RSET

RAJAGIRI SCHOOL OF
ENGINEERING & TECHNOLOGY

COURSE HANDOUT

Department of Electrical & Electronics Engineering

SEMESTER 5

Period: August 2018 –November 2018

RAJAGIRI SCHOOL OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Vision of the Institution:

To evolve into a premier technological and research institution, moulding eminent professionals with creative minds, innovative ideas and sound practical skill, and to shape a future where technology works for the enrichment of mankind.

Mission of the Institution:

To impart state-of-the-art knowledge to individuals in various technological disciplines and to inculcate in them a high degree of social consciousness and human values, thereby enabling them to face the challenges of life with courage and conviction.

Vision of the Department:

To excel in Electrical and Electronics Engineering education with focus on research to make professionals with creative minds, innovative ideas and practical skills for the betterment of mankind.

Mission of the Department:

To develop and disseminate among the individuals, the theoretical foundation, practical aspects in the field of Electrical and Electronics Engineering and inculcate a high degree of professional and social ethics for creating successful engineers.

Programme Educational Objectives (PEOs):

PEO 1: To provide Graduates with a solid foundation in mathematical, scientific and engineering fundamentals and depth and breadth studies in Electrical and Electronics engineering, so as to comprehend, analyse, design, provide solutions for practical issues in engineering.

PEO 2: To strive for Graduates' achievement and success in the profession or higher studies, which they may pursue.

PEO 3: To inculcate in Graduates professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, the life-long learning needs and an ability to relate engineering issues for a successful professional career.

Program Outcomes (POs)

Engineering Students will be able to

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, Engineering fundamentals, and Electrical and Electronics Engineering to the solution of complex Engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and Engineering sciences.
3. **Design/development of solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
6. **The Engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional Engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional Engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex Engineering activities with the Engineering Community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.
12. **Life -long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

Programme-Specific Outcomes (PSOs)

Engineering Students will be able to:

PSO1: Apply the knowledge of Power electronics and electric drives for the analysis design and application of innovative, dynamic and challenging industrial environment.

PSO2: Explore the technical knowledge and development of professional methodologies in grid interconnected systems for the implementation of micro grid technology in the area of distributed power system.

PSO3: Understand the technologies like Bio inspired algorithms in collaboration with control system tools for the professional development and gain sufficient competence to solve present problems in the area of intelligent machine control.

INDEX		PAGE NO.
I	**Assignment Schedule**	**i**
1	**EE 301 Power Generation, Transmission & Protection**	**1**
1.1	Course Information Sheet	2
1.2	Course Plan	10
1.3	Tutorials	14
1.4	Assignments	17
2	**EE 303 Linear Control Systems**	**18**
2.1	Course Information Sheet	19
2.2	Course Plan	24
2.3	Tutorials	27
2.4	Assignments	29
3	**EE 305 Power Electronics**	**30**
3.1	Course Information Sheet	31
3.2	Course Plan	36
3.3	Tutorials	39
3.4	Assignments	40
4	**EE 307 Signals & Systems**	**41**
4.1	Course Information Sheet	42
4.2	Course Plan	47
4.3	Tutorials	49
4.4	Assignments	51
5	**EE 309 Microcontroller & Embedded Systems**	**53**
5.1	Course Information Sheet	54
5.2	Course Plan	60
5.3	Tutorials	63
5.4	Assignments	66
6	**EE 367 New & Renewable Sources of Energy**	**67**
6.1	Course Information Sheet	68
6.2	Course Plan	74
6.3	Tutorials	76
6.4	Assignments	77
7	**EE 369 High Voltage Engineering**	**78**
7.1	Course Information Sheet	79
7.2	Course Plan	85
7.3	Assignments	88
8	**EE 331 Digital Circuits & Embedded Systems Lab**	**89**
8.1	Course Information Sheet	90
8.2	Course Plan	95
8.3	Lab Cycle	96
8.4	Open Questions	97
8.5	Advanced Questions	98
9	**EE 333 Electrical Machines II Lab**	**99**
9.1	Course Information Sheet	100
9.2	Course Plan	105
9.3	Lab Cycle	106
9.4	Open Questions	107

9.5	Advanced Questions	111
10	**EE 341 Design Project**	**112**
10.1	Course Information Sheet	113
10.2	Course Plan	117

ASSIGNMENT SCHEDULE

SUBJECT	DATE
EE 301 Power Generation, Transmission & Protection	Week1
	Week 7
EE 303 Linear Control Systems	Week 2
	Week 8
EE 305 Power Electronics	Week 3
	Week 9
EE 307 Signals & Systems	Week 4
	Week 10
EE 309 Microcontroller & Embedded Systems	Week 5
	Week 11
EE 367 New & Renewable Sources of Energy	Week 6
EE 369 High Voltage Engineering	Week 12

1. EE301 POWER GENERATION, TRANMISSION & PROTECTION

1.1 COURSE INFORMATION SHEET

PROGRAMME: **EEE**	DEGREE**: B.Tech**
COURSE: **POWER GENERATION, TRANSMISSION AND PROTECTION**	SEMESTER: **FIFTH** CREDITS: 4
COURSE CODE: **EE 301** REGULATION: UG	COURSE TYPE: CORE
COURSE AREA/DOMAIN: POWER SYSTEM	CONTACT HOURS: 3+1 (Tutorial) hours/Week.
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME:

SYLLABUS:

MODULE	DETAILS	HOURS
I	**Introduction: Typical layout of Power system Network** **Generation of Electric Power:** Overview of conventional (Hydro, Thermal and Nuclear) and Nonconventional Sources (Solar and Wind) (Block Diagram and Brief Description Only) Economics of Generation: Load factor, diversity factor, Load curve (Brief description only) Numerical Problems. Methods of power factor improvement using capacitors	9
II	**Power Transmission** **Transmission Line Parameters:** Resistance, inductance and capacitance of 1-Φ, 2 wire lines-composite conductors (Derivation Required). Inductance and capacitance of 3-Φ lines. Symmetrical and unsymmetrical spacing-transposition-double circuit lines-bundled conductors (Derivation Required) .Numerical Problems **Modelling of Transmission Lines**: Classification of lines-short lines-voltage regulation and efficiency-medium lines-nominal T and Π configurations-ABCD constants-long lines-rigorous solution-interpretation of long line equation-Ferranti effect. Tuned power lines-power flow through lines-Basics only	10

III	**Introduction of Overhead transmission and underground transmission** Conductors -types of conductors -copper, Aluminium and ACSR conductors -Volume of conductor required for various systems of transmission-Choice of transmission voltage, conductor size -Kelvin's law. Mechanical Characteristics of transmission lines –configuration-Types of Towers. Calculation of sag and tension-supports at equal and unequal heights -effect of wind and ice-sag template Insulators -Different types -Voltage distribution, grading and string efficiency of suspension insulators. Corona -disruptive critical voltage -visual critical voltage -power loss due to corona -Factors affecting corona -interference on communication lines.	9
IV	**Underground Cables** -types of cables -insulation resistance -voltage stress -grading of cables -capacitance of single core and 3 -core cables -current rating. **HVDC Transmission:** Comparison between AC &DC Transmission ,Power flow equations and control, Types of DC links **Flexible AC Transmission systems**: Need and Benefits, SCV, Configuration of FC + TCR, Series compensation, Configuration of TCSC	8
V	**Need for power system protection.** **Circuit breakers** –principle of operation-formation of arc-Arc quenching theory-Restriking Voltage-Recovery voltage, RRRV (Derivation Required). Interruption of Capacitive currents and current chopping (Brief Description Only). Types of Circuit Breakers: Air blast CB –Oil CB –SF6 CB –Vacuum CB –CB ratings. **Protective Relays-**Zones of Protection, Essential Qualities-Classification of Relays -Electro mechanical, Static Relays, Microprocessor Based Relay. Electromechanical Relays-Attracted Armature, Balanced Beam, Induction disc, Thermal Relays (Brief Description only) Static Relays-Merits and Demerits, Basic components, Comparison and duality of Amplitude and Phase comparators. Static overcurrent, Differential, Distance Relays, Directional Relay-(principle and Block diagram only) Microprocessor Based Relay-Block diagram and flow chart of Over current Relay, Numerical Relay(Basics Only)	12
VI	**Protection of alternator:** Stator inter turn, Earth fault Protection and Differential protection **Protection of transformers-**Percentage Differential Protection-	8

	Buchholz Relay **Protection of transmission lines-**Differential Protection-carrier current protection **Protection against over voltages** –Causes of over voltages-Surge diverters -Insulation co-ordination **Power distribution systems** –Radial and Ring Main Systems -DC and AC distribution: Types of distributors-bus bar arrangement -Concentrated and Uniform loading -Methods of solving distribution problems.	
	TOTAL HOURS	66

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
1	D.P.Kothari and I Nagrath "Power system Engineering", 2/e Tata McGraw Hills,2008
2	B.R. Gupta: "Power system Analysis and Design", Wheeler publishers
3	J.B. Gupta, "A course in Electrical Power", Kataria and sons, 2004
4	Wadhwa, "Electrical Power system", Wiley Eastern Ltd. 2005
5	Principles of power system: V.K Mehta , Rohit Mehta
6	FACTS controllers in power transmission and distribution : K.R Padiyar
7	Electrical power Distribution and Transmission: Luces M. Faulkenberry, Walter Coffer, Pearson Education
8	Stevenson Jr. Elements of Power System Analysis, TMH
9	Sunil S Rao ,"Switch gear and Protection",Khanna Publishers

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
	Introduction to Electrical Engineering	**Basics of Electrical Engineering**	**I**

COURSE OBJECTIVES:

1	To impart knowledge on the basic aspects in the area of power generation and power factor correction
2	To impart knowledge on various transmission line constants (Resistance, Inductance and capacitance) and to do the performance analysis of transmission lines.
3	To be able to do the mechanical designing of overhead lines and underground cables
4	To impart the knowledge on HVDC transmission ,FACTS devices and power distribution systems
5	To develop an understanding of various protection schemes used in power systems.

COURSE OUTCOMES:

Sl.NO	DESCRIPTION	BLOOM'S TAXONOMY LEVEL
1	Students will be able to acquire knowledge about the basic aspects in the area of power generation and power factor correction	Comprehension [level 2]
2	Students will be able to **learn** about various transmission line constants (Resistance, Inductance and capacitance).	Comprehension [level 2]
3	Students will be able to do the performance analysis of transmission lines	Evaluation[level 6]
4	Students will be able to **perform** the mechanical designing of overhead lines and underground cables	Evaluation[level 6]
5	Students will be able to **write** about the HVDC transmission and FACTS controllers.	Analyze [level 4]
6	Students will be able to **list** various circuit breakers and relays used in power system	Knowledge [Level 1]
7	Students will be able to **summarize** the protection schemes for generator, transformer, motor, feeder and transmission lines	Synthesis[Level 5]

MAPPING COURSE OUTCOMES (COs) – PROGRAM OUTCOMES (POs) AND COURSE OUTCOMES (COs) – PROGRAM SPECIFIC OUTCOMES (PSOs)

	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
C301.1	3	3	2		3				2		2			3	
C301. 2	3	3	2		3				2		3			3	
C301. 3	3	2	2		2				2		2			3	
C301. 4	3	1	3		3				3	3	2			3	
C301. 5	3	2	3	2	1		2		1		1	3		3	
C301. 6	3	3	3		2		1		2	3		1		3	
C301. 7	3	1	1	3			2			3		2		3	
EE 301	3	2	2	1	2		1		2	2	2	1		3	

JUSTIFATIONS FOR CO-PO MAPPING:

Mapping	L/H/M	Justification
C301.1-PO1	H	Students will be able to acquire knowledge about the basic aspects in the area of power generation and power factor correction
C301.1-	H	Student will be able to explain about various transmission line

PO2		constants
C301.1-PO3	H	Student will be able to design transmission line (both electrical and mechanical)
C301.1-PO4	M	Students will be able to design underground cables and locate faults correctly
C301.1-PO5	H	Students will demonstrate an ability to identify, formulate and solve transmission line losses
C301.1-PO9	M	Students will be able to acquire new knowledge in the power system design and testing
C301.1-PO11	L	Student will be able to use the skills in modern Electrical engineering tools like SIMULINK to know the operational principles of FACTS devices and controllers
C301.2-PO1	H	Students will be able to apply the knowledge of mathematics, and engineering Fundamentals for solving power system fault analysis
C301.2-PO2	H	Student will be able to anlayse and conduct experiments on power system models
C301.2-PO3	M	Students will be able to design power system to meet power quality, reliability and safety
C301.2-PO5	H	Students will demonstrate an ability to identify, formulate and solve Electrical and Electronics Engineering problems using the power system techniques
C301.2-PO9	M	Students will be able to suggest improvements in the power transmission system for increasing its efficiecy leading to life long learning
C301.2-PO11	H	Students can evaluate the performance of the various transmission network models using modern simulation tools
C301.3-PO1	H	Students will be able to apply the mathematics and engineering fundamentals for analyzing the merits and demerits of power transmission networks .
C301.3-PO2	H	Students will be able to design FACTS devices for compensation.
C301.3-PO3	H	Students will demonstrate an ability to identify different methods to improve the transmission efficiency .
C301.3-PO5	M	Students will demonstrate an ability to identify, formulate and solve Electrical and Electronics Engineering problems using

		FACTS techniques
C301.3-PO9	H	Students will be able to suggest improvements in power factor to life long learming
C301.3-PO11	M	Students can evaluate the performance of the various models using modern simulation tools
C301.4-PO1	H	Students will be able to apply the mathimatics and engineering fundamentals for designing HVDC circuits.
C301.4-PO3	H	Students will demonstrate an ability to identify different methods to improve the demerits of power sytem
C301.4-PO9	H	Students will demonstrate an ability to identify, Electrical and Electronics Engineering problems
C301.5-PO1	H	Students will be able to apply the knowledge of mathematics, and engineering Fundamentals for understanding designing of transmission lines.
C301.5-PO2	M	Student will be able to anlayse and conduct experiments on line insulators
C301.5-PO3	M	Students will be able to design transmission to meet safety, economic and societal considerations
C301.5-PO5	H	Students will demonstrate an ability to identify, formulate and solve Electrical and Electronics Engineering problems for the HVDC system
C301.5-PO9	M	Students will be able to suggest improvements in the circuit for increasing it efficiecy leading to life long learming
C301.5-PO11	M	Students can evaluate the performance of the circuits using modern simulation tools
C301.6-PO1	H	Students will be able apply the knowledge science & electrical engineering for the installation of circuit breakers
C301.6-PO2	H	Students will be able to identify and provide solutions to complex problems associated with circuit breakers
C301.6-PO3	H	Students will be able to design circuit breakers considering the safety of the society
C301.6-PO5	M	Students will be able to identify and formulate problems in the area of power system protection
C301.6-PO7	L	Students can create models of various protection schemes and predict its performance
C301.6-	M	Students will be able to manage projects linked with power system

PO9		protection
C301.6-PO11	H	Students will be able to give an effective presentation on static relays
C301.6-PO12	L	Students will be able to manage projects linked with power system protection using static relays
C301.7-PO1	H	Students can design a system for the protection of generators
C301.7-PO2	L	Students can conduct suitable experiments and synthesize a protection scheme for motors and transformers
C301.7-PO3	L	Students can provide sustainable solutions for protection of electrical machines considering its impacts on the environment
C301.7-PO4	H	Students will be able to design lightning arresters considering the safety of the society
C301.7-PO7	M	Students will be able to apply the knowledge of overvoltages to assess the societal health and safety issues
C301.7-PO12	M	Student will get an initiation to study different power system protection schemes

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS
1	Power circle diagram not included	NPTEL
2	Simulation of various applications using FACTs devices	MATLAB Tool

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

1	Modeling of FACTS devices
2	Application of various compensation techniques in power system

WEB SOURCE REFERENCES:

1	www.nptel.iitm.ac.in
2	http://ocw.mit.edu/index.htm

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☐☑CHALK & TALK	☐☑ STUD. ASSIGNMENT	☐☑WEB RESOURCES	
☐☑ LCD/SMART BOARDS	☐☑STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

☐☑ASSIGNMENTS	☐☑ STUD. SEMINARS	☐☑TESTS/MODEL EXAMS	☐☑UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	. STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☑ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☐☑STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by
PRATHIBHA P.K.

Approved by
Dr.P.C. Unnikrishnan
(HOD)

1.2 COURSE PLAN

Sl.No	Module	Planned Date	Planned
1	1	Lecture 1	Introduction to electrical power generation, transmission and protection
2	1	Lecture 2	Introduction to electrical power generation, transmission and protection
3	1	Lecture 3	Overview of Hydro and Thermal power plant with block diagram
4	1	Lecture 4	Overview of Nuclear power plant
5	1	Lecture 5	Solar and Wind- Non- conventional sources
6	1	Lecture 6	Maximum Demand -Demand Factor, Diversity Factor and load factor
7	1	Lecture 7	Load Curve and numerical problems
8	1	Lecture 8	Methods of power factor improvement using capacitors
9	2	Lecture 9	Introduction class of Constants of transmission line
10	2	Lecture 10	Resistance, Skin effect and Proximity effect
11	2	Lecture 11	Flux linkages due to internal flux,Flux linkages due to external flux
12	2	Lecture 12	Flux linkages in a group of parallel current carrying conductors Inductance of a single phase two wire line - Derivation
13	2	Lecture 13	Inductance of three phase overhead line- Symmetrical spacing
14	2	Lecture 14	Inductance of a three phase overhead line- Unsymmetrical spacing, Transposition Concept of Self and Mutual GMD
15	2	Lecture 15	solving Problems of Symmetrical and unsymmetrical spacing

16	2	Lecture 16	Capacitance, potential at a charged single conductor Potential at a conductor in a group of conductors
18	2	Lecture 17	Capacitance of a single phase two wire line Capacitance of a three phase line with symmetrical and unsymmetrical spacing
19	2	Lecture 18	Tutorials on Capacitance of line with symmetrical and unsymmetrical spacing
20	2	Lecture 19	Introduction-Classification of transmission line
21	2	Lecture 20	Analysis of single phase and three phase short line
22	2	Lecture 21	Medium lines- Nominal T and Pi method Solving problems of short and medium lines
23	2	Lecture 22	Rigorous solution of long transmission line - interpretation of long line equation ABCD constants of TL
24	2	Lecture 23	Ferranti effect-tuned power lines-power flow through lines
25	3	Lecture 24	Conductors -types of conductors -Volume of conductor required for various systems of transmission
26	3	Lecture 25	Choice of transmission voltage, conductor size -Kelvin's law
27	3	Lecture 26	Mechanical Characteristics of transmission lines – configuration-Types of Towers.
28	3	Lecture 27	Calculation of sag and tension- supports at equal and unequal heights -effect of wind and ice- sag template
29	3	Lecture 28	Insulators -Different types -Voltage distribution, grading and string efficiency of suspension insulators
30	3	Lecture 29	Corona -disruptive critical voltage -visual critical voltage - power loss due to corona -Factors affecting corona - interference on communication lines.
31	3	Lecture 30	Underground Cables -types of cables -insulation resistance - voltage stress -grading of cables
32	3	Lecture 31	Capacitance of single core and 3 -core cables -current rating.

33	4	Lecture 32	HVDC Transmission: Comparison between AC &DC Transmission ,Power flow equations and control
34	4	Lecture 33	Types of DC links -Flexible AC Transmission systems: Need and Benefits
35	4	Lecture 34	SVC, Configuration of FC + TCR, Series compensation, Configuration of TCSC
36	4	Lecture 35	Power distribution systems –Radial and Ring Main Systems - DC and AC distribution:
37	4	Lecture 36	Types of distributors- bus bar arrangement -Concentrated and Uniform loading
38	4	Lecture 37	Methods of solving distribution problems
39	5	Lecture 38	Circuit breakers – principle of operation- formation of arc-Arc quenching theory
40	5	Lecture 39	Restriking Voltage-Recovery voltage, RRRV, Interruption of Capacitive currents and current chopping
41	5	Lecture 40	Air blast CB – Oil CB – SF6 CB Vacuum CB – CB ratings.
42	5	Lecture 41	Protective Relays- Zones of Protection, Essential Qualities-Classification of Relays -Electro mechanical, Static Relays, Microprocessor Based Relay.
43	5	Lecture 42	Electro mechanical Relays-Attracted Armature, Balanced Beam, Induction disc, Thermal Relays
44	5	Lecture 43	Static Relays-Merits and Demerits, Basic components, Comparison and duality of Amplitude and Phase comparators.
45	5	Lecture 44	Static over current, Differential, Distance Relays, Directional Relay
46	5	Lecture 45	Microprocessor Based Relay-Block diagram and flow chart of Over current Relay, Numerical Relay
47	6	Lecture 46	Protection of alternator: Stator inter turn, Earth fault Protection and Differential protection

48	6	Lecture 47	Protection of transformers- Percentage Differential Protection-Buchholz Relay
49	6	Lecture 48	Protection of transmission lines-Differential Protection-carrier current protection
50	6	Lecture 49	Causes of over voltages – surges and traveling waves
51	6	Lecture 50	Protection against over voltages
52	6	Lecture 51	Surge diverters
53	6	Lecture 52	Insulation co-ordination
54	6	Lecture 53	Module I and II revision
55	6	Lecture 54	Module III and IV revision
56	6	Lecture 55	Module V and VI revision

1.3 TUTORIALS

1. Calculate the capacitance of a 100km long 3-phase, 50Hz overhead line consisting of three conductors, each of diameter 2cm and spaced 2.5m at the corners of an equilateral triangle.
2. Two conductors of a single phase line, each of 1cm diameter are arranged in a vertical plane with one conductor mounted 1m above the other. A second identical line is mounted at the same height as the first and spaced horizontally 0.25m apart from it. The two upper and the two lower are connected in parallel. Determine the inductance per km of the resulting double circuit line.
3. Determine the efficiency and regulation of a 3phase, 100 Km, 50 Hz transmission line delivering 20 MW at a power factor of 0.8 lagging and 66 kV to a balanced load. The conductors are of copper, each having resistance 0.1 Ω / Km, 1.5 cm outside dia, spaced equilaterally 2 meters between centres. Use nominal T method.
4. A three phase 5 km long transmission line, having resistance of 0.5 Ω / km and inductance of 1.76 mH / km is delivering power at 0.8 pf lagging. The receiving end voltage is 32kV. If the supply end voltage
5. is 33 kV, 50 Hz, find line current, regulation and efficiency of the transmission line.
6. In a 3-unit insulator, the joint to tower capacitance is 20 % of the capacitance of each unit. By how much should the capacitance of the lowest unit be increased to get a string efficiency of 90 %. The remaining two units are left unchanged.
7. A single core 66 kV cable working on 3-phase system has a conductor diameter of 2cm and sheath of inside diameter 5.3 cm. If two inner sheaths are introduced in such a way that the stress varies between the same maximum and minimum in the three layers find: a) position of inner sheaths b) voltage on the linear sheaths c) maximum and minimum stress.
8. A 3 phase overhead transmission line is being supported by three disc insulators. The potential across top unit (i.e. near the tower) and the middle

unit are 8 kV and 11 kV respectively. Calculate, a) The ratio of capacitance between pin and earth to the self capacitance of each unit b) Line Voltage c) String Efficiency

9. A conductor of 1cm diameter passes centrally through porcelain cylinder of internal diameter 2 cms and external diameter 7cms. The cylinder is surrounded by a tightly fitting metal sheath. The permittivity of porcelain is 5 and the peak voltage gradient in air must not exceed 34 kV / cm. Determine the maximum safe working voltage.
10. Calculate the most economical diameter of a single core cable to be used on 132 kV, 3 phase system. Find also the overall diameter of the insulation, if the peak permissible stress does not exceed 60 kV / cm. also derive the formula used here.
11. A string of 4 insulator units has a self capacitance equal to 4 times the pin to earth capacitance. Calculate a) Voltage distribution as a % of total voltage b) String efficiency
12. With a neat diagram, explain the strain and stay insulators. A cable is graded with three dielectrics of permittivity 4, 3 and 2. The maximum permissible potential gradient for all dielectrics is same and equal to 30 kV/cm. The core diameter is 1.5cm and sheath diameter is 5.5 cm. Determine the working voltage.
13. The towers of height 30m and 90m respectively support a transmission line conductor at water crossing. The horizontal distance between the towers is 500m. If the tension in the conductor is 1600kg, find the minimum clearance of the conductor and water and clearance mid-way between the supports. Weight of conductor is 1.5 kg/m. Bases of the towers can be considered to be at water level.
14. An overhead line has a span of 336m. The line is supported at a water crossing from two towers whose heights are 33.6m and 29m above water level. The weight of conductor is 8.33N/m and tension in the conductor is not to exceed $3.34*10^4$N.Find 1) Clearance between lowest point on conductor and water 2) Horizontal distance of this point from lower support.

15. A three phase, 220kV, 50 Hz transmission line consists of 1.5cm radius conductor spaced 2 meters apart in equilateral triangular formation. If the temperature is 40^0C and atmospheric pressure is 76cm, calculate the corona loss per km of the line. Take $m_o = 0.85$

1.4 ASSIGNMENTS

ASSIGNMENT 1

1. Derive the inductance of composite and bundled conductors.
2. Derive the capacitance of composite and bundled conductors.

Submission date : 3rd September 2018

ASSIGNMENT 2

1. Derive the dielectric stress and insulation resistance of single core cable.
2. Derive the capacitance of single core and three core cable

Submission date : 29th October 2018

2. EE303 LINEAR CONTROL SYSTEMS

2.1 COURSE INFORMATION SHEET

PROGRAMME: **EEE**	DEGREE: **BTECH**
COURSE: **Linear Control Systems**	SEMESTER: **5** CREDITS:**3**
COURSE CODE: **EE 303** REGULATION: **UG**	COURSE TYPE: **Core**
COURSE AREA/DOMAIN: **Control Systems**	CONTACT HOURS: **2+1 (Tutorial) hours/Week.**
CORRESPONDING LAB COURSE CODE (IF ANY): **No**	LAB COURSE NAME: **Nil**

SYLLABUS:

Module	***Contents***	***Hours***	***Sem. Exam Marks***
I	Open loop-and closed loop control systems: Transfer function of LTI systems-Mechanical and Electromechanical systems – Force voltage and force current analogy - block diagram representation - block diagram reduction - signal flow graph - Mason's gain formula - characteristic equation.	8	15%
II	Control system components: DC and AC servo motors – synchro - gyroscope - stepper motor - Tacho generator. Time domain analysis of control systems: Transient and steady state responses - time domain specifications - first and second order systems - step responses of first and second order systems.	6	15%
FIRST INTERNAL EXAMINATION			
III	Error analysis - steady state error analysis - static error coefficient of type 0,1, 2 systems - Dynamic error coefficients. Concept of stability: Time response for various pole locations - stability of feedback system - Routh's stability criterion	7	15%
IV	Root locus - General rules for constructing Root loci – stability from root loci - effect of addition of poles and zeros.	7	15%
SECOND INTERNAL EXAMINATION			
V	Frequency domain analysis: Frequency domain specifications-Analysis based on Bode plot - Log magnitude vs. phase plot,	7	20%
VI	Polar plot- Nyquist stability criterion-Nichols chart - Non-minimum phase system - transportation lag.	7	20%

TEXT/REFERENCE BOOKS:

T/R	*BOOK TITLE/AUTHORS/PUBLICATION*
T	Dorf R. C. and R. H. Bishop, Modern Control Systems, Pearson Education, 2011.
T	Nagarath I. J. and Gopal M., Control System Engineering, Wiley Eastern, 2008.
T	Nise N. S., Control Systems Engineering, 6/e, Wiley Eastern, 2010.
T	Ogata K., Modern Control Engineering, Prentice Hall of India, New Delhi, 2010.
R	Gopal M., Control Systems Principles and Design, Tata McGraw Hill, 2008
R	Gibson J. E., F. B. Tuteur and J. R. Ragazzini, Control System Components, Tata McGraw Hill, 2013
R	Imthias Ahamed T P, Control Systems, Phasor Books, 2016
R	Kuo B. C., Automatic Control Systems, Prentice Hall of India, New Delhi, 2002.

COURSE PRE-REQUISITES:

C.CODE	*COURSE NAME*	*DESCRIPTION*	*SEM*
MA 202	Probability distributions, Transforms and Numerical Methods	A basic understanding about the various Mathematical Transformation techniques (Laplace Transform)	3

COURSE OBJECTIVES:

1	To provide a strong foundation on the analytical and design techniques on classical control theory and modelling of dynamic systems

COURSE OUTCOMES:

Sl No	*Description*	*Blooms' Taxonomy Level*
1	Students will be able to **explain** the various practices of modelling physical systems.	Application [Level 3]
2	Students will be able to **differentiate** between various control system components and will be able to **explain** the time domain specifications.	Analysis [Level 4]
3	Students will be able to develop basic **knowledge** in error and stability analysis	Knowledge [Level 1]
4	Students will be able to **compare** and analyse the stability of the systems - thereby having a more	Analysis [Level 4]

	realistic approach towards the design of Control systems	
5	Students will be able to **classify** and understand the various frequency domain analysis technique in control systems.	Comprehension [Level 2]

MAPPING COURSE OUTCOMES (COs) – PROGRAM OUTCOMES (POs) AND COURSE OUTCOMES (COs) – PROGRAM SPECIFIC OUTCOMES (PSOs):

	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
C303.1	1		3		2		2			2			1	3	
C303.2			1	2		2								2	
C303.3		2	1		2		3			2				3	
C303.4				2		3				2		2		2	
C303.5		3			2			1						3	
EE 303	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**		**2**		**2**		**3**	

JUSTIFATIONS FOR CO-PO MAPPING:

Mapping	L/H/M	Justification
C303.1-PO1	L	Students will be able to explain the fundamentals of control system classifications.
C303.1-PO3	H	Students will be able to develop models of physical systems to meet specific needs of society.
C303.1-PO5	M	Students will be able to use modern tools to model control systems to better understand its usage and limitations.
C303.1-PO7	M	Students will be able to understand the importance of control systems for sustainable development.
C303.1-P10	M	Students will be able to communicate effectively on complex control system strategies after its design using presentations with public.
C303.2-PO3	L	Students will be able to design systems, using various control system components as actuators to meet the needs of the end user
C303.2-PO4	M	Students will be able to analyze and interpret control signal data in

		time domain.
C303.2-PO6	M	Student will be able to apply the knowledge in the area of control systems for the solution of various societal issues
C303.3-PO2	M	Students will be able to analyse errors persisting in the area of electrical engineering in an control systems point of view.
C303.3-PO3	L	Students will be able to develop rugged systems to meet the specific societal needs, by incooperating error & stability analysis.
C303.3-PO5	M	Students will be able to apply modern tools to predict and analyse the error and stability of systems.
C303.3-PO7	H	Students will be able to demonstrate the need for stability analysis of systems for sustainable development
C303.3-PO10	M	Students will be able to communicate effectievly with public the need for stability and error analysis for societal developments.
C303.4-PO4	M	Students will be able to analyse and interpret data in the area of design of control ststems.
C303.4-PO6	H	Students will be able to apply the knowledge of stability analysis and design of systems for the betterment of society.
C303.4-P10	M	Students will be able to communicate effectievly with public the importance of realistic approach towards the design of Control systems
C303.4-P12	M	Students will be able to learn continoulsy from the fast changing and modern design aspects of control engineering.
C303.5-PO2	H	Studnets will be able to identify the various types of frequency domain analysis techniques for systems.
C303.5-PO5	M	Students will be able to use the modern tools and techniques for frequency domain analysis of systems.
C303.5-PO8	L	Students will be able to understand principles in the area of control system.

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SI No.	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Implementation of Matlab Modeling of control systems	Implemented using MATLAB 15	1,2,3,5,6	1,2

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SI No.	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Introduction to Matlab Modeling	Additional Class	1,2,3,5,6	1, 2

WEB SOURCE REFERENCES:

1	(2018) Matlab Website [Online] Available: http://www.matlab.com

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☑ CHALK & TALK	☐ STUD. ASSIGNMENT	☐ WEB RESOURCES	
☑ LCD/SMART BOARDS	☐ STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

☑ ASSIGNMENTS	☐ STUD. SEMINARS	☑ TESTS/MODEL EXAMS	☑ UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☐ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☑ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by
Dr Elizabeth Rita Samuel

Approved by
Dr P. C. Unnikrishnan
(HOD)

2.2 COURSE PLAN

Sl.No	Module	Planned Date	Planned
1	1	3-Aug-2018	Introduction to Linear Control System
2	1	7-Aug-2018	Open loop-and closed loop control systems
3	1	8-Aug-2018	Classification of Systems
4	1	9-Aug-2018	Transfer function of LTI systems
5	1	10-Aug-2018	Transfer function of Electrical System
6	1	14-Aug-2018	Transfer function of Electrical System
7	1	16-Aug-2018	Transfer function of Mechanical System
8	1	17-Aug-2018	Transfer function of Mechanical System
9	1	21-Aug-2018	Transfer function of Electro - Mechanical System
10	1	22-Aug-2018	Transfer function of Electro - Mechanical System
11	1	23-Aug-2018	Block diagram representation - block diagram reduction
12	1	24-Aug-2018	Block diagram representation - block diagram reduction
13	1	28-Aug-2018	signal flow graph - Mason's gain formula
14	1	29-Aug-2018	signal flow graph - Mason's gain formula
15	1	30-Aug-2018	Tutorials
16	2	11-Sep-2018	Control system components
17	2	13-Sep-2018	DC and AC servo motors
18	2	14-Sep-2018	synchro
19	2	15-Sep-2018	gyroscope -
20	2	18-Sep-2018	stepper motor - Tacho generator
21	2	25-Sep-2018	Time domain analysis of control systems: Transient and steady state responses
22	2	26-Sep-2018	Time domain specifications - first and second order systems
23	2	27-Sep-2018	Time domain specifications - first and second order systems
24	2	28-Sep-2018	Step responses of first and second order systems.

25	2	29-Sep-2018	Tutorials
26	3	3-Oct-2018	Error analysis - steady state error analysis
27	3	4-Oct-2018	Error analysis - steady state error analysis
28	3	5-Oct-2018	static error coefficient of type 0,1, 2 systems
29	3	9-Oct-2018	static error coefficient of type 0,1, 2 systems
30	3	10-Oct-2018	Dynamic error coefficients.
31	3	11-Oct-2018	Concept of stability: Time response for various pole locations
32	3	12-Oct-2018	stability of feedback system - Routh's stability criterion
33	3	16-Oct-2018	stability of feedback system - Routh's stability criterion
34	4	17-Oct-2018	Root locus - General rules for constructing Root loci
35	4	18-Oct-2018	stability from root loci
36	4	19-Oct-2018	Root Loci
37	4	23-Oct-2018	effect of addition of poles and zeros.
38	4	24-Oct-2018	Root Loci
39	5	25-Oct-2018	Frequency domain analysis
40	5	26-Oct-2018	Frequency domain specifications
41	5	26-Oct-2018	Frequency domain specifications
42	5	30-Oct-2018	Analysis based on Bode plot - Log magnitude vs. phase plot.
43	5	31-Oct-2018	Analysis based on Bode plot - Log magnitude vs. phase plot.
44	5	1-Nov-2018	Analysis based on Bode plot - Log magnitude vs. phase plot.
45	5	2-Nov-2018	Analysis based on Bode plot - Log magnitude vs. phase plot.
46	6	6-Nov-2018	Polar plot-
47	6	7-Nov-2018	Polar plot-
48	6	8-Nov-2018	Polar plot-
49	6	9-Nov-2018	Nyquist stability criterion
50	6	13-Nov-2018	Nyquist stability criterion

51	6	14-Nov-2018	Nichols chart
52	6	15-Nov-2018	Non-minimum phase system - transportation lag
53	6	16-Nov-2018	Non-minimum phase system - transportation lag
54	6	20-Nov-2018	Non-minimum phase system - transportation lag

2.3 TUTORIALS

1. A unity feedback control system has a forward gain

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

Find Kp, Kv and Ka, and steady state error for input

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

2. Determine the step, ramp and parabolic error coefficients for unity feedback system that has the forward transfer function.

$$G(s) = \frac{64(s+4)}{s(s^2+4s+8)}$$

3. Plot the complete root loci for the following open loop transfer function. Show the break-in and break-away points, centroid and jw-cross-over points:

$$G(s) = \frac{k(0.5+5)}{s(1+s)(2+s)}$$

4. The open loop transfer function of a unity feedback system is

$$G(s) = \frac{k}{s(s+3)(s^2+s+1)}$$

Determine the values of k that will have sustained oscillation in the closed loop system. What is the oscillation frequency?

5. Using Routh Criterion, determine the stability of the system represented by the following characteristic equations. Comment on the location of the roots of the characteristic equation.

$s^4+8s^3+18s^2+16s+5=0$

$9s^5+20s^4+10s^3+s^2+9s+10=0$

6. The OLTF of a system is given by,

$$G(s)H(s) = \frac{1}{s(s+\frac{1}{2})(s+1)}$$

Find phase crossover frequency, gain crossover frequency, gain margin and phase margin

7. By Nyquist stability criterion, determine the stability of the open loop and closed loop system whose OLTF is

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

8. Draw the Bode plot for the system and obtain the gain margin and phase margin of the system with open loop transfer function

$$G(s) = \frac{10(s+8)}{s(s+3)(s+7)}$$

2.4 ASSIGNMENTS

ASSIGNMENT 1

Prepare short Notes on the following topic

1. AC & DC Servo Motor
2. Synchro
3. Stepper Motor
4. Gyro
5. Tacho generator

Hint:

a) Each topic to be explained for - 6 Marks
b) Figure
c) Working Principle
d) Equations etc… to be included.

Submission date : 30th August 2018 - Time 10:30AM

ASSIGNMENT 2

1. Draw the root locus for given closed loop systems

    1. $G(s) = k/ s(s^2+4s +13)$
    2. $G(s) = k/ s(s+2)(s+4)$
    3. $G(s) = k/ s(s+6)(s^2+4s +13)$

Hint

a) Each Question carries - 12 Marks
b) Figure should be drawn in Normal graph paper
c) Each step should be included for drawing root locus
d) Equations etc… to be included.

Submission date : 30th October 2018 - Time 10:30AM

3. EE305 POWER ELECTRONICS

3.1 COURSE INFORMATION SHEET

PROGRAMME: **Electrical & Electronics Engineering**	DEGREE: **B.TECH**
COURSE: **Power Electronics**	SEMESTER**: V** CREDITS: **3**
COURSE CODE: **EE 305** REGULATION: **UG**	COURSE TYPE: **CORE**
COURSE AREA/DOMAIN: **Power Electronics**	CONTACT HOURS: **3+1 (Tutorial) hours/Week.**
CORRESPONDING LAB COURSE CODE (IF ANY): **Nil**	LAB COURSE NAME: **Nil**

SYLLABUS:

UNIT	DETAILS	HOURS
I	SCR-Structure, static characteristics & switching (turn-on & turnoff) characteristics - di/dt & dv/dt protection – turn-on methods of SCR - two transistor analogy - series and parallel connection of SCRs Structure and principle of operation of power diode, TRIAC, GTO, Power MOSFET & IGBT – Comparison	6
II	Gate triggering circuits – R, RC, UJT triggering circuits – natural and forced commutation (concept only). Requirements of isolation and synchronisation in gate drive circuits- Opto and pulse transformer based isolation. Controlled rectifiers – half-wave controlled rectifier with R load – 1-phase fully controlled bridge rectifier with R, RL and RLE loads (continuous & discontinuous conduction) – output voltage equation – 1-phase half controlled bridge rectifier with R, RL and RLE loads – displacement power factor – distortion factor.	8
III	3-phase half-wave controlled rectifier with R load – 3-phase fully controlled & half-controlled converter with RLE load (continuous conduction, ripple free) – output voltage equation-waveforms for various triggering angles (no analysis) – 1-phase & 3-phase dual converter with & without circulating current – four-quadrant operation	7
IV	Inverters – voltage source inverters– 1-phase half-bridge & full bridge inverter with R & RL loads – THD in output voltage – 3phase bridge inverter with R load – 120° & 180° conduction mode – current source inverters.	7
V	Voltage control in inverters – Pulse Width Modulation – single pulse width, multiple pulse width & sine PWM – modulation index & frequency modulation ratio. AC voltage controllers (ACVC) – 1-phase full-wave ACVC with R, & RL loads – waveforms – RMS output voltage, input power factor with R load – sequence control (two	7

	stage) with R load	
VI	DC-DC converters – step down and step up choppers – single quadrant, two-quadrant & four quadrant chopper – pulse width modulation & current limit control in dc-dc converters. Switching regulators – buck, boost & buck-boost - continuous conduction mode only – waveforms – design of filter inductance & capacitance	7
	TOTAL HOURS	42

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	Muhammad H. Rashid, Power Electronics Circuits, Devices and Applications, Pearson Education
R	1. Mohan N., T. M. Undeland and W. P. Robbins., Power Electronics, Converters, Applications & Design, Wiley-India
R	2. Krein P. T., Elements of Power Electronics, Oxford University Press, 1998.
R	3. P.S. Bimbhra, Power Electronics, Khanna Publishers, New Delhi
R	4. L. Umanand, Power Electronics – Essentials & Applications, Wiley-India
R	5. Singh M. D. and K. B. Khanchandani, Power Electronics, Tata McGraw Hill, New Delhi, 2008.

COURSE PRE-REQUISITES:

NIL

COURSE OBJECTIVES:

1	To get an overview of different types of power semiconductor devices and their switching characteristics
2	To study the operation and characteristics of various types of power electronic converters

COURSE OUTCOMES:

SNO	DESCRIPTION	BLOOMS' TAXONOMY LEVEL
1	Choose appropriate power semiconductor device in converter circuits and develop their triggering circuits.	Knowledge[Level 1], Analysis[Level 4], Application[Level 3]
2	Analyze various types of power electronic converters and apply different switching techniques	Knowledge[Level 1], Analysis[Level 4], Application[Level 3]

3	Select appropriate power converter for specific applications	Knowledge[Level 1], Analysis[Level 4], Application[Level 3]
4	Interpret and use datasheets of power semiconductor devices for design.	Knowledge[Level 1], Analysis[Level 4], Application[Level 3]

MAPPING COURSE OUTCOMES (COs) – PROGRAM OUTCOMES (POs) AND COURSE OUTCOMES (COs) – PROGRAM SPECIFIC OUTCOMES (PSOs)

	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
C 305.1	3	2	2	1									2		
C 305. 2	3	2	2	1									2		
C 305. 3	3	2	2	1	1								2		
C 305. 4	3	2	2	1									2		
EE 305	3	2	2	1		-	-	-	-	-	-	-	2		

JUSTIFICATIONS FOR CO-PO MAPPING

Mapping	L/H/M	Justification
C305.1-PO1	H	Students will have a general idea of various types of measuring instruments
C305.1-PO2	M	Students will be able to select the apt instrument based on the application requirements
C305.1-PO3	M	Students will be able to select the apt instrument based on the application requirements
C305.1-PO4	L	Research papers to supplement knowlwdge
C305.2-PO1	H	Students will have a general idea of various types of measuring instruments
C305.2-PO2	M	Students will be able to select the apt instrument based on the application requirements
C305.2-PO3	M	Students will be able to select the apt instrument based on the application requirements
C305.2-PO4	L	Research papers to supplement knowlwdge

C305.3-PO1	H	Students will have a general idea of various types of measuring instruments
C305.3-PO2	M	Students will be able to select the apt instrument based on the application requirements
C305.3-PO3	M	Students will be able to select the apt instrument based on the application requirements
C305.3-PO4	L	Research papers to supplement knowlwdge
C305.3-PO5	L	Appropriate IT tools like MATLAB can be used to analyse circuits
C305.4-PO1	H	Students will have a general idea of various types of measuring instruments
C305.4-PO2	M	Students will be able to select the apt instrument based on the application requirements
C305.4-PO3	M	Students will be able to select the apt instrument based on the application requirements
C305.4-PO4	M	IDAC Lab provides an industrial environment
C305.1-PSO1	M	IDAC Lab provides an industrial environment
C305.2-PSO1	M	IDAC Lab provides an industrial environment
C305.3-PSO1	M	IDAC Lab provides an industrial environment
C305.4-PSO1	M	IDAC Lab provides an industrial environment

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS	MAPPING WITH POs
1	Visit an industry dealing with power electronic devices	Industrial Visits	1, 2, 3, 5

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

1	Matlab Simulations of Power Electronic Circuits
2	

WEB SOURCE REFERENCES:

1	http://nptel.ac.in/courses/108101038/
2	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-334-power-electronics-spring-2007/lecture-notes/

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☑ CHALK &	☑ STUD.	☑ WEB	

TALK	ASSIGNMENT	RESOURCES	
☑ LCD/SMART BOARDS	☑ STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

☑ASSIGNMENTS	☑ STUD. SEMINARS	☑ TESTS/MODEL EXAMS	☑UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☐ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☑ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by **Approved by**

Caroline Ann Sam **Dr. Unnikrishnan P.C**
HOD EEE

3.2 COURSE PLAN

Sl. No.	Module	Date	Planned
1	1	Lec 1	Introduction to Power Electronics
2		Lec 2	SCR-Structure ,static characteristics
3		Lec 3	switching (turn-on & turnoff) characteristics
4		Lec 4	di/dt & dv/dt protection
5		Lec 5	turn-on methods of SCR - two transistor analogy
6		Tut 1	Tutorial
7		Lec 6	series and parallel connection of SCRs
8		Lec 7	Structure and principle of operation of power diode
9		Tut 2	Tutorial
10			Assignment 1 Submission
11	2	Lec 8	Gate triggering circuits – R, RC, UJT triggering circuits
12		Lec 9	natural and forced commutation (concept only). Requirements of isolation and synchronisation in gate drive circuits- Opto and pulse transformer based isolation.
13		Lec 10	Controlled rectifiers – half-wave controlled rectifier with R load
14		Lec 11	1-phase fully controlled bridge rectifier with R, RL and RLE loads (continuous & discontinuous conduction)
15		Tut 3	Tutorial
		Lec 12	1-phase fully controlled bridge rectifier with R, RL and RLE loads (continuous & discontinuous conduction)
16		Lec 13	output voltage equation – 1-phase half controlled bridge rectifier with R, RL and RLE loads
17		Lec 14	output voltage equation – 1-phase half controlled bridge rectifier with R, RL and RLE loads

18		Lec 15	displacement power factor – distortion factor.
19		Tut 4	Tutorial
20	3	Lec 16	3-phase half-wave controlled rectifier with R load
21			3-phase fully controlled & half-controlled converter with RLE load (continuous conduction, ripple free)
22		Tut 5	output voltage equation-waveforms for various triggering angles (no analysis)
23		Lec 17	1-phase & 3-phase dual converter with & without circulating current – four-quadrant operation
24		Tut 6	Tutorial
25		Lec 18	1-phase & 3-phase dual converter with & without circulating current – four-quadrant operation
26		Lec 19	Assignment 2 Submission
27	4	Lec 20	Inverters
28		tut 7	Tutorial
29		Lec 21	voltage source inverters
30		Lec 22	1-phase half-bridge & full bridge inverter with R & RL loads
31		Lec 23	THD in output voltage – 3phase bridge inverter with R load – 120° & 180° conduction mode.
32		tut 8	Tutorial
33		lec 24	current source inverters
34	5	lec 25	Voltage control in inverters
35		lec 26	Pulse Width Modulation – single pulse width
36		Tut 9	Tutorial
37		lec 27	multiple pulse width & sine PWM
38		lec 28	modulation index & frequency modulation ratio. AC voltage controllers (ACVC)
39		lec 29	1-phase full-wave ACVC with R, & RL loads – waveforms
40		Tut 10	Tutorial
41		Lec 30	RMS output voltage, input power factor with R load – sequence control (two stage) with R load
42	6	Lec 31	DC-DC converters – step down and step up choppers

43	Lec 32	single quadrant, two-quadrant & four quadrant chopper
44	Lec 33	pulse width modulation & current limit control in dc-dc converters.
45	Lec 34	Switching regulators – buck, boost & buck-boost
46	Lec 35	Switching regulators – buck, boost & buck-boost
47	Lec 36	continuous conduction mode only – waveforms
48	Lec 37	design of filter inductance & capacitance
49	Lec 38	Revision

3.3 TUTORIALS

Tutorial 1

1. If a single-phase half-wave controlled rectifier using a thyristor has a purely resistive load R and the delay angle $\alpha = \frac{\pi}{2}$, determine

   a) Converter efficiency

   b) Ripple factor,

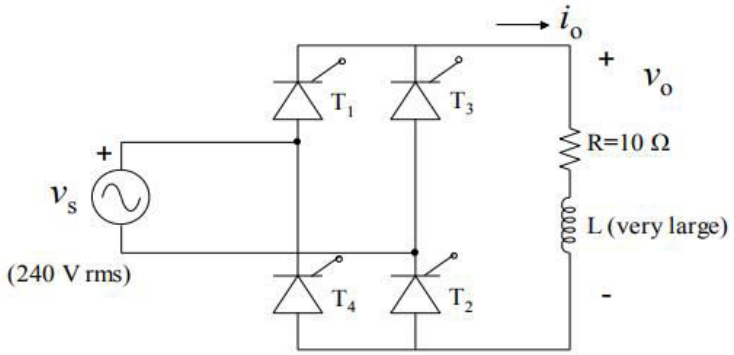
   c) Peak Inverse Voltage, PIV.

Tutorial 2

A single-phase fully-controlled bridge converter supplies power to a highly-inductive load with resistance R = 10 Ω from a 240 V rms 50 Hz AC source, as shown below.

(a) Find the firing angle α so that the average power supplied to the load is P_{av} = 1200 W.

(b) For α = π/6 find the input power factor of the rectifier.



3.4 ASSIGNMENTS

Assignment 1 *Submission Date: On or before* 24-08-2018

1. Compare and explain the construction and working principle of

    a. TRIAC
    b. MOSFET
    c. .IGBT
    d. GTO

Assignment 2 *Submission Date: On or before* 20-09-2018

1. Draw a three phase fully controlled bridge Converter with RL Load for $\alpha = 90^{\circ}$, $\alpha = 120^{\circ}$ and $\alpha = 150^{\circ}$.

Assignment 3 *Submission Date: On or before* **5-10-2018**

1. Explain the working principle of a Current Source Inverter.

4. EE307 SIGNALS & SYSTEMS

4.1 COURSE INFORMATION SHEET

PROGRAMME : **Electrical & Electronics Engg.**	DEGREE: **B -TECH**
COURSE : **Signals & Systems**	SEMESTER : **V** CREDITS : **4**
COURSE CODE : **EE 307** REGULATION : **UG**	COURSE TYPE : **CORE**
COURSE AREA/DOMAIN : **Electrical & Electronics Engg.**	CONTACT HOURS: **3 (Tutorial) hours/Week**.
CORRESPONDING LAB COURSE CODE (IF ANY) : **EE**	LAB COURSE NAME:

SYLLABUS:

UNIT	DETAILS	HOURS
I	***Module 1:*** Introduction to signals and systems - Classification of signals -Basic operations on signals – Elementary signals –Concept of system - Properties of systems - Stability, inevitability- time invariance- Linearity -Causality – Memory-Convolution- Impulse response- Representation of LTI systems - Differential equation representations of LTI systems	7
II	***Module 2:*** Laplace transform analysis of systems - Relation between the transfer function and differential equation –Causality and stability - Inverse system - Determining the time domain and frequency response from poles and zeros	7
III	***Module 3:*** Fourier representation of continuous time signals –Fourier Series- Harmonic analysis of common signals-Fourier transform - Existence –properties of FT- Energy spectral density and power spectral density – Frequency response of LTI systems -	7
IV	***Module 4:*** Sampled data systems- Sampling process-sampling theorem signal re construction- Zero order and First order hold circuits-Difference equation representations of LTI systems -Discrete form of special functions- Discrete convolution and its properties	7
V	***Module 5:*** Z Transform - Region of convergence- Properties of the Z transform – Inverse ZT-methods Z-transfer function- Analysis of difference	7

	equation of LTI systems – Basic idea on Stability and causality conditions-	
VI	***Module 6:*** Fourier representation of discrete time signals – Discrete Fourier series–properties- Frequency response of simple DT systems Basics of Non linear systems-types and properties Introduction to random signals and processes (concepts only)	7
	TOTAL HOURS	42

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	Haykin S. & Veen B.V., Signals & Systems, John Wiley
T	Oppenheim A.V., Willsky A.S. & Nawab S.H., Signals and Systems, Tata McGraw Hill
T	Signals and Systems: I J Nagrarth- Tata McGraw Hill
R	Bracewell R.N., Fourier Transform & Its Applications, McGraw Hill
R	Farooq Husain , Signals and Systems, Umesh pub.
R	Papoulis A., Fourier Integral & Its Applications, McGraw Hill
R	Taylor F.H., Principles of Signals & Systems, McGraw Hill

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
	Engineering Mathematics II	Z transforms	IV
	Engineering Mathematics I	Matrix , Ordinary Differential Equations , Laplace Transforms	I&II

COURSE OBJECTIVES:

1	To impart knowledge about the representation and properties of signal and systems
2	To impart knowledge about the applications of signals and systems in engineering

COURSE OUTCOMES:

SNO	DESCRIPTION	PO MAPPING
1	Students will be able to **Represent** various signals and systems	a,b,e
2	Students will be able to **Analyze** the continuous time system with	a,e

	Laplace transform	
3	Students will be able to **Recall and Analyze** signals using Fourier representation	a,b ,e,i,k
4	Students will be able to **Analyze** the discrete time system using ZT	a,b,e,k
5	Students will be able to **Analyze** the DT systems with DFS	a,b,e,k
6	Students will be able to **Acquire** basic knowledge in nonlinear systems	

SI No	DESCRIPTION	BLOOMS' TAXONOMY LEVEL
1	Students will be able to **Represent** various signals and systems	Knowledge[Level 1]
2	Students will be able to **Analyze** the continuous time system with Laplace transform	Analyze[Level 1]
3	Students will be able to **Recall and Analyze** signals using Fourier representation	Analyze[Level 1], Comprehension [Level 2]
4	Students will be able to **Analyze** the discrete time system using ZT	Analyze[Level 1]
5	Students will be able to **Analyze** the DT systems with DFS	Analyze[Level 1]
6	Students will be able to **Acquire** basic knowledge in nonlinear systems	Knowledge[Level 1]

MAPPING COURSE OUTCOMES (COs) – PROGRAM OUTCOMES (POs) AND COURSE OUTCOMES (COs) – PROGRAM SPECIFIC OUTCOMES (PSOs):

	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**
EE307.1	1														
EE307.2		1													
EE307.3	1	1													
EE307.4	1	1		1											
EE307.5		1													
EE307.6		1													

EE 307															

JUSTIFATIONS FOR CO-PO MAPPING:

Mapping	L/H/M	Justification
EE307.1-PO1	H	Students will be able to ability to acquire basic knowledge of various signals and systems
EE307.2-PO2	H	Students will be able to apply knowledge of mathematics to solve the continuous time system
EE307.3-PO1	H	Students will be able to recollect Fourier transform
EE307.3-PO2		Students will be able to apply knowledge of mathematics to analyze signals
EE307.4-PO1	H	Students will be apply the knowledge of mathematics to solve discrete time system
EE307.4-PO2	M	
EE307.4-PO4	L	Students will be able to Design solutions for complex Engineering problems and design system components in discrete domain
EE307.5-PO2	H	Students will be apply the knowledge of mathematics to solve discrete time systems using DFS
EE307.6-PO2	M	Students will be able to acquire basic knowledge about nonlinear systems

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Sl no	*Gap in syllabus*	*Mapping to CO*	*Mapping to PO*
1.	Students are not informed about solution of signals and systems using software tools.	CO5	PO5, PO12
2	Students are not requested to look into new areas like wavelets	CO4,CO12	PO4, PO12

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

Sl no	*Content beyond syllabus*	*Mapping to CO*	*Mapping to PO*
1.	Introduction to Filtering of Signals	CO3	PO12

WEB SOURCE REFERENCES:

1	www.engg-maths.com
2	http://nptel.ac.in/courses/117101055

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☑ CHALK & TALK	☑ STUD. ASSIGNMENT	☑s WEB RESOURCES	
☑ LCD/SMART BOARDS	☐ STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

☑ ASSIGNMENTS	☐ STUD. SEMINARS	☑ TESTS/MODEL EXAMS	☑ UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☐ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☐ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by
Rinu Alice Koshy

Approved by
(HOD)

4.2 COURSE PLAN

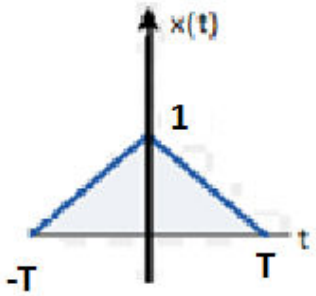
Sl. No	Date	Module	Planned
1	Lecture1	1	Introduction to signals and systems - Classification of Signals
2	Lecture2	1	Periodic and non-periodic signals, Problems
3	Lecture3	1	Even and Odd Signals, Problems
4	Tutorial 1	1	Causal, Anticausal, Non causal signals, Energy and power signals, Problems
5	Lecture4	1	Deterministic and random signals, Problems
6	Tutorial 2	1	Problems on Energy and Power signals, Elementary signals
7	Tutorial 3	1	Basic operation on signals, Problems, Introduction to systems
8	Lecture5	1	Classification of systems, Linear time invariant system, Checking time invariance
9	Lecture6	1	Representing Linear time invariant system, Convolution Integral, Problems on convolution integral
10	Lecture7	2	Differential equation representation of LTI systems, Laplace transform introduction
11	Lecture8	2	Causality, Stability and Invertibility of LTI system. derivation on BIBO Stability
12	Lecture9	2	Solution of Differential equation by Laplace transform
13	Lecture10	2	Transfer function from differential equation.
14	Tutorial 4	2	Problems on differential equation and Laplace transform
15	Tutorial 5	2	Determining the time domain and frequency response from poles and zeros
16	Lecture11	3	Fourier representation of continuous time signal
17	Lecture12	3	Fourier representation of continuous time signal-Trigonometric series
18	Lecture13	3	Fourier representation of continuous time signal-Cosine representation
19	Lecture14	3	Fourier representation of continuous time signal-complex exponential series representation

20	Lecture15	3	Fourier Series-Harmonic analysis of common signals, Problems
21	Lecture16	3	Fourier Series-Harmonic analysis of common signals, Problems
22	Lecture17	4	Fourier transform - Condition for Existence – Properties of FT
23	Lecture18	4	Energy spectral density and power spectral density
23	Lecture19	4	Frequency response of LTI systems, Problems on Frequency response of LTI Systems
24	Lecture20	4	Sampled data systems- Sampling process- sampling theorem
25	Lecture21	4	Signal re construction- Zero order hold
26	Lecture22	5	Reconstruction using First order hold circuits
27	Lecture23	5	Difference equation representations of LTI systems ,Problems
28	Lecture24	5	Discrete convolution and its properties, Problems
29	Lecture25	5	Z Transform - Region of convergence- Properties of the Z transform
30	Tutorial 6	5	Inverse ZT-methods Z-transfer function, Problems
31	Lecture26	6	Analysis of difference equation of LTI systems ,Problems
32	Lecture27	6	Basic idea on Stability and causality conditions, Problems
33	Lecture28	6	Fourier series representation of discrete time signals – Discrete Fourier series
34	Lecture29	6	Tutorials on Discrete Fouries Series
35	Lecture30	6	Properties of Fourier series- Frequency response of simple DT systems.
36	Lecture31	4	Tutorials on Energy spectral density and power spectral density
37	Lecture31	4	Energy spectral density and power spectral density

4.3 TUTORIALS

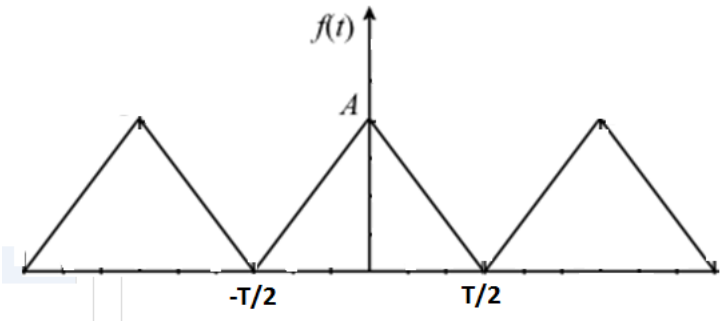
1. Check whether the system is linear or non linear $y(t) = 4x(t) + 2\frac{dx(t)}{dt}$
2. Check which of the following systems are causal?
   a. $y(t)=x(t)-x(t-1)$
   b. $y(t)=x(t)+\int_0^{3t} x(\alpha)d\alpha$
   c. $y(t)=2x(t)+\frac{dx(t)}{dt}$
3. Test whether the following systems are time invariant
   a. $y(t)=2tx(t)$
   b. $y(t)= 3x(t^2)$
4. Test the stability of the linear time invariant system whose impulse response are
   a. $h(t)=e^{-5|t|}$
   b. $h(t)=t(cost)u(t)$
5. Find the output $y(t)$ given
   a. $x(t)=cost\ u(t)$ & $h(t)=tu(t)$
   b. $x(t)= e^{-2t}u(t)$ & $h(t)= e^{-5t}u(t)$

1. Determine the Fourier transform of triangular pulse.



1.

2. Find the exponential Fourier series and trigonometric Fourier series of



3. Determine the convolution of $x_1(t) = e^{-2t}u(t)$ and $x_2(t) = e^{-6t}u(t)$ using Fourier transform.

4. Determine the magnitude spectrum of $x(t) = te^{-at}u(t)$.

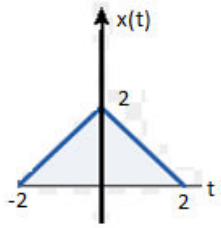
5. Find the Fourier transform of $x(t) = \begin{cases} 1-t^2 & 0 < t < 1 \\ 0 & elsewhere \end{cases}$

4.4 ASSIGNMENTS

ASSIGNMENT 1

Date of submission: 13 September 2018

1. Which are the causal and non causal systems? Justify the answer.
   a. $x(t) = e^{2t}u(t-1)$
   b. $x(t) = \left[\frac{1}{4}\right]^n u(n+2) - u(n-2)$
   c. $x(t) = \cos 2t$
2. Find energy of the signal given below



3. Check whether the following signals are
   a. Static or Dynamic
   b. Linear or Non linear
   c. Time variant or Time invariant
   d. Causal or Non causal
      i. $\frac{d^3y}{dt^3} + 2\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 3y^2 = x(t+1)$
      ii. $\frac{d^2y}{dt^2} + 2y(t)\frac{dy}{dt} + 3ty = x(t)$
      iii. $y(n) = a^n u(n)$
4. Find the Laplace transform of the following signals.
   a. $x(t) = e^{-a|t|}$
   b. $x(t) = e^{-5t}u(t-1)$
   c. $x(t) = e^t \sin t$
   d. $x(t) = [\cos^2 2t]u(t)$
   e. $x(t) = \sin(\omega t + \phi)u(t)$
5. Find the inverse Laplace transform of

$$X(s) = \frac{s^3 + 1}{s(s+1)(s+2)}$$

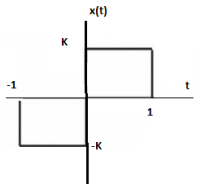
6. Determine impulse response for the system given by

$$T_o \frac{d^2y}{dt^2} + y(t) = x(t)$$

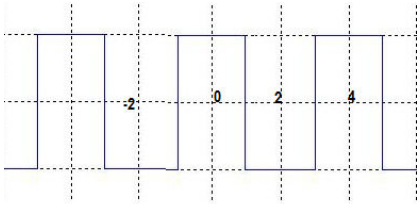
ASSIGNMENT 2

Date of Submission: October 2nd Week

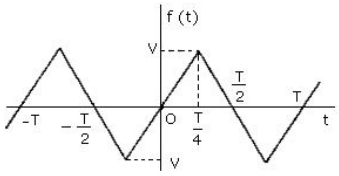
1. Find the magnitude and phase spectra of



2. Find the fourier transform of the aperiodic waveform



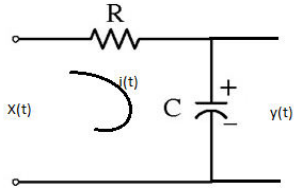
3. Find the Fourier series of the given waveform and plot the frequency response of the following waveform



4. Find the frequency response of a LTI System described by the differential equation

$$\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + 4y = 3x(t)$$

5. Find the frequency response of the following RC Circuit with RC = 1, Plot magnitude and phase plot.



6. Obtain the frequency response, if Capacitor of the above question is replaced by inductor.

5. EE309 MICROPROCESSOR AND EMBEDDED SYSTEMS

5.1 COURSE INFORMATION SHEET

COURSE INFORMATION SHEET

PROGRAMME: **Electrical & Electronics Engineering**	DEGREE: **B.TECH**
COURSE: **Microprocessors and Embedded Systems**	SEMESTER: **V** CREDITS: **3**
COURSE CODE: **EE309** REGULATION: **UG**	COURSE TYPE: **CORE**
COURSE AREA/DOMAIN: **Microprocessors**	CONTACT HOURS: **3 hours/Week.**
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME:

SYLLABUS:

UNIT	DETAILS	HOURS
I	Internal architecture of 8085 microprocessor –Instruction set - Addressing modes – Classification of instructions. Assembly language programming – standard programs in assembly language – code conversion, sorting – binary and BCD arithmetic.	7
II	Stack and Subroutines – CALL and RETURN instructions – Delay subroutines. Timing and control – Machine cycles, instruction cycle and T states – fetch and execute cycles – Timing diagram for instructions.	7
III	IO and memory interfacing – Address decoding– interrupt structure of 8085. I/O ports- Programmable peripheral interface PPI 8255 - Modes of operation. Interfacing of LEDs, ADC and DAC with 8085	7
IV	Introduction to Embedded Systems-Application domain of embedded systems, features and characteristics, System model, Microprocessor Vs Microcontroller, current trends and challenges, hard and soft real time systems, Embedded product development, Life Cycle Management (water fall model), Tool Chain System, Assemblers, Compilers, linkers, Loaders, Debuggers Profilers & Test Coverage Tools	7
V	8051- Microcontrollers Hardware: Microcontroller Architecture: IO Port structure, Register organization, general purpose RAM, Bit Addressable RAM, Special Function Registers (SFRs). Instruction Set, addressing modes Instruction Types.	7
VI	8051- assembly language programming, data types and directives, Time delay and I/O port programming, Embedded Programming in C, data type and time delay in C, I/O port programming, Timer / counter programming, serial port programming, Interfacing – LCD, ADC, Stepper motor, and DAC.	7
	TOTAL HOURS	42

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	Ramesh Gaonkar, Microprocessor, Architecture, Programming and Applications, Penram International Publishing; Sixth edition, 2014.
T	Mathur A., Introduction to Microprocessors, Tata McGraw Hill, New Delhi, 1992.
T	Douglas V. Hall, Microprocessors and Interfacing, Tata McGraw Hill, Education, New Delhi, Third Edition.

T	Rafiquzzaman, Microprocessor Theory and Application, PHI Learning, First Edition.
T	Mohamed Ali Mazidi,Janice Gillispie Mazidi," The 8051 microcontroller and embedded systems using Assembly and C", 2/e, Pearson education /PHI
T	Scott MacKenzie, Raphael C W Phan, " The 8051 Microcontroller", Fourth Edition, Pearson education
T	Ray Ajoy and Burchandi, Advanced Microprocessor & Peripherals, Tata McGraw Hill, Education, New Delhi, Second Edition.

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
EE 207	Computer Programming	Basics of Programming in C	III

COURSE OBJECTIVES:

1	To give an understanding on the Microprocessor 8085 and programming
2	To program 8085 microprocessor for different applications
3	To impart an insight into the architecture of 8051 microcontroller.
4	To develop sound understanding about programming and interfacing of 8051 microcontroller.
5	To give an understanding on the embedded system
6	To design an embedded system for different applications

COURSE OUTCOMES:

SNO	DESCRIPTION	Blooms' Taxonomy Level
1	Students will be able to **justify** and **explain** the use of microprocessors in different applications	Comprehension [Level 2]
2	Students will be able to **choose and use** a microprocessor for an application.	Application [Level 3]
3	Students will be able to **combine different technologies** for the betterment of society	Synthesis [Level 5]
4	Students will be able to **develop an idea** about the basics of embedded systems and of microcontrollers.	Knowledge [Level 1]
5	Students will be able to **design and interface** microcontroller-based embedded systems.	Application [Level 3]
6	Students will be able to **design** different embedded systems for different applications	Application [Level 3]

MAPPING COURSE OUTCOMES (COs) – PROGRAM OUTCOMES (POs) AND COURSE OUTCOMES (COs) – PROGRAM SPECIFIC OUTCOMES (PSOs)

	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
C 309.1	1	1	1		2	1	1		2	2	2	1			
C 309.2	1	1	1		2	2	1		1	1	1			2	2
C 309.3	1	1				1			2	2	2	1		1	1
C 309.4	2	2	1		1	1	1		1		1	2	1		1

C 309.5	2	2	2		1	1			2		2	2	1		1
C 309.6	1	1	1		2	2	1		1	1	1			2	2
EE 309	**1**	**1**	**2**		**2**	**2**		**1**	**2**	**2**	**1**			**2**	**2**

JUSTIFATIONS FOR CO-PO MAPPING

Mapping	L/M/H	Justification
C309.1-PO1	L	Students will be able to make use of the basic knowledge on microprocessors to find solutions for the engineering problems
C309.1-PO2	L	Students will be able to analyse engineering problems to reach conclusions
C309.1-PO3	L	Students will be able to design solutions for complex engineering problems
C309.1-PO5	M	Students will be able to apply modern techniques to model engineering activities
C309.1-PO6	L	Students will be able to make use of their knowledge for the betterment of the society
C309.1-PO7	L	Students will be able to give a sustainable and constructive development for the society
C309.1-PO9	M	Students will be able to work in a group with their background in microprocessors
C309.1-P10	M	Students will be able to communicate and comprehend properly in a group work
C309.1-P11	M	Students will be able to manage a project properly
C309.1-P12	L	Students will be able to acquire more knowledge in the advanced fields of processors
C309.2-PO1	L	Students will be able to make use of the basic knowledge on microprocessors to find solutions for the engineering problems
C309.2-PO2	L	Students will be able to analyse engineering problems to reach conclusions
C309.2-PO3	L	Students will be able to design solutions for complex engineering problems
C309.2-PO5	M	Students will be able to apply modern techniques to model engineering activities
C309.2-PO6	M	Students will be able to make use of their knowledge for the betterment of the society
C309.2-PO7	L	Students will be able to give a sustainable and constructive development for the society
C309.2-PO9	L	Students will be able to work in a group with their background in microprocessors
C309.2-P10	L	Students will be able to communicate and comprehend properly in a group work
C309.2-P11	L	Students will be able to manage a project properly
C309.3-P01	L	Students will be able to combine their knowledge for different applications
C309.3-PO2	L	Students will be able to analyse engineering problems properly
C309.3-PO6	L	Students will be able to make use of their knowledge for the betterment of the society as a whole
C309.3-PO9	M	Students will be able to work in a group understanding each other properly
C309.3-P1O	M	Students will be able to communicate the ideas properly
C309.3-P11	M	Students will be able to handle a project considering the financial

		constraints too
C309.3-P12	L	Students will be able to acquire good knowledge on advanced fields and will help them to be familiar with advanced technologies.
C309.4-PO1	M	Students will be able to reach solutions of many problems with the help of basic knowledge in the embedded systems and microcontrollers.
C309.4-PO2	M	The knowledge on the microcontroller and embedded system will help to analyse the problem properly.
C309.4-PO3	L	Students will be able to design solutions keeping in mind the safety of the society.
C309.4-PO5	L	Students will be at a better position to use the modern tools of IT for solutions.
C309.4-PO6	L	Students will have a better stand for the societal problems from the perspective of an engineer
C309.4-PO7	L	Students can help for a sustainable development with their proper understanding of technology.
C309.4-PO9	L	Students can contribute for a team work with their basic knowledge in different fields.
C309.4-P11	L	As a team students will be able to manage the team in a project in a better way.
C309.4-P12	M	For further development in their intellectual level the basics will be very much helpful for students.
C309.5-P01	L	Students will be able to combine their knowledge for different applications
C309.5-PO2	L	Students will be able to analyse engineering problems properly
C309.5-PO6	L	Students will be able to make use of their knowledge for the betterment of the society as a whole
C309.5-PO9	M	Students will be able to work in a group understanding each other properly
C309.5-P1O	M	Students will be able to communicate the ideas properly
C309.5-P11	M	Students will be able to handle a project considering the financial constraints too
C309.5-P12	L	Students will be able to acquire good knowledge on advanced fields and will help them to be familiar with advanced technologies.
C309.6-PO1	L	Students will be able to make use of the basic knowledge on microprocessors to find solutions for the engineering problems
C309.6-PO2	L	Students will be able to analyse engineering problems to reach conclusions
C309.6-PO3	L	Students will be able to design solutions for complex engineering problems
C309.6-PO5	M	Students will be able to apply modern techniques to model engineering activities
C309.6-PO6	M	Students will be able to make use of their knowledge for the betterment of the society
C309.6-PO7	L	Students will be able to give a sustainable and constructive development for the society
C309.6-PO9	L	Students will be able to work in a group with their background in microprocessors
C309.6-P10	L	Students will be able to communicate and comprehend properly in a group work
C309.6-P11	L	Students will be able to manage a project properly

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1.	Real time experience of the microprocessors	Lab Classes	1,6,7,12	1,3
2	Programming of the microprocessors using software	Additional class	1,6,7,12	1,3
3	Programming using simulation software MULTISIM.	Various programming examples using MULTISIM.	3,5,9,11	1,3

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Advanced microprocessors to be introduced	Additional class	1,6,7,12	1,3
2	Software to program the microprocessors	Additional class	1,6,7,12	1,3
3	KEIL C programming for timers, interrupts & serial communication.	Extra Classes to introduce the same	3,5,9,11	1,3
4	Interfacing of 8255 PPI to 8051 microcontroller.	Extra Classes to introduce the same	3,5,9,11	1,3

WEB SOURCE REFERENCES:

1	http://mvn.edu.in/mvnlms/mod/book/view.php?id=1394&chapterid=338 (Accessed on 02/08/2016)
2	http://8085microprocessor4u.blogspot.in/p/introduction-to-8085-1.html (Accessed on 02/08/2016)
3	http://www.daenotes.com/electronics/digital-electronics/Intel-8085-8-bit-microprocessor (Accessed on 02/08/2016)
4	Microchip, "28/40-pin 8-bit cmos flash microcontrollers," ds30292c datasheet, 2001.

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☑ CHALK & TALK	☑ STUD. ASSIGNMENT	☑ WEB RESOURCES	
☑ LCD/SMART BOARDS	☑ STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

☑ASSIGNMENTS	☑ STUD. SEMINARS	☑ TESTS/MODEL EXAMS	☑UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☑ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☑ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by **Approved by**

Fr. Mejo Gracevilla CMI **Dr. Unnikrishnan P.C.**
HOD EEE

5.2 COURSE PLAN

Sl No.	Module	Day	Topics
1	1	1	Introduction to the subject
2		2	Internal architecture of 8085 microprocessor
3		3	Instruction set Addressing modes
4		4	Instruction set Addressing modes
5		5	Classification of instructions
6		6	Assembly language programming
7		7	Standard programs in assembly language
8		8	Code conversion
9		9	Sorting of numbers
10		10	Binary and BCD arithmetic.
11	2	11	Stack and Subroutines
12		12	CALL and RETURN instructions
13		13	Delay subroutines
14		14	Delay subroutines
15		15	Timing and control
16		16	Machine cycles, instruction cycle and T states
17		17	Fetch and execute cycles
18		18	Timing diagram for instructions.
19	3	19	IO and memory interfacing
20		20	Address decoding
21		21	Interrupt structure of 8085

22		22	I/O ports- Programmable peripheral interface PPI 8255
23		23	I/O ports- Programmable peripheral interface PPI 8255
24		24	Modes of operation
25		25	Interfacing of LEDs
26		26	ADC and DAC with 8085
27	5	27	Intel 8051 Microcontroller, Internal Architecture
28		28	I/O port structure,
29		29	Register organisation - general purpose RAM, Bit addressable RAM, register banks
30		30	Special function registers
31		31	Instruction set summary-addressing modes
32		32	Instruction types
35	6	35	Assembly language programming
36		36	Data types and directives
37		37	Time delay and I/O port programming
38		38	Embedded Programming in C, data type and time delay in C
39		39	I/O port programming, Timer / counter programming
40		40	Serial port programming
41		41	Interfacing – LCD, ADC
42		42	Stepper motor, and DAC
43	4	43	Introduction to Embedded System
44		44	Application domain of embedded systems, features and characteristics
45		45	System model
46		46	Microprocessor Vs Microcontroller, current trends and challenges
47		47	Hard and soft real time systems

48		48	Embedded product development, Life Cycle Management (water fall model)
49		49	Tool Chain System, Assemblers, Compilers
50		50	Linkers, Loaders, Debuggers Profilers & Test Coverage Tools

5.3 TUTORIALS

1. Write an assembly level program to add two eight bit numbers. (8085)
2. Write an assembly level program to subtract two eight bit numbers. (8085)
3. Write an assembly level program to add two sixteen bit numbers.(8085)
4. Write an assembly level program to subtract two sixteen bit numbers.(8085)
5. Write an assembly level program to multiply two eight bit numbers by repeated addition method.(8085)
6. Write an assembly level program to divide two eight bit numbers by repeated subtraction method.(8085)
7. Write an assembly level program to find the sum of a data array.(8085)
8. Write an assembly level program to find the largest in a data array.(8085)
9. Write an assembly level program to find the smallest number in a data array.(8085)
10. Write an assembly level program to arrange a data array in ascending order.(8085)
11. Write an assembly level program to arrange a data array in descending order.(8085)
12. Write an assembly level program to find square from look-up table.(8085)
13. Interface the given ROM and RAM memories with the microprocessor.(8085)
14. Write an assembly level program to generate square wave for given frequency and duty cycle.(8085)
15. Write a program to add two 8 bit numbers stored in Port 0 and Port 1. Send the result to Port 2 and carry to Port 3.1.
16. Write a program to subtract two 8 bit numbers stored in Port 0 and Port 1. Send the result to Port 2 and carry to Port 3.0.
17. Write a program to get the value of x from P1 and send x^2 to P2 continuously.
18. Write a program to swap the nibbles of R0 and R1 so that low nibble of R0 swaps with high nibble of R1 and high nobble of R0 with low nibble of R1.
19. You have five numbers stored in locations 40H to 44H. Check of any value equals 65H. If yes, copy its location to R4, else make R4=0.
20. Assume 5 BCD numbers are stores in locations starting from 40H. Write a program to find the sum of all the numbers. Result should be in BCD and store in register R7 9MSB) and R6 (LSB).
21. Write a program to copy the value 55H into RAM locations 40H to 45H using (a) direct addressing mode (b) register indirect addressing mode without a loop and (c) with a loop

22. For an 8051 system, with a crystal frequency of 11.0592 MHz, write a program to generate a square wave on pin P1.0 with a duty cycle of 50%.
23. You have got the marks of 6 subjects out of 25d (19H). They are stored in locations starting from 40H onwards. Find the average of your marks and store the result at 50H.
24. Write a program to convert a hexadecimal number to a decimal number
25. Write a program to read the temperature and test it for the value 75. According to the test results, place the temperature value into the register indicated.
26. Ten hex numbers are stored in RAM locations 50H onwards. Write a program to find the biggest number in the set. Save the biggest number in the location 60H.
27. Write an 8051 C program to send values 00-FF to port P1.
28. Write an 8051 C program to monitor bit P1.5. If it is high, send 55H to P0, otherwise send AAH to P2.
29. Write an 8051 C program to get a byte of data from P0. If it is less than 100, send it to P1, otherwise send it to P2.
30. Write an 8051 C program to toggle all the bits of P1 continuously.
31. Write an 8051 C program to toggle bits of P1 ports continuously with a 250 ms delay.
32. WAP to create a square wave of 50% duty cycle on the P1.5 bit. Use Timer 0 to generate the time delay.
33. Assume XTAL = 11.0592 MHz, WAP to generate a square wave of 50 Hz frequency on pin P2.3
34. Generate a square wave with on time of 3ms and off time of 10ms on P1.0. Assume an XTAL of 22MHz.
35. Assume XTAL = 11.0592 MHz. WAP to generate a square of time period 4 sec on P2.4.Use Timer 1 in mode 1.
36. Write an 8051 C program to generate a square wave with 50% duty cycle on P1.5. Use Timer 0, 16-bit mode to generate the delay.
37. Assume XTAL = 11.0592 MHz. WAP to generate a square wave with a frequency of 1835 Hz on pin P1.0.Use Timer 1 in mode 2.
38. Assume XTAL = 22 MHz, WAP to generate a square wave of frequency 1kHz on pin P1.6. Use Timer 1 in mode 2.

39. Design a counter for counting no. of pulses of an input signal for 1sec and display the count at Port 2(LSB) & Port 1(MSB). The pulses are to be fed to pin P3.4.Use XTAL=22 MHz.
40. Assume that a 1-Hz external clock is being fed into pin T1 (P3.5).Write a C program for counter 1 in mode 2 (8-bit auto reload) to count up and display the state of the TL1 count on P1. Start the count at 0H.

5.4 ASSIGNMENTS

Assignment 1 *Submission Date: On or before* ***20 – 09 - 2018***

1. Write a program to functions as a calculator.
   1 for addition, **2** for subtraction, **3** for multiplication and **4** for division
2. Write a program to find the square of a number by odd number addition.
3. Write a program to find the square root of a number by odd number subtraction.
4. Write a program to find the numbers which are divisible by 3 from an array and store those numbers in another array.
5. Write a program to find 'n' elements of the Fibonacci series and store in an array.
   (0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ……..)
6. Write a program to find the factorial of a number. (Including 6!)

Assignment 2 *Submission Date: On or before* ***19 – 11 - 2018***

1. Write a program to add two 8-bit numbers stored at external memory 2000H and 2001H, store the result at 2002H and carry at 2003H.
2. Write a program to subtract two 8-bit numbers stored at external memory 2000H (Data 2) and 2001H (Data 1), store the result at 2002H and borrow at 2003H.
3. Write a program to multiply two 8-bit numbers stored at external memory 2000H and 2001H, store the result at 2002H and at 2003H.
4. Write a program to divide two 8-bit numbers stored at external memory 2000H (Data 2) and 2001H (Data 1), store the result at 2002H and at 2003H.
5. Write a program to find the average of an array of numbers given, the array starts from 2000H, the first location gives the number of elements in the array, the result is to be stored just after the array, consider that the sum of elements of the array be only of 8-bits.
6. Sort the numbers in an array in descending order. The array starts from 2000H and the first location contains the number of elements in the array.
7. Find the largest number in an array in which the array starts from 2000H and the first location gives the number of elements in the array. The result is to be stored at the location next to the array and the array is not to be disturbed.

6. EE367 NEW & RENEWABLE SOURCES OF ENERGY

6.1 COURSE INFORMATION SHEET

PROGRAMME: **Electrical & Electronics Engineering**	DEGREE: **B.TECH**
COURSE: **New and Renewable Sources of Energy**	SEMESTER: **V** CREDITS: **3**
COURSE CODE: **EE367** REGULATION: **UG**	COURSE TYPE: **ELECTIVE**
COURSE AREA/DOMAIN: **Renewable Energy**	CONTACT HOURS: **3 hours/Week.**
CORRESPONDING LAB COURSE CODE (IF ANY): **Nil**	LAB COURSE NAME: **Nil**

SYLLABUS:

UNIT	DETAILS	HOURS
I	Introduction, Classification of Energy Resources; Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources; World Energy Scenario; Indian Energy Scenario. ENERGY STORAGE: Sizing and Necessity of Energy Storage.	5
II	SOLAR THERMAL SYSTEMS: Introduction, Solar Constant, Basic Sun-Earth Angles, Measurement of Solar Radiation Data – Pyranometer and Pyrheliometer .Principle of Conversion of Solar Radiation into Heat, – Solar thermal collectors – General description and characteristics – Flat plate collectors – Heat transfer processes – Solar concentrators (parabolic trough, parabolic dish, Central Tower Collector) –performance evaluation.	11
III	SOLAR ELECTRIC SYSTEMS: Solar Thermal Electric Power Generation –; Solar Photovoltaic – Solar Cell fundamentals, characteristics, classification, construction of module, panel and array. Solar PV Systems – stand-alone and grid connected; Applications – Street lighting, Domestic lighting and Solar Water pumping systems..	5
IV	ENERGY FROM OCEAN: Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant (TPP), Classification of Tidal Power Plants, Advantages and Limitations of TPP. Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle) and Hybrid cycle (block diagram description of OTEC); Site-selection criteria, Biofouling, Advantages & Limitations of OTEC.	7
V	WIND ENERGY: Introduction, Wind and its Properties, History of Wind Energy, Wind Energy Scenario – World and India. Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS,	7

	Advantages and Disadvantages of WECS	
VI	BIOMASS ENERGY: Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production from waste biomass, factors affecting biogas generation, types of biogas plants – KVIC and Janata model; Biomass program in India. Small hydro power: Classification as micro, mini and small hydro projects - Basic concepts and types of turbines - Design and selection considerations. EMERGING TECHNOLOGIES: Fuel Cell, Small Hydro Resources, Hydrogen Energy, alcohol energy, nuclear fusion and power from satellite stations.	7
	TOTAL HOURS	42

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	1. A.A.M. Saigh (Ed): Solar Energy Engineering, Academic Press, 1977
T	2. Abbasi S. A. and N. Abbasi, Renewable Energy Sources and Their Environmental Impact, Prentice Hall of India, 2001.
T	3. Boyle G. (ed.), Renewable Energy - Power for Sustainable Future, Oxford University Press, 1996
R	4. Earnest J. and T. Wizelius, Wind Power Plants and Project Development, PHI Learning, 2011.
R	5. F. Kreith and J.F. Kreider: Principles of Solar Engineering, McGraw Hill, 1978
R	6. G.N. Tiwari: Solar Energy-Fundamentals, Design, Modelling and Applications, Narosa Publishers, 2002
R	7. J.A. Duffie and W.A. Beckman: Solar Energy Thermal Processes, J. Wiley, 1994
R	8. Johansson T. B., H. Kelly, A. K. N. Reddy and R. H. Williams, Renewable Energy – Sources for Fuel and Electricity, Earth scan Publications, London, 1993.
R	9. Khan B. H., Non-Conventional Energy Resources, Tata McGraw Hill, 2009.
R	10. Rao S. and B. B. Parulekar, Energy Technology, Khanna Publishers, 1999.
R	11. Sab S. L., Renewable and Novel Energy Sources, MI. Publications, 1995.
R	12. Sawhney G. S., Non-Conventional Energy Resources, PHI Learning, 2012.
R	13. Tiwari G. N., Solar Energy- Fundamentals, Design, Modelling and Applications, CRC Press, 2002.

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
BE 103	Introduction to Sustainable Engineering	Basic concepts in renewable energy	I

COURSE OBJECTIVES:

1	• To give sufficient knowledge about the promising new and renewable sources of energy • To equip students in working with projects and to take up research work in connected areas.

COURSE OUTCOMES:

SNO	DESCRIPTION	Bloom's Taxonomy Level
1	Students will be able to **recognize** and understand the world and Indian energy scenario and necessity of sustainable development utilising Renewable Energy recourses.	Knowledge [Level 1]
2	Students will be able to **analyse** and infer the potentials and design systems based on solar thermal systems.	Analyze [Level 4]
3	Students will be able to **illustrate**, design and implement solar electric systems.	Apply [Level 3]
4	Students will be able to understand the fundamentals and **interpret** basic components of energy from the ocean	Understand [Level 2]
5	Students will be able to understand the fundamentals and **interpret** basic components of energy from the wind	Understand [Level 2]
6	Students will be able to understand the fundamentals and **interpret** basic components of energy from the biomass and emerging technologies	Understand [Level 2]

MAPPING COURSE OUTCOMES (COs) – PROGRAM OUTCOMES (POs) AND COURSE OUTCOMES (COs) – PROGRAM SPECIFIC OUTCOMES (PSOs)

	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**
C 367.1	1	1			2	1	3						1		
C 367. 2		2	3				3						2		
C 367. 3			3			2	3						2	2	
C 367. 4						2	2						1	2	
C 367. 5			2		2	2							2	2	2
C 367.6	1			2						2		1	1	2	
EE 367	1	1	2	1	1	2	2	-	-	2	-	1	2	2	1

JUSTIFICATIONS FOR CO-PO MAPPING

Mapping	L/H/M	Justification
C367.1-PO1	H	Students will be able to explain and identify the energy scenario world wide
C367.1-PO2	H	Students will be able to formulate necessity of sustainable development utilizing Renewable Energy recourses
C367.1-PO5	M	Students will be able to identify renewable energy sources and suggest the apt one for the society
C367.1-PO7	H	Students will be able to understand the importance of Renewable energy for sustainable development and importance of climate change
C367.1-PO10	M	Students will be able to understand the importance of communication to the society for sustainable development
C367.2-PO 2	M	Students will be able to analyse and identify the problems on sustainable development using solar thermal systems
C367.2-PO 3	H	Students will be able to design solar thermal systems which is required for the society to improve environmental conditions
C367.2-PO 7	H	Students will be able to understand the Solar thermal systems that will reduce the pollution in the Environment
C367.3-PO 3	M	Students will be able to illustrate and design solar electric systems.
C367.3-PO 5	M	Students will be able to apply modern tools to predict and analyse the advantages and limitations of SPV systems
C367.3-PO 6	M	Students will be able to become an Engineer to implement solar based systems and benefit the society
C367.3-PO 7	H	Students will be able to understand the Solar photovoltaic systems that will reduce the pollution in the Environment
C367.4-PO 6	M	Students will be able to become an Engineer to implement ocean based systems and benefit the society
C367.4-PO 7	M	Students will be able to understand the energy from the ocean that will reduce the pollution in the Environment
C367.5-PO3	M	Students will be able to illustrate and design wind electric systems
C367.5-PO4	L	Students will be able to research, analyse and interpret data in the

		area of wind energy extraction.
C367.5-PO 5	M	Students will be able to apply modern tools to predict and analyse the advantages and limitations of wind energy
C367.5-PO 6	M	Students will be able to become an Engineer to implement wind energy based systems and benefit the society
C367.5-PO 7	M	Students will be able to understand the wind electric systems that will improve the Environmental conditions of the world
C367.6-PO 1	L	Students will be able to explain and identify the emerging renewable technologies
C367.6-PO 4	L	Students will be able to research, analyse and interpret data in the new area of renewable
C367.6-PO 10	M	Students will be able to apply the knowledge of basic renewable energy systems and communicate effectively with public its need for societal development like biomas energy
C367.6-PO 12	L	Students will be able to understand and learn new renewable resources and it became a life learning experience

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS	MAPPING WITH COs	MAPPING WITH POs
1	Details regarding the existing renewable energy installations in Kerala is not present in the syllabus	Details are provided by using power point slides and Industrial Visits	CO1	PO1, PO 2, PO 6, PO7, PO8, PO9, PO 12
2	Geo thermal energy is not incorporated in the syllabus in details	Basic details are presented using power point slides	CO6	PO6, PO7

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

Sl no	*Content beyond syllabus*	*Mapping to CO*	*Mapping to PO*
1.	Information regarding the climate change, Paris agreement for climate change and latest trends in the Renewable Energy Industry is introduced to the students	CO1, CO6	PO3,PO7,PO12

WEB SOURCE REFERENCES:

1	www.nptel.iitm.ac.in
2	http://ocw.mit.edu/index.htm
3	Prof. G.D. Roy, Prof. N.K. De, Prof. T.K. Bhattacharya, Basic Electrical Technology, www.nptel.com, retrieved on July 05, 2013 from URL: http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☑ CHALK & TALK	☐ STUD. ASSIGNMENT	☑ WEB RESOURCES	
☑ LCD/SMART BOARDS	☐ STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

☑ASSIGNMENTS	☐ STUD. SEMINARS	☑ TESTS/MODEL EXAMS	☑UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☐ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☑ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by **Approved by**

Ms. Ragam Rajagopal **Dr. Unnikrishnan P.C.**
HOD EEE

6.2 COURSE PLAN

Lecture (L) **/ Tutorial** (T) **Sr. No.**	**Day Sr.No.**	**Topics** **Module I**
L1	Day 1	Introduction, Classification of Energy Resources
L2	Day 2	Conventional Energy Resources - Availability and their limitations;
L3	Day 3	Non-Conventional Energy Resources – Classification, Advantages, Limitations
L4	Day 4	Non-Conventional Energy Resources – Classification, Advantages, Limitations
L5	Day 5	Comparison of Conventional and Non-Conventional Energy Resources
L6	Day 6	World Energy Scenario;
L7	Day 7	Indian Energy Scenario
L8	Day 8	ENERGY STORAGE: Sizing and Necessity of Energy Storage.
L9	Day9	SOLAR THERMAL SYSTEMS: Introduction, Solar Constant
L10	Day10	Basic Sun-Earth Angles
L11 & T1	Day11	Measurement of Solar Radiation Data
L12	Day12	Pyranometer and Pyrheliometer
L13	Day13	Principle of Conversion of Solar Radiation into Heat
L14	Day14	Solar thermal collectors – General description and characteristics
L15	Day15	Flat plate collectors – Heat transfer processes – Solar concentrators
L16 & T2	Day16	Solar concentrators (parabolic trough, parabolic dish, Central Tower Collector) performance evaluation.
L17	Day 17	SOLAR ELECTRIC SYSTEMS: Solar Thermal Electric Power Generation
L18 &T3	Day 18	Solar Photovoltaic – Solar Cell fundamentals
L19	Day 19	characteristics, classification,
L20	Day 20	construction of module, panel and array
L21	Day 21	Solar PV Systems – stand-alone
L22	Day 22	Solar PV Systems grid connected
L23	Day 23	Applications – Street lighting, Domestic lighting and Solar Water pumping systems.
L24	Day 24	ENERGY FROM OCEAN: Tidal Energy – Principle of Tidal Power
L25	Day 25	Components of Tidal Power Plant (TPP),
L26	Day 26	Classification of Tidal Power Plants, Advantages and Limitations of TPP
L27	Day 27	Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system

L28	Day 28	Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle) and Hybrid cycle
L29	Day 29	Site-selection criteria, Biofouling, Advantages & Limitations of OTEC.
L30	Day 30	WIND ENERGY: Introduction, Wind and its Properties
L31	Day 31	History of Wind Energy, Wind Energy Scenario – World and India
L32	Day 32	Basic principles of Wind Energy Conversion Systems (WECS)
L33	Day 33	Classification of WECS, Parts of WECS, Derivation for Power in the wind
L34	Day 34	Electrical Power Output and Capacity Factor of WECS, Advantages and Disadvantages of WECS
L35	Day 35	BIOMASS ENERGY: Introduction, Photosynthesis process, Biomass fuels,
L36	Day 36	Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production,
L37	Day 37	Biogas production from waste biomass, factors affecting biogas generation, types of biogas plants – KVIC and Janata model; Biomass program in India.
L38	Day 38	Small hydro power: Classification as micro, mini and small hydro projects - Basic concepts and types of turbines – Design and selection considerations
L39	Day 39	EMERGING TECHNOLOGIES: Fuel Cell, Small Hydro Resources, Hydrogen Energy, alcohol energy, nuclear fusion and power from satellite stations.

6.3 TUTORIALS

1. Find the angle subtended by beam radiation with the normal to a flat-plate collector at 9.00 am for the day on November 3, 2013. The collector is in Delhi (28° 35' N, 77° 12' E), inclined at an angle of 36° with the horizontal and is facing due south.

2. A PV source having maximum power point at (25V, 5A), is supplying power to a load whose load line intersects the characteristics at (10V, 8A). Determine the additional power gained if an MPPT is interposed between the source and the load. If the cost of the MPPT is Rs.4000.00, for how long does the system need to operate in order to recover the cost of MPPT? The cost of electricity may be assumed as Rs. 3.00 per kWh.

3. A PV system feeds a dc motor to produce 1 hp power at the shaft. The motor efficiency is 85%. Each module has 36 multi crystalline silicon solar cells arranged in a 9x4 matrix. The cell size is 125mmx125mm and the cell efficiency is 12%. Calculate the number of modules required in the PV array. Assume global radiation incident normally to the panel as 1000W/m^2.

4. A PV system is installed for water supply for minor irrigation needs. The water is pumped through a bore well from a depth of 25m. The PV array consist of 24 modules. Each module has 36 multi crystalline silicon solar cells arranged in 9x4 matrix. The cell size is 125mmx125mm and the cell efficiency is 12%. The combined motor and pump efficiency is 50%. Calculate the water discharge rate at noon when global radiation incident normally to the panel is 800W/m^2. Assume fresh water density as 996 kg/m^3.

5. The following data were measured for a HAWT:
   Speed of wind=20m/s at 1 atm and 27 deg C
   Rotor diameter=80m
   Speed of rotor=40rpm
   Calculate the torque produced at the shaft for maximum output of the turbine.

6. A HAWT is installed at a location having free wind velocity of 15m/s. The 80m diameter rotor has three blades

6.4 ASSIGNMENTS

Assignment I

Submit on/before: September 2nd week

1. Discuss Sizing and necessity of energy storage
2. Explain in detail about solar thermal electric power plant

Assignment II

Submit on/before: October 4th week

1. Explain following emerging technologies
    a. Hydrogen energy
    b. Alcohol energy
    c. Nuclear fusion energy
    d. Power from satellite stations

7. EE369 HIGH VOLTAGE ENGINEERING

7.1 COURSE INFORMATION SHEET

PROGRAMME: **Electrical & Electronics Engineering**	DEGREE: **B.TECH**
COURSE: **High Voltage Engineering**	SEMESTER**:** **V** CREDITS: **3**
COURSE CODE: **EE369** REGULATION: **UG**	COURSE TYPE: **ELECTIVE**
COURSE AREA/DOMAIN: **Electrical Power**	CONTACT HOURS: **3(L)-0(T)-0(P)/Week.**
CORRESPONDING LAB COURSE CODE (IF ANY): **Nil**	LAB COURSE NAME: **Nil**

SYLLABUS:

UNIT	DETAILS	HOURS
I	Generation and transmission of electric energy – voltage stress –testing voltages-AC to DC conversion – rectifier circuits – cascaded circuits – voltage multiplier circuits – Cockroft-Walton circuits –voltage regulation – ripple factor – Van de-Graaff generator.	7
II	Generation of high AC voltages-Testing transformer – single unit testing transformer, cascaded transformer – equivalent circuit of cascaded transformer – generation of high frequency AC voltage series resonance circuit – resonant transformer – voltage regulation.	7
III	Generation of impulse voltages-Marx generator – Impulse voltage generator circuit –analysis of various impulse voltage generator circuits - multistage impulse generator circuits – Switching impulse generator circuits – impulse current generator circuits	7
IV	Peak voltage measurements by sphere gaps – Electrostatic voltmeter – generating voltmeters and field sensors – Chubb-Fortescue method-– voltage dividers and impulse voltage measurements- measurement of impulse currents	7
V	Objectives of high voltage testing, Classification of testing methods self restoration and non-self restoration systems-standards and specifications, Measurement of dielectric constant and loss factor, Partial discharge measurements-Basic partial discharge(PD) circuit – PD currents- PD quantities - Corona and RIV measurements	7
VI	Testing of insulators, bushings, air break switches, isolators, circuit breakers, power transformers, surge diverters, cables –testing methodology. Classification of high voltage laboratories, Voltage and power rating of test equipment, Layout of high voltage laboratories,	10

	Grounding of impulse testing laboratories.	
	TOTAL HOURS	45

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T1	C.L Wadhwa *High voltage Engineering*, New age international (P) ltd, 2007
R1	Dieter Kind, Kurt Feser, "High voltage test techniques", SBA Electrical Engineering Series, New Delhi, 1999.
R2	Kuffel, E., Zaengl, W.S. and Kuffel J., "High Voltage Engineering Fundamentals", Elsvier India P Ltd, 2005
R3	Naidu M.S. and Kamaraju V., "High voltage Engineering", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2004.

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
BE101-03	Introduction to Electrical Engineering	Basic concepts in circuit theorems	I
EE203	Analog Electronic circuits	Basic Electronic Circuit operations	III
EE206	Material Science	Breakdown in Solid, Liquid and Gaseous dielectrics	IV
EE208	Measurements and Instrumentation	Different measuring methods and instruments.	IV

COURSE OBJECTIVES:

1	The students will know several of methods of generating different test voltages, testing methods used in power equipments.
2	To provide basic knowledge in the area of design of high voltage laboratories.

COURSE OUTCOMES:

SNO	DESCRIPTION	Blooms' Taxonomy Level
1	Students will be able to **understand** the concepts of generation of high voltage dc using Rectifier circuits, Cockroft Walton Voltage Multiplier circuit and Electrostatic generator like Van de Graaff generator.	Knowledge [Level 1] Comprehension [Level 2]
2	Students will be able to **understand and compare** the generation of high voltage ac using cascaded transformers and different type of resonant circuits like series, parallel and series-parallel	Knowledge [Level 1] Comprehension [Level 2]
3	Students will be able to **understand** the generation of impulse voltage generator circuits, Impulse current generator and perform analysis of different type of impulse circuits.	Knowledge [Level 1] Analysis [Level 4]
4	Students will be able to **understand** different measuring techniques like sphere gaps, Electrostatic voltmeter, voltage dividers and impulse voltage & current measurements	Knowledge [Level 1]
5	Students will be able to **classify** different testing methods like self restoration and non-self restoration systems and to **understand** the measurement of partial discharges, dielectric loss, corona and interference.	Knowledge [Level 1] Application [Level 3]
6	Students will be able to **understand** the testing of various power system components and to classify the high voltage laboratories and to **design** the layout of high voltage laboratories	Knowledge [Level 1] Application [Level 3]

MAPPING COURSE OUTCOMES (COs)- PROGRAM OUTCOMES (POs) AND COURSE OUTCOMES (COs) – PROGRAM SPECIFIC OUTCOMES (PSOs)

	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**
C 369.1	2		2										1		
C 369.2	2		2										1		

C 369.3	2		2										1		
C 369.4	2		2												
C 369.5	2		2												
C 369.6	2			2		2		2							
EE 369	**2**		**2**	**2**		**2**		**2**					**1**		

JUSTIFATIONS FOR CO-PO MAPPING

Mapping	L/M/H	Justification
C369.1-PO1	M	Student will be able to apply the knowledge gained from engineering fundamentals electronic circuits like Rectifier circuits, Voltage Multiplier circuit and Electrostatic generators for generation of high voltage dc .
C369.1-PO3	M	Student will be able to design system components for high voltage dc generation using rectifier and voltage multiplier circuits and to meet specific needs of voltage regulation and ripple factor.
C369.2-PO1	M	Student will be able to apply the knowledge gained from engineering fundamentals of transformers and different type of resonant circuits and apply that for generation of high voltage ac .
C369.2-PO3	M	Student will be able to understand how the cascaded transformer and different type of resonant circuits are designed for generation of high voltage ac.
C369.3-PO1	M	Student will be able to apply the knowledge gained from engineering fundamentals for the generation of Impulse voltages and currents .
C369.3-PO3	M	Student will be able to design and compare the different circuit used for the generation of Impulse voltages and currents .
C369.4-PO1	M	Student will be able to apply the knowledge gained from engineering fundamentals to understand different techniques in measuring high voltages like sphere gaps, Electrostatic voltmeter, voltage dividers and impulse voltage & current measurements
C369.4-	M	Student will be able to understand the design aspects in measuring high

PO3		voltages using sphere gaps, voltage dividers and impulse voltage & current measurements
C369.5-PO1	M	Student will be able to apply the knowledge gained from engineering fundamentals in understanding different testing methods like self restoration and non-self restoration systems and measurement of partial discharges, dielectric loss, corona and interference.
C369.5-PO3	M	Student will be able understand the design aspects in measurement of partial discharges, dielectric loss, corona and interference.
C369.6-PO1	M	Student will be able to apply the knowledge gained from engineering fundamentals in understanding the testing of various power system components like circuit breaker, surge arresters etc
C369.6-PO4	M	Students will be able to design the layout of high voltage laboratories with experimental and interpreted datas.
C369.6-PO6	M	Students will be able to design the layout of high voltage laboratories with social responsibility considering proper safety aspects
C369.6-PO8	M	Students will be able to design the layout of high voltage laboratories with professional ethics and norms of engineering practices

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSIONAL REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS
1.	Practical exposure in high voltage generation and measurement	Visit to high voltage labs at CPRI /IIT/IISc
2.	Recent trends in high voltage concepts	Invited talk by experts /attending seminars/workshops.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

1	Application of high voltage engineering
2	Overvoltage Phenomenon and insulation coordination in Electric power systems

WEB SOURCE REFERENCES:

1	www.nptel.iitm.ac.in –Reviewed date 2/07/2017

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☑ CHALK & TALK	☑ STUD. ASSIGNMENT	☑ WEB RESOURCES	
☑ LCD/SMART BOARDS	☑ STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

☑ASSIGNMENTS	☑ STUD. SEMINARS	☑ TESTS/MODEL EXAMS	☑UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☑ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☑ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by **Approved by**

Ms. Santhi.B

HOD EEE

7.2 COURSE PLAN

Sl.No	Module	Planned Date	Planned
1	1	L1	Introduction to subject and syllabus Generation-transmission of electric energy-Overall picture around the globe
2	1	L2	Voltage Stresses-Testing Voltages
3	1	L3	Generation of high voltage Dc-Basic concept-Rectifier circuits(HWR)
4	1	L4	HWR-analysis-Simple voltage doubler circuit
5	1	L5	Cascaded voltage doubler circuit-Voltage multiplier circuit-Cockroft -Walton circuit-principle
6	1	L6	Cockroft -Walton circuit-Analysis-Ripple voltage & voltage regulation
7	1	L7	Electrostatic generator-Van de-Graaff generator
8	2	L8	Generation of high AC voltages-Testing transformer – single unit testing transformer
9	2	L9	Gen. of high AC voltages-cascaded transformer-equivalent circuit
10	2	L10	generation of high frequency AC voltage -series resonance circuit
11	2	L11	High freq AC gen-Resonant transformers
12	2	L12	Voltage regulation
13	2	L13	Problem-cascaded transformer-Resonant transformer
14	2	L14	summary on high voltage AC generation
15	3	L15	Generation of impulse voltages-different circuits-analysis
16	3	L16	Generation of impulse voltages-different circuits-analysis---continued
17	3	L17	multistage impulse generator circuits-Marx circuit-schematic diagram explanation-different components

18	3	L18	Switching impulse generator circuits
19	3	L19	impulse current generator circuits-rec current pulse
20	3	L20	impulse current generator circuits-tripping and control
21	3	L21	Problems in impulse generators
22	4	L22	Peak voltage measurements by sphere gaps
23	4	L23	Electrostatic voltmeter – generating voltmeters and field sensors
24	4	L24	Chubb-Fortescue method
25	4	L25	voltage dividers and impulse voltage measurements
26	4	L26	impulse voltage measurements..contd
27	4	L27	measurement of impulse currents
28	4	L28	measurement of impulse currents...contd
29	5	L29	Objectives of high voltage testing, Classification of testing methods self restoration and non-self -restoration systems-standards and specifications
30	5	L30	Measurement of dielectric constant and loss factor
31	5	L31	Partial discharge measurements-Basic partial discharge(PD) circuit
32	5	L32	PD currents measurements
33	5	L33	PD quantities
34	5	L34	Corona and RIV measurements
35	6	L35	Testing of insulators, bushings, air break switches & isolators
36	6	L36	Testing of circuit breakers, power transformers, surge diverters & cables

37	6	L37	Testing testing methodology. Classification of high voltage laboratories,
38	6	L38	Voltage and power rating of test equipment
39	6	L39	Layout of high voltage laboratories
40	6	L40	Grounding of impulse testing laboratories. Revision & univ Question Discussion

7.3 ASSIGNMENTS

Assignment-I

`1. Briefly explain the recent applications in the field of High Voltage Engineering.

Due Date : 1st Week September

Assignment II

1. A Tesla coil has a primary winding rated for 10 kV. If L1, L2 and coefficient of coupling K are 10 mH, 200mH and 0.6 respectively find the peak value of the output voltage if the capacitance in the primary side is 2microF and that on the secondary side is 1nF.Neglect the winding resistance. Find also the highest resonant frequency produced with the rated voltage applied.

2. An absolute electrostatic voltmeter has a movable circular plate 8cms in diameter. If the distance between the plates during a measurement is 4mm, determine the potential difference when the force of attraction is 0.2 gm wt.

3. A 20 kV, 50Hz Schering bridge has a standard capacitance of 106 MicroF. In a test on a Bakelite sheet balance was obtained with a capacitance of 0.35 MicroF in parallel with a non-inductive resistance of 318ohms,the non-inductive resistance in the remaining arm of the bridge being 130ohms..Determine the a) equivalent series resistance and capacitance b) equivalent parallel resistance and capacitance and c)the p.f of the test specimen.

4. Following measurements are made to determine the dielectric constant and complex permittivity of a test specimen:
   i. The air capacitance of the electrode system=50MicroF.
   ii. The capacitance and loss angle of the electrodes with specimen=190pF and 0.0085 respectively.

5. Why is grounding very important in an HV laboratory? Describe a typical grounding system used.

Due Date : 2nd Week November

8. EE331 DIGITAL CIRCUITS AND EMBEDDED SYSTEMS LAB

8.1 COURSE INFORMATION SHEET

PROGRAMME: **Electrical & Electronics Engineering**	DEGREE: **B.TECH**
COURSE: **Digital Circuits and Embedded Systems Lab**	SEMESTER: **V** CREDITS: **1**
COURSE CODE: **EE 331** REGULATION: **UG**	COURSE TYPE:**PRACTICAL**
COURSE AREA/DOMAIN: **Digital Electronics**	CONTACT HOURS: **3 hours/Week.**
CORRESPONDING LAB COURSE CODE (IF ANY):	LAB COURSE NAME:

SYLLABUS:

CYCLE	DETAILS	HOURS
I	**A. DIGITAL CIRCUITS EXPERIMENTS**: (at least 7 experiments are mandatory) 1. Realisation of SOP & POS functions after K map reduction 2. Half adder & Full adder realization using NAND gates 3. 4-bit adder/subtractor & BCD adder using IC 7483 4. BCD to decimal decoder and BCD to 7-segment decoder & display 5. Study of multiplexer IC and Realization of combinational circuits using multiplexers. 6. Study of counter ICs (7490, 7493) 7. Design of synchronous up, down & modulo N counters 8. Study of shift register IC 7495, ring counter and Johnsons counter 9. VHDL implementation of full adder, 4 bit magnitude comparator	24
II	**B. EMBEDDED SYSTEM EXPERIMENTS**: (Out of first six, any two experiments using 8085 and any two using 8086. Out of the last 3 experiments, any two experiments using 8051 or any other open source hardware platforms like PIC, Arduino, MSP430, ARM etc) (at least 5 experiments are mandatory) 1. Data transfer instructions using different addressing modes and block transfer. 2. Arithmetic operations in binary and BCD-addition, subtraction, multiplication and division	21

	3. Logical instructions- sorting of arrays in ascending and descending order 4. Binary to BCD conversion and vice versa. 5. Interfacing D/A converter- generation of simple waveforms-triangular wave, ramp etc 6. Interfacing A/D converter 7. Square wave generation. 8. LED and LCD display interfacing 9. Motor control	
	TOTAL HOURS	45

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	FLOYD T.L, DIGITAL FUNDAMENTALS , 10/E, PEARSON EDUCATION
T	C.H.ROTH AND L.L.KIMNEY FUNDAMENTALS OF LOGIC DESIGN, 7/E, CENGAGE LEARNING
T	RAMESH GAONKAR, MICROPROCESSOR ARCHITECTURE, PROGRAMMING AND APPLICATIONS WITH 8085, PENRAM INTL.
T	MOHAMED ALI MAZIDI,JANICE GILLISPIE MAZIDI," THE 8051 MICROCONTROLLER AND EMBEDDED SYSTEMS USING ASSEMBLY AND C", 2/E, PEARSON EDUCATION /PHI
T	RAY AJOY AND BURCHANDI, ADVANCED MICROPROCESSOR & PERIPHERALS, TATA MCGRAW HILL, EDUCATION, NEW DELHI, SECOND EDITION.
T	SCOTT MACKENZIE, RAPHAEL C W PHAN, " THE 8051 MICROCONTROLLER", FOURTH EDITION, PEARSON EDUCATION

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
EE204	DIGITAL ELECTRONICS AND LOGIC DESIGN	DIGITAL ELECTRONICS	IV
EE309	MICROPROCESSOR AND EMBEDDED SYSTEMS	8085 AND 8086 MICROCONTROLLERS AND 8051 MICROCONTROLLER ARCHITECTURE AND PROGRAMMING	V

COURSE OBJECTIVES:

1	TO IMPART PRACTICAL EXPERIENCE IN THE DESIGN AND SETUP OF DIGITAL CIRCUITS AND EMBEDDED SYSTEMS.

COURSE OUTCOMES:

SNO	DESCRIPTION	Blooms' Taxonomy Level
1	Design, setup and analyse various digital circuits.	Analysis [Level 4]
2	Students will be able to program and explain 8085 microprocessor for different applications	Application [Level 3]
3	Students will be able to program and use advanced microprocessors	Analysis [Level 4]

4	Students will be able to program and interface 8051 microcontroller	Analysis [Level 4]
5	Students will be able to combine different system for a practical applications	Synthesis [level 5]

MAPPING COURSE OUTCOMES (COs) – PROGRAM OUTCOMES (POs) AND COURSE OUTCOMES (COs) – PROGRAM SPECIFIC OUTCOMES (PSOs)

	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
C 331.1	2		2				1		2			2			
C 331.2	2		1		1		1		1			2	1		1
C 331.3	2		1		1		1		1			2	1		1
C 331.4	2		1		1		1		1			2	1		1
C 331.5	2		1		1		1		1			2	1		1
EE 331	**2**		**1**		**1**		**1**		**1**			**2**	**1**		**1**

JUSTIFATIONS FOR CO-PO MAPPING

Mapping	L/H/M	Justification
C 331.1-PO1	M	With the basic knowledge, students will be able to find solutions for engineering problems
C 331.1-PO3	M	Students will be able to find solutions for specific needs of the society
C 331.1-PO7	L	Students can contribute for the sustainable development of the society
C 331.1-PO9	M	Students can contribute in group for different solutions, helping the team work
C 331.1-PO12	M	Students can build up from the basic knowledge to higher levels of digital circuits
C 331.2-PO1	M	Students will be able to make use of their basic knowledge on programming and interfacing of 8085 microprocessor to find solutions for engineering problems
C 331.2-PO3	L	Students will be able to design solutions for the issues of society with their knowledge on microprocessors
C 331.2-PO5	L	With the help of knowledge on microprocessors and programming they will be able to extend the area to the modern IT tools for many situations.
C 331.2-PO7	L	Students will be able to contribute for the sustainable development of the society.
C 331.2-PO9	L	The knowledge on microprocessors will help students for the team work
C 331.2-PO12	M	Stuents will be able to build up their knowlege in advanced systems
C 331.3-PO1	M	The basic knowledge on advanced microcontrollers can help students to reach solutions in many problems
C 331.3-PO3	L	Students will be able to design solutions in many areas
C 331.3-PO5	L	Modern IT tools can be made use in many situations
C 331.3-PO7	L	Students will be able to cpontribute for the sustainable development of the socienty

C 331.3-PO9	L	Will be able to contribute for the team work in reaching solutions for the problems
C 331.3-PO12	M	Students can build on their basics to go to the depths of knowledge
C 331.4-PO1	M	Students will be able to make use of their basic knowledge on programming and interfacing of 8051 microcontroller to find solutions for engineering problems
C 331.4-PO3	L	Students will be able to design solutions for the issues of society with their knowledge on microcontrollers
C 331.4-PO5	L	With the help of knowledge on microcontrollers and programming they will be able to extend the area to the modern IT tools for many situations.
C 331.4-PO7	L	Students will be able to contribute for the sustainable development of the society.
C 331.4-PO9	L	The knowledge on microcontrollers will help students for the team work
C 331.4-PO12	M	Stuents will be able to build up their knowlege in advanced systems
C 331.5-PO1	M	Students will be able to make use of their basic knowledge in embedded systems to find solutions for engineering problems
C 331.5-PO3	L	Students will be able to design solutions for the issues of society with their knowledge on embedded systems
C 331.5-PO5	L	With the help of knowledge on embedded systems and programming skill, they will be able to extend the area to the modern IT tools for many situations.
C 331.5-PO7	L	Students will be able to contribute for the sustainable development of the society.
C 331.5-PO9	L	The knowledge on embedded systems will help students for team work
C 331.5-PO12	M	Stuents will be able to build up their knowlege in advanced systems

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1.	SIMULATIONS OF THE RELEVANT EXPERIMENTS CAN BE DONE AND COMPARED WITH EXPERIMENTAL RESULTS.	SIMULATIONS CAN BE DONE USING MULTISIM SOFTWARE.	1, 3, 9, 12	1, 2
2..	INTERFACING OF STEPPER MOTORS WITH 8085 TO BE INCLUDED	INCLUDED AS ADVANCED EXPERIMENT IN THE COURSE	1,5,9,11	1, 3

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1.	DIFFERENT MODE COUNTERS.	ADDITIONAL CLASS	1, 3, 9, 12	1, 2

2.	PROJECT BASED ON EXPERIMENTS.	ADDITIONAL CLASS	1, 3, 9, 12	1, 2
3.	IMPLEMENTATION OF TRAFFIC SIGNAL CONTROL IN A COMPLEX JUNCTION.	PROJECT WORK	1,5,9,11	1, 3

WEB SOURCE REFERENCES:

1	PROF. PRAMOD AGARWAL (2013,JUNE 10) , ANALOG CIRCUITS [ONLINE], AVAILABLE:HTTP://NPTEL.IITM.AC.IN/COURSES/WEBCOURSECONTENTS/IIT-ROORKEE/ANALOG%20CIRCUITS/INDEX.HTM.
2	HTTP://NPTEL.IITM.AC.IN/COURSES/WEBCOURSE CONTENTS/IISCBANG/MICROPROCESSORS AND MICROCONTROLLERS/PDF/LECTURE_NOTES/LNM1.PDF
3	PROF. KRISHNA KUMAR (JULY 2012) MICROPROCESSOR AND CONTROLLERS WWW.NPTEL.COM RETRIEVED AUGUST 03, 2013, FROM URL : HTTP://NPTEL.IITM.AC.IN/COURSES/WEBCOURSE-CONTENTS/IISC BANG/MICROPROCESSORS%20AND%20MICROCONTROLLERS/NEW_INDEX1.HTML

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☑ CHALK & TALK	☐ STUD. ASSIGNMENT	☐ WEB RESOURCES	
☑ LCD/SMART BOARDS	☐ STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

☐ ASSIGNMENTS	☐ STUD. SEMINARS	☑ TESTS/MODEL EXAMS	☑ UNIV. EXAMINATION
☑ STUD. LAB PRACTICES	☑ STUD. VIVA	☑ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☑ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by

Fr. Mejo Gracevilla CMI
Mr. Jebin Francis

Approved by

Dr. Unnikrishnan PC
HOD EEE

8.2 COURSE PLAN

Batch A Date	Planned	Batch B Date
Day 1	Introduction Realisation of SOP & POS functions after K map reduction	Day 1
Day 2	Half adder & Full adder realization using NAND gates	Day 2
Day 3	4-bit adder/subtractor& BCD adder using IC 7483	Day 3
Day 4	BCD to decimal decoder and BCD to 7-segment decoder & display	Day 4
Day 5	Study of counter ICs (7490, 7493)	Day 5
Day 6	Design of synchronous up, down & modulo N counters	Day 6
Day 7	Study of shift register IC 74164, ring counter and Johnsons counter	Day 7
Day 8	Arithmetic operations in binary and BCD-addition, subtraction, multiplication and division (8085) Logical instructions- sorting of arrays in ascending and descending order (8085)	Day 8
Day 9	Square wave generation. (8051) LED and LCD display interfacing (8051)	Day 9
Day 10	Repeat Lab	Day 11
Day 11	Lab Exam	Day 12

8.3 LAB CYCLE

CYCLE I - *DIGITAL CIRCUIT EXPERIMENTS*

1. Realisation of SOP & POS functions after K map reduction
2. Half adder & Full adder realization using NAND gates
3. 4-bit adder/subtractor& BCD adder using IC 7483
4. BCD to decimal decoder and BCD to 7-segment decoder & display
5. Study of counter ICs (7490, 7493)
6. Design of synchronous up, down & modulo N counters
7. Study of shift register IC 74164, ring counter and Johnsons counter

CYCLE II - *EMBEDDED SYSTEM EXPERIMENTS*

8. Arithmetic operations in binary and BCD-addition, subtraction, multiplication and division (8085)
9. Logical instructions- sorting of arrays in ascending and descending order (8085)
10. Square wave generation. (8051)
11. LED and LCD display interfacing(8051)

8.4 OPEN QUESTIONS

1. Write a program to extract odd numbers in a given array and find the average of the odd numbers using 8051.
2. WAP to find factorial of a 8-bit number using 8085.
3. WAP to find N^N using 8085 where N>0
4. WAP to display today's date in seven segment display using 8085/8051
5. WAP to display your name in a seven segment display using 8085
6. WAP to find the numbers of multiples of 6 in an array of 8 bytes using INTEL 8085
7. WAP to function as calculator (8085)
8. WAP to generate 10 terms of Fibonacci series using 8085
9. WAP to generate a signal with 50% and 90% duty cycle with 1KHz frequency
10. WAP to separate even numbers from a given data array and find the largest one using 8085/8051
11. WAP to find X^3+5X^2 where X>0
12. WAP to evaluate $(a+b)^2/2$ using 8085
13. WAP to convert the given BCD to Hex. If the answer is odd subtract 05 from it otherwise add 02 to it, using 8085.
14. WAP to find the largest and the smallest from an array (Sort and find) using 8085
15. WAP to find $(A/B)^{1/2}$, A>B, A>0, B>0, using 8085.
16. Convert the given decimal number to hexadecimal format. If the number is odd add 03 to it. Otherwise subtract 03 form it using 8085.
17. WAP to separate odd numbers from a given data array and find the smallest one using 8051.
18. WAP to find the mean of first 10 numbers
19. WAP to perform (A+B)/(A-B), where A and B are two positive real numbers and A>B.
20. WAP to find the average of first 5 numbers
21. WAP to generate a square wave of 1KHz (1.5 KHz) frequency using 8051
22. WAP a program to perform $2X^2+5X$ where X>0
23. WAP to perform largest – Smallest in a data array

8.5 ADVANCED QUESTIONS

1. WAP to take mean of first five odd numbers
2. WAP to take mean of first five even numbers
3. Add two real numbers. If sum is positive, make a LED to glow for 1 second otherwise make it OFF
4. Interface microprocessor with stepper motor. If the number given is 00 make it to rotate in clockwise direction. If the number given is FF make it to rotate in CCW direction
5. Write a program to do down counter from 33, 32,31…..1
6. WAP to find $(A*B)^{1/2}$, where A and B are positive real numbers and A>B
7. WAP to perform X^3+2X^2+3X+2
8. WAP to show the output of a Johnson counter using LEDs
9. WAP to show the output of ring counter using LEDs
10. Write a program to find the largest and the smallest numbers of the given data array and perform $(Largest/Smallest)^{1/2}$
11. WAP to find the count of odd parity and even parity numbers in a data array and perform (O+E/O-E) where O- count of odd parity numbers and E-count of even parity numbers

9. EE333 ELECTRICAL MACHINES LAB II

9.1 COURSE INFORMATION SHEET

PROGRAMME : **Electrical & Electronics Engineering**	DEGREE : **B.TECH**
COURSE : **Electrical Machines Lab - II**	SEMESTER : **Fifth** CREDITS : **1**
COURSE CODE: **EE333** REGULATION: **UG**	COURSE TYPE : **CORE**
COURSE AREA/DOMAIN: **Electrical Machines**	CONTACT HOURS: **3 hours / week.**
CORRESPONDING LAB COURSE CODE (IF ANY): **Nil**	LAB COURSE NAME : **Nil**

SYLLABUS:

CYCLE	DETAILS	HOUR
I	1. REGULATION OF THREE PHASE ALTERNATOR BY EMF & MMF METHODS 2. REGULATION OF SALIENT POLE ALTERNATOR USING TWO REACTION THEORY 3. PERFORMANCE CHARACTERISTICS OF INDUCTION GENERATOR 4. V CURVES AND INVERTED V CURVES - ALTERNATOR 5a. NO-LOAD AND BLOCKED ROTOR TEST ON A THREE PHASE INDUCTION MOTOR 5b. CIRCLE DIAGRAM OF A THREE PHASE INDUCTION MOTOR	24
II	1. REGULATION OF AN ALTERNATOR BY POTIER METHOD USING A VARIABLE INDUCTIVE LOAD 2. SEPARATION OF LOSSES IN A THREE PHASE SQUIRREL CAGE INDUCTION MOTOR 3. V- AND INVERTED V-CURVES OF A SYNCHRONOUS MOTOR 4. LOAD TEST ON THREE PHASE SLIPRING INDUCTION MOTOR **OPEN QUESTIONS** (i) INDIRECT TEST ON THREE PHASE SQUIRREL CAGE INDUCTION MOTOR	12
	Total hours	48

TEXT/REFERENCE BOOKS:

T/R	BOOK TITLE/AUTHORS/PUBLICATION
T	Dr. P. S. Bimbra, *Electrical Machinery*, Khanna Publishers
T	Theraja B. L., A Textbook of Electrical Technology, S. Chand & Company, New

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
EE202	Synchronous and induction machines	To give exposure to the students about the concepts of alternating current machines, including their constructional details, principle of operation and performance analysis.	**S3**
BE101-03	**Introduction to Electrical Engineering**	The objective of this course is to set a firm and solid foundation in Electrical Engineering To equip the students with strong analytical skills and conceptual understanding of basic laws and analysis methods in electrical and in electrical and magnetic circuits.	**S1**

COURSE OBJECTIVE

To give hands on experience in testing Alternators, Three phase and Single phase Induction Motors and Induction generators

COURSE OUTCOMES:

Sl.	DESCRIPTI	Bloom's Taxonomy Level
1	Students will be able to **predict** the performance of Induction machines using standard equivalent circuit models	Application [Level3]
2	Students will be able to **select** the appropriate machines based on the application requirements	Knowledge [Level 1]
3	Students will be able to **illustrate** laboratory data and experimental results using professional quality graphical representations	Comprehension [Level 2]
4	Students will work in teams to conduct experiments, **analyze** results, and develop technically sound reports of outcomes.	Analysis [Level 4]

5	Students will be able to **identify** faults occurring in machines and take necessary corrective measures	Comprehension [Level 2]

MAPPING COURSE OUTCOMES (COs) – PROGRAM OUTCOMES (POs) AND COURSE OUTCOMES (COs) – PROGRAM SPECIFIC OUTCOMES (PSOs)

	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
C 232.1	3		3	3									2		
C 232.2	2	3		3										2	
C 232.3		2	2												
C 232.4				2					3						
C 232.5		3	3	3										2	
EE232	**1**	**2**	**2**	**3**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**1**	**0**

JUSTIFATIONS FOR CO-PO MAPPING

Mapping	L/H/M	Justification
C 232.1-PO1	H	Students will be able to apply the knowledge of AC machines to predict their performance
C 232.1-PO3	H	Students will be able to design system components based on the performance characteristics of AC machines
C 232.1-PO4	H	Students will be able to provide valid conclusions regarding complex engineering based on the characteristics of machines
C 232.2-PO1	M	Students can apply the knowledge of basic engineering to select machines based on the application
C 232.2-PO2	H	Students will be able to analyze the characteristics of various machines and provide substantiated conclusions
C 232.2-PO4	H	Students will be able to interpret the data the from various experiments and provide suggestions for different applications
C 232.3-	M	Student will be able to easily analyze the characteristics of machines

PO2		using graphical representations
C 232.3-PO3	M	Student will be able to design solutions for engineering problems from graphical representations
C 232.4-PO4	M	Student will be able to conduct experiments on AC Machines and interpret the data and provide valid suggestions
C 232.4-PO9	H	Student will be able to work as a team and function effectively in multidisciplinary environments
C 232.5-PO2	H	Student will be able to formulate the problems in the area of fault analysis of Synchronous and Induction machines
C 232.5-PO3	H	Student will be able to design solutions for faults occurring in machines
C 232.5-PO4	H	Students will be able to conduct investigations on machine faults and provide valid suggestions

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

Sl. NO:	**DESCRIPTION**	PROPOSED ACTIONS
1	It would be better for students if Cascade method of speed control technique for Induction motors is	To be included in Syllabus

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

1	MATLAB _ Simulink model can be used for enhanced learning and understanding the AC Machines.

WEB SOURCE REFERENCES:

1	Prof. Sasidhara Rao, , Prof. G. Sridhara Rao, Dr. Krishna Vasudevan (July 2012) Electrical Machine – 1 *www.nptel.com* Retrieved July 11, 2014, from URL: http://nptel.iitm.ac.in/ocurses/IIT-MADRAS

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☐ CHALK & TALK	☐STUD. ASSIGNMENT	☑WEB RESOURCES
☐LCD/SMART BOARDS	☐STUD. SEMINARS	☐ADD-ON COURSES

ASSESSMENT METHODOLOGIES-DIRECT

☐ASSIGNMENTS	☐STUD. SEMINARS	☐ TESTS/MODEL EXAMS	☐ UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☐ STUD. VIVA	☐MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ADD-ON COURSES	☐OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☐ STUDENT FEEDBACK ON FACULTY
☐ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐OTHERS

Prepared By; **Approved By;**

Mr. Thomas K.P **. Dr.Unnikrishnan P.C.**

HOD, DEE

9.2 COURSE PLAN

Date	**Experiment**	**Days**
Day 1	Regulation Of Three Phase Alternator By Emf & Mmf Methods	1
Day 2	Regulation Of Salient Pole Alternator Using Two Reaction Theory	2
Day 3	Performance Characteristics Of Induction Generator	3
Day 3	V Curves And Inverted V Curves - Alternator	4
Day 4	No-Load And Blocked Rotor Test On A Three Phase Induction Motor Circle Diagram Of A Three Phase Induction Motor	5
Day 4	Equivalent Circuit Of Single-Phase Induction Motor	6
Day 5	Regulation Of Alternator By Direct Loading	7
Day 6	Load Test On Three Phase Squirrel Cage Induction Motor	8
	Cycle II	
Day 7	Regulation Of An Alternator By Potier Method Using A Variable Inductive Load	1
Day 7	Separation Of Losses In A Three Phase Squirrel Cage Induction Motor	2
Day 8	V- And Inverted V-Curves Of A Synchronous Motor	3
Day 8	Load Test On Three Phase Slipring Induction Motor	4
Day 9	**Model Exam – 17 students DAY 1**	
Day 10	**Model Exam – 16 students DAY2**	

9.3 LAB CYCLE

CYCLE I

1. Regulation of Three phase Alternator by MMF & EMF Methods
2. Regulation Of Salient Pole Alternator Using Two Reaction Theory
3. Performance Characteristics Of Induction Generator
4. V Curves And Inverted V Curves - Alternator
5. No-Load And Blocked Rotor Test On A Three Phase Induction Motor
6. Circle Diagram Of A Three Phase Induction Motor
7. Equivalent Circuit Of Single-Phase Induction Motor

CYCLE II

1. Regulation Of An Alternator By Potier Method Using A Variable Inductive Load
2. Separation Of Losses In A Three Phase Squirrel Cage Induction Motor
3. V- And Inverted V-Curves Of A Synchronous Motor
4. Load Test On Three Phase Slipring Induction Motor

9.4 OPEN QUESTIONS

1. Predetermine the % Voltage Regulation of a Non-salient pole alternator at Full load 0.8 pf lag, using Pessimistic method.
2. Predetermine the % Voltage Regulation of a Non-salient pole alternator at Full load 0.8 pf lead, using pessimistic method.
3. Predetermine the % Voltage Regulation of a Non-salient pole alternator at Full load u.p.f, using pessimistic method.
4. Predetermine the % Voltage regulation of a Smooth cylindrical alternator at 3/4th Full load 0.866 pf lag, using e.m.f method.
5. Predetermine the % Voltage Regulation of a Smooth cylindrical alternator at 3/4th Full load 0.866 pf lead, using e.m.f method.
6. Predetermine the % Voltage Regulation of a Smooth cylindrical alternator at 3/4th Full load u.p.f, using e.m.f method.
7. Conduct a suitable experiment on a given round rotor alternator to determine its synchronous impedance. Also predetermine the %Voltage Regulation at Full load 0.8 p.f. leading. Draw the phasor diagram.
8. Conduct a suitable experiment on a given round rotor alternator to determine its synchronous impedance. Also predetermine the %Voltage Regulation at Full load 0.8 p.f. lagging. Draw the phasor diagram.
9. Conduct a suitable experiment on a given round rotor alternator to determine its synchronous impedance. Also predetermine the %Voltage Regulation at Full load u.p.f. Draw the phasor diagram.
10. Predetermine the % Voltage Regulation of a Non-salient pole alternator at 3/4th Full load 0.8 pf lag, using Synchronous Impedance method.
11. Predetermine the % Voltage Regulation of a Non-salient pole alternator at 3/4th Full load 0.8 pf lead, using Synchronous Impedance method.
12. Predetermine the % Voltage Regulation of a Non-salient pole alternator at 3/4th Full load u.p.f, using Synchronous Impedance method.
13. Predetermine the % Voltage Regulation of a Smooth cylindrical alternator at Full load 0.866 pf lead, using Optimistic method.
14. Predetermine the % Voltage Regulation of a Smooth cylindrical alternator at Full load 0.866 pf lag, using Optimistic method.
15. Predetermine the % Voltage Regulation of a Smooth cylindrical alternator at Full load u.p.f, using Optimistic method.
16. Predetermine the % Voltage Regulation of a Non-salient pole alternator at 3/4th Full load 0.8 pf lead, using m.m.f method.
17. Predetermine the % Voltage Regulation of a Non-salient pole alternator at 3/4th Full load 0.866 pf lead using Optimistic method.
18. Predetermine the % Voltage Regulation of a Non-salient pole alternator at 3/4th Full load u.p.f, using m.m.f method.
19. Predetermine the % Voltage Regulation of a Smooth cylindrical alternator at Full load u.p.f using Potier method.
20. Predetermine the % Voltage Regulation of a Smooth cylindrical alternator at **3/4th** Full load 0.866 p.f lag, using Potier method.
21. Predetermine the % Voltage Regulation of a Smooth cylindrical alternator at **1.25 times** Full load, 0.8 p.f lead, using Potier method.
22. Predetermine the % Voltage Regulation of a Smooth cylindrical alternator at Full load u.p.f using ZPF method.

23. Predetermine the % Voltage Regulation of a Smooth cylindrical alternator at Full load 0.8 p.f lag, using ZPF method.
24. Predetermine the % Voltage Regulation of a Smooth cylindrical alternator at Full load 0.8 p.f lead, using ZPF method.
25. Conduct a proper test on a given round rotor alternator to determine its Potier reactance.
26. Conduct proper tests on a non-salient pole alternator and determine the field current required to overcome the effect of armature reaction drop at Full load.
27. Predetermine the % Voltage Regulation of a Salient pole alternator at Full load 0.8 p.f lag, using suitable method.
28. Predetermine the % Voltage Regulation of a Salient pole alternator at full load 0.8 p.f lead, using suitable method.
29. Predetermine the % Voltage Regulation of a Salient pole alternator at full load u.p.f, using suitable method.
30. Predetermine the % Voltage Regulation of a Salient pole alternator at Full load 0.8 p.f lag, using Blondel's method.
31. Predetermine the % Voltage Regulation of a Salient pole alternator at full load 0.8 p.f lead, using Blondel's method.
32. Predetermine the % Voltage Regulation of a Salient pole alternator at full load u.p.f, using Blondel's method.
33. Predetermine the % Voltage Regulation of a Salient pole alternator at Full load 0.8 p.f lag, using Slip test.
34. Predetermine the % Voltage Regulation of a Salient pole alternator at full load 0.8 p.f lead, using Slip test.
35. Predetermine the % Voltage Regulation of a Salient pole alternator at full load u.p.f, using Slip test.
36. For a given A.C. Machine, determine the reactances due to the effect of saliency of the rotor by conducting suitable tests.
37. Conduct suitable experiments on a Salient pole alternator to determine its synchronous reactances.
38. Plot the performance characteristics (η Vs O/P, p.f Vs O/P & % slip Vs O/P) of the given Induction Generator.
39. Plot the performance characteristics (η Vs O/P, p.f Vs O/P & % slip Vs O/P) of the given Induction Machine when the same is operated at super synchronous speed.
40. Run the given 3 φ Induction machine at a hyper synchronous speed and determine the efficiency and p.f. at a particular load current (5A).
41. Run the given 3 φ Induction machine at a leading p.f. operation and determine the slips at a load current of 5 A.
42. Conduct a proper test on a given 3 φ Induction machine, allowing it to run with a negative slip and determine the p.f. and efficiency at any two load currents.
43. Plot the V curve & Inverted V curve of the given alternator at an output of 1800W.
44. Plot the V curve & Inverted V curve of the given alternator at no-load.
45. Plot the variation of armature current with field current of the given alternator at an output of 1800W
46. Plot the variation of p.f. with field current of the given 3 φ alternator at an output of 1800W.
47. Plot the variation of armature current with field current of the given 3 φ alternator at no-load condition.
48. Plot the variation of p.f. with field current of the given 3 φ alternator at no-load condition.

49. Plot the p.f. Vs I_f characteristics of the given 3 φ Synchronous Motor at an output load of 2160 W.
50. Plot the V-Curve of the given 3 φ Synchronous Motor at No-load.
51. Plot the Inverted V-Curve of the given 3 φ Synchronous Motor at an output load of 2160W
52. Plot the Armature current Vs I_f characteristics of the given 3 φ Synchronous Motor at No-load.
53. Plot the Armature current Vs field current characteristics of the given 3 φ Synchronous Motor at a power output of 2160W.
54. Plot the p.f. Vs field current characteristics of the given 3 φ Synchronous Motor at a power output of 2160W.
55. Draw the exact equivalent circuit of the given 3φ Induction motor by conducting suitable tests.
56. Determine the total resistance & leakage reactance per phase of the given 3φ Squirrel Cage Induction motor referred to stator by conducting suitable test.
57. By conducting suitable tests, determine the Power input to the Rotor, Efficiency and Torque developed at a slip of 0.04 of the given 3φ Squirrel Cage Induction motor.
58. By conducting suitable tests, draw the circle diagram of the given 3 φ Induction motor & obtain the maximum power output.
59. For a given 3 φ Induction motor, pre-determine the maximum power output by conducting proper tests.
60. Conduct proper tests on a 3 φ Induction motor and determine the input p.f. at a slip of 4% using exact equivalent circuit.
61. Conduct suitable tests on a 3 φ Induction motor and obtain maximum torque that the motor can develop.
62. Conduct suitable tests on a 3 φ Induction motor and obtain maximum power output that the motor can develop.
63. By conducting suitable tests, draw the circle diagram of the given 3 φ Induction motor & obtain the maximum torque.
64. By conducting suitable tests, draw the circle diagram of the given 3 φ Induction motor & obtain the stator current at full load power.
65. By conducting suitable tests, draw the circle diagram of the given 3 φ Induction motor & obtain the efficiency at full load condition.
66. By conducting suitable tests, draw the circle diagram of the given 3 φ Induction motor & obtain the slip at full load condition.
67. Determine equivalent resistance and reactance of a given 3 φ Induction motor. Also construct the circle diagram.
68. Draw the equivalent circuit of the given **1 φ** Induction motor based on double field revolving theory by conducting suitable tests.
69. For the given **1 φ** Induction motor, determine the rotor circuit resistance with respect to the forward and backward rotating fields.
70. For the given **1 φ** Induction motor, determine the equivalent resistance and reactance with respect to the forward and backward rotating fields.
71. Conduct proper test on the given 3-phase