse Z transform-power series method, partial fraction method.	To acquaint students Z transform properties	Lecture Interaction	EE 1503(N).3 EE 1503(N).4	
39,40	Application of Z transform to discrete-time systems, solution of difference equations using z transform.	To acquaint students Z transform applications	Lecture Interaction	EE 1503(N).2 EE 1503(N).3 EE 1503(N).5	
13,14	Tutorial 11,12 (L37 – L40)	To acquaint students Laplace and Z transform applications	Lecture Interaction	EE 1503(N).1 EE 1503(N).2 EE 1503(N).3 EE 1503(N).5	
END TERM EXAM					

2. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 1503(N).1	Development of skill set for the classification and mathematical operation on signals and LTI system	3			2				1				1	3	1	2
EE 1503(N).2	Formulate the response of the LTI system to any input signal		3	1												2
EE 1503(N).3	Implement the transform techniques in continuous – time and discrete – time domain such as Laplace Transform, Fourier analysis and Z transform	2			3	3						2	2	3	3	3
EE 1503(N).4	Determine the stability of the CT and DT systems	1		2		1								1		2
EE 1503(N).5	Apply signals and systems in circuit theory and power systems							1		1			1		1	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Electrical Electronics and Communication Engineering

Department of Electrical Engineering
Course Hand-out

Power Electronics EE 1504(N) | 4 Credits | 3 1 0 4

Session: 17.08.2020 – 20.11.2020 | Faculty: Mr. S P Singh | Class: 5th Sem. | Programme: B Tech (EE)

A. Introduction: This course is offered by Dept. of Electrical Engineering as a Core Course with the purpose to create general awareness among undergraduates about the general nature of power conditioning modules. A simplified treatment of the semiconductor devices used as switching elements in these conditioners is given in this course to start with, in terms of their operating principle and specifications. Different categories of simple generic templates of the power conditioners is presented in bottom-up approach, and then such converters are analysed for their important performance indices. A student taking this course has to have elementary appreciation of circuit analysis, semiconductor fundamentals, and engineering mathematics. This course gives an aptitude for understanding subsequent courses (Solid State Drives, HVDC, FACTS, Renewable Energy System Design, Advanced Power Converters). The most important take-away of this course is to appreciation for the importance of energy conservation and inspiration for designing energy-efficient systems using their knowledge of power electronics.

B. Course Outcomes: At the end of the course, students will be able to

[1504(N).1]. Describe the importance, relevance, interdisciplinary nature & scope of power conditioning equipment's and Interpret and illustrate the static and dynamic V-I characteristics of semiconductor devices.

[1504(N).2]. Synthesize different types of converters (AC to DC, DC to DC, AC to AC, DC to AC) for matching the load requirements, analyse the functionality of different converters.

[1504(N).3]. Analyse the effects of different types of load on the performance of the converters and modify different operating parameters to improve these performances indices and hence develop employability skills.

[1504(N).4]. Describe the methodology to improve power quality issues and recall different power conditioning techniques and judge the best way to achieve energy conversion for a particular application.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4]. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOMES

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	15
	Sessional Exam II (Open Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Open Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.

E. SYLLABUS

Power Semiconductor devices: SCR, Triac, GTO, BJT, Power MOSFET, IGBT – characteristics, safe operating area, device rating, base/gate drive requirements, **Converter Topologies:** Controlled Rectifiers, Single phase converters - half wave, half controlled and fully controlled bridge converters, Three-phase Converters- half controlled & fully controlled bridge, triggering sequence, operation, effect of source inductance, Line commutated inverters, Dual converters, **AC to AC converters:** Cycloconverters and AC voltage regulators, **DC – DC Converters:** Step down and step up operation, Classification of choppers, **DC – AC Converters:** Single phase and three phase bridge inverters, Square wave operation, PWM Inverters- PWM techniques, harmonics in output voltage , Multi-level inverters, Space vector modulation, **Resonant converters:** Principle of soft switching- concept of zero current switching and zero voltage switching.

F. TEXT BOOKS

1. D. W.Hart, *Introduction to Power Electronics*, PHI Learning Publications, 1997.

2. N. Mohan et. al*., Power Electronics, Converters*, Applications & Design (2e), Wiley.

G. REFERENCES

1. L. Umanand, Power Electronics – Essentials and Applications, Wiley India Pvt. Ltd., 2014
2. https://onlinecourses.nptel.ac.in

H. Lecture Plan:

L/T	Topics to be covered	Session Objective	Mode of delivery	Corresponding CO	Mode of assessing the outcome
L1-2	Course hand-out briefing	Describe the need of an undergraduate course on Power Electronics , its interdisciplinary nature power switching)electronics versus analog (linear) electronics, classification of power processors (describe the need for matching the load requirements with available electrical power supply , and discuss the classification DC to DC, DC to AC , AC to DC, and AC to AC and converters) Example Applications: SMPS, renewable energy converters, UPS, etc.	Lecture, Activity (Think Pair Share), Misconception check(is power electronics all about high power applications?),	[1504.1(N)]	Formative Assessment (Classroom Quiz)
L3	Generic controllable switching element	Enumerate desirable characteristics in controllable switches. Review	Lecture	[1504.1(N)]	Formative Assessment(Classroom Quiz)
L4	Semiconductor device fundamentals	Crisply review the fundamentals of semiconductor device carrier action.	Flipped Classroom	[1504.1(N)]	Formative Assessment (Home Assignment,)
L5-6	Semiconductor devices : Diodes	Describe the static characteristics, dynamic characteristics, classification, parameters, breakdown voltage considerations, surge current, thermal viewpoint, and circuit model of diode	Flipped Classroom	[1504.1(N)]	Formative Assessment (Home Assignment)
L7-8	Semiconductor devices : BJTs	Describe the static characteristics, dynamic characteristics, second breakdown , circuit model(Ebers-Moll model), power dissipation, safe operating areas, drive circuits	Flipped Classroom	[1504.1(N)]	Formative Assessment (Home Assignment)
L9-10	Semiconductor devices : MOSFETs	Describe static characteristics, dynamic characteristics, circuit model, safe operating areas, drive circuits	Flipped Classroom	[1504.1(N)]	Formative Assessment (Home Assignment)
L11-12	Semiconductor devices : IGBTs	Describe the static characteristics, dynamic characteristics, latch-up,	Lecture	[1504.1(N)]	Formative Assessment (Home Assignment)

		drive circuits ,comparison with IGBT and MOSFET			
L13-17	Semiconductor devices : Thyristors	Describe the static and dynamic characteristics, thyristor(two-transistor model) model ,thyristor ratings, snubber circuits, gate-drive circuits, thyristor gate characteristics, thyristor commutation ,thyristor protection and snubber circuits, series and parallel operation ,other members of thyristor family.	Lecture	[1504.1(N)]	Summative Assessment
T1-2	Computational problems on semiconductor devices for power conditioning				
L18-19	Power computations :	Power and Energy, Inductors and Capacitors, Energy recovery; Effective values and parameters, Apparent Power and Power factor; Power computations for sinusoidal AC circuits; Power computations for non-sinusoidal periodic waveforms – Application of Fourier series	Flipped Classroom, Misconception checkpoints	[1504.1(N)]	Summative Assessment
T3-5	Problems on power computations				
L20-22	Half-Wave rectifiers	Analyze the operating principle of uncontrolled and controlled circuit topologies for R, RL, RLE load, with freewheeling diode, load with a capacitor filter, commutation , effect of source inductance Review of solving first order differential equations for dealing with first order circuits for solution of current.	Lecture	[1504.2(N)]	Summative Assessment(Class Quiz, Sessional)
L23-25	Full wave rectifiers	Analyze uncontrolled and controlled circuit topologies for R, RL, RLE load, with freewheeling diode, load with a capacitor filter, commutation , effect of source inductance Overview of three-phase rectifier and m-pulse rectifier systems, dual converters.	Lecture, Activity	[1504.2(N)]	Summative Assessment
T6-8	Computational problems on rectifiers				
L26	AC voltage controllers	Analyze the principle of operation for single phase	Lecture	[1504.2(N)]	Summative Assessment

		AC voltage controller with R and RL load			
L27	Cycloconverters	Analyze the functionality of mid-point and bridge-type cycloconverter – step up and step down operations	Lecture	[1504.2(N)]	Formative Assessment (Classroom) Quiz
L28	DC-DC converters: Buck converter	Identify the need for DC-DC converters, Buck converter – synthesis, analysis, issues, simplified state-space model	Lecture	[1504.2(N)]	Formative Assessment (Classroom) Quiz
L30	DC-DC converters: Boost converter	Boost converter- synthesis, analysis, issues, simplified state-space model	Lecture, Misconception check(regarding duty cycle-boost action correlation)	[[1504.3(N)]	Summative Assessment(CIA Quiz, ETE, Sessional)
L31-32	DC-DC converters: Buck-Boost converter, Ćuk converter, SEPIC	Problems with Buck, Boost, and Buck-Boost converters- Ćuk converter and SEPIC - analysis	Lecture, Misconception check(regarding duty cycle)	[1504.3(N)]	Summative Assessment(CIA Quiz, ETE, Sessional)
T9-11	Computational problems on DC-DC converters				
L33	Isolated DC-DC converters – Flyback topology	Advantages of isolated converters over conventional topologies, Flyback converter – design, operating principle	Lecture, Think Pair share, Misconception checkpoint(regarding use of transformers)	[1504.2(N)]	Summative Assessment(CIA Quiz, ETE, Sessional)
L34	Isolated DC-DC converters – Forward topology	Forward converter, Double ended forward converters, Push pull, Current fed converters design, operating principle -	Lecture	[1504.2(N)]	Formative Assessment
L35-36	Resonant converters	Describe the concept of soft switching in contrast to hard switching; and use the concept of L-C resonance to achieve soft switching in ZCS and ZVS buck converter.	Lecture	[1504.3(N)]	Summative Assessment(CIA Quiz, ETE, Sessional)
T12	Computational problems on resonant converters				
L37-39	DC–AC converters : single phase inverters	Design single phase inverter using switching elements; analyse the waveforms; use Fourier series analysis to identify the harmonics, and eliminate them using PWM techniques.	Lecture	[1504.4(N)]	Summative Assessment(CIA Quiz, ETE, Sessional)
L40-42	DC–AC converters : multi-phase inverters	Synthesize multi-phase inverters from the single phase H-bridge template; analyse the three phase inverters with 120^{o} and 180^{o} CSI and VSI using Fourier series analysis	Lecture	[1504.4(N)	Summative Assessment(CIA Quiz, ETE, Sessional)

		;demonstrate its in VVVF drives with Induction motor speed control as an illustration.			
T13-14	Computational problems on DC–AC switched mode inverters				

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 1504(N).1	Describe the importance, relevance, interdisciplinary nature & scope of power conditioning equipment's and Interpret and illustrate the static and dynamic V-I characteristics of semiconductor devices.	3	1				2	3	3				1	1		
1504(N).2	Synthesize different types of converters (AC to DC, DC to DC, AC to AC, DC to AC) for matching the load requirements, analyse the functionality of different converters.	2	3		2					1					2	3
1504(N).3	Analyse the effects of different types of load on the performance of the converters and modify different operating parameters to improve these performances indices and hence develop employability skills.		2	3		1	2				1			3	3	3
1504(N).4	Describe the methodology to improve power quality issues and recall different power conditioning techniques and judge the best way to achieve energy conversion for a particular application.			3	2			1				1	3	2	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

J. Course Outcome Attainment Level Matrix:

CO	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES **THRESHOLD VALUE: 40%**												ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1504(N).1	Describe the importance, relevance, interdisciplinary nature & scope of power conditioning equipment's and Interpret and illustrate the static and dynamic V-I characteristics of semiconductor devices.															
1504(N).2	Synthesize different types of converters (AC to DC, DC to DC, AC to AC, DC to AC) for matching the load requirements, analyse the functionality of different converters.															
1504(N).3	Analyse the effects of different types of load on the performance of the converters and modify different operating parameters to improve these performances indices and hence develop employability skills.															
1504(N).4	Describe the methodology to improve power quality issues and recall different power conditioning techniques and judge the best way to achieve energy conversion for a particular application.															

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

MANIPAL UNIVERSITY JAIPUR
School of Electrical & Electronics Engineering
Department of Electrical Engineering
Course Handout
[Organization and Management | BB1540 | 3 Credits |
Session: Aug-Dec 2020 | Faculty: Dr. Sonal Sidana | Class: B Tech V Semester|

A. Course Introduction: Today's world consists of many local, national, multinational and global organizations. Success of all business depends on their effective and efficient management. Therefore, management plays a most powerful and crucial role in the success and survival of the whole world. The significance of the course enlightens the dynamic life-giving element in every business. Consequently, it will emerge as a great resource as well an important 'discipline of learning' in the modern business world. The objective is to provide an understanding of basic concepts, principles and practices of organization and management. The aim is to inculcate the ability to apply multifunctional approach to organizational objectives. This course will enable students understand the basic concept of organization and management and various functions of it.

B. Course Outcomes: On completion of the course the students shall be able to:

[BB1540.1]. Understand theory and practice of organization and management.
[BB1540.2]. Build a comprehensive knowledge about marketing and personnel management
[BB1540.3]. Develop the skills of leadership and motivation.
[BB1540.4]. Illustrate the concept of entrepreneurship for developing skill for employability.
[BB1540.5]. Develop the knowledge of management information system (MIS).

C. Program Outcomes and Program Specific Outcomes

[PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives**.**

[PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

[PSO.1]. Understanding Traditional and Contemporary Managerial Concepts and Models: Understanding in detail, the contents of various functional areas of Business & Management and the implications of psychological and behavioral aspects on the organizations.

[PSO.2]. Analyzing Business Environment: Identifying opportunities existing in the domestic and global business and economic environment and initiating systematic approach towards rational decision making.

[PSO.3]. Application of Business Concepts and Managerial Skills: Implementing conceptual knowledge in real business situations for ensuring business sustainability and growth.

D. Assessment Plan

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. Syllabus

Unit 1: Meaning and definition of an organization, Necessity of Organization, Principles of Organization, Formal and Informal Organizations. Management: Functions of Management, Levels of Management, Managerial Skills, Importance of Management, Models of Management, Scientific Management, Forms of Ownership, Organizational Structures, Purchasing and Marketing Management, Functions of Purchasing Department, Methods of Purchasing, Marketing, Functions of Marketing, Advertising.

Unit 2: Introduction, Functions of Personal Management, Development of Personal Policy, Manpower Planning, Recruitment and Selection of manpower.

Unit 3: Motivation – Introduction, Human needs, Maslow's Hierarchy of needs, Types of Motivation, Techniques of Motivation, Motivation Theories, McGregor's Theory, and Herzberg's Hygiene Maintenance Theory. Leadership - Introduction Qualities of a good Leader, Leadership Styles, Leadership Approach, Leadership Theories.

Unit 4: Entrepreneurship – Introduction, Entrepreneurship Development, Entrepreneurial Characteristics, Need for Promotion of Entrepreneurship, Steps for establishing small scale unit.

Unit 5: Data and Information; Need, function and Importance of MIS; Evolution of MIS; Organizational Structure and MIS, Computers and MIS, Classification of Information Systems, Information Support for functional areas of management.

F. Text Books

T1. Koontz, Harold, Cyril O'Donnell, and Heinz Weihrich: Essentials of Management, Tata McGraw-Hill, New Delhi

T2. Robbins, Stephen P, and Mary Coulter: Management, Prentice Hall, New Delhi

T3. E. S. Buffa and R. K. Sarin "Modern Production / Operations Management", 8th Edition, Wiley, 1987

G. Reference Books

R1. H. J. Arnold and D. C. Feldman "Organizational Behavior", McGraw – Hill

R2. Aswathappa K: Human Resource and Personnnel Management, Tata McGraw Hill

R3. William Wether& Keith Davis, Human Resource and Personnel Management, McGraw Hill

H. Lecture Plan

Lecture No.	PARTICULARS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1.	Meaning and definition of an organization, Necessity of Organization	Understands the importance and concepts of organization management.	Lecture PPT , Discussion	BB1540.1	Class Quiz Mid Term I End Term
2.	Principles of Organization, Formal and Informal Organizations	Learn and understand the process and principles as well learn types of organizations	Lecture PPT, Discussion	BB1540.1	Class Quiz Mid Term I End Term
3.	Management Function: Planning & Organizing	Learn the principles of management and administration as well how they are applicable in a business Organization	Lecture PPT, Discussion	BB1540.1	Class Quiz Mid Term I End Term
4.	Management Function: Leading & Controlling	Understand the basic process of various management functions and how they are applicable in the organization	Lecture PPT, Discussion	BB1540.1	Class Quiz Mid Term I End Term
5.	Managerial Skills, Importance of Management,	Understanding of different managerial skills	Lecture PPT, Discussion	BB1540.1	Class Quiz Mid Term I End Term
6.	Activity	Understanding of previous lectures	Class activity	BB1540.1	Quiz/ Case study
7.	Models of Management: Scientific and Administrative management	Students will gain the knowledge of different Scientific and Administrative management	Lecture , Discussion	BB1540.1	Class Quiz Mid Term I End Term
8.	Models of Management: Behavioral approach	Understand the approach of behavioral management	Lecture , Discussion	BB1540.1	Class Quiz Mid Term I End Term

9.	Activity related models of management	Understanding of previous lectures	Class activity	BB1540.1	Class Quiz/ case study
10.	Forms of Ownership and Organization Structures	Understanding of Ownership and Organization Structures	Lecture, Discussion	BB1540.2	Class Quiz Mid Term I End Term
11.	Activity	Understanding of previous lectures	Class activity	BB1540.2	Class Quiz/ case study
12.	Purchasing Function and Marketing Function	Understanding of purchasing function and marketing function	Lecture PPT ,Discussio n	BB1540.2	Class Quiz Mid Term I End Term
13.	Advertising and Changing Dynamics of Advertising	Students will gain knowledge of advertising and how advertising is changing with market	Lecture PPT, Discussion	BB1540.2	Class Quiz Mid Term I End Term
14.	Activity	Understanding of previous lectures	Class activity	BB1540.2	Class Quiz/ case study
15.	Introduction, Functions of Personnel Management, Development of Personnel Policy	Understanding of human resource function and policies of personnel management	Lecture PPT, Discussion	BB1540.2	Class Quiz Mid Term II End Term
16.	Manpower Planning	Students will gain the knowledge of manpower planning	Lecture, Discussion	BB1540.2	Class Quiz Mid Term II End Term
17.	Recruitment of Manpower	Students will gain the knowledge of various steps and process of recruitment in human resource	Lecture PPT, Discussion :	BB1540.2	Class Quiz Mid Term II End Term

18.	Selection of Manpower	Students will gain the knowledge of various steps and process of selection in human resource	Lecture PPT, Discussion	BB1540.2	Mid Term II End Term
19.	Activity	Understanding of previous lectures	Class activity	BB1540.2	Class Quiz/ case study
20.	Introduction to Motivation, Human needs, Maslow's Hierarchy of needs	Understand the meaning of the motivation, human needs and the Maslow's theory of motivation Students will learn various types of motivation.	Recap of previous lecture, Lecture PPT, Discussion	BB1540.3	Class Quiz Mid Term II End Term
21.	Types and techniques of Motivation	Understand different techniques of motivation and their uses.	Lecture PPT, Discussion	BB1540.3	Class Quiz Mid Term II End Term
22.	McGregor's Theory, Herzberg's Hygiene Maintenance Theory	Students will learn the popular theories of motivation.	Lecture PPT, Discussion	BB1540.3	Class Quiz Mid Term II End Term
23.	Activity	Understanding of previous lectures	Class activity	BB1540.3	Class Quiz/ case study
24.	Leadership - Introduction Qualities of a good Leader, Leadership Styles	Students will learn different approaches of leadership.	Lecture PPT, Discussion	BB1540.3	Class Quiz Mid Term II End Term
25.	Leadership Theories	Understand different theories of leadership	Lecture PPT, Discussion	BB1540.3	Class Quiz Mid Term II End Term
26.	Leadership Theories	Understand different theories of leadership	Class Activity, PPT	BB1540.3	Class Quiz Mid Term II End Term

27.	Activity	Understanding of previous lectures	Class activity	BB1540.3	Class Quiz/ case study
28.	Entrepreneurship – Introduction, Entrepreneurship Development	Students will learn about entrepreneurship and its development.	Lecture PPT, Discussion	BB1540.4	Class Quiz Mid Term II End Term
29.	Entrepreneurial Characteristics, Need for Promotion of Entrepreneurship	Understand the characteristics and need for promoting entrepreneurship unit.	Lecture, Discussion	BB1540.4	Class Quiz Mid Term II End Term
30.	Steps for establishing small scale unit	Analyze the various steps involved in establishing small scale.	Lecture PPT, Discussion	BB1540.4	Class Quiz Mid Term II End Term
31.	Activity	Understanding of previous lectures.	Class activity	BB1540.4	Class Quiz/ case study
32.	Data and Information; Need and Importance of MIS	Understand the difference between data and information and the importance of managerial information system in an organization.	Lecture, Discussion	BB1540.5	Class Quiz End Term
33.	Functions of MIS and Evolution of MIS	Understand different phases related to evolution of MIS.	Lecture PPT, Discussion	BB1540.5	Class Quiz End Term
34.	Activity	Understanding of previous lectures	Class activity	BB1540.5	Class Quiz/ case study
35.	Organizational Structure and MIS	Understand the use of managerial information system in organizational structure. Student will learn about management information system.	Lecture PPT, Discussion	BB1540.5	Class Quiz End Term

36.	Activity	Analyze the close ended case study related to the management.	Case study	BB1540.5	Case study analysis
37.	Computers and MIS	Understand the basic requirement of management and computers in business	Lecture PPT, Discussion	BB1540.5	Class Quiz End Term
38.	Classification of Information Systems and Information Support for functional areas of management	Learn the importance of Control and it is the fourth and final principle element of the managerial process.	Lecture PPT, Discussion	BB1540.5	Class Quiz End Term
39.	Classification of Information Systems and Information Support for functional areas of management	Lear the controlling that intends to ensure that everything occurs in conformity with the plans	Lecture PPT, Discussion	BB1540.5	Class Quiz End Term

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
BB 1540.1	Understand theory and practice of organization and management	2							2		2
BB 1540.2	Build a comprehensive knowledge about marketing and personnel management		1	2						1	
BB 1540.3	Develop the skills of leadership and motivation.		2	2		2			2		
BB 1540.4	Illustrate the concept of entrepreneurship.	2			1		1		1		
BB 1540.5	Develop the knowledge of management information system.							1			2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and Communication Engineering

Department of Electrical Engineering
Course Hand-out

Microprocessor & Microcontroller | EE 1601N | 4 Credits | 3 1 0 4

Session: JAN2021 – MAY2021 | Faculty: Abhishek Kumar | Class: VI Sem B Tech (EE)

A. Introduction: This course is offered by Dept. of Electrical Engineering as a core course, targeting students who wish to work in the area of embedded systems and automation. This course provides an understanding about the concepts and basic architecture of 8051,8085 and 8086, an overview of difference between microprocessor and micro controller, background knowledge and core expertise in microcontroller, study the architecture and addressing modes of 8051,8085 and 8086, knowledge about assembly language programs of 8051, knowledge of different types of external interfaces including LEDS, LCD, Keypad Matrix, Switches & Seven segment display, motors etc. The course also build up the basic understanding of the importance of different peripheral devices & their interfacing to 8051 and give an overview of recent growth and trends of controllers & processors.

B. Course Outcomes: At the end of the course, students will be able to

[EE1601(N).1] Acquire the **knowledge** of Microcontroller types and variants, its features, specifications and architecture. **(Bloom's Level: Cognitive level Knowledge).**

[EE1601(N).2] Acquire the **knowledge** of Microprocessor types and variants, its features, specifications and architecture. **(Bloom's Level: Cognitive level Knowledge).**

[EE1601(N).3] Simulate, **Analyze** and **develop** Microcontroller 8051 based programs using assembly language and high level language ('C') in simulation software like Keil. **(Bloom's Level: Cognitive level Analysis, Synthesis).**

[EE1601(N).4] Analyze and simulate the working of on-chip features of 8051 like timers, interrupts of 8051. **(Bloom's Level: Cognitive level Analysis).**

[EE1601(N).5] Design, analyze and simulate circuits to interface stepper motor and LCD to 8051 microcontroller Kit. **(Bloom's Level: Cognitive level Synthesis, Analysis).**

[EE1601(N).6] Ability to **analyze** a problem and **formulate** appropriate computing solution for microcontroller and microprocessor based applications and hence **enhancing skill development** in the area. . **(Bloom's Level: Cognitive level Analysis, Synthesis, Evaluation).**

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering

fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4]. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmentally friendly and feasible solutions.

[PSO.3]. Develop, investigate, and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Plan:

Criteria	Description	Maximum Marks
	Sessional Exam I (Close Book)	15

Internal Assessment (Summative)	Sessional Exam II (Close Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Introduction: Evolution of microprocessors and microcontrollers, memory devices, number system, architecture, interrupts instruction set and assembly language programming of **8085 microprocessor**. **8086 Microprocessor**: Pin assignments, minimum and maximum mode, architecture, addressing modes, interrupts, instruction format, instruction set and assembly language programming, introduction to 8087 math coprocessor. **Peripheral Devices and Their Interfacing:** Introduction, memory and I/O interfacing, data transfer schemes, programmable peripheral interface (8255), programmable DMA controller (8257, 8237A), programmable interrupt controller (8259), programmable communication interface (8251), programmable counter/interval timer (8253 and 8254), elements and circuits for interfacing, **Microcontrollers:** Architecture, instruction set and assembly language programming of 8051 microcontroller, introduction to 8031/8052 microcontroller. Applications: Measurement and control of electrical and physical quantities, case studies.

F. TEXT BOOKS

T1. M.A. Mazidi and G. Mazidi, The 8051 microcontroller & Embedded Systems using Assembly & **'**C**'**, Pearson, 2011

T2. Rajkamal, Microcontrollers, Architecture, Programming, Interfacing & System Design, Pearson, 2005

T3. Ramesh S. Gaonkar, *Microprocessor architecture, programming, and applications with the 8085 (5e)*, Prentice Hall, 2002.

G. REFERENCE BOOKS

R1. K.J. Ayala, The 8051 Microcontroller & Embedded Systems using Assembly & 'C', Cengage, 2009

R2. Predko, Programming & Customizing the 8051 Microcontroller, Tata McGraw Hill

R3. Ray A.K. and Bhurchandi K.M., *Advanced Microprocessors and Peripherals (2e)*, Mc Graw Hill Education, 2009.

H. Lecture Plan:

Lec No	**Topics**	**Session Objective**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	Revision : Introduction of number system, Digital system, Adder, MUX, DeMUX, Decoder, Encoder	Recall of concepts of digital electronics	Lecture	[1601N.1].	
2	Memory : Flip flop, Register, Definitions of Bit, nibble, byte, word, Memory Organization, Memory size & address line, data lines	Recall of concepts of digital electronics and memory managements	Lecture	[1601N.2].	Class Quiz
3	Introduction of Keil Software, Creating the new project, Create, translate, build and debug of Assembly program	Introduce the concepts of simulation software and its features	Lecture, Hands on Practice Session	[1601N.1].	Home Assignment Software based executions
4	Computer system: Organization, Block diagram; Introduction of Embedded system, History of ICs, Difference b/w Microprocessor & Microcontroller	Introduce the basic computer systems and its components	Lecture	[1601N.2].	
5	Introduction of Microcontroller 8051,8085 microprocessor, Various flavors of uC 8051: 8031, 8052, features & specification	Introduce the Microcontroller 8051 and its various variant	Lecture	[1601N.2].	
6	Assembly programing, Working of CPU, Various blocks available in 8051: CPU registers, register bank, SFRs	Introduce the assembly programming concepts and its functioning	Lecture, Hands on Practice Session	[1601N.2].	
7	8051 blocks: Internal registers, Program Counter, Instruction Decoder and their role and	Describe the execution functional blocks of Mc 8051	Lecture, Hands on Practice Session	[1601N.2].	
8	8051 Memory, ROM addressing, RAM architectures: , Various special function registers, Register bank & their selections, bit addressable area, Scratch Pad RAM	Describe the Memory architecture of Mc 8051	Lecture	[1601N.2].	
9	Memory: ROM, PROM, UVPROM, EEPROM, Flash memory: Descriptions and Role in Computer system	Describe various types of Memory units	Lecture	[1601N.2].	
10	PSW & its bits, Concept of Carry, Auxiliary Carry, Parity & examples	Introduce the functioning of PSW register	Lecture, Practice Session	[1601N.2].	
11	Concept of Overflow, Signed & unsigned Number presentation, Concept of overflow in signed operations.	Introduce the signed and unsigned operations and the concept of overflow.	Lecture, Practice Session	[1601N.2].	
12	Architecture of 8051 : Diagram, Description	Describe the architecture of Mc 8051	Lecture	[1601N.1].	Home Assignment Class Quiz MID TERM 1 END TERM
13	Pin Diagram of 8051: Discussion on Pins & Signals (1): Supply Pins, Oscillator Pins, Pull up registers, Port P0,	Describe the Pin Diagram of Mc 8051 and its signal functioning	Lecture	[1601N.3].	

	P1, P2 & P3, their specifications, functions and uses				
14	Pin Diagram of 8051: Discussion on Pins & Signals (2): Reset Pin, Special function pins: ALE, PSEN, EA/VPP	Describe the Pin Diagram of Mc 8051 and its signal functioning	Lecture	[1601N.3].	
15	Reset Operations in 8051, Power on status of 8051, Address data De-multiplexing and external memory interface	Describe the Pin Diagram of Mc 8051 and RESET signal functioning	Lecture, Practice Session	[1601N.3].	
16	Instructions: Definitions, general format, Classification: (Bit wise & Byte wise), (1 Byte, 2 bytes & 3 Bytes Instructions)	Describe the various classifications of assembly language instructions	Lecture	[1601N.3].	
17	Process flow chart of program execution, Concept of list file, absolute file & OH file, Hex file, Assembler Directives, Data Directives	Describe the systematic execution of assembly language instruction	Lecture	[1601N.3].	
18	Addressing Mode: Definition, Types, explanation of each types with examples	Introduce the Addressing Modes and its types	Practice Session, Activities	[1601N.3].	
19	Instructions (1): Data transfer operations (inside the RAM): MOV , XCH and XCHD ; formats, explanation, specifications and Assembly Programs	Explain the utilisation of instructions in various applications	Lecture, Practice Session	[1601N.3].	
20	Instructions (2): Data transfer operations (From internal ROM to RAM): MOVC ; formats, explanation, specifications and Assembly Programs	Explain the utilisation of instructions in various applications	Lecture, Practice Session	[1601N.3].	Home Assignment Class Quiz MID TERM 1 END TERM
21	Instructions (3): Data transfer instructions((B/w external Memory & RAM): MOVX ; formats, explanation, specifications and Assembly Programs	Explain the utilisation of instructions in various applications	Practice Session, Activities	[1601N.3].	
22	Instructions (4): Arithmetic operations: ADD, ADDC, INC, DEC: formats, explanation, specifications and Assembly Programs	Explain the utilisation of instructions in various applications	Lecture, Practice Session	[1601N.3].	
23	Instructions (5): Arithmetic operations: SUBB, MUL, DIV, DA : formats, explanation, specifications and Assembly Programs, BCD operations	Explain the utilisation of instructions in various applications	Lecture, Practice Session	[1601N.3].	
24	Instructions (6): Logical operations: ANL, ORL, XRL, CLR, CPL : formats, explanation, specifications and Assembly Programs	Explain the utilisation of instructions in various applications	Practice Session, Activities	[1601N.4].	
25	Instructions (7): Rotate Operations: RR, RRC, RL, RLC : formats, explanation, specifications and Assembly Programs; Stepper motor Programming	Explain the utilisation of instructions in various applications	Lecture, Practice Session	[1601N.4].	Home Assignment Class Quiz MID TERM 2 END TERM
26	Instructions (8): Boolean Manipulation operation: CLR,	Explain the utilisation of instructions in	Lecture, Practice	[1601N.4].	

	SETB, CPL, ANL, ORL : formats, explanation, specifications and Assembly Programs	various applications	Session		
27	Instructions (9): Conditional Branching operation: DJNZ, CJNE : formats, explanation, specifications and Assembly Programs, Concept of Looping and Pointers	Explain the utilisation of instructions in various applications	Practice Session, Activities	[1601N.4].	
28	Instructions (10): Conditional Branching operation: JZ, JNZ, JC, JNC : formats, explanation, specifications and Assembly Programs, Concept of Looping and Pointers	Explain the utilisation of instructions in various applications	Lecture, Practice Session	[1601N.4].	
29	Instructions (11): Unconditional Branching operation: SJMP, LJMP, AJMP: formats, size, range, explanation, Hex code Calculations and Assembly Programs, Concept & calculation of relative address, absolute address.	Explain the utilisation of instructions in various applications	Practice Session, Activities	[1601N.4].	
30	Instructions (12): Unconditional Branching operation: ACALL, LCALL, RET: formats, size, range, explanation, Hex code Calculations and Assembly Programs, Role of stack in calling instructions	Explain the utilisation of instructions in various applications	Lecture, Practice Session	[1601N.4].	
31	Time delay calculation, Generation using 8051 instructions, Programming using 8051 instructions	Explain the utilisation of instructions for delay generations	Lecture, Practice Session	[1601N.4].	
32	8051 timers: Introductions, Timer Registers, TMOD & TCON Registers: Presentations and explanations	Introduce the Timer registers and Timer control registers of Microcontroller	Practice Session, Activities	[1601N.4].	
33	8051 , 8085 Timers, Programming timers, timer modes : Mode 0 and Mode 1 Programming for particular delay generations	Explain the Timer Modes of Timer and its utilisations	Lecture, Practice Session	[1601N.4].	
34	8051, 8085 Timers, Programming timers, timer modes : Mode 2 (split timer mode)Programming for delay generations	Explain the Timer Modes of Timer and its utilisations	Lecture, Practice Session	[1601N.4].	
35	Counter programming, Programming using 8051 instructions, parallel I/O ports of 8051, Alternate functions	Explain the Counter Modes of Timer and its utilisations	Practice Session, Activities	[1601N.5].	
36	Pull up registers, Interrupts: Interrupts versus polling, Interrupt service routine, Interrupts of 8051	Introduce the concept of Interrupt in Microcontroller	Lecture, Practice Session	[1601N.5].	
37	Enabling/Disabling interrupts, IE Register and IP Register: Presentations, explanations and uses	Explain the use of Interrupt in Microcontroller	Lecture, Practice Session	[1601N.5].	Home Assignment Class Quiz MID TERM 2 END TERM
38	Interrupt Programming: timer interrupts T0 and T1: programming and application Programs	Explain the use of Interrupt in Microcontroller	Lecture, Practice Session	[1601N.5].	

39	Interrupt Programming: External Hardware interrupts EX0 and EX1: programming and application Programs	Explain the use of Interrupt in Microcontroller	Lecture, Practice Session	[1601N.5].	
40	LCD Interfacing with 8051: LCD Basics, Pin descriptions, Command Code, Busy flag concept, Programming	Explain the use of LCD and its interface with Microcontroller	Practice Session, Activities	[1601N.4].	
41	LCD Interfacing with 8051 (2): Busy flag concept, LCD Read concept, Application Programs	Explain the use of LCD and its interface with Microcontroller and hence enhancing skill development in the area.	Lecture, Practice Session	[1601N.5]. [1601N.6].	
42	Stepper motor Interfacing with 8051: Stepper motor Basics, Pin descriptions, Rotate sequence, Programming, Speed Control using delay	Explain the use of Stepper Motor and its interface with Microcontroller and hence enhancing skill development in the area.	Lecture, Practice Session	[1601N.5]. [1601N.6].	Home Assignment Class Quiz MID TERM 2 END TERM
43	8085 microprocessor pin diagram and architecture	Explain the use of microprocessor	Practice Session, Activities	[1601N.2].	
44	8085 addressing modes with instructions	Explain the use of 8085 addressing modes	Lecture, Practice Session	[1601N.2].	
45	8086 microprocessor pin diagram and architecture	Explain the fundamentals of 8086	Lecture, Practice Session	[1601N.2].	
46	8086 addressing modes with instructions	Explain the use of addressing modes of 8086	Practice Session, Activities	[1601N.2].	
47	Assembly versus high level programming, Introduction to embedded programming in C/C++, Example programs.	Introduce the high level language like C for Microcontroller 8051 environment	Lecture, Practice Session	[1601N.3].	
48	programming 8051 in C/C++, External memory interfacing	Explain the external memory interface with Microcontroller	Lecture, Practice Session	[1601N.3].	
49	programmable DMA controller (8257, 8237A), programmable interrupt controller (8259)	Explain interface with Microprocessors and hence enhancing skill development in the area.	Lecture	[1601N.2]. [1601N.6].	
50	programmable communication interface (8251), programmable counter/interval timer (8253 and 8254)	Explain interface with Microprocessors and hence enhancing skill development in the area.	Lecture, flipped Classroom	[1601N.2]. [1601N.6].	Home Assignment Class Quiz END TERM

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 1601N.1	Acquire the knowledge of Microcontroller types and variants, its features, specifications and architecture	2			3								2	2		
EE 1601N.2	Acquire the knowledge of Microprocessor types and variants, its features, specifications and architecture	2												3	2	1
EE 1601N.3	Simulate, Analyze and develop Microcontroller 8051 based programs using assembly language and high level language (‘C’) in simulation software like Keil.	2	2	1	2	1							1		3	2
EE 1601N.4	Analyze and simulate the working of on-chip features of 8051 like timers, interrupts of 8051.	2	2	1	2	1							1		3	2
EE 1601N.5	Design, analyze and simulate circuits to interface stepper motor and LCD to 8051 microcontroller Kit.	2	2	2	2	1							1		3	2
EE 1601N.6	Ability to analyze a problem and formulate appropriate computing solution for microcontroller and microprocessor based applicationsandhenceenhancingskill development in the area.	2	3	3	2	2	2	1					2	2	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and Communication Engineering

Department of Electrical Engineering
Course Hand-out

Power System Analysis| EE 1602 (N) | 4 Credits | 3 1 0 4

Session: Jan 2021 – May 2021 | Faculty: Dr. Amit Saraswat | Class: VI Semester, B.Tech. (EE)

A. Introduction: The course is offered by Department of Electrical Engineering as a Regular Course, targeting all the students of VI Semester, B.Tech. (EE). It is one of the foundation courses in the domain of Power System. The main objective of the course is to develop an attitude and aptitude, in the undergraduate students of Electrical Engineering, to solve complex power system problems. The course offers an in-depth understanding of mathematical modelling of various basic power system components (i.e. Generators, Transformers, Transmission Lines and Electrical Loads) and basic power system analysis concepts such as: Symmetrical and Unsymmetrical Fault Analysis (Short-Circuit Analysis), Load Flow Analysis, and Power System Stability Analysis. Students are expected to have prerequisite knowledge of engineering mathematics, electrical circuit analysis and electrical machines.

B. Course Outcomes: Upon successful completion of the course, the student will be able to:

[EE1602N.1] Develop the appropriate mathematical representation i.e. one-line diagram and its per-phase per-unit impedance (or reactance) diagram for a given power system.

[EE1602N.2] Analyze the behaviour of synchronous machines in the small power system under symmetrical fault condition (i.e. 3-phase short circuit condition).

[EE1602N.3] Draw the positive, negative and zero sequence diagrams for the given small power system and analyze its behaviour under different unsymmetrical fault conditions (i.e. L-G, L-L and L-L-G faults).

[EE1602N.4] Develop the appropriate mathematical model and analyze the real power - angle stability of the given small power system.

[EE1602N.5] Evaluate bus admittance matrix (i.e. Y_{BUS}), formulate the load flow problem and carryout load flow analysis for the given small power systems.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1] Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2] Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3] Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4] Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5] Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6] The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

[PO.7] Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8] Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

[PO.9] Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10] Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11] Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12] Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

[PSO.1] To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2] To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3] Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Plan

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who miss a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	

E. SYLLABUS

EE 1602 (N) **POWER SYSTEM ANALYSIS** **[3 1 0 4]**

Representation of power systems: One line diagram, impedance diagram, per unit notations, selection and change of base quantities, Thevenin's model, equivalent circuit of three-winding transformers. **Symmetrical three-phase faults:** Short circuit current and reactance of synchronous machines, short-circuit current calculations of unloaded and loaded generators and power systems, selection of circuit breakers, current limiting reactors. **Asymmetrical faults:** Symmetrical components, Sequence components of line and phase voltages and currents of star-delta transformer banks, sequence impedances and sequence networks of power systems, analysis of unsymmetrical faults in generators and power systems under no-load and loaded conditions, faults through impedances. **Stability studies:** Steady-state and transient-state stability, swing equation, critical clearing time, Multi machine stability. **Load flow studies:** Admittance & impedance model for power systems & network calculations Load flow studies. Load flow solution techniques using Gauss-Siedel method, Newton-Raphson's method.

F. TEXT BOOKS

[T1] I. J. Nagrath & D. P. Kothari, *Modern Power System Analysis (2e)*, Tata Mc-Graw Hill, 2008.
[T2] T. K. Nagsarkar and M. S. Sukhija, *Power system Analysis (1e)*, Oxford University Press, 2007.

G. REFERENCE BOOKS

[R1] J. J. Grainger and W. D. Stevenson, *Elements of Power System Analysis (4e)*, Tata McGraw Hill, 2003.
[R2] H. Saadat, *Power System Analysis*, MGH Publications, 1999.
[R3] C. L. Wadhwa, *Electrical Power Systems (6e)*, New Age International Private Limited, 2010.

H. Lecture Plan

EE 1602 (N): Power System Analysis (PSA)

Lecture / Tutorial No.	Topic to be covered	Session Objectives	Mode of Delivery	Corresponding Course Outcome	Mode of Assessing the Outcome
L1	**Preamble of the Course:** Discussion on Course Contents (Syllabus), Course Prerequisites, Course Objectives and Outcomes.	To acquaint students with the outcome-based education (OBE) and Course outcomes (COs) and program outcomes (POs) assessment process	Lecture & Interaction	N.A.	N.A.
L2-L3	**Brief Introduction to Power System Analysis**	Structure of a typical power system, Basic components, Operational and Control Issues.	Lecture & Interaction	EE1602N.1	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L4-L5	**Representation of Power System:** One-line diagram, Impedance and Reactance diagram	One-line diagram, Impedance and Reactance diagram	Lecture & Interaction	EE1602N.1	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L6-L7	**Per-Unit Representation:** Per unit notations, selection and change of base quantities	Per unit notations, selection and change of base quantities	Lecture & Interaction	EE1602N.1	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L8-L9	**Per-Unit Representation:** Equivalent circuit of three-winding transformers.	Equivalent circuit of three-winding transformers.	Lecture & Interaction	EE1602N.1	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L10	**Thevenin's model:** Representation and its significance in power system analysis	Representation and its significance in power system analysis	Lecture & Interaction	EE1602N.1	Quiz Test / Mid Term Exam / End Term Exam

T1-T2	**Problems and Numerical Examples**	Numerical problems based on L1 – L10	Tutorial & Interaction / Group Discussion	EE1602N.1	Mid Term Exam / End Term Exam
L11	**Brief Introduction to Fault (Short-circuit) Analysis**	Classification and Types of faults in power system, Purpose of short-circuit (fault) analysis	Lecture & Interaction	EE1602N.2	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L12-L13	**Symmetrical three-phase faults:** Transients on transmission lines, Short Circuit Capacity (SCC)	Transients on transmission lines, Short Circuit Capacity (SCC)	Lecture & Interaction	EE1602N.2	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L14-L15	**Symmetrical three-phase faults:** Short circuit current and reactance of synchronous machines on No-load condition	Short circuit current and reactance of synchronous machines on No-load condition	Lecture & Interaction	EE1602N.2	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T3-T4	**Problems and Numerical Examples**	Numerical problems based on L11 – L15	Tutorial & Interaction / Group Discussion	EE1602N.2	Mid Term Exam / End Term Exam
L16	**Symmetrical three-phase faults:** Short circuit current and reactance of synchronous machines under Loaded condition	Short circuit current and reactance of synchronous machines under Loaded condition	Lecture & Interaction	EE1602N.2	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T5	**Problems and Numerical Examples**	Numerical problems based on L16	Tutorial & Interaction / Group Discussion	EE1602N.2	Mid Term Exam / End Term Exam
L17	**Symmetrical three-phase faults:** Computation of short-circuit current using Thevenin's Theorem in No-load and loaded conditions	Computation of short-circuit current using Thevenin's Theorem in No-load and loaded conditions	Lecture & Interaction	EE1602N.2	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T6	**Problems and Numerical Examples**	Numerical problems based on L17	Tutorial & Interaction / Group Discussion	EE1602N.2	Mid Term Exam / End Term Exam

L18-T19	**Symmetrical three-phase faults:** Selection of circuit breakers, current limiting reactors-types and locations	Selection of circuit breakers, current limiting reactors-types and locations	Lecture & Interaction	EE1602N.2	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T7	**Problems and Numerical Examples**	Numerical problems based on L18 – L19	Tutorial & Interaction / Group Discussion	EE1602N.2	Mid Term Exam / End Term Exam
L20	**Symmetrical Components:** Definition, Concept and Representation of unbalanced power systems	Definition, Concept and Representation of unbalanced power systems	Lecture & Interaction	EE1602N.3	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L21-L22	**Asymmetrical three-phase faults:** Sequence components of line and phase voltages and currents of star-delta transformer banks	Sequence components of line and phase voltages and currents of star-delta transformer banks	Lecture & Interaction	EE1602N.3	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L23-L24	**Asymmetrical three-phase faults:** Sequence impedances and sequence networks of power system components such as Transmission lines, transformers and synchronous machines	Sequence impedances and sequence networks of power system components such as Transmission lines, transformers and synchronous machines	Lecture & Interaction	EE1602N.3	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T8	**Problems and Numerical Examples**	Numerical problems based on L20 – L24	Tutorial & Interaction / Group Discussion	EE1602N.3	Mid Term Exam / End Term Exam
L25-L26	**Analysis of Unsymmetrical Faults:** Single Line-to-Ground (L-G) fault, Line-to-Line (L-L) faults and Double Line to Ground (L-L-G) fault in no-load and loaded conditions, faults through impedances.	Single Line-to-Ground (L-G) fault, Line-to-Line (L-L) faults and Double Line to Ground (L-L-G) fault in no-load and loaded conditions, faults through impedances.	Lecture & Interaction	EE1602N.3	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T9-T10	**Problems and Numerical Examples**	Numerical problems based on L25 – L26	Tutorial & Interaction / Group Discussion	EE1602N.3	Mid Term Exam / End Term Exam

L27-L28	**Stability studies:** Brief Introduction, Concept of Rotor Angle stability, Dynamics of synchronous machine	Brief Introduction, Concept of Rotor Angle stability, Dynamics of synchronous machine	Lecture & Interaction	EE1602N.4	Quiz Test / Mid Term Exam / End Term Exam
L29-L30	**Stability studies:** Swing Equation, Power Angle Equation and Power Angle Curve	Swing Equation, Power Angle Equation and Power Angle Curv	Lecture & Interaction	EE1602N.4	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L31	**Stability studies:** Simple examples of single machine connected to infinite bus and two machine system	Simple examples of single machine connected to infinite bus and two machine system	Lecture & Interaction	EE1602N.4	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T11	**Problems and Numerical Examples**	Numerical problems based on L27 – L30	Tutorial & Interaction / Group Discussion	EE1602N.4	Mid Term Exam / End Term Exam
L32-L33	**Stability studies:** Definitions and Concept of Steady-state stability and Transient-state stability, Critical Clearing Time	Definitions and Concept of Steady-state stability and Transient-state stability, Critical Clearing Time	Lecture & Interaction	EE1602N.4	Quiz Test / Mid Term Exam / End Term Exam
L34-L35	**Stability studies:** Equal Area Criterion for Transient-state stability	Equal Area Criterion for Transient-state stability	Lecture & Interaction	EE1602N.4	Quiz Test / Mid Term Exam / End Term Exam
L36-L37	**Mathematical Modelling of Power System**	Admittance (Y_{BUS}) & impedance (Z_{BUS}) models representations for power systems & networks	Lecture & Interaction	EE1602N.5	Quiz Test / Mid Term Exam / End Term Exam
T12	**Problems and Numerical Examples**	Numerical problems based on L31 – L37	Tutorial & Interaction / Group Discussion	EE1602N.5	Mid Term Exam / End Term Exam
L38-L39	**Load Flow Studies:** Types of Power system Buses - PQ, PV and Slack Buses, Bus Mismatch, Mathematical Formulation of Load Flow Problem	Types of Power system Buses - PQ, PV and Slack Buses, Bus Mismatch, Mathematical Formulation of Load Flow Problem	Lecture & Interaction	EE1602N.5	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam

L40-L41	**Load Flow Solution Techniques:** Gauss-Siedel method	Gauss-Siedel method	Lecture & Interaction	EE1602N.5	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T13	**Problems and Numerical Examples**	Numerical problems based on L38 – L41	Tutorial & Interaction / Group Discussion	EE1602N.5	Mid Term Exam / End Term Exam
L42-L43	**Load Flow Solution Techniques:** Newton-Raphson's method	Newton-Raphson's method	Lecture & Interaction	EE1602N.5	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T14	**Problems and Numerical Examples**	Numerical problems based on L42– L43	Tutorial & Interaction / Group Discussion	EE1602N.5	Mid Term Exam / End Term Exam

I. Course Articulation Matrix: (Mapping of COs with POs)

CO No.	CO STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE1602N.1	Develop the appropriate mathematical representation i.e. one line diagram and its per-phase per-unit impedance (or reactance) diagram for a given power system.	3	2		2								1	2	1	1
EE1602N.2	Analyze the behaviour of synchronous machines in the small power system under symmetrical fault condition (i.e. 3-phase short circuit condition).	3	2		2								1	2	1	1
EE1602N.3	Draw the positive, negative and zero sequence diagrams for the given small power system and analyze its behaviour under different unsymmetrical fault conditions (i.e. L-G, L-L and L-L-G faults).	3	2		2									2	1	1
EE1602N.4	Develop the appropriate mathematical model and analyze the real power - angle stability of the given small power system.	3	2		2									2	1	1
EE1602N.5	Evaluate bus admittance matrix (i.e. Y_{BUS}), formulate the load flow problem and carryout load flow analysis for the given small power systems.	3	2		2									2	2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

J. Course Outcome Attainment Level Matrix:

CO	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES **THRESHOLD VALUE: 40%**												ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE1602N.1	Develop the appropriate mathematical representation i.e. one line diagram and its per-phase per-unit impedance (or reactance) diagram for a given power system.															
EE1602N.2	Analyze the behaviour of synchronous machines in the small power system under symmetrical fault condition (i.e. 3-phase short circuit condition).															
EE1602N.3	Draw the positive, negative and zero sequence diagrams for the given small power system and analyze its behaviour under different unsymmetrical fault conditions (i.e. L-G, L-L and L-L-G faults).															
EE1602N.4	Develop the appropriate mathematical model and analyze the real power - angle stability of the given small power system.															
EE1602N.5	Evaluate bus admittance matrix (i.e. Y_{BUS}), formulate the load flow problem and carryout load flow analysis for the given small power systems.															

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and Communication Engineering

Department of Electrical Engineering

Course Hand-out

CMMUNICATION SYSTEMS| EE1603 (N) | 3 Credits | 3 0 0 3

Session: Jan 21- May 21 | Faculty: Vikash Kumar Boradak | Class: VI Sem B Tech (EE)

A. INTRODUCTION: This course is offered by Dept. of Electrical Engineering as a regular course, targeting students who wish to pursue research& development in industries or higher studies in field of Communication Engineering, including AM, FM, Digital comm., Optical comm,, and Satellite communication. Offers basic knowledge necessary for transmitting and receiving information using today's communication technologies. The techniques that will be studied involve coding information onto a carrier (modulation) which is then transmitted. The received signal is then decoded (demodulated) yielding the original information. Emphasis will be given to analog modulation of both analog and digital signals.

B. Course Outcomes: At the end of the course, students will be able to

EE1603(N).1. Interpret and illustrate various techniques for analog modulation and demodulation, compare their performance based on different parameters and analyze efficiency. (**Bloom's Level: knowledge, Comprehensive)**

EE1603(N).2. Interpret and illustrate various techniques for angle modulation and demodulation and describe frequency division multiplexing. (Bloom's Level: knowledge, Comprehensive)

EE1603(N).3. Familiarize students with digitization and methods for generating pulse modulation technique- PAM, PWM and PPM concepts, PCM, and time division multiplexing. (Bloom's Level: Application)

EE1603(N).4. Recognize different digital modulation techniques and judge the best way to achieve overall performance for a specific application and error control coding. (Bloom's Level: Analysis)

EE1603(N).5. Recognize and classify the structures of Optical fiber and types, describe the channel impairments and basics of satellite communication systems. (Bloom's Level: Application, Synthesis)

EE1603(N).6. Impart and exemplify the concepts and operation of Multiple Access Techniques, Microwave links, wireless communication hence develop employability skills. (Bloom's Level: Application)

C. Program Outcomes and Program Specific Outcomes

[PO.1]. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences**.**

[PO.3]. **Design/ Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

[PO.4]. **Conduct investigations** of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions**.**

[PO.5]. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an under- standing of the limitations.

[PO.6]. **The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

[PO.7]. **Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

[PO.8]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice**.**

[PO.9]. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

[PO.10]. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions**.**

[PO.11]. **Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to owners own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyze the prevalent domains of electrical systems for sustainable, reliable, environmentally friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	15
	Sessional Exam II (Close Book)	15
	Quizzes and Assignment	30
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Quizzes	Quizzes (Close Book)	

E. Syllabus

Elements of an Electrical Communication System: Communication Networks, Analog Communication Systems - Principles of Amplitude modulation, double and single side band, suppressed carrier system, AM circuits, AM Transmitters and Receivers, Angle modulation, Frequency modulation, FM receivers, Digital Communication: Sampling theorem, pulse modulation techniques - PAM, PWM and PPM concepts, PCM encoder and decoder, Multliplexing – TDM, **FDM - Data communication techniques:** Data transmission using analog carriers, MODEMS employing FSK, PSK, DPSK, QPSK, and QAM, error control coding techniques - Multiple Access Techniques, Microwave links, Satellite communication systems, Optical communication systems, Wireless Communication.

F. Text Book:

T1. T1. B. P. Lathi, Modern Analog and Digital Communication – Oxford Press

G. Reference Book:

R1. Tomasi W., Electronics Communications systems, Pearson Publications, 2001.

R2. Haykin S., Analog and Digital Communications, Wiley Publishers, 1989.

H. Lecture Plan:

Lecture	Topics to be covered	Session Outcome	Mode of Delivery	Corresponding Course Outcome	Mode of Assessing the Outcome
L1	Course overview	To acquaint students with the outcome-based education (OBE) and Course outcomes (COs) and program outcomes (POs) assessment process	Interaction	-	-
L2	Basics of signals and systems, Fourier transformation	Frequency analysis of signals	Lecture & Interaction	EE1603(N).1 EE1603(N).2	First Session Exam Quiz ET Exam
L3	Communication Networks	Overview of different communication networks	Lecture & Interaction	EE1603(N).1 EE1603(N).2	
L4-L5	Analog Communication Systems- Principles of Amplitude modulation	Need of modulation and Representation of AM signals	Lecture & Interaction	EE1603(N).1	
L6-L9	double and single side band, suppressed carrier system	Generation and demodulation of DSB and SSB	Lecture & Interaction	EE1603(N).1	
L10	AM circuits, AM Transmitters and Receivers	Hardware circuit implementation	Lecture & Interaction	EE1603(N).1	
L11-L14	Angle modulation- Frequency modulation,	Representation of FM and PM signals	Lecture & Interaction	EE1603(N).2	
L15	FM receivers	Hardware circuit implementation	Lecture & Interaction	EE1603(N).2	

L16	Digital Communication: Sampling theorem	Signal conversion and its requirement	Lecture & Interaction	EE1603(N).3 EE1603(N).4	
L17 – L19	pulse modulation techniques - PAM, PWM and PPM concepts, PCM encoder and decoder	Different pulse modulation schemes	Lecture & Interaction	EE1603(N).3 EE1603(N).4	Sessional Session Exam Quiz ET Exam
L20–L21	Multiplexing : TDM; FDM	Concept of multiplexing	Lecture & Interaction	EE1603(N).3 EE1603(N).4	
L22	Data communication techniques: Data transmission using analog carriers	Concept of digital data transmission using analog carrier	Lecture & Interaction	EE1603(N).3 EE1603(N).4	
L23-L26	MODEMS employing FSK, PSK, DPSK, QPSK, and QAM	Generation and demodulation of FSK, PSK, DPSK, QPSK, and QAM	Lecture & Interaction	EE1603(N).4	
L27–L29	error control coding techniques		Lecture & Interaction	EE1603(N).4	
L30	Multiple Access Techniques	Concept and Representation of MAT	Lecture & Interaction	EE1603(N).6	
L31 – L33	Satellite communication systems	Concept and Representation of Satellite communication systems	Lecture & Interaction	EE1603(N).5	
L34 – L35	Optical communication systems	Concept and Representation of Optical communication systems	Lecture & Interaction	EE1603(N).5	
L36 – L37	Wireless Communication, Microwave links	Concept and Representation of Wireless Communication, Microwave links	Lecture & Interaction	EE1603(N).6	Quiz ET Exam

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE1603(N).1	Interpret and illustrate various techniques for analog modulation and demodulation, compare their performance based on different parameters and analyze efficiency	2	2				2				2					
EE1603(N).2	Interpret and illustrate various techniques for angle modulation and demodulation, and describe frequency division multiplexing.	3	2	2			2				3					
EE1603(N).3	Familiarize students with digitization and methods for generating pulse modulation technique- PAM, PWM and PPM concepts, PCM, and time division multiplexing.	2	2													
EE1603(N).4	Recognize different digital modulation techniques and judge the best way to achieve overall performance for a specific application and error control coding.	1	2							1						
EE1603(N).5	Recognize and classify the structures of Optical fiber and types, describe the channel impairments and basics of satellite communication systems.	3	3				1						2			
EE1603(N).6	Impart and exemplify the concepts and operation of Multiple Access Techniques, Microwave links, wireless communication hence develop employability skills.	2	3				2				1					

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics & Communication Engineering (SEEC)

Department of Electrical Engineering

Course Hand-out

Renewable Energy Resources | EE1653| 3 Credits | 3 0 0 3

Session: Oct. 2020 – Jan.2021 | Faculty: Dr. Amit Soni | Class: VI Sem B Tech. (EE)

A. Introduction: Department of Electrical Engineering offers this course as Program Elective in view to provide Introduction to Energy Systems and Renewable Energy Resources and their applications. This will help to explore present needs, challenges and future energy demands of leading Renewable Energy Sources such as Solar, Biomass (conversions), Wind power, Geothermal, and Ocean Thermal Energy conservation methods. Present course emphasizes and will be targeting students who wish to pursue Research & Development in the related areas of alternate energy resources.

B. Course Objectives: At the end of the course, students will be able to:

[1653.1]. To understand Present Energy Scenario, Energy Sources and their Availability in various forms.

[1653.2]. Describe various forms of Conventional and Non-Conventional Energy Resources. In addition, the Awareness will be made related to Need for Energy Conservation.

[1653.3]. Analyse and understand operating principles and concepts of Renewable Energy Production using various renewable sources, especially Solar, Wind Energy, Biomass, Geo-Thermal, Ocean and Hybrid Energy Systems.

[1653.4]. Interpret and compare advantages and disadvantages of various renewable energy technologies and propose the best possible energy conversion system for a particular location.

[1653.5]. To understand and make comparisons among energy uses, resources, and technologies for different Energy Resources.

C. Program Outcomes and Program Specific Outcomes

[PO.1]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

[PO.9]. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

D. Program Specific Outcomes (PSO): At the end of the program student should be able

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

E. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	**15**
	Sessional Exam II (Closed Book)	**15**
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	**30**
End Term Exam (Summative)	End Term Exam (Closed Book)	**40**
	Total	**100**
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Assignment on the topic related to the running unit will be given which has to be submitted within a week. These assignments are limited to a maximum of 5 throughout the entire semester.	
Activity Assignment (Formative)	A student is expected to participate and perform the activity/ flipped classroom participation related to the course which will be assessed, and marks will be awarded.	

F. Syllabus:

Energy sources and their availability: **Solar Energy**, solar radiation and measurements, solar energy storage, Solar Photo-Voltaic systems design, **Wind Energy** estimation, Maximum power and power coefficient, wind energy conversion systems , design considerations and applications, **Energy from Bio Mass**: Sources of bio-mass, Bio-mass conversion technologies, Thermo-chemical conversion and Biochemical conversions, Anaerobic digestion and Fermentation, Bio-gas generation Pyrolysis and Liquefaction, Classification of Gasifiers, Energy plantation, Geo-Thermal Energy, Energy from the Oceans: Ocean Thermal Energy

Conversion, Open and Closed Cycle plants, Site selection considerations, Origin of tides: Tidal energy conversion systems, Wave energy conversion systems, Hybrid Energy Systems.

G. Text Books:

T1. B. H. Khan, Non-conventional Energy Resources (3e), Tata Mc-Graw Hill, 2009.
T2. G. D Rai, Non- Conventioal Energy Sources, Khanna Publishers, 2004.

H. Reference Books:

R1. Twidell, T. Weir, Renewable Energy Resources (4e), ELBS, 2015.
R2. Mukherjee, S. Chakrabarti, Fundamentals of Renewable Energy Systems (1e), New Age Intl., 2007.

I. Lecture Plan:

Lec No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
L1	Introduction, Course Objective and overview of the contents of Renewable Energy Resources	To Understand and provide overview related to Aims, Objective and Contents and to understand student expectations	Lecture	NA	NA
L2-L3	Introduction, Classification, Importance, Advantages & Disadvantages of different Energy Sources on the basis of different criterions.	To Understand Classification, and Importance of different types of Energy Sources	Lecture	[1653.1]	In Class Quiz (Not Accounted)
L4	Review related to availability of Energy Sources and Energy Scenario of India	To analyse availability of Energy Sources and Indian Energy Scenario.	Lecture	[1653.2]	In Class Quiz Mid Term
L5	Introduction of Solar Energy and Solar Radiation and Measurements.	Able to understand Solar Energy concepts and measurements.	Lecture	[1653.2]	Home Assignment End Term
L6 - L7	Solar energy storage and Solar Photo-Voltaic systems	Able to understand SPV Systems	Lecture	[1653.3]	In Class Quiz End Term
L8	Solar Cell Materials, Characteristics and Equivalent Circuit.	Analyze different materials and its characteristics	Lecture	[1653.3]	Class Quiz Mid Term I End Term
L9	Solar Cell Design and Classification.	Analyze designing and classifications	Lecture	[1653.3]	Class Quiz Mid Term 1 End term
L10	Solar PV Module and Maximum Power Point Tracking.	Analyze MPPT concepts related to maximum power	Lecture	[1653.3]	Home Assignment Class Quiz Mid Term 1 End Term
L11	Classification of Solar PV Systems and Applications of Solar PV Modules.	Able to determine various classifications	Lecture	[1653.3]	Class Quiz Mid Term 1 End Term
T1	L2 – L11	Analyse analytical approaches for topics covered above.	Tutorial	[1653.1] [1653.3]	Class Quiz Mid Term I

L12	Introduction to Wind Energy Systems and Origin of Winds	To understand Wind energy systems and its concepts	Lecture	[1653.2]	Class Quiz End Term
L13	Estimation of Wind Energy and Different Technological Terms.	Analyse and understand different technological terms.	Lecture	[1653.3]	Class Quiz Mid Term II End Term
L14-L15	Maximum power and power coefficient, wind energy conversion systems, design considerations and applications	Able to determine existing design considerations and applications	Lecture	[1653.3]	Class Quiz Mid Term II End Term
T2	L12 - L15	Analyse analytical approaches for topics covered above.	Tutorial	[1653.1] [1653.3]	Class Quiz Mid Term II End Term
L16	Introduction to Bio-Mass Energy Conversion.	To understand concepts of Bio Mass Energy Conversion	Lecture	[1653.2]	Class Quiz Mid Term II End Term
L17	Sources of bio-mass, Bio-mass conversion technologies.	Understand different sources of Bio Mass and conversion technologies	Lecture	[1653.3]	Class Quiz End Term
L18	Anaerobic digestion and Fermentation, Bio-gas generation	Able to understand Biogas generation	Lecture	[1653.3]	Class Quiz End Term
L19	Pyrolysis and Liquefaction.	Able to understand Pyrolysis and Liquefaction.	Lecture	[1653.3]	Class Quiz End Term
L20	Classification of Gasifiers, Energy plantation	To understand Classifications of Gasifiers and energy plantation	Lecture	[1653.3]	Class Quiz End Term
T3	L16 – L20	Analyse analytical approaches for topics covered above.	Tutorial	[1653.2] [1653.3]	Class Quiz End Term
L21	Introduction to Geo-Thermal Energy and its Applications.	To understand concepts of Geo-Thermal energy	Lecture	[1653.2]	Class Quiz End term
L22	Types of Geothermal Resources and their Analysis.	To acquaint with different resources of Geothermal	Lecture	[1653.3]	Class Quiz
L23	Geothermal Energy Scenario in India.	To Understand Geothermal Energy Scenario in India	Lecture	[1653.3]	Class Quiz Mid Term II End Term
T4	L21-L23	Analyse analytical approaches for topics covered above.	Tutorial	[1653.2] [1653.3]	Class Quiz Mid Term II End Term

L24	Introduction to Energy from the Oceans: Ocean Thermal Energy Conversion.	To understand concepts of Ocean Thermal Energy Conversion.	Lecture	[1653.2] [1653.3]	Class Quiz Mid Term II End Term
L25	Open and Closed Cycle plants, Site selection considerations, Origin of tides.	Able to determine site selection considerations and origin of tides	Lecture	[1653.2] [1653.3]	Class Quiz End Term
L26	Tidal energy conversion systems.	Analyze Tidal energy conversion system	Lecture	[1653.2] [1653.3]	Class Quiz End Term
L27	Wave energy conversion systems.	Analyze wave energy conversion system	Lecture	[1653.3]	Class Quiz End Term
T5	L24-L27	Analyse analytical approaches for topics covered above.	Tutorial	[1653.2] [1653.3]	Class Quiz End Term
L28	Hybrid Energy Systems	Able to determine concepts of Hybrid Energy Systems	Lecture	[1653.4]	Class Quiz End Term
L29	Emerging Technologies used for Energy Production.	Understand Emerging Technologies for Energy Production.	Lecture	[1653.4]	Class Quiz End Term
L30-31	Review for the Concepts related to Renewable Energy Resources	Able to develop the concepts related to Renewable Energy Resources	Lecture	[1653.5]	NA

J. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

CO	STATEMENT	Correlation with Program Outcomes												Correlation with Program Specific Outcomes		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE1653.1	To understand Present Energy Scenario, Energy Sources and their Availability in various forms.	2		1	3			2	1				1	2	2	1
EE1653.2	Describe various forms of Conventional and Non-Conventional Energy Resources. In addition, the Awareness will be made related to Need for Energy Conservation.	2		1	3			2					2	3	2	1

EE1653.3	Analyse and understand operating principles and concepts of Renewable Energy Production using various renewable sources, especially Solar, Wind Energy, Bio Mass, Geo-Thermal, Ocean and Hybrid Energy Systems.	2	2	2		1		2					1	2	1	2
EE1653.4	Interpret and compare advantages and disadvantages of various renewable energy technologies and propose the best possible energy conversion system for a particular location.	1	1	1		1	1	2		1		2	1	2	2	3
EE1653.5	To understand and make comparisons among energy uses, resources, and technologies for different Energy Resources.	1	1	1			1						2	2	1	3

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and Communication Engineering

Department of Electrical Engineering
Course Hand-out

DATA STRUCTURES AND ALGORITHMS| EE 1654(N) | 3 Credits | 3 0 0 3

Session: Jan. 2020 – June.2021 | Faculty and Course Coordinator: Himanshu Priyadarshi| Class: III Year

A. Introduction: The Computers have become ubiquitous to all scientific and engineering disciplines. This course aims at imparting the fundamental knowledge of data structures and algorithms to Electrical Engineering students. The course will impart the necessary knowledge and skills required in design and analysis of the algorithms, along with relevant data structures for real-time problem solving.

B. Course Outcomes: At the end of the course, students will be able to

[EE1654(N).1] Describe linear and non-linear data-structures (arrays, records, linked structures, stacks, queues, trees, and graphs), its application and representation in memory. (**Bloom's Level: knowledge, Comprehensive)**

[EE1654(N).2] Write programs /algorithms and develop skills to use data-structures like arrays, records, linked structures, stacks, queues, trees, and graphs to solve problems. (**Bloom's Level: Application)**

[EE1654(N).3] Compare and contrast the operation of common data structures (such as linear structures, priority queues, tree structures, hash tables, maps, and graphs) in terms of time complexity, space utilization, and the abstract data types they implement. (**Bloom's Level: Analysis)**

[EE1654(N).4] Read an algorithm or program code segment that contains iterative constructs and analyze it in terms of its time and space complexity of the algorithm or code segment. (**Bloom's Level: Analysis)**

[EE1654(N).5] Draw the graph as well as tree data structure and algorithms related to different operations on them. (**Bloom's Level: Application, Synthesis)**

C. Program Outcomes and Program Specific Outcomes

[PO.1]. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences**.**

[PO.3]. **Design/ Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

[PO.4]. **Conduct investigations** of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions**.**

[PO.5]. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an under- standing of the limitations.

[PO.6]. **The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

[PO.7]. **Environment and Sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

[PO.8]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice**.**

[PO.9]. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

[PO.10]. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions**.**

[PO.11]. **Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to owners own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. **Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	15
	Sessional Exam II (Close Book)	15
	Quizzes (03) and Assignment (03)	30
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Quizzes	3 Quizzes (Close Book)	

E. Syllabus

Analysis of algorithms - Stacks - application to evaluation of postfix expressions, conversion from infix to postfix representation - Queues - Sequential representation, operations, priority queues, and array implementation Linked Lists – Trees – Graphs – Sorting - Searching - Greedy techniques - Prim's & Kruskal's algorithms for minimum spanning trees, shortest paths, optimal tape storage, job scheduling with deadlines, Knapsack problem - Divide and Conquer - General technique, maximum and minimum., multiplying long integers, Strassen's matrix multiplication, finding the closest pair of points - Dynamic programming - matrix chain ordering, all pairs shortest paths, optimal BST – Backtracking - NP completeness - Introduction to parallel algorithms.

F. Text Book:

T1. Data structures with C, Lipschutz, McGraw Hill, (Thirteenth Edition), 2017

G. Reference Book:

R1. Introduction to algorithms, Cormen, Leiserson and Rivest, McGraw Hill (Fifth Edition), 2001.

R2. Design and Analysis of Algorithms, Aho, Hopcroft and Ulmann, Addison Wesley, 2000

H. Lecture Plan:

Lec No	**Topics**	**Session Objective**	**Mode of Delivery (Online/Classroom)**	**Corresponding CO**	**Mode of Assessing the Outcome**
1-2	Introduction to Data structures and Algorithms	Appreciate the relevance of the course	Lecture	EE 1654(N).1	Assignments Class Quiz Mid-Term I End-Term
3	Analysis of Algorithms (Introduction)	Understand the method of analyzing algorithms for their time and space complexity	Lecture	EE1654[N].5	
4-6	Introduction to Basic Data structures	Explain the relevance of data structures for programming	Lecture	EE1654[N].1	
7-8	Review of pointers in C/C++, Introduction to implementation of data structures using C/C++	Explain the power of pointers and arrays for implementing data structures starting from struct	Lecture/Hand-on coding	EE1654[N].1 EE1654[N].2	
9-10	Stacks and Queues Data structures.	Explain the uses cases of stacks and queues for specific applications	Lecture/Hand-on coding	EE1654[N].1 EE1654[N].2	
11-12	Application of stacks for evaluation of Postfix expressions, conversion from infix to postfix	Appreciate the importance of postfix expressions and write codes for postfix-infix conversions	Lecture/Hand-on coding	EE1654[N].1 EE1654[N].2	
13-14	Sequential representation of the Queues, Operation on queues, priority queues and array implementation of queues	Perform basic operations on queues	Lecture/Hand-on coding	EE1654[N].1 EE1654[N].2	
15-16	Linked List and implementation using C	Appreciate linked list for data handling and storage	Lecture/Hand-on coding	EE1654[N].1 EE1654[N].2	Assignments Class Quiz Mid-Term I End-Term
17-18	Trees and implementation, adding, deleting, searching, traversal and sorting	Understanding trees and their importance for problem-solving	Lecture	EE1654[N].3 EE1654[N].4 EE1654[N].4	
19-20	Searching and Sorting Algorithms – Design and Analysis	Implement sorting and searching algorithms and analyze their time and space complexity	Lecture	EE1654[N].1 EE1654[N].2 EE1654[N].3	
21-22	Introduction to Graph and Graph Theory concepts;	Revisit the concepts of graph theory	Lecture/Hand-on coding	EE1654[N].2 EE1654[N].5	

23-24	Graphs and implementation using C++	Implement graphs using C++ STL	Lecture	EE1654[N].1 EE1654[N].2	
25-26	Minimum spanning Trees using Prim's and Krushkal Algorithms & Introduction to Shortest path problem	Finding connected components using Prim's, Krushkal, and Dijikstra's algorithm	Lecture/Hand-on coding	EE1654[N].3 EE1654[N].4	
27-28	Application of graphs and algorithms for optimal tape storage, job scheduling with deadlines		Lecture	EE1654[N].3 EE1654[N].4 EE1654[N].5	
29	Knapsack Problem	Implement the algorithm for Knapsack problem	Lecture	EE1654[N].2 EE1654[N].3	
30-32	Divide and Conquer Approach – General Techniques for sorting, searching	Understand Divide and Conquer approach for complicated problems	Lecture	EE1654[N].3 EE1654[N].4 EE1654[N].5	
33-36	Divide and conquer approach for maximum and minimum, multiplying long integers, Strassen's matrix multiplication, finding closest pairs on points	Implement Divide and Conquer approach for maximum and minimum, multiplying long integers, Strassen's matrix multiplication, finding closest pairs on points	Lecture/Hand-on coding	EE1654[N].3 EE1654[N].4 EE1654[N].5	
37-38	Dynamic Programming, matrix chain ordering, all pair shortest path, optimal BST	Appreciate the importance of Dynamic programming and comparing with recursion	Lecture/Hand-on coding	EE1654[N].1 EE1654[N].2 EE1654[N].3	Assignments Class Quiz Mid-Term II End-Term
39-40	Backtracking, NP Completeness, Introduction to Parallel Programming	Solve N-Queen problem using Backtracking	Lecture/Hand-on coding	EE1654[N].1 EE1654[N].2 EE1654[N].3	
41-42	Strongly connected components	Understanding algorithms for strongly connected components	Lecture/Hand-on coding	EE1654[N].3 EE1654[N].4 EE1654[N].5	

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

EE 1654.1	Describe linear and non-linear data-structures (arrays, records, linked structures, stacks, queues, trees, and graphs), its application and representation in memory	3	3			2								3	2	
EE 1654.2	Write programs /algorithms and develop skills to use data-structures like arrays, records, linked structures, stacks, queues, trees, and graphs to solve problems.	3	3	2										3	2	2
EE 1654.3	Compare and contrast the operation of common data structures (such as linear structures, priority queues, tree structures, hash tables, maps, and graphs) in terms of time complexity, space utilization, and the abstract data types they implement.	3	3	3	2	2								3	2	2
EE 1654.4	Read an algorithm or program code segment that contains iterative constructs and analyze time complexity of the algorithm or code segment	2	2											3	2	
EE 1654.5	Describe the graph and tree data structure and algorithms related to different operations on them.	2	2	2	2	2								3	3	3

MANIPAL UNIVERSITY JAIPUR

School of Electrical Electronics and Communication Engineering

Department of Electrical Engineering
Course Hand-out

Distributed Energy Resources| EE 1663 | 3 Credits | 3 0 0 3

Session: Jan 21 – May 21 | Faculty: Dr. Neeraj Kanwar | Class: B.Tech 6th semester

A. INTRODUCTION: This course is offered by Dept. of Electrical Engineering as a Program Elective, targeting students who wish to pursue research & development in industries or higher studies in field of Electrical Engineering, including Renewable Energy Resources, Distributed Generation, Smart and Micro Grids. The course familiarizes students with the state-of-art understanding of distributed energy resources. It deals with the understanding of their economic potential and practical applicability. Students are expected to have background knowledge on Electric Power Systems for a better learning.

B. COURSE OUTCOMES: At the end of the course, students will be able to

[EE 1663.1]. Describe the working knowledge of various distributed generation sources.
[EE 1663.2]. Understand the working of various Energy Storage Systems applicable to distributed energy resources.
[EE 1663.3]. Perform basic analysis and assessment for interconnecting distributed energy resources with grid.
[EE 1663.4]. Develop skill set to understand the impact of distributed energy resources on electric power network operation and control.
[EE 1663.5]. Develop an understanding of various standards and codes for distributed energy resources integration and future grid structure.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice
[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices
[PO.9]. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments , (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who miss a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	

E. SYLLABUS

Overview of Electric Grid: Distributed Generation, Definition, Need and advantages, Renewable Energy Resources: as DGs, Fuel cell powered DG, Gas Turbine Powered DG, Hybrid System, Energy Storage Systems applicable to DGs, Grid interconnection options, Integration of DERs with grid, Analysis of small Generating systems: Equivalent Models, Generators used with DERS for grid interconnection, Control Techniques for DER integration systems, Standards and codes for interconnection, future structure of grid.

F. TEXT BOOKS

1. H Lee Willis & W. G. Scott, *Distributed Power Generation- Planning & Evaluation*, CRC Press, 2000.
2. F.A. Farret, M. Godoy Simões, *Integration of Alternative Source of Energy*, Wiley InterScience, 2006.
3. M. H. Nehrir & C. Wang, *Modelling and Control of Fuel Cells : Distributed generaion Applications*,- IEEE Wiley- IEEE Press, 2009.

G. REFERENCE BOOKS

1. T. Funabashi, *Integration of Distributed Energy Resources in Power Systems: Implementation Operation, and Control* , Academic Press-Elsevier,2016.

H. LECTURE PLAN:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To familiarize and clear teachers expectations and understand student expectations	Lecture	NA	NA
2,3	Over view of Electric Grid: History of Electric Power Transmission, Evolution of Power Grids	Recall and explain evolution of Power Grids	Lecture	[EE 1663.1]	Class Quiz Mid Term I End Term
4,5	Distributed Generation – Introduction, Definition, Need and advantages	Describe Distributed Generation, definition, importance and advantages of DER	Lecture, Activity	[EE 1663.1] [EE 1663.2]	Class Quiz Mid Term I End Term
6,7	Distributed Generation Sources: Introduction to Power Generation Systems and Energy Storage Systems	Explain power generation and energy storage sources for DG sources	Lecture	[EE 1663.1]	Class Quiz Mid Term I End Term
8,9	DER – Power Generation Systems: Introduction to Fossil fuel based system - Reciprocating engines and micro turbines and Non fossil fuel based	Recall different Power Generation Sources : f Reciprocating engines and micro turbines and Non fossil fuel based for Distributed Generation	Lecture	[EE 1663.1]	Class Quiz Mid Term I End Term
10	DER – Power Generation Systems: Introduction to Non Fossil fuel based system – Electrochemical sources and Renewable sources	Recall different Power Generation Sources : fuel cells and renewable sources for Distributed Generation	Lecture	[EE 1663.1]	Class Quiz Mid Term I End Term
11,12	DER – Energy Storage Systems: Introduction to EDLC, BESS, SMES, FW, PEV	Recall Energy Storage Systems: EDLC, BESS, SMES, FW, PEV for Distributed Generation	Lecture	[EE 1663.1]	Class Quiz Mid Term I End Term
13,14	Renewable Sources – Types, schemes for DG	Recall on availability of solar radiation, solar insolation, solar constant on given day of year and location on earth	Lecture	[EE 1663.1] [EE 1663.2]	Class Quiz Mid Term I End Term
15	RS: Solar Electric Power Generation system – Schemes for STPGS	Describe various schemes available for solar thermal electric power generation system	Lecture	[EE 1663.1] [EE 1663.2]	Class Quiz Mid Term I End Term
16,17	RS: Solar Electric Power Generation system – PV Generation	Recall working of solar cell, calculation of efficiency, expression for current	Lecture	[EE 1663.1] [EE 1663.2]	Class Quiz Mid Term I End Term
18,19,20	RS: Wind Power Generation	Describe working of Wind Power Generation System and its usage as distributed generation	Lecture	[EE 1663.1] [EE 1663.2]	Class Quiz Mid Term II End Term
21,22,23	RS: Other Generation Resources	Identify and understand other Renewable Sources Distributed Generation	Lecture	[EE 1663.1] [EE 1663.2]	Class Quiz Mid Term II End Term
24,25	Fuel Cell Powered DG: Fuel Cells, Proton Exchange Membrane Fuel cells, Phosphoric Acid	Describe working of Proton Exchange Membrane Fuel cells,	Lecture	[EE 1663.1] [EE 1663.2]	Class Quiz Mid Term II

	Fuel Cells	Phosphoric Acid Fuel Cells, examine their chemical properties and understand the chemical reaction involved.			End Term
26,27	Fuel Cell Powered DG: Molten Carbonate Fuel Cells, Solid Oxide Fuel Cells	Describe working of Molten Carbonate Fuel Cells, Solid Oxide Fuel Cells examine their chemical properties and understand the chemical reaction involved.	Lecture	[EE 1663.1] [EE 1663.2]	Class Quiz Mid Term II End Term
28,29	Gas Turbine Powered DG: Types, utility system	Describe the working of Gas Turbine Powered DG, utility system	Lecture	[EE 1663.1] [EE 1663.2]	Class Quiz Mid Term II End Term
30	Gas Turbine Powered DG: Mini Gas and Micro Gas Turbine Generators	Describe the working of Mini Gas and Micro Gas Turbine Generators	Lecture	[EE 1663.1] [EE 1663.2]	Class Quiz Mid Term II End Term
31	Hybrid System DG	Describe the working of Hybrid Power System with combination of Fossil fuel based Generator, wind power and SVC FACTS device	Lecture, Activity	[EE 1663.1] [EE 1663.5]	Class Quiz Mid Term II End Term
32,33	Grid Interconnection Options, Integration of DERs with Grid	Examine the Grid Interconnection Options for DER and their Integration	Lecture	[EE 1663.3] [EE 1663.4]	Class Quiz End Term
34,35	Analysis of Small Generating Systems – Equivalent Models, Generators applicable to DER for Grid interconnection	Describe the mathematical model for Small Generating Systems applicable to DEr	Lecture	[EE 1663.1]	Class Quiz End Term
36,37	DER: Control Techniques for integration systems	Examine Control Techniques for DER integration systems	Lecture	[EE 1663.3]	Class Quiz End Term
38	Standards and Codes for Interconnection	Examine Standards and Codes for Interconnection of DER with Power System	Lecture	[EE 1663.4]	Class Quiz End Term
39,40	Future Structure of Grids: Smart Grid and Micro Grid	Identify the Future structure of Power Grids, development of Smart and Micro Grids	Lecture	[EE 1663.5]	Class Quiz End Term
41,42	Overview of small example distributed generation system in DIgSILENT Power Factory	To have general overview of DER using example test system in environment of standard Power system software	Lab	NA	NA

I. COURSE ARTICULATION MATRIX: (MAPPING OF COS WITH POS)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 1663.1	Describe the working knowledge of various distributed generation sources.	2	1	2	1								3	2	3	1
EE 1663.2	Understand the working of various Energy Storage Systems applicable to distributed energy resources.	2	1	2	1								3	2	3	1
EE 1663.3	Perform basic analysis and assessment for interconnecting distributed energy resources with grid.	3	3	2	3	2							2	3	1	3
EE 1663.4	Develop skill set to understand the impact of distributed energy resources on electric power network operation and control.	3	2	3	3	2	2						2	3	1	2
EE 1663.5	Develop an understanding of various standards and codes for distributed energy resources integration and future grid structure.	2	1	3	1	3	2						3	2	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY
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School of Electrical, Electronics and Communication Engineering

Department of Electrical Engineering

Course Hand-out

Utilization of Electric Power | EE 1661 | 3 Credits | 3 0 0 3

Session: Jan. 2021 – May 2021 | Faculty: Prof. Ashish Shrivastava | Class: VI Semester, B. Tech. (EE)

A. Introduction: The course is offered by Department of Electrical Engineering as an Electrical Engineering program elective course, targeting Electrical Engineering students of VI Semester, B. Tech. (EE). The course offers an in-depth understanding of various fundamentals of Utilization of Electric Power and Traction. The topics covered include the Electric drives, AC and DC Drives, electric heating and their advantages, electric welding, AC and DC welding. Electric traction, method of electric braking, mechanism of train movement, speed time curve for different services, specific energy consumption and tractive efforts are also included in the course.

B. Course Outcomes: Upon successful completion of the course, the student will be able to:

[EE1661.1] Describe the fundamental concepts of Electric Drives and discuss the applications of Electric drives for different industrial loads. **(Bloom's Level: Knowledge)**

[EE1661.2] Identify the different types and applications of Electric heating. **(Bloom's Level: Analysis)**

[EE1661.3] Understand the different types of electric welding and their advantages & applications. **(Bloom's Level: Application)**

[EE1661.4] Identify the importance of electric traction and analyze special features of existing electric traction system. **(Bloom's Level: Analysis)**

[EE1661.5] Analyze the mechanism of train movement and evaluate different parameters such as tractive effort, power, specific energy consumption for different speed time curves which improves the employability skills. **(Bloom's Level: Application)**

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1] Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2] Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3] Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4] Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5] Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

[PO.6] The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

[PO.7] Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8] Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

[PO.9] Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10] Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11] Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12] Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

[PSO.1] To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2] To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3] Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Plan

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who miss a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. These assignments are limited to a maximum of 5 throughout the entire semester.	

E. SYLLABUS

EE1661 UTILIZATION OF ELECTRIC POWER [3 0 0 3]

Electric Drives: Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, Particular applications of electric drives, Types of industrial loads, continuous, Intermittent and variable loads, load Equalization. **Electric Heating:** Advantages and methods of electric heating, resistance heating, induction heating and dielectric heating. **Electric Welding:** Electric welding, resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding. **Electric Traction:** System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, methods of electric braking-plugging, rheostatic braking and regenerative braking, Mechanics of train movement. Speed-time curves for different services-trapezoidal and quadrilateral speed time curves. Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion.

F. TEXT BOOKS

T1. C. L. Wadhwa, *Generation, Distribution and Utilization of electrical Energy (3e)*, New Age International (P) Limited Publishers, 2010.

T2. H. Partab, *Modern Electric Traction*, Dhanpat Rai & Sons, 2012

G. REFERENCE BOOKS

R1. N. V. Surya Narayana, *Utilization of Electrical Power including Electric drives and Electric traction (1e)*, New Age International Publishers, 1996.

R2. R. K. Rajput, *Utilization of Electrical Power (2e)*, Laxmi Publications, 2016.

R3. G. K. Dubey, *Fundamentals of Electric Drives (2e)*, Narosa Publications, 2016.

H. Lecture Plan:

Lec No.	Topics	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
	Introduction to the Course	To acquaint students with the subject and outcomes of the course. Students will be introduced with outcome based education (OBE) and Course outcome (CO) and program outcome (PO) assessment process	Lecture		NA
Lec - 1	Introduction to the subject	Discuss the subject and its importance in modern engineering education.	Lecture	[EE1661.1]	NA
Lec - 2	Electric drives and Type of electric drives	Introduction to Electric Drives	Lecture	[EE1661.1]	Home Assignment / Mid Term Exam / Class Quiz
Lec - 3	choice of motor, starting and running characteristics	Discuss the selection of motor, starting and running characteristics	Lecture	[EE1661.1]	Home Assignment / Class Quiz / Mid Term Exam
Lec - 4	speed control	Understand the methods of speed control	Lecture	[EE1661.1]	Class Quiz / Mid Term Exam / End Term Exam
Lec - 5	temperature rise, Particular applications of electric drives	Learn the importance of temperature rise and applications of electric drives	Lecture	[EE1661.1]	Class Quiz / Mid Term Exam / End Term Exam
Lec - 6	Types of industrial loads, continuous, Intermittent and variable loads,	Learn fundamentals of types of industrial loads	Lecture	[EE1661.1]	Class Quiz / Mid Term Exam / End Term Exam
Lec - 7	load Equalization	Analyze the process of load Equalization	Lecture	[EE1661.1]	Home Assignment / Class Quiz / Mid Term Exam
Lec - 8	Advantages and methods of electric heating	Learn electric heating and its advantages	Lecture	[EE1661.2]	Class Quiz / Mid Term Exam / End Term Exam
Lec - 9	resistance heating	Learn resistance heating and its merits and demerits	Lecture	[EE1661.2]	Class Quiz / Mid Term Exam / End Term Exam
Lec - 10	induction heating	Understand the concept of induction heating and its advantages & applications	Lecture	[EE1661.2]	Class Quiz / Mid Term Exam / End Term Exam
Lec - 11	dielectric heating	Understand dielectric heating and its industrial applications	Lecture	[EE1661.2]	Class Quiz / Mid Term Exam / End Term Exam
Lec – 12 (Tutorial)	Tutorial – 1 [Problem solving]	Numerical problems based on electric heating	Tutorial	[EE1661.2]	Class Quiz / Mid Term Exam / End Term Exam
Lec - 13	Electric welding	Learn electric welding and its advantages	Lecture	[EE1661.3]	Class Quiz / Mid Term Exam / End Term Exam
Lec - 14	resistance and arc welding	Learn and compare the resistance and arc welding	Lecture	[EE1661.3]	Mid Term Exam / End Term Exam

Lec - 15	electric welding equipment	Understand equipments use in the electric welding	Lecture	[EE1661.3]	Mid Term Exam / End Term Exam
Lec - 16	comparison between A.C. and D.C. Welding	Understand the difference between A.C. and D.C. Welding	Lecture	[EE1661.3]	Mid Term Exam / End Term Exam
Lec - 17 (Tutorial)	Tutorial – 2 [Problem solving]	Numerical problems based on electric welding	Tutorial	[EE1661.3]	Mid Term Exam / End Term Exam
Lec - 18	System of electric traction and track electrification	Learn the electric traction system and related technology advancements	Lecture	[EE1661.4]	Mid Term Exam / End Term Exam
Lec - 19	Review of existing electric traction systems in India	Understand and review the present electric traction systems used in India	Lecture	[EE1661.4]	Mid Term Exam / End Term Exam
Lec - 20	Special features of traction motor	Describe the concept and principle of working of traction motor	Lecture	[EE1661.4]	Mid Term Exam / End Term Exam
Lec - 21, 22	methods of electric braking-plugging, rheostatic braking and regenerative braking	Learn the different methods used for electric braking	Lecture	[EE1661.4]	Class Quiz / Mid Term Exam/ End Term Exam
Lec - 23	Mechanics of train movement	Understand the train movement mechanism	Lecture	[EE1661.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lec - 23, 24	Speed-time curves for different services-trapezoidal speed time curves	Describe the importance of different Speed-time curves for different services	Lecture	[EE1661.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lec - 25 (Tutorial)	Tutorial – 3 [Problem solving]	Numerical problems based on solving exercises based on trapezoidal speed time curves	Tutorial	[EE1661.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lec - 26, 27	Speed-time curves for different services-quadrilateral speed time curves	Describe the importance of quadrilateral speed time curves	Lecture	[EE1661.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lec – 28 (Tutorial)	Tutorial – 4 [Problem solving]	Numerical problems based on trapezoidal speed time curves	Tutorial	[EE1661.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lec - 29, 30	Calculations of tractive effort	Learn the calculation of tractive effort	Lecture	[EE1661.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lec - 31 (Tutorial)	Tutorial – 5 [Problem solving]	Numerical problems based on L29-L30	Tutorial	[EE1661.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lec - 32	power, specific energy consumption for given run	Understand the calculation of power, specific energy consumption for given run	Lecture	[EE1661.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lec – 33 (Tutorial)	Tutorial – 6 [Problem solving]	Numerical problems based on L32	Tutorial	[EE1661.5]	Class Quiz / Mid Term Exam / End Term Exam
Lec - 34, 35	effect of varying acceleration and braking retardation	Learn the effect of acceleration and retardation in electric traction	Lecture	[EE1661.5]	Class Quiz/ Mid Term Exam/ End Term Exam
Lec – 36	adhesive weight and coefficient of adhesion	Understand the importance and calculation of adhesive weight and coefficient of adhesion	Lecture	[EE1661.5]	Class Quiz / Mid Term Exam / End Term Exam

Lec – 37	adhesive weight and coefficient of adhesion	Understand the importance and calculation of adhesive weight and coefficient of adhesion	Lecture	[EE1661.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lec – 38 (Tutorial)	Tutorial – 7 [Problem solving]	Numerical exercises based on Lectures 36-37	Tutorial	[EE1661.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lec - 39 (Tutorial)	Tutorial – 8 [Problem solving]	Numerical exercises based on Lectures 36-37	Tutorial	[EE1661.5]	Class Quiz / Mid Term Exam/ End Term Exam
Lec - 40 (Tutorial)	Tutorial – 9 [Problem solving]	Numerical exercises based on Lectures 36-37	Tutorial	[EE1661.5]	Class Quiz / Mid Term Exam/ End Term Exam

I. Course Articulation Matrix: (Mapping of COs with POs)

CO No.	CO STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE1661.1	Describe the fundamental concepts of Electric Drives and discuss the applications of Electric drives for different industrial loads.	3	3	3	2	2	2				2		2	3	2	2
EE1661.2	Identify the different types and applications of Electric heating.	3	3	3	2	1								3	2	2
EE1661.3	Understand the different types of electric welding and their advantages & applications.	3	3	3	2	1								3	2	2
EE1661.4	Identify the importance of electric traction and analyse special features of existing electric traction system.	2	2											3	1	1
EE1661.5	Analyse the mechanism of train movement and evaluate different parameters such as tractive effort, power, specific energy consumption for different speed time curves which improves the employability skills.	3	3	2	2									3	2	2

1- **Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and communication Engineering (SEEC)

Department of Electrical Engineering

Course Hand-out

Electrical Energy Systems (EES)| EE 1691| 3 Credits | 3 0 0 3

Session: Jan. 2021 – May 2021 | Faculty: Mr. Divya Rishi Shrivastava | Class: VI Semester (Open Elective)

A. **Introduction:** This course is offered by Dept. of Electrical Engineering as an Open Elective, targeting students who wish to pursue research & development in industries or higher studies in the field of Integration of renewable and non-renewable energy sources, including, thermal, nuclear, hydroelectric, solar, wind, biomass, wave and hybrid systems, power generation and transmission and the related electrical engineering practices. Most of the non- renewable energy comes from petroleum and coal and is expected to exhaust in the coming years and the renewable energy comes either directly or indirectly from sun and wind and can never be exhausted, and therefore they are called renewable. Worldwide attention to environmental issues combined with the energy crisis has forced us to increase the use of renewable energy sources which are freely available in the nature and are environment friendly. Energy found in the renewable and non-renewable resources is converted into a form, we can use as heat or electricity. To understand this course students are expected to have background knowledge of electricity and magnetism.

B. **Course Outcomes:** At the end of the course, students will be able to

[1691.1]. Describe the global and Indian energy scenario and the role of energy in economic development and social transformation

[1691.2]. Discuss the utilization of renewable sources in India, their utilization pattern in the past, present and future projections of consumption pattern.

[1691.3]. State the fundamentals of power systems and explain the operation and working of various kinds of power plants.

[1691.4]. Recognize the need and advancements in the renewable energy sources, analyse the problems and their possible solutions in harnessing renewable and non-renewable energy sources.

C. **PROGRAM OUTCOMES (PO)**

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and

environmental considerations

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9]. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

D. PROGRAM SPECIFIC OUTCOMES (PSO)

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

E. Assessment Plan:

Criteria	Description	Maximum Marks

Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	

F. SYLLABUS

Global Energy Scenario: Role of energy in economic development and social transformation: Energy & GDP, GNP and its dynamics. **Indian Energy Scenario**: Energy resources & Consumption: Commercial and non-commercial forms of energy, Fossil fuels, Renewable sources including Bio-fuels in India, their utilization pattern in the past, present and future projections of consumption pattern, Sector wise energy consumption, **Electrical Energy Sources**: Diesel Power Plant, Hydro Electric Power Plants, Gas turbine power plant, Applications Combined operation of power plants, load division among different types of power plants, **Renewable Energy:** Solar, Wind, Biomass, Geothermal, tidal, Fuel Cell, Introduction to transmission and distribution systems, Protection of electrical systems.

G. TEXT BOOKS

1. M. A. El-Sharkawi*, Electric Energy – An Introduction* (2e), CRC press, 2008.

H. REFERENCE BOOKS

1. C. E. Brown, *World Energy Resources (1e)*, Springer, 2002.
2. V. Balzani, N Armanroli, *Energy for a Sustainable World (1e)*, Wiley-VCH, 2011.
3. J. B. Gupta, *A Course in Electrical Power*, S.K. Kataria & Sons, 1996.
4. C. L. Wadhwa, *Electrical Power System (3e),* New Age Intl., 2000.

I. Lecture Plan:

LEC NO	TOPICS
1	Course objective and overview of the contents
2	Brief Introduction of the energy sources and their availability
3	Introduction and history of Power Systems, Voltage and Frequency Standards
4	Energy Conservation, Management and associated terms & definitions
5-6	**Global Energy Scenario:** Role of energy in economic development and social transformation
7-8	Energy & GDP, GNP and its dynamics
9-10	**Indian Energy Scenario**: Energy resources & Consumption
11	Commercial and non-commercial forms of energy
12	Fossil fuels, Renewable sources in India
13-14	Bio-fuels in India
15	Renewable sources : their utilization pattern in the past, present and future projections of consumption pattern
16	Renewable sources : Sector wise energy consumption
17-18	**Electrical Energy Sources**: Diesel Power Plant
19-20	Hydro Electric Power Plants
21-22	Hydro Electric Power Plants continued
23	Gas turbine power plant
24	Diesel Power Plant
25	Combined operation of power plants
26	Load division among different types of power plants
27-28	**Renewable Energy:** Solar Energy
29-30	Solar Energy contd.
31	Wind Energy
32-33	Wind Energy contd.
34	Biomass Energy
35	Geothermal Energy
36-37	Tidal Energy, Fuel Cell
38	**Introduction to transmission and distribution systems**
39	Components of transmission and distribution systems
40	Transformers
41	Induction Motors
42	Protection of electrical systems.

J. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 1691.1	Describe the global and Indian energy scenario and the role of energy in economic development and social transformation.	3	2	3	0	0	1	0	0	0	0	1	2	1	2	0
EE 1691.2	Discuss the utilization of renewable sources including Bio-fuels in India, their utilization pattern in the past, present and future projections of consumption pattern.	3	2	0	0	1	0	2	0	0	1	0	0	2	1	2
EE 1691.3	State the fundamentals of power systems and explain the operation and working of various kinds of power plants.	3	2	0	1	0	0	0	0	1	0	1	1	2	1	1
EE 1691.5	Recognize the need and advancements in the renewable energy sources, analyse the problems and their possible solutions in harnessing renewable and non-renewable energy sources.	2	3	3	1	0	2	1	1	0	1	1	1	1	0	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Electronics & Electrical Engineering

Department of Electrical Engineering
Course Hand-out

Power Electronics & Drives Lab| EE1632(N)| 1 Credits | 0 0 2

Session: July-November 2021 | Faculty: Mahipal Bukya, Himanshu Priyadarshi | Class: VI Semester, B.Tech. (EE)

A. **Introduction:** This lab course includes experiments to study the following: ac to dc single phase controlled & Uncontrolled converters, symmetrical & unsymmetrical controlled converters, Harmonics Analysis, performance improvements with freewheeling diode, effects of variable load on performance of converter, power factor improvement, AC to AC voltage controller.

B. **Course Outcomes:** At the end of the course, students will be able to

[EE1632(N).1]. Understand practical aspects of operating various classes of power electronic converters and its firing control circuit. (**Bloom's Level: knowledge, Comprehensive)**

[EE 1632(N).2]. Describe the operation of power electronic converters with freewheeling diode to improve the performance of the converters for enhancing the employability. (**Bloom's Level: Analysis)**

[EE 1632(N).3]. Examine the performance of phase-controlled converter for different kind of load. (**Bloom's Level: Analysis, Synthesis)**

[EE 1632(N).4.]. Understand proper turn on and turnoff of given thyristor by latching & holding currents, for applying it for different power conditioning circuits. (**Bloom's Level: Application, Synthesis)**

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1].Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2].Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3].Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4].Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5].Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6].The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7].Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8].Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9].Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

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[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Internal Assessment	60
End Term Exam (Summative)	End Term Exam	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

E. SYLLABUS

SCR characteristics : Measurement of latching and holding current, Single Phase Half Wave and Full Wave AC – DC converters, Three Phase Half Wave and Full wave Controlled Converter, AC Voltage Regulator, Cycloconverter controlled Induction machine, Matrix Converter controlled Induction Machine, Open Loop and Closed Loop Speed control of D.C. motor using DSP kit, Open Loop and Closed Loop Speed control of Induction motor using DSP kit, Study harmonics Analysis of Three Phase Power electronic Converter Circuit, Single Phase and Three Phase and Single Phase converter/ Inverter circuit simulation using MATLAB.

F. TEXT BOOKS

T1. Bimbhra P.S., Power Electronics. Khanna Publishers, 2015
T2. Ned Mohan et al, Power Electronics – Converters, Applications and Design, Wiley Publications,

G. REFERENCE BOOKS

R1. D. W. Hart, Power Electronics, TMH, 2011.
R2. L. Umanand, Power Electronics – Essentials and Applications, Wiley India Pvt. Ltd., 2014

H. Lecture Plan:

Class Number	Topics	Session Outcome	Mode of Delivery	Corresponding Course Outcome	Mode of Assessing the Outcome
1	Single Phase Half-Wave Uncontrolled Rectifier	To Analyze the Operation of Single Phase Half-Wave Uncontrolled Rectifier For R, RL & RL Load .	*Hands-on session, Think pair share*	**EE1632(N).1, EE1632(N).2**	*Continuous internal assessment, carried out after*
2	Single Phase Half-Wave Uncontrolled Rectifier	To Analyze the Operation of Single Phase Half-Wave Uncontrolled Rectifier For R, RL & RL Load with freewheeling diode	*Hands-on session, Think pair share*	**EE1632(N).1, EE1632(N).2**	
3	Single Phase Full Wave Uncontrolled Rectifier	To Verify the Voltage Waveform of Single Phase Full Wave Uncontrolled Rectifier For R and RL load.	*Hands-on session, Think pair share* – D.I.Y. experiment , capture your experiment in a short video – max 5 minutes	**EE1632(N).1, EE1632(N).2 EE1632(N).3, EE1632(N).4**	
4	Single Phase Half-Wave Controlled Rectifier	To Verify the Voltage Waveform of Single Phase Half-Wave Controlled Rectifier For R, RL & RL Load with Freewheeling diode.	*Hands-on session, Think pair share*	**EE1632(N).1, EE1632(N).2 EE1632(N).3, EE1632(N).4**	
5	Single Phase Full-Wave Controlled Rectifier	To Verify the Voltage Waveform of Single Phase Full-Wave Controlled Rectifier For R, RL & RL Load with Freewheeling diode.	*Hands-on session, Think pair share*	**EE1632(N).1, EE1632(N).2 EE1632(N).3, EE1632(N).4**	
6	Latching and holding current determination for SCR.	To find out the Latching and Holding Currents measurement of the given SCR..	*Hands-on session, Think pair share*	**EE1632(N).4**	
7	Single Phase Full-Wave Half Controlled Asymmetrical Rectifier	To Implement the Single Phase Full-Wave Half Controlled Asymmetrical Rectifier.	*Hands-on session, Think pair share*	**EE1632(N).1, EE1632(N).2 EE1632(N).3, EE1632(N).4**	
8	Single Phase Full-Wave Half Controlled Symmetrical Rectifier.	To Implement the Single Phase Full-Wave Half Controlled Symmetrical Rectifier.	*Hands-on session, Think pair share*	**EE1632(N).1, EE1632(N).2 EE1632(N).3, EE1632(N).4**	
9	Single Phase AC Voltage Controller	To Verify the Voltage Waveform of Single Phase AC Voltage Controller.	*Hands-on session, Think pair share*	**EE1632(N).1, EE1632(N).2 EE1632(N).3, EE1632(N).4**	
10	Power Factor Improvement	To Demonstrate the Power Factor Improvement of Fluorescent Tube.	*Hands-on session, Think pair share*		

11	Three Phase Half Wave Controlled AC to DC Converter	Perform the Experiment & Harmonic Analysis of Supply Currents on Three Phase Half Wave Controlled AC to DC Converter for R & RL Load.	*Hands-on session, Think pair share*	**EE1632(N).1, EE1632(N).2 EE1632(N).3, EE1632(N).4**	
12	Three Phase Full Wave Controlled AC to DC Converter	Perform the Experiment & Harmonic Analysis of Supply Currents on Three Phase Full Wave Controlled AC to DC Converter for R & RL Load.	*Hands-on session, Think pair share*	**EE1632(N).1, EE1632(N).2 EE1632(N).3, EE1632(N).4**	
13	Buck Converter	Design, simulate and analyze Buck Converter from first principles	*Hands-on session, Think pair share*	**EE1632(N).1, EE1632(N).2 EE1632(N).3, EE1632(N).4**	
14	Speed Control of AC Induction Motor	Perform Speed Control of AC Induction Motor Drives using Micro Controller with Open Loop & Closed Loop Configuration.	*Hands-on session, Think pair share*	**EE1632(N).1, EE1632(N).2 EE1632(N).3, EE1632(N).4**	
END TERM EXAM					

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 1632(N)1	Understand practical aspects of operating various classes of power electronic converters and its firing control circuit.	3	1				2	3	3				1	1		
EE 1632(N)2	Describe the operation of power electronic converters with freewheeling diode to improve the performance of the converters for enhancing the employability	2	3		2					1					2	3
EE 1632(N)3	Examine the performance of phase controlled converter for different kind of load.		2	3		1	2				1			3	3	3
EE 1632(N)4	Understand proper turn on and turnoff of given thyristor by latching & holding currents.			3	2			1				1	3	2	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and Communication Engineering

Department of Electrical Engineering
Course Hand-out

Microcontroller Laboratory | EE 1631 (N) | 1 Credits | 0 0 2 1

Session: JAN2021 – MAY2021 | Faculty: Abhishek Kumar | Class: VI Sem B Tech (EE)

A. Introduction: This course is offered by Dept. of Electrical Engineering as a Laboratory course, targeting students who wish to work in the area of embedded systems and automation. This course provides an understanding about the concepts and basic architecture of 8051, background knowledge of Keil Software in microcontroller, knowledge about assembly language programs of 8051, knowledge of different types of external interfaces including LEDS, LCD, Switches, stepper motor etc. The course also build up the basic understanding of the importance of different peripheral devices & their interfacing to 8051 and give an overview of recent growth and trends of controllers & processors.

B. Course Outcomes: At the end of the course, students will be able to

[EE1631(N).1] Explain the features of Microcontroller ESA MCB51 Kit and Keil Software. **(Bloom's Level: Cognitive level Knowledge).**

[EE1631(N).2] Introduce Assembly Language Program (ALP) concepts and features. **(Bloom's Level: Cognitive level Knowledge).**

[EE1631(N).3] Write ALP for Data block operations, arithmetic and logical operations, Code Conversion operations in 8051 **(Bloom's Level: Cognitive level Synthesis, Analysis).**

[EE1631(N).4] Analyze the working of on-chip features of 8051 like timers, counter and interrupts of Microcontroller 8051. **(Bloom's Level: Cognitive level Analysis, Synthesis).**

[EE1631 (N).5] Simulate various interface kits (LCD, stepper motor, elevator, traffic light control). **(Bloom's Level: Cognitive level Analysis, Synthesis).**

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified

needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4]. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

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[PSO.3]. Develop, investigate, and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Plan:

Criteria	Description	Maximum Marks

Internal Assessment (60 Marks)	Documentation Preparation and Observation Regularity and Performance : Assignment Submission : Internal Viva :	Total 60 15 10 15 10 10
End Term Exam	Procedure with logic, flowchart Experiment Conduction : Calculations : Viva Voce :	40 15 10 5 10
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Introduction to ESAMCB – 51 kit and Keil software, Programs of Data transfer & Addressing modes, Programs of Data block transfer, Programs of Searching of data in array & sorting of data Array, Programs of Arithmetic & Logical operations, Programs of various Code Conversion techniques, Programs of Delay Generation using timer and counter, Simulation of LCD interface, Simulation of Interrupts Programming on ESA MCB51 Kit, Simulation of Logic Controller Interface, Speed control simulation

of Stepper Motor Interface, Simulation of Traffic Light Interface and Elevator Interface, Arduino based motor and LED array interface.

F. TEXT BOOKS

T1. M.A. Mazidi and G. Mazidi, The 8051 microcontroller & Embedded Systems using Assembly & **'**C**'**, Pearson, 2011

T2. Rajkamal, Microcontrollers, Architecture, Programming, Interfacing & System Design, Pearson, 2005.**T3.** Ramesh S. Gaonkar, *Microprocessor architecture, programming, and applications with the 8085 (5e)*, Prentice Hall, 2002.

G. REFERENCE BOOKS

R1. K.J. Ayala, The 8051 Microcontroller & Embedded Systems using Assembly & **'**C**'**, Cengage, 2009

R2. Predko, Programming & Customizing the 8051 Microcontroller, Tata McGraw Hill

R3. Ray A.K. and Bhurchandi K.M., *Advanced Microprocessors and Peripherals (2e)*, Mc Graw Hill Education, 2009.

H. Lecture Plan:

ExpNo	Experiment Description	Lab Objective	Mode of Delivery	Corresponding COs	Mode of Assessing Outcome
1	Study of 8051 based Microcontroller Kit (ESA MCB51 Kit) and Keil Software.	Student will learn to write an ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE1631(N).1 EE1631(N).2	Continuous Lab Evaluation and End Term Practical exam
2	Write assembly language programs to transfer the data from one memory location to another memory location using different addressing mode.	Student will learn to develop a logic of data block transfer among different memories for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE1631(N).1 EE1631(N).2 EE1631(N).3	Continuous Lab Evaluation and End Term Practical exam
3	Write assembly language programs to transfer a data block from one place to another place in the memory of Microcontroller 8051.	Student will learn to apply the logic of exchanging the data for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE1631(N).1 EE1631(N).2 EE1631(N).3	Continuous Lab Evaluation and End Term Practical exam
4	Write assembly language programs to search a number in block available in memory of Microcontroller 8051.	Student will learn to develop a logic for searching algorithms in ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE1631(N).1 EE1631(N).2 EE1631(N).3	Continuous Lab Evaluation and End Term Practical exam
5	Write assembly language programs to sort a data block available in memory of Microcontroller 8051.	Student will learn to develop a logic for sorting algorithms in ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE1631(N).1 EE1631(N).2 EE1631(N).3	Continuous Lab Evaluation and End Term Practical exam

6	Write assembly language programs for mathematical operation (addition and subtraction) using Microcontroller 8051.	Student will learn to develop a logic for addition and subtraction in ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE1631(N).1 EE1631(N).2 EE1631(N).3	Continuous Lab Evaluation and End Term Practical exam
7	Write and perform programs for mathematical operation (multiplication and division) using Microcontroller 8051.	Student will learn to develop a logic for multiplication and division in ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE1631(N).1 EE1631(N).2 EE1631(N).3	Continuous Lab Evaluation and End Term Practical exam
8	Write and perform programs of mathematical operations on BCD Numbers.	Student will learn to develop a logic for BCD addition in ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE1631(N).1 EE1631(N).2 EE1631(N).3	Continuous Lab Evaluation and End Term Practical exam
9	Write and perform programs of the various number system based code conversion operation.	Student will learn to develop a logic for code conversion in ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE1631(N).1 EE1631(N).2 EE1631(N).3	Continuous Lab Evaluation and End Term Practical exam
10	Write and simulate programs for Delay Generation, Timer & Counter operations.	Student will learn to develop a logic for timer and counter in ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE1631(N).1 EE1631(N).2 EE1631(N).4	Continuous Lab Evaluation and End Term Practical exam
11	Write and simulate programs for interrupt operation on ESA51 Microcontroller Kit.	Student will learn to develop a logic for interrupt operation in ALP for 8051 microcontroller.	Laboratory Tutorial and Experiments	EE1631(N).1 EE1631(N).2 EE1631(N).4	Continuous Lab Evaluation

					and End Term Practical exam
12	Write and perform programs to display the data on LCD Screen interfaced with ESA51 Microcontroller	Student will learn to develop a logic for LCD interface to 8051 microcontroller.	Laboratory Tutorial and Experiments	EE1631(N).1 EE1631(N).2 EE1631(N).5	Continuous Lab Evaluation and End Term Practical exam
13	Write and perform programs of various logic operations on ESA51 Microcontroller Kit.	Student will learn to develop a logic for logic operations KIT interface to 8051 microcontroller.	Laboratory Tutorial and Experiments	EE1631(N).1 EE1631(N).2 EE1631(N).5	Continuous Lab Evaluation and End Term Practical exam
14	Write assembly language programs to interface & run a stepper motor at various speed using ESA51 Microcontroller Kit.	Student will learn to develop a logic for stepper motor control interface to 8051 microcontroller.	Laboratory Tutorial and Experiments	EE1631(N).1 EE1631(N).2 EE1631(N).5	Continuous Lab Evaluation and End Term Practical exam

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 1631(N).1	Explain the features of Microcontroller ESA MCB51 Kit and Keil Software.	2			3								2	2		
EE 1631(N).2	Introduce Assembly Language Program (ALP) concepts and features.	2												3	2	1
EE 1631(N).3	Write ALP for Data block operations, arithmetic and logical operations, Code Conversion operations in 8051.	2	2	1	2	1							1		3	2
EE 1631(N).4	Analyze the working of on-chip features of 8051 like timers, counter and interrupts of Microcontroller 8051.	2	2	1	2	1							1		3	2
EE 1631(N).5	Simulate various interface kits (LCD, stepper motor, elevator, traffic light control).	2	2	2	2	1							1		3	2

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MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronic Communication Engineering

Department of Electrical Engineering
Course Hand-out

Power System Protection & Switchgear | EE 1701(N) | 3 Credits | 3 0 0 3

Session: Aug. 2020 –Dec. 2020 | Faculty: Dr. Neeraj Kanwar | Class: VII Semester, B.Tech. (EE)

A. Introduction: This course is offered by Department of Electrical Engineering as core subject, targeting students who wish to pursue research & development in Electric utility or higher studies in field of Switchgear & Protection, including various power system elements and their protection, Fuses, Circuit Breakers, Earthing, Protective Relays, Protection Schemes, recent trends in relays. Students are expected to have background knowledge on Transmission & Distribution System, Various type of faults for a better learning.

B. Course Outcomes: At the end of the course, students will be able to:

[EE 1701(N).1] Understand and explain power system protection, terminologies, classification and essential qualities.

[EE 1701(N).2] Comprehend different protection schemes and their applications.

[EE 1701(N).3] Compare and explain static relay, digital protection.

[EE 1701(N).4] Develop skill to acquire knowledge about different types of circuit breakers and their applications.

[EE 1701(N).5] Understand linear couplers, autoreclosure, metal clad switchgear, Isolators, earthing switches, fuses and neutral grounding.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

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[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work at home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. Syllabus

Protective Relaying: Functional characteristics, standard definition of relay terminologies, classifications & operating principles, Feeder Protection, Distance Protection, Generator Protection, Transformers Protection, Translay Relay, Carrier Current Protection, Comparators, Static Relays, Digital Protection, Linear Couplers, Current Transformers, Potential Transformers. Circuit breakers: Arc phenomenon, arc interruption theories, Current chopping. CB types: Oil circuit breakers, Air circuit breakers, SF6 CB, Vacuum CB, MCB, MCCB, ELCB, RCCB and HVDC circuit breakers. CB rating, testing, operating mechanism, Autoreclosure, metal clad switchgear, Isolators and earthing switches, Fuses, Neutral grounding.

F. Reference Books

R1. Chakraborti, A., Soni, M.L., Gupta, P.V. and Bhatnagar, U.S.: A Text Book on Power System Engineering, Dhanpat Rai and Co. (P) Ltd., 2008.

R2. Pathinkar, Y.G. and Bhide, S.R.: Fundamentals of Power System Protection, PHI Learning Pvt. Limited, 2008.

R3. Deshpande, M.V.: Switchgear and Protection, Tata McGraw-Hill, 2005.

R4. Elmore, W.A.: Protective Relaying Theory and Applications, ABB Power T and D Company Inc., 2003.

G. Text Books

T1. Rao, S. S.: Switchgear Protection and Power systems, Khanna Publishers, 2015.

T2. Ram, B. and Vishwakarma, D. N.: Power System Protection & Switchgear, MGH, 2014.

T3. Ravindranath, B. and Chander, M.: Power System Protection and Switchgear, New Age International, 2018.

T4. Singh, R. P.: Digital Power System Protection, PHI, 2007.

H. Lecture Plan:

Class Number	Topics	Session Outcome	Mode of Delivery	Corresponding Course Outcome	Mode of Assessing the Outcome
1	Introduction to Power System Protection System and basic introduction of syllabus	Brief knowledge about syllabus	Lecture	NA	NA
2	Protective Relaying and its Functions, Standard definition of relay terminologies, Fundamental characteristic of a protective relay	Know about different functions, definitions and relay characteristics	Lecture	CO1	Mid Term Exam and Class Quiz
3	Operating principle of Electromagnetic attraction and induction relays and their types	Understand principle of operation of different Electromagnetic attraction and induction relays	Lecture	CO1 and CO2	Mid Term Exam and Class Quiz
4	Types of Protection: primary protection and back-up protection, types of back-up protection	Knowledge about primary and back-up protection schemes	Lecture	CO1	Mid Term and End Term Exam
5	Overcurrent Relays	Understand Instantaneous overcurrent relay, Inverse time-current relay, Inverse definite minimum time (IDMT) overcurrent relay, Very inverse relay, and Extremely inverse relay	Lecture and discussion	CO1	Mid Term Exam and Class Quiz
6	Time and current setting of Relays: Plug-setting multiplier (PSM), Time multiplier setting (TMS)	Acquire knowledge about time and current setting of relays and solve numericals	Tutorial	CO1	Mid Term Exam and Class Quiz
7	Basic functional relay types	Understand Induction type overcurrent relays, Induction type reverse power relays, Distance relays, Differential relays and Translay scheme	Lecture	CO2	Mid Term Exam
8	Transformer protection	Understand Buchholz Relay, Earth-Fault or Frame Leakage Protection, Combined Leakage and Overload	Lecture	CO2	Mid Term and End Term Exam

		Protection, Differential protection for Transformer protection			
9	Numericals on Transformer Protection	Solve numericals on Transformer Protection	Tutorial	CO2	Mid Term and End Term Exam
10	Alternator protection	Understand differential protection, balanced earth-fault protection, stator inter-turn protection for Alternator protection	Lecture	CO2	Mid Term and End Term Exam
11	Numericals on Alternator Protection	Solve numericals on Alternator Protection	Tutorial	CO2	Mid Term Exam
12	Busbar protection	Know about Differential protection, Fault bus protection, Frame leakage protection for bus bars used for Busbar protection	Lecture	CO2	Mid Term and End Term Exam
13	Line protection	Understand Time-graded overcurrent protection, Differential protection and Distance protection used for line protection	Lecture	CO2	Mid Term Exam and Class Quiz
14	Numericals on Busbar protection and Line protection	Solve numericals on Numericals on Busbar and Line protection	Tutorial	CO2	Mid Term Exam and Class Quiz
15	Induction motor protection	Understand methods of Induction motor protection	Lecture	CO2	Class Quiz
16	Carrier Current Protection	Understand Carrier current protection	Lecture	CO2	Assignment
17	Static Relays, Advantages of static relays over electromechanical relays	Understand and compare static relays with electromechanical relays	Lecture	CO3	Mid Term Exam
18	Comparators	Learn about amplitude and phase comparators, duality between	Lecture	CO3	Mid Term Exam

		amplitude and phase comparators			
19	Digital Protection	Understand Digital Protection	Lecture	CO3	Assignment and Group discussion
20	Current Transformers (CT)	Study CT operation, different errors and its characteristic	Lecture and discussion	CO5	Mid Term Exam
21	Potential Transformers (PT)	Study PT operation, different errors and its characteristic	Lecture and discussion	CO5	Assignment and Class Quiz
22	Numericals on CT and PT	Solve numericals on CT and PT	Tutorial	CO5	Assignment and Mid Term Exam
23	Circuit breakers	Understand Arc Phenomenon, Principles of Arc Extinction	Lecture	CO4	End Term Exam and Class Quiz
24	Methods of Arc Extinction	Know about methods of Arc Extinction and Low resistance or current zero method	Lecture	CO4	Class Quiz
25	Important Terms	Understand different important terms: Arc Voltage/Restriking voltage/Recovery voltage	Lecture	CO4	End Term Exam and Class Quiz
26	Classification of Circuit Breakers	Understand basic about different types of Circuit Breakers	Lecture	CO4	End Term Exam and Class Quiz
27	Oil Circuit Breakers	Know about advantages and disadvantages, Types of Oil Circuit Breakers: Bulk oil circuit breakers & Low oil circuit breakers	Lecture	CO4	End Term Exam and Class Quiz
28	Oil Circuit Breakers	Know about advantages and disadvantages, working of Low oil circuit breakers	Lecture	CO4	End Term Exam and Class Quiz
29	Plain break oil circuit breakers	Know about construction, operation, and advantages & disadvantages of Plain break oil circuit breakers	Lecture	CO4	Assignment and Class Quiz
30	Arc control oil circuit breakers	Understand different types- Self-blast oil	Lecture	CO4	Assignment and Class Quiz

		circuit breakers & Forced-blast oil circuit breakers, their construction, operation, and advantages & disadvantages			
31	Low Oil Circuit Breakers	Knowledge about construction, operation, and advantages & disadvantages of Low Oil Circuit Breakers	Lecture	CO4	End Term Exam and Class Quiz
32	Air-Blast Circuit Breakers	Knowledge about types, construction, operation, and advantages & disadvantages of Air-Blast Circuit Breakers	Lecture	CO4	Assignment and Class Quiz
33	Sulphur Hexaflouride (SF6)	Understand about construction, operation, advantages & disadvantages, and applications of Sulphur Hexaflouride (SF6) Circuit Breakers	Lecture	CO4	End Term Exam and Class Quiz
34	Vacuum Circuit Breakers (VCB)	Knowledge about construction, operation, advantages & disadvantages, and applications of VCB	Lecture	CO4	Class Quiz
35	Numericals on Circuit Breaker	Solve numericals on Circuit Breaker	Tutorial	CO4	End Term Exam and Class Quiz
36	MCB, MCCB, ELCB, RCCB	Compare and understand MCB, MCCB, ELCB, RCCB	Lecture	CO4	End Term Exam and Assignment
37	HVDC circuit breakers, CB rating, testing, operating mechanism	Understand HVDC circuit breakers, CB rating, testing, operating mechanism	Lecture	CO4	Assignment
38	Autoreclosure, metal clad switchgear	Understand Autoreclosure, metal clad switchgear	Lecture	CO5	Assignment
39	Isolators and earthing switches	Understand Isolators and earthing switches	Lecture	CO5	End Term Exam and Assignment

40	Fuses	Acquire knowledge about selection of fuses, Desirable Characteristics of Fuse Element, Important Terms, Types of Fuses, Current Carrying Capacity of Fuse Element	Lecture and discussion		Mid Term and End Term Exam
41	Numericals on Fuses	Solve numericals on Fuses	Tutorial	CO5	Mid Term and End Term Exam
42	Neutral grounding	Understand methods of Neutral Grounding, advantages, disadvantages and applications	Lecture	CO5	End Term Exam

I. Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	STATEMENT	Correlation with Program Outcomes **(POs)**							Correlation with Program Specific Outcomes (**PSOs**)				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
[EE1701(N).1]	Understand and explain power system protection, terminologies, classification and essential qualities	**3**	**2**	**2**					**2**	**1**	**1**		
[EE1701(N).2]	Comprehend different protection schemes and their applications	**3**	**3**	**3**		**1**			**3**	**2**	**3**		
[EE1701(N).3]	Compare and explain static relay, digital protection	**2**	**3**	**1**		**3**			**2**	**2**	**2**		
[EE1701(N).4]	Develop skill to acquire knowledge about different types of circuit breakers and their applications	**3**	**3**	**2**		**2**			**3**	**2**	**3**		
[EE1701(N).5]	Understand linear couplers, autoreclosure, metal clad switchgear, Isolators, earthing switches, fuses and neutral grounding	**2**	**2**	**1**		**2**			**2**	**2**	**1**		

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and Communication Engineering

Department of Electrical Engineering
Course Hand-out

Power System Operation & Control| EE 1703 (N) | 4 Credits | 3 1 0 4

Session: July 2020 – Dec 2020 | Faculty: Dr. Amit Saraswat | Class: VII Semester, B.Tech. (EE)

A. **Introduction:** The course is offered by Department of Electrical Engineering as a Regular Course, targeting all the students of VII Semester, B.Tech. (EE). It is one of the advanced courses in the domain of Electrical Power System Engineering. The main objective of the course is to create awareness, in the undergraduate students of Electrical Engineering, about the basic operations and the desired various control actions in modern power system such Automatic Load Frequency Control (ALFC), Automatic Voltage Regulation (AVR), Reactive Power Compensation and Voltage Control, and Economic Operations. The course offers an in-depth understanding of mathematical modelling of various components (i.e. Speed-Governor, Turbine and Generator-Load) of ALFC, fundamentals related to reactive power compensation and voltage control techniques, and economic load dispatch. It deals with the devising and assessment of the operation and control strategies available for practical applicability. Students are expected to have prerequisite knowledge of engineering mathematics, electrical machines, generation transmission and distribution of electrical power and power systems analysis for a better learning.

B. **Course Outcomes:** Upon successful completion of the course, the student will be able to:

[EE1703N.1] Aware about the general structure of modern electrical power system, its operating states and the critical operational and control issues.

[EE1703N.2] Formulate the appropriate mathematical models for various components of Automatic Load Frequency Control (ALFC) such as speed-governing system, turbine, generator, load etc.

[EE1703N.3] Analyze the mathematical model (Block Diagram Representation) for Automatic Load Frequency Control (ALFC) in Single-Area and Multi-Area control Scenarios, hence develop employability skills.

[EE1703N.4] Realize the various critical issues for Reactive Power & Voltage Control in uncompensated and compensated transmission line with FACTs. Also realize the complete block diagram representation of Automatic Voltage Regulator (AVR).

[EE1703N.5] Comprehend the appropriate mathematical models for Economic Load Dispatch (ELD) and Unit Commitment (UC) problems.

C. **PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

[PO.1] Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2] Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3] Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4] Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5] Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6] The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

[PO.7] Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8] Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

[PO.9] Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10] Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11] Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12] Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

[PSO.1] To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2] To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3] Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Plan

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who miss a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	

E. SYLLABUS

EE 1703 (N) POWER SYSTEM OPERATION AND CONTROL [3 1 0 4]

Basic introduction to power system operations and control: The structure of modern electrical power system, Operating states of power system, Basic power system control and objectives - generating unit controls. **Automatic Generation Control (AGC):** Basic generator control loops, automatic load frequency control (ALFC), Mathematical modelling of turbine speed-governing system, steam turbine model and generator load model, complete block diagram representation, stead-state and dynamic analysis, Concept of control area- single and two area control, proportional-integral controller. **Automatic Voltage Regulator (AVR):** basic control loop, block diagram representation- exciter system, generator models, stability of excitation system. **Reactive Power & Voltage Control:** Necessity of voltage control, generation and absorption of reactive power, methods of reactive power/voltage control, reactive power flow and voltage collapse, concept of voltage stability, synchronous generator capability curve, reactive power compensation-series & shunt compensation, basic introduction to Flexible AC Transmission Systems (FACTS). **Introduction to Economic Operations:** Basics formulations of Economic Load Dispatch (ELD) and Unit Commitment (UC).

F. TEXT BOOKS

[T1] S. Sivanagaraju & G. Sreenivasan, *Power System Operation and Control (1e)*, Pearson, 2013.

G. REFERENCE BOOKS

[R1] P. Kundur, *Power System Stability Analysis & Control (1e)*, Tata Mc Graw Hill, 2006.

[R2] Wood & B. F. Woolenberg, *Power System Operation & Control (2e)*, John – Wiley, 2003.

[R3] J. J. Grainger and W. D. Stevenson, *Elements of Power System Analysis (4e)*, TMH, 2003.

[R4] D. P. Kothari & I. J. Nagrath, *Modern Power System Analysis (2e)*, TMH, 2013.

H. Lecture Plan

EE 1703 (N): Power System Operation & Control (PSOC)

Lecture / Tutorial No.	Topic to be covered	Session Objectives	Mode of Delivery	Corresponding Course Outcome	Mode of Assessing the Outcome
L1	**Preamble of the Course:** Discussion on Course Contents (Syllabus), Course Prerequisites, Course Objectives and Outcomes.	To acquaint students with the outcome-based education (OBE) and Course outcomes (COs) and program outcomes (POs) assessment process	Lecture & Interaction	N.A.	N.A.
L2-L3	**Brief Introduction to Power System Operation and Control**	Structure of a typical power system, Review of basic concepts in power system engineering, Power System Representations.	Lecture & Interaction	EE1703N.1	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L4-L5	**Power System Operation and Control:** Operating States of Power System, Operational and Control Issues, Objectives of Power System Control.	Operating States of Power System, Operational and Control Issues, Objectives of Power System Control.	Lecture & Interaction	EE1703N.1	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L6-L7	**Critical Issues with Power System Operation and Control**	Automatic Generating Control (AGC): Automatic Voltage Control (AVC) & Load Frequency Control (LFC), Economic Operations such as ELD, OPF, ORPD, Unit Commitment, Stability & Security Analysis and Contingency Analysis.	Lecture & Interaction	EE1703N.1	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T1	**Problems and Numerical Examples**	Numerical problems based on L1 – L7	Tutorial & Interaction / Group Discussion	EE1703N.1	Mid Term Exam / End Term Exam

L8	**Automatic Generation Control (AGC):** Block Diagram of Generator Control and Load Frequency Control (LFC).	Block Diagram of Generator Control and Load Frequency Control (LFC).	Lecture & Interaction	EE1703N.1	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L9-L10	**Automatic Generation Control (AGC):** Governor Characteristics of a single generator, Adjustments of governor characteristic of parallel operating units.	Governor Characteristics of a single generator, Adjustments of governor characteristic of parallel operating units.	Lecture & Interaction	EE1703N.1	Quiz Test / Mid Term Exam / End Term Exam
L11-L12	**Speed Governing System**	Schematic diagram, working, components, and Mathematical Modelling of Speed Governing System.	Lecture & Interaction	EE1703N.2	Quiz Test / Mid Term Exam / End Term Exam
L13-L14	**Turbine Model and Generator-Load Model**	Mathematical Modelling of Automatic Load Frequency Control (ALFC): Turbine Model and Generator-Load Model.	Lecture & Interaction	EE1703N.2	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L15	**Mathematical Modelling of Automatic Load Frequency Control (ALFC):** Complete Block Diagram Representation.	Complete Block Diagram Representation.	Lecture & Interaction	EE1703N.2	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L16-L17	**Single-Area Automatic Load Frequency Control (ALFC):** Steady-State Analysis - Free Governor Operation (FGO) and Constant Load Demand, Static Load Frequency Curves.	Steady-State Analysis - Free Governor Operation (FGO) and Constant Load Demand, Static Load Frequency Curves.	Lecture & Interaction	EE1703N.3	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L18	**Single-Area Automatic Load Frequency Control (ALFC):** Dynamic Analysis – Transient or dynamic Response (Δf Vs t).	Dynamic Analysis –Transient or dynamic Response (Δf Vs t).	Lecture & Interaction	EE1703N.3	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam

L19	**Proportional-Integral Controller:** Requirement of Control Strategy in ALFC, Analysis of Proportional-Integral controller.	Requirement of Control Strategy in ALFC, Analysis of Proportional-Integral controller.	Lecture & Interaction	EE1703N.3	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T2-T3	**Problems and Numerical Examples**	Numerical problems based on L8 – 18	Tutorial & Group Discussion	EE1703N.3	Mid Term Exam / End Term Exam
L20-L21	**Two-Area Automatic Load Frequency Control (ALFC):** Concept of control areas in an interconnected power system, Block diagram representation.	Concept of control areas in an interconnected power system, Block diagram representation.	Lecture & Interaction	EE1703N.3	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L22-L23	**Two-Area Automatic Load Frequency Control (ALFC):** Steady-State and Dynamic response.	Steady-State and Dynamic response.	Lecture & Interaction	EE1703N.3	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T4-T5	**Problems and Numerical Examples**	Numerical problems based on L19 – L22	Tutorial & Group Discussion	EE1703N.3	Mid Term Exam / End Term Exam
L24-L25	**Automatic Voltage Regulator (AVR)**	Basic control loop, block diagram representation- exciter system, generator models.	Lecture & Interaction	EE1703N.4	Quiz Test / Mid Term Exam / End Term Exam
L26-L27	**Excitation Systems**	Types of Exciters, Standard block diagrams - DC Excitation System, AC Excitation System and Static Excitation System and Stability of excitation system.	Lecture & Interaction	EE1703N.4	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L28-L29	**Reactive Power & Voltage Control:** Generation & absorption of reactive power, Methods of voltage control.	Generation & absorption of reactive power, Methods of voltage control.	Lecture & Interaction	EE1703N.4	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam

L30-L31	**Reactive Power & Voltage Control:** Generation & absorption of reactive power, Methods of voltage control.	Steady-state operation of uncompensated transmission line, power flow in two bus system, voltage regulation and its relationship with reactive power.	Lecture & Interaction	EE1703N.4	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T6-T7	**Problems and Numerical Examples**	Numerical problems based on L23 – L30	Tutorial & Interaction / Group Discussion	EE1703N.4	Mid Term Exam / End Term Exam
L32-L33	**Reactive Power & Voltage Control:** Analysis of uncompensated transmission line at No Loading and Loading condition, Surge Impedance Loading (SIL), No Loading, voltage and current profiles.	Analysis of uncompensated transmission line at No Loading and Loading condition, Surge Impedance Loading (SIL), No Loading, voltage and current profiles.	Lecture & Interaction	EE1703N.4	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L34-L35	**Reactive Power & Voltage Control:** Power Balance Equations, Concept of Voltage Stability and Voltage Collapse, Methods of improving Voltage Stability.	Power Balance Equations, Concept of Voltage Stability and Voltage Collapse, Methods of improving Voltage Stability.	Lecture & Interaction	EE1703N.4	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
L36-L37	**Reactive Power & Voltage Control:** Principles of transmission system compensation - series & shunt compensation. Basic Introduction of Flexible AC Transmission Systems (FACTS).	Principles of transmission system compensation - series & shunt compensation. Basic Introduction of Flexible AC Transmission Systems (FACTS).	Lecture & Interaction	EE1703N.4	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T8-T9	**Problems and Numerical Examples**	Numerical problems based on L31 – L36	Tutorial & Interaction / Group Discussion	EE1703N.4	Mid Term Exam / End Term Exam
L38-L39	**Economic Operations in Power System:** Characteristics of Power Generation Units for Economic Operations.	Characteristics of Power Generation Units for Economic Operations.	Lecture & Interaction	EE1703N.5	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam

L40-L41	**Economic Operations in Power System:** Economic Load Dispatch (ELD) – Mathematical Problem Formulation.	Economic Load Dispatch (ELD) – Mathematical Problem Formulation.	Lecture & Interaction	EE1703N.5	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T10	**Skills Development Activities for Employability: Hands-On / Demonstration of MATLAB based Simulations**	Numerical problems / Hands-On / Demonstration of MATLAB Simulations based on L37 – L40	Tutorial & Interaction / Group Discussion	EE1703N.5	Home Assignment / Quiz Test
L42	**Economic Operations in Power System:** Unit Commitment (UC) – Mathematical Problem Formulation.	Unit Commitment (UC) – Mathematical Problem Formulation.	Lecture & Interaction	EE1703N.5	Home Assignment / Quiz Test / Mid Term Exam / End Term Exam
T11	**Skills Development Activities for Employability: Hands-On / Demonstration of MATLAB based Simulations**	Hands-On Demonstration of MATLAB Simulations based on L41	Tutorial & Interaction / Group Discussion	EE1703N.5	Home Assignment / Quiz Test

I. Course Articulation Matrix: (Mapping of COs with POs)

CO No.	CO STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE1703N.1	Aware about the general structure of modern electrical power system, its operating states and the critical operational and control issues.	3	2		2								1	2	1	1
EE1703N.2	Formulate the appropriate mathematical models for various components of Automatic Load Frequency Control (ALFC) such as speed-governing system, turbine, generator, load etc.	3	2		2								1	2	1	1
EE1703N.3	Analyze the mathematical model (Block Diagram Representation) for Automatic Load Frequency Control (ALFC) in Single-Area and Multi-Area control Scenarios.	3	2		2									2	1	1
EE1703N.4	Realize the various critical issues for Reactive Power & Voltage Control in uncompensated transmission line and compensated transmission line with FACTs. Also realize the complete block diagram representation of Automatic Voltage Regulator (AVR).	3	2		2									2	1	1
EE1703N.5	Comprehend the appropriate mathematical models for Economic Load Dispatch (ELD) and Unit Commitment (UC) problems.	3	2		2									2	2	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

J. Course Outcome Attainment Level Matrix:

CO	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES **THRESHOLD VALUE: 40%**												ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE1703N.1	Aware about the general structure of modern electrical power system, its operating states and the critical operational and control issues.															
EE1703N.2	Formulate the appropriate mathematical models for various components of Automatic Load Frequency Control (ALFC) such as speed-governing system, turbine, generator, load etc.															
EE1703N.3	Analyze the mathematical model (Block Diagram Representation) for Automatic Load Frequency Control (ALFC) in Single-Area and Multi-Area control Scenarios.															
EE1703N.4	Realize the various critical issues for Reactive Power & Voltage Control in uncompensated transmission line and compensated transmission line with FACTs. Also realize the complete block diagram representation of Automatic Voltage Regulator (AVR).															
EE1703N.5	Comprehend the appropriate mathematical models for Economic Load Dispatch (ELD) and Unit Commitment (UC) problems.															

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics & Communication Engineering (SEEC)

Department of Electrical Engineering

Course Hand-out

EHV AC/DC TRANSMISSION | EE1752| 3 Credits | 3 0 0 3

Session: August 20 – December 20 | Faculty: Dr. Amit Soni | Class: VII Sem B Tech. (EE)

A. Introduction: Department of Electrical Engineering offers this course as Program Elective in view to provide Introduction to Energy Systems and Renewable Energy Resources and their applications. This will help to explore present needs, challenges and future energy demands of leading Renewable Energy Sources such as Solar, Biomass (conversions), Wind power, Geothermal, and Ocean Thermal Energy conservation methods. Present course emphasizes and will be targeting students who wish to pursue Research & Development in the related areas of alternate energy resources.

B. Course Objectives: At the end of the course, students will be able to:

[EE1752.1] Describe and systematically understand different needs and problems associated with EHV transmission systems.

[EE1752.2] Develop the skills of students to identify and calculate the various parameters such as inductance and capacitance of EHV line for modelling.

[EE1752.3] Analyse and assess the effects of electrostatic field, radio & TV interference, corona and to understand the methods of load frequency control.

[EE1752.4] Identify the effect of electrostatic field and over humans, animal and plants and hence the grounding system for EHVAC systems.

[EE1752.5] Interpret, illustrate and develop the skills to understand the concepts of series and shunt compensation, Sub synchronous resonance and Static VAR compensators.

C. Program Outcomes and Program Specific Outcomes

[PO.1]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

[PO.9]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

D. Program Specific Outcomes (PSO): At the end of the program student should be able

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

E. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	**15**
	Sessional Exam II (Closed Book)	**15**
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	**30**
End Term Exam (Summative)	End Term Exam (Closed Book)	**40**
	Total	**100**
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Assignment on the topic related to the running unit will be given which has to be submitted within a week. These assignments are limited to a maximum of 5 throughout the entire semester.	
Activity Assignment (Formative)	A student is expected to participate and perform the activity/ flipped classroom participation related to the course which will be assessed and marks will be awarded.	

F. Syllabus:

EHV AC Transmission: Need of EHV transmission lines, power handling capacity and surge impedance loading, traveling and standing waves. Problems associated with EHV transmission, Electrostatic fields of EHV lines and their effects, Radio and TV interference due to EHV AC systems and methods to reduce interference. Load Frequency Control: Introduction to control of active and reactive power flow, turbine speed governing system. Speed governing characteristic of generating unit and load sharing between parallel operating generators. Method of Load Frequency Control: Flat frequency, flat tie line and tie line load bias control. Voltage Control: Power circle diagram and its use, Voltage control using synchronous condensers,

Cascade connection of shunt and series compensation, Sub synchronous resonance, Compensated lines, Static VAR compensating system – TCR, FC-TCR and TSC- TCR. HVDC Transmission: Types of D.C. links, advantages and disadvantages of HVDC transmission. Converter configurations and their characteristics, DC link control, converter control characteristics, Ground return, Application of HVDC transmission.

G. Text Books:

T1. R. D. Begamudre, EHV AC Transmission Engineering (4e), New Age International, 2014.
T2. K. R. Padiyar, HVDC Power Transmission Systems (3e), New Age Publishers, New Delhi 2017.

H. Reference Books:

R1. W. Kimbark, Direct Current Transmission Vol-I (1e), John-Wiley Interscience, NY 1971.
R2. Arrillaga, High voltage Direct Current Transmission (1e), Peter Peregrinus Ltd., London, UK, 1983.

I. Lecture Plan:

Lec No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
L1	Course objective and overview of the contents	To Understand and provide overview related to Aims, Objective and Contents and to understand student expectations	Lecture Online	NA	NA
L2	Introduction to EHV AC Transmission.	To Understand EHV AC Transmission needs	Lecture Online	[1752.1]	Class Quiz (Not Accounted)
L3	Need of EHV transmission lines.	To Understand EHV AC Transmission needs	Lecture Online	[1752.1]	Class Quiz (Not Accounted)
Activity - 1	Basic Concepts of EHV AC Transmission.	To analyse Student understanding and connect with the Course	Activity	[1752.1]	Activity Analysis
L4	Introduction to terms power handling capacity and surge impedance loading, traveling and standing waves	To understand different terms used for Transmission	Lecture Online	[1752.1]	Mid Term I
L5 – L6	Problems associated with EHV transmission.	Able to understand various problems associated with EHV	Lecture Online	[1752.1]	Class Quiz Mid term I End Term
L7	Electrostatic fields of EHV lines and their effects	Analyze effects of electrostatic fields on Human, Plants and Animals	Lecture Online	[1752.3]	Class Quiz Mid Term I End Term
T1	L1 – L7	Analyze Student understanding for the concepts	Tutorial	[1752.1] [1752.3]	Mid Term 1 End term
Activity - 2	Understand various installations of EHV transmission Lines	To give practical overview of EHV concepts	Activity	[1752.1]	Activity Analysis
L9 – L10	Radio and TV interference due to EHV AC systems and methods to reduce interference	Analyze Radio and TV interference due to EHV AC systems	Lecture	[1752.3]	Class Quiz Mid Term 1 End Term
L11	Load Frequency Control	Able to understand concepts of Load Frequency Control	Lecture	[1752.3]	Class Quiz Mid Term 1 End Term

L12	Introduction to control of active and reactive power flow, turbine speed governing system.	Analyse active and reactive power flow.	Lecture	[1752.1] [1752.3]	Class Quiz Mid Term II
L13 -L14	Speed governing characteristic of generating unit and load sharing between parallel operating generators.	To understand speed governing characteristics and load sharing	Lecture	[1752.2]	Class Quiz End Term
L15	Method of Load Frequency Control: Flat frequency, flat tie line and tie line load bias control	Analyse and understand Method of Load Frequency Control.	Lecture	[1752.3]	Class Quiz Mid Term II End Term
T2	L9 - L15	To understand learning of students for the concepts covered above.	Tutorial	[1752.1] [1752.3]	Mid Term II End Term
Activity -3	Invited Talk on Topics Covered above	To give practical exposure to students	Activity	[1752.1] [1752.3]	Activity Analysis
L16 - L17	Voltage Control: Power circle diagram and its use	To understand concepts of Voltage Control and Power Circle diagram.	Lecture	[1752.2] [1752.3]	Class Quiz Mid Term II End Term
L18	Voltage control using synchronous condensers.	To understand concepts of Synchronous Condensers	Lecture	[1752.2] [1752.3]	Class Quiz Mid Term II End Term
L19	Cascade connection of shunt and series compensation	To understand concepts of cascade connections of shunt and series compensation	Lecture	[1752.5]	Class Quiz Mid Term II End Term
T3	L16 -L19	To understand learning of students for the concepts covered above.	Tutorial	[1752.3] [1752.5]	Mid Term II End Term
L20-L21	Sub synchronous resonance, Compensated lines, Static VAR compensating system – TCR, FC-TCR and TSC- TCR.	To understand concepts of sub synchronous resonance and compensating schemes	Lecture	[1752.5]	Class Quiz Mid Term II End Term
L22	Introduction to HVDC Transmission	Able to understand HVDC Transmission.	Lecture	[1752.5]	Class Quiz End Term
Activity - 4	Overview of 400 kV GSS Heerapura	To understand practical concepts	Activity	[1752.3] [1752.5]	Activity Analysis
L23 – L24	Types of D.C. links, advantages and disadvantages of HVDC transmission.	Analyse different types of DC links	Lecture	[1752.3] [1752.5]	Class Quiz End Term

L25	Converter configurations and their characteristics	To understand different converter configurations	Tutorial	[1752.5]	Class Quiz End term
L26 – L27	DC link control, converter control characteristics.	To acquaint with DC link control	Lecture	[1752.5]	Class Quiz End Term
T4	L23 – L27	To understand learning of students for the concepts covered above.	Tutorial	[1752.5]	Class Quiz End term
L28	Ground return, Application of HVDC transmission.	Analyse analytical approaches for Ground Return.	Lecture	[1752.5]	Class Quiz End Term
L29 -L30	Review and Discussions	To review whole course major topics and discussion.	Lecture	[1752.1] to [1752.5]	Class Quiz End Term

J. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

CO	STATEMENT	Correlation with Program Outcomes												Correlation with Program Specific Outcomes		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
[EE1752.1]	Describe and systematically understand different needs and problems associated with EHV transmission systems.		1	2				3					1		2	1
[EE1752.2]	Develop the skills of students to identify and calculate the various parameters such as inductance and capacitance of EHV line for modelling.	1	1		3											3
[EE1752.3]	Analyse and assess the effects of electrostatic field, radio & TV interference, corona and to understand the methods of load frequency control.	3	2			1							1	3		1
[EE1752.4]	Identify the effect of electrostatic field and over humans, animal and plants and hence the grounding system for EHVAC systems.		3	1			2								2	1
[EE1752.5]	Interpret, illustrate and develop the skills to understand the concepts of series and shunt compensation, Sub synchronous resonance and Static VAR compensators.			3		1		2					1	2	1	1

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics & Communication Engineering (SEEC)
Department of Electrical Engineering
Course Hand-out
POWER QUALITY ISSUES | EE1753 | 3 Credits | 3 0 0 3

Session: August 20 – December 20 | Faculty: Dr. Ashish Shrivastava | Class: VII Sem B Tech. (EE)

A. Introduction: Department of Electrical Engineering offers this course as Program Elective in order to provide awareness of Power Quality (PQ) Issues and their mitigations, PQ standards, causes of PQ problems. The subject also deals with effect of harmonics on power system equipments and loads. This will also help in understanding different types of voltage and current based PQ problems and their solutions by using passive & active filters, series, shunt and hybrid compensations methods. The present course emphasizes on the number of techniques are evolved for the mitigation of PQ problems resulted into a new direction of research and development activities for the design and development engineers in the field of power electronics, power system, electric drives etc.

B. Course Objectives: At the end of the course, students will be able to:

[EE1753.1] Describe and systematically understand the importance of Power Quality Standards, different PQ problems and their mitigations. **(Bloom's Level: knowledge, Comprehensive)**

[EE1753.2] Develop the skills of students to identify PQ problems due to non-linear loads, effect of harmonics on power system equipments and on their performance. **(Bloom's Level: Analysis)**

[EE1753.3] Analyse the effects of passive and active compensation, passive filtering and to understand the single-phase and three-phase power factor correction methods using different control techniques. **(Bloom's Level: Analysis)**

[EE1753.4] Identify the effect of active harmonic filtering for single-phase and three-phase systems, active power filtering for harmonic cancellation. **(Bloom's Level: Application)**

[EE1753.5] Interpret, illustrate and develop the skills to understand the concepts of series, shunt and hybrid compensation for single-phase and three-phase systems, grounding and wiring requirements, and associated problems and their solutions. **(Bloom's Level: Application)**

C. Program Outcomes and Program Specific Outcomes

[PO.1]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PO.2]. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

[PO.3]. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

[PO.8]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

[PO.9]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

D. Program Specific Outcomes (PSO): At the end of the program student should be able

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

E. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	**15**
	Sessional Exam II (Closed Book)	**15**
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	**30**
End Term Exam (Summative)	End Term Exam (Closed Book)	**40**
	Total	**100**
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Assignment on the topic related to the running unit will be given which has to be submitted within a week. These assignments are limited to a maximum of 5 throughout the entire semester.	
Activity Assignment (Formative)	A student is expected to participate and perform the activity/ flipped classroom participation related to the course which will be assessed and marks will be awarded.	

F. Syllabus:

Power Quality Issues: Standards and indices, Voltage sags, swell, surges, spikes, Interruptions, Harmonics: harmonic distortion of fluorescent lamps, effect of power system harmonics on power system equipment and loads, Power factor improvement, Passive Compensation, Passive Filtering, Harmonic Resonance, Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques, PFC Based on Bilateral Single Phase and Three Phase Converter-static var compensators, SVC and STATCOM, Active Harmonic Filtering: Shunt Injection Filter for single phase , three-phase three-wire and three-phase four-wire systems, UPS, constant voltage transformers, series active power filtering techniques for harmonic cancellation and isolation, Dynamic Voltage Restorers, Grounding and wiring, NEC grounding requirements, solutions to grounding and wiring problems.

G. Text Books:

T1. S. Santoso, H. W. Beaty, R. C. Dugan, M F. McGranaghan, *Electrical Power System Quality*, Second edition, McGraw Hill Pub, 2002.

T2. C. Shankran, *Power quality*, CRC Press, 2001.

H. Reference Books:

R1. H. B. Math, *Understanding Power Quality Problems*, IEEE Press, 1st Edition, 2001.

R2. J. Arrillaga, *Power System Quality Assessment*, John Wiley, 2000.

R3. A. Ghosh and G. Ledwich, *Power Quality Enhancement using Custom Power Devices*, Kluwer Academic Publication, 2002.

I. Lecture Plan:

Lec. No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
L1	Course outcome and their correlation with program outcome (PO) and program specific outcomes (PSO) and overview of the contents	To Understand and provide overview related to Aims, Objective and Contents and to understand student expectations	Lecture Online	NA	NA
L2	Introduction to power quality, standards and indices, and definitions of transients	To Understand Power quality definition, issues and challenges	Lecture Online	[1753.1]	Class Quiz Mid Term I
L3	Long duration voltage variations, under voltage, sustained interruptions, Short duration voltage variations, interruption, voltage sag, voltage swell, Voltage imbalance, voltage fluctuation, notching, dc offset	To Understand different parameters associated with Power Quality	Lecture Online	[1753.1]	Class Quiz Mid Term I
L4 – L5	Voltage and Current harmonics, their effects on power system equipments, and loads	To understand the harmonics due to non-linear loads and its ill effects on different equipments	Lecture Online	[1753.1]	Class Quiz Mid Term I
L6 – L7	Harmonic distortion in fluorescent lamps and its solution, passive compensation, passive filtering	Able to understand various PQ problems associated with lighting load and their solutions	Lecture Online	[1753.2]	Class Quiz Mid Term I End Term
Activity - 1	Invited Talk on Topics Covered above	To give practical exposure to students	Activity	[1753.1]	Activity Analysis
L8-L10	Power factor improvement in LED lighting as single-phase APFC, harmonic resonance	Analyze effects of power quality improvement in LED lighting using different control schemes	Lecture Online	[1753.2]	Class Quiz Mid Term I End Term
L11 – L12	Three-phase APFC and associated control techniques	Analyze different PFC techniques used in three-phase systems	Lecture Online	[1753.3]	Class Quiz Mid Term 1 End Term
L13-L14	PFC based on bilateral single-phase and three-phase converters with closed loop control	Able to understand concepts of Active PFC using bidirectional single and three-phase converters	Lecture Online	[1753.3]	Class Quiz Mid Term 1 End Term

L15-L16	Introduction to control of active and reactive power flow, Static VAR compensating system, SVC, STATCOM	Analyse active and reactive power flow and shunt compensation	Lecture Online	[1753.3]	Class Quiz Mid Term II
L17-L18	Active harmonic filtering, Shunt injection filter for single-phase systems	To understand concept of active harmonic filtering	Lecture Online	[1753.4]	Class Quiz End Term
L19-L20	Shunt injection filter for three-phase three-wire and three-phase four-wire systems, neutral current compensation	Analyse and understand Method of shunt compensation for three-phase systems	Lecture Online	[1753.4]	Class Quiz Mid Term II End Term
Activity - 2	Invited Talk on Topics Covered above	To give practical exposure to students	Activity	[1753.2] [1753.3]	Activity Analysis
L21-L22	UPS, UPS switching transients, neutral voltage switching	To understand concepts of UPS and associated PQ problems.	Lecture Online	[1753.4]	Class Quiz Mid Term II End Term
L23	Concept of constant voltage transformer (CVT) and its importance	To understand concepts of CVT	Lecture Online	[1753.4]	Class Quiz Mid Term II End Term
L24-25	Series active power filtering for harmonic cancellation and isolation	To understand concepts of harmonic cancellation and isolation	Lecture Online	[1753.5]	Class Quiz Mid Term II End Term
L26-L27	Dynamic voltage restorer, UPQC	To understand concepts of series and hybrid compensation	Lecture Online	[1753.5]	Mid Term II End Term
L28-L29	Network reconfiguration devices, load compensation and voltage regulation using DVR, DSTATCOM & UPQC	To understand concepts of custom power devices for power quality improvement	Lecture Online	[1753.5]	Class Quiz Mid Term II End Term
L30	Power quality measurement devices, harmonic analyzer, transient disturbance analyzer	Able to understand different measuring instruments used to capture PQ Indices	Lecture Online	[1753.5]	Class Quiz End Term
Activity - 3	Invited Talk on Topics Covered above	To understand practical concepts in real time environment	Activity	[1753.4] [1753.5]	Activity Analysis
L31	Grounding and wiring, NEC grounding requirements	Analyse different types grounding and wiring requirements	Lecture Online	[1753.5]	Class Quiz End Term
L32	Solutions to Grounding and wiring problems	To understand solution of grounding problems	Lecture Online	[1753.5]	Class Quiz End term

L33	Improved PQ converters (IPQC) used for power quality improvements	To acquaint with IPQC for power quality improvement	Lecture Online	[1753.5]	Class Quiz End Term
L34 -L35	Review and Discussions	Exhaustive review of the whole course in terms of learning outcome, major topics and discussion.	Lecture Online	[1753.1] to [1753.5]	Class Quiz End Term

J. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

CO	STATEMENT	Correlation with Program Outcomes												Correlation with Program Specific Outcomes		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
[EE1753.1]	Describe and systematically understand the importance of Power Quality Standards, different PQ problems and their mitigations.	3	3	3	2	2		2					2	1	1	2
[EE1753.2]	Develop the skills of students to identify PQ problems due to non-linear loads, effect of harmonics on power system equipments and on their performance.	3	3	3	3	2	2	3					3	3	2	3
[EE1753.3]	Analyse the effects of passive and active compensation, passive filtering and to understand the single-phase and three-phase power factor correction methods using different control techniques.	3	3	3	3	1		2					2	3	1	2
[EE1753.4]	Identify the effect of active harmonic filtering for single-phase and three-phase systems, active power filtering for harmonic cancellation.	3	3	3	2	2		2					2	2	2	2
[EE1753.5]	Interpret, illustrate and develop the skills to understand the concepts of series, shunt and hybrid compensation for single-phase and three-phase systems, grounding and wiring requirements, and associated problems and their solutions.	3	3	3	3	2	2	3					3	3	2	3

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Electrical Electronics and Communication Engineering

Department of Electrical Engineering
Course Hand-out

Smart Grid Systems| EE 1763 | 3 Credits | 3 0 0 3

Session: Aug 20 –Dec 20 | Faculty: Divya Rishi Shrivastava | Class: B.Tech 7 semester

A. Introduction: This course is offered by Dept. of Electrical Engineering as a Program Elective. The course will help students to understand Smart Grid Systems and its underlying perspectives, including functionality and realization in urban/rural areas. The course familiarizes with the detailed understanding SCADA, control layer and control algorithms. Students are expected to have background knowledge on Engineering Mathematics, basic electrical technology and power system for a better learning.

B. Course Outcomes: At the end of the course, students will be able to

[EE 1763.1]. Comprehend the characteristics, functionality, reliability and standards of smart grid.
[EE 1763.2]. Understand the vision, realization and operation of Smart Grid.
[EE 1763.3]. Develop skill set to apprehend the SCADA, Control Algorithms and Volt-VAR control.
[EE 1763.4]. Know and understand the distribution automation, grid storage systems.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

[PO.3]. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

[PO.4]. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

[PO.5]. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

[PO.6]. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

[PO.7]. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

[PO.8]. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

[PO.9]. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.10]. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

[PO.11]. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who miss a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this.	

E. SYLLABUS

Smart Grid Overview- Smart Grid evolution, Definition of the Smart Grid, Key Characteristics of Smart Grid, Key Functions of a Smart Grid, Smart Grid Elements. Traditional Electric Grid Model, Generation, Transmission, Distribution, Energy Storage, Micro-grids, Integration of new technologies into the grid, Smart Grid vision and its realization in Urban/Rural, Smart Grid infrastructure, Functionality, Reliability, Cost/Tariff, Standards, Smart Grid cyber security, Smart Grid Operations-Electric Grid (power delivery), SCADA (supervisory control and data acquisition), Smart Grid Control Layer-fault detection and location, Data collection and management, Control Layer Infrastructure, Software-Define Networks (SDN), Control Algorithms, Volt-VAR control, Distribution automation, Grid storage systems, Intermittent renewable, Cooperative grids.

F. TEXT BOOKS

1. J. Momoh, *Smart Grid: Fundamentals of Design and Analysis*, IEEE press, John Wiley & Sons, 2012.
2. T. Sato, Daniel M. Kammen, B. Duan, M. Macuha, Z. Zhou, and Jun Wu, *Smart Grid Standards: Specifications, Requirements, and Technologies*, Wiley-Blackwell, 2015.
3. J. Ekanayake, K. Liyanage, Jianzhong Wu, A. Yokoyama, and N. Jenkins, *Smart Grid: Technology and Applications*, Wiley, New Delhi, 2015.
4. L. T. Berger and K. Iniewski, *Smart Grid Applications, Communications, and Security*, Wiley, New Delhi, 2015.
5. K. Salman, *Introduction to the Smart Grid: Concepts, Technologies and Evolution*, The Institution of Engineering and Technology, United Kingdom, 2017

G. Lecture Plan:

Class Number	Topics	Session Outcome	Mode of Delivery	Corresponding Course Outcome	Mode of Assessing the Outcome
1	Introduction to course and course handout distribution	To acquaint and clear teachers expectations and understand student expectations	Lecture Interaction	NA	NA
2,3	Introduction to Smart Grid Concept	To introduce concept of smart grid	Lecture Interaction	EE 1763.1	Class Quiz Assignment Mid Term I End Term
4,5,6,7	Characteristics of Conventional Electrical Networks, Smart Grid vs conventional electrical networks	To acquaint students difference between conventional and smart grids	Lecture Interaction	EE 1763.1	Class Quiz Assignment Mid Term I End Term

8,9,10	Smart Grid Characteristics and motives	To acquaint students characteristics and motives	Lecture Interaction	EE 1763.1	Class Quiz Assignment Mid Term I End Term
11,12,13	Smart Grid vision and realization	To acquaint students vision and realization	Lecture Interaction	EE 1763.1 EE 1763.2	Class Quiz Assignment Mid Term I End Term
14,15	Smart Grid Infrastructure	To acquaint students Smart Grid Infrastructure	Lecture Interaction	EE 1763.2	Class Quiz Assignment Mid Term I End Term
FIRST SESSIONAL EXAM					
16	Smart Grid Communication and Measurement	To acquaint students Communication and Measurement	Lecture Interaction	EE 1763.2	Class Quiz Assignment Mid Term II End Term
17,18,19,20,21,22	Monitoring, PMU, Smart Meters	To acquaint students Smart Meters	Lecture Interaction	EE 1763.2	Class Quiz Assignment Mid Term II End Term
23,24,25	Multiagent system for smart grid implementation	To acquaint students smart grid implementation	Lecture Interaction	EE 1763.2	Class Quiz Assignment Mid Term II End Term
26	Microgrid vs Smart Grid	To acquaint students Microgrid vs Smart Grid	Lecture Interaction	EE 1763.2	Class Quiz Assignment Mid Term II End Term
27,28,29,30,31	SCADA (supervisory control and data acquisition), Smart Grid Control Layer – fault detection and location	To acquaint students SCADA Smart Grid Control Layer	Lecture Interaction	EE 1763.1 EE 1763.3	Class Quiz Assignment Mid Term II End Term
SECOND SESSIONAL EXAM					
32,33	Data collection and management, Control Layer Infrastructure, Software-Define Networks (SDN)	To acquaint students Data collection and management	Lecture Interaction	EE 1763.2	Class Quiz Assignment End Term
34,35,36,37	Control Algorithms, Volt-VAR control	To acquaint students Volt-VAR control	Lecture Interaction	EE 1763.2 EE 1763.3	Class Quiz Assignment End Term
38,39	Distribution automation, Grid storage systems	To acquaint students Distribution automation	Lecture Interaction	EE 1763.1 EE 1763.4	Class Quiz Assignment End Term
40,41,42	Intermittent renewable, Cooperative grids	To acquaint students Cooperative grids	Lecture Interaction	EE 1763.2	Class Quiz Assignment End Term
END TERM EXAM					

H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 1763.1	Comprehend the characteristics, functionality, reliability and standards of smart grid	3	3			1	1		1				1	1	1	1
EE 1763.2	Understand the vision, realization and operation of Smart Grid	2	2	1		2	2	1	1				2	2	1	1
EE 1763.3	Develop skill set to apprehend the SCADA, Control Algorithms and Volt-VAR control	2	2	1	2	2	1	1	1				1	2	2	2
EE 1763.4	Know and understand the distribution automation, grid storage systems and cooperative grids	1	1			1	1	1					1	1	1	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

I. Course Outcome Attainment Level Matrix:

CO	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES **THRESHOLD VALUE: 40%**												ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE 1763.1	Comprehend the characteristics, functionality, reliability and standards of smart grid															
EE 1763.2	Understand the vision, realization and operation of Smart Grid															
EE 1763.3	Develop skill set to apprehend the SCADA, Control Algorithms and Volt-VAR control															
EE 1763.4	Know and understand the distribution automation, grid storage systems and cooperative grids															

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics & Communication Engineering

Department of Electrical Engineering
Course Hand-out

Object Oriented Programming (OOPS) | EE 1764 | 3 Credits | 2 1 0 3

Session: Aug 20– Dec 20 | Faculty: Abhishek Kumar | Class: VII Sem B Tech. (EE)

A. Introduction: This course is offered by Department of Electrical Engineering as a program elective, targeting students who wish to get a software job and to pursue research & development in industries or higher studies in field of Programming. This course is to explore the concept and Programming skills in C++. Programming skills in C++ is so fundamental that all companies dealing with systems as well as application development (including web, IoT, embedded systems) have a need for the same. These include – Microsoft, Samsung, Xerox, Yahoo, Google, IBM, TCS, Infosys, Amazon, Flipkart, etc. There has been a continual debate on which programming language/s to learn, to use. As the latest TIOBE Index for April 2016 indicates – Java (21%), C (14%), C++ (6%), C#(4%), and Python (3%) together control nearly half the programming community. Given this, it is still important to learn C and C++ because of the efficiency they offer. Students are expected to have background knowledge on Programming in C language for a better learning. Besides the constructs, syntax and semantics of C++ (over C), we also focus on various idioms of C++ and attempt to go to depth with every C++ feature justifying and illustrating them with several examples and assignment problems. On the way, we illustrate various OOP concepts. While this course can be understood independently (after a course in C programming), it would help in developing understanding in OOP.

B. Course Objectives: At the end of the course, students will be able to

[EE1764.1] Understand and use the basic programming constructs of C/C++.
[EE1764.2] Manipulate various C/C++ datatypes, such as arrays, strings, and pointers.
[EE1764.3] Isolate and fix common errors in C++ programs.
[EE1764.4] Use memory appropriately, including proper allocation/deallocation procedures.
[EE1764.5] Apply object-oriented approaches to software problems in C++ and hence foster employability skills.

C. Program Outcomes and Program Specific Outcomes

[PO.1]. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
[PO.2]. 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
[PO.3]. 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
[PO.4]. 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
[PO.5]. 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
[PO.6]. 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
[PO.7]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices
[PO.8]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

[PO.9]. 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

[PO.10]. 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

[PO.11]. 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.

[PO.12]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

[PSO.1]. To solve complex practical problems related to electrical & electronics engineering applications by applying and correlating the knowledge gained from mathematics, basic sciences and other fundamental courses.

[PSO.2]. To design, develop and analyse the prevalent domains of electrical systems for sustainable, reliable, environmental friendly and feasible solutions.

[PSO.3]. Develop, investigate and solve different models of electrical networks using modern engineering tools for variety of real time, industrial and research problems.

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	15
	Sessional Exam II (Closed Book)	15
	In class Quizzes and Assignments. Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. Syllabus

EE1764: OBJECT ORIENTED PROGRAMMING [3 0 0 3]

Introduction to fundamental concepts of programming language, Object Oriented Programming paradigm, Characteristics of object-oriented languages. Classes and Objects: Class specification, Class objects, Accessing Class Members, Static members, Constructors and Destructors, Parameterized constructors, Multiple Constructors, Friend function. Operator Overloading & Type conversion: Defining operator overloading, Overloading Unary and Binary operators, Overloading using friend function,

Type conversion: Basics to class type, class to basic type and class to another class type. Inheritance: Derived class and base class, Types of inheritance, Levels of Inheritance, Single inheritance, Multiple Inheritance, Hierarchical inheritance and Hybrid inheritance. Polymorphism: Virtual Functions: Pure function, Friend classes. Files and Exception Handling: Classes for file stream operation, Opening and closing a file, file modes, file pointers and manipulators. Exception handling mechanism: throwing, catching all the exceptions.

F. Text Books

T1. E. Balagurusamy, "*Object Oriented Programming with C++*", (6e), Tata McGraw-Hill Education Pvt. Ltd, New Delhi, 2013.
T2. R. Lafore, "*Object Oriented Programming in Turbo C++*", (3e), Galgotia Publications Pvt. Ltd., New Delhi, 2006
T3. S. B. Lippman, Josee Lajoie, Barbara E Moo, "*C++ Primer*",(5e), Addison-Wesley Professional, 2012
T4. H. Schildt, "*The Complete Reference C++*", (4e), TMH, New Delhi, 2004

G. Reference Books

R1. J. Rumbaugh et. al, "Object Oriented Modeling and Design", PHI, 2004

H. Lecture Plan:

Lec No	**Topics**	**Session Objective**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	Course overview, Introduction to programming language.	To acquaint and clear teacher's expectations and understand student expectations	Lecture		NA
2,3,4	Introduction to Structured programming, object-oriented programming, OOP features, C++ data types	To Understand basic data types of C++ and features of Object oriented programming.	Lecture	**[EE1764.1] [EE1764.2]**	In Class Quiz
5,6,7,8,9,10	Introduction to classes and objects, structures, unions , inline functions, parameter passing techniques, function overloading, friend functions & classes , constructors , destructors , static class members , nested classes , local classes	To understand the concept of class, function, friend function, function overloading, static class member , constructor and destructors.	Lecture	**[EE1764.1] [EE1764.5]**	In Class Quiz
11,12,13	**Dynamic memory management** New & delete operators , array objects , pointer objects , 'this' pointers , pointers to derived type and class members	To be capable of handling dynamic memory management in C++.	Lecture	**[EE1764.4]**	In Class Quiz
14,15,16,17	**Operator overloading** Overloading operators using member functions & friend functions , overloading arithmetic and relational and special operators	Able to understand and implement the operator overloading concept and techniques in C++.	Lecture	**[EE1764.2]**	Home Assignment
18,19,20,21	**Inheritance** Introduction , kinds of inheritance , forms of derivation, base and derived class pointers , constructors &destructors	Able to implement and design inheritance concept in C++.	Lecture	**[EE1764.1] [EE1764.2]**	Class Quiz
22,23,24	**Dynamic polymorphism** Need and mechanism of virtual functions , pure virtual functions , abstract classes ,early vs. late binding , virtual destructors , run time type identification.	Analyze and implement Dynamic polymorphism in C++.	Lecture, Activity	**[EE1764.3] [EE1764.4] [EE1764.2]**	Class Quiz

25,26,27	**Templates** Introduction ,function templates , class templates	Understand the concept of function template and class templates.	Lecture	**[EE1764.3]**	Class Quiz
28,29,30	**Stream handling** C++ stream class hierarchy , files ,file manipulations , file pointer manipulations , error handling	Able to do programming of stream handling and file manipulation.	Lecture	**[EE1764.3]** **[EE1764.5]**	Class Quiz
31,32,33	**Stream handling (continued)** Manipulators , overloading <<&>> operators	Able to do programming of stream handling and operator overloading.	Lecture	**[EE1764.3]** **[EE1764.5]**	Class Quiz
34,35,36	**Exception handling** Throwing out an exception , try block , catching an exception	Understanding Exception handling concept in C++.	Lecture	**[EE1764.3]** **[EE1764.5]**	Class Quiz

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
[EE1764.1]	Understand and use the basic programming constructs of C/C++.	3	2	2	2	1			1			1	1	2	1	2
[EE1764.2]	Manipulate various C/C++ datatypes, such as arrays, strings, and pointers.	3	2	1	3								2	2	1	1
[EE1764.3]	Isolate and fix common errors in C++ programs.	2	2	1	2				1				1	2	1	2
[EE1764.4]	Use memory appropriately, including proper allocation/deallocation procedures.	2	1	1	2	1			1				1	2	1	3
[EE1764.5]	Apply object-oriented approaches to software problems in C++ and hence foster employability skills.	3	2	2	3	1	1		2	1		1	2	2	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Electrical, Electronics and communication Engineering (SEEC)

Department of Electrical Engineering
Course Hand-out

Solar Photovoltaics Energy Conversion | EE 1792| 3 Credits | 3 0 0 3

Session: August 20 – Dec 20 | Faculty: Mahipal Bukya | Class: Open-Elective

A. INTRODUCTION: This course is offered by Dept. of Electrical Engineering as an open-Elective subject, targeting students who wish to pursue researchand development in solar photo-voltaicsystem or higher studies in field of solar energy including solar radiations, PN junction diode & its characteristics, solar cell, solar PV modules, balance of solar PV systems, etc. Students are expected to have background knowledge on semiconductors, charge carriers and their motion in semiconductors, p-type and n-type of semiconductors, etc. for a better learning.

B. COURSE OUTCOMES: At the end of the course, students will be able to

[1701.1]. To understand the basics of Solar Radiations, their measurement and tracking
[1701.2]. Comprehend the PN Junction Diode & Characteristics
[1701.3]. Interpret and explain the Solar Cell and its application in SPV System
[1701.4]. Understand and develop skills for Solar PV Modules
[1701.5]. Acquire knowledge about Balance of System (BOS) and Batteries

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

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E. SYLLABUS

Solar Radiation: Spectrum, Terminologies, Measurement, Estimation; Sun-Earth Movement & Angles, Sun Tracking, PN Junction Diode & Characteristics, Solar Cell, Photovoltage, Light Generated Current, I-V equation & Characteristics: Short Circuit Current, Open Circuit Voltage, Maximum Power Point, Fill Factor, Efficiency, Losses, Equivalent Circuit, Effect of Series & Shunt Resistance, Solar Radiation, Temperature on Efficiency, Solar PV Modules: Series & Parallel connection, Hotspots, Bypass & Blocking Diodes, Power Output, Ratings, I-V & Power Curve, Effect of Solar Irradiation & Temperature, Balance of System (BOS): Batteries: Classification, Capacity, Voltage, Depth of Discharge, Life Cycle, Factors affecting Battery Performance; Charge Controllers, DC to DC Converters, DC to AC converters, Maximum Power Point Tracking (MPPT).

F. TEXT BOOKS:

1. C. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Application, PHI New Delhi, 2009.
2. G. N. Tiwari, Solar Energy: Fundamentals, Design, Modeling and Applications, Narosa Publications New Delhi, 2013.

G. REFERENCE BOOKS

1. S. Deambi, Photovoltaic System Design, CRC Press USA, 2016.
2. F. Kreith and D. Y. Goswami, Energy Management and Conservation Handbook (2e), CRC Press USA, Fairmont Press, USA, 2017.
3. J. Balfour, M. Shaw and N. B. Nash, Advanced Photovoltaic Installations, Jones &Barlett Learning USA, 2013.
4. B.H. Khan, Non-conventional Energy Resources, TMH, 2006.
5. G.D. Rai, Non-conventional Energy Resources, Khanna Publishers.

H. LECTURE PLAN:

Lecture no.	Topic to be covered
L1	Introduction of course
L2	Introduction Non-renewable and Renewable Energy sources
L3	Solar Energy, applications, & advantages.
L4	Extra-terrestrial Solar radiation
L5	Solar spectrum at the earth surface
L6	Terminologies
L7	Sun-Earth Movement & Angles
L8	Angles of Sunrays on Solar collector
L9	Sun Tracking
L10	Estimation of solar radiation
L11	Measurement of solar radiation
L12	Numericals on Solar radiations
L13	Fundamentals of Semiconductors
L14	Energy bands
L15	Charge carriers, their concentration and distribution, motion,
L16	Electric field and Energy band bending, generation and recombination of carriers
L17	Introduction to P-N junction in equilibrium and non-equilibrium condition
L18	Numericals on PN Junction Diode & Characteristics
L19	Numericals on PN Junction Characteristics
L20	Photovoltage, Light Generated Current
L21	I-V equation and characteristics
L22	Short Circuit Current, Open Circuit Voltage
L23	Maximum Power Point, Fill Factor, Efficiency, Losses
L24	Equivalent Circuit of Solar cell
L25	Effect of Series & Shunt Resistance
L26	Solar Radiation, Temperature on Efficiency
L27	Numericals on Solar Cell
L28	Solar PV modules from Solar cells
L29	Series & Parallel connection
L30	Mismatch in Series connection: Hotspots, Bypass & Blocking Diodes
L31	Mismatch in Parallel connection
L32	Design and Structure of PV modules
L33	PV module Power Output, Ratings, I-V & Power Curve
L34	Effect of Solar Irradiation & Temperature
L35	Numericals on Solar PV Modules
L36	Introduction to Batteries
L37	Factors affecting battery performance
L38	Battery Parameters: Capacity, Voltage, Depth of Discharge, Life Cycle
L39	Batteries for PV systems, comparison
L40	DC to DC Converters
L41	Charge controllers
L42	DC to AC converters
L43	Maximum Power Point Tracking (MPPT)
L44	Numericals on Balance of Solar PV systems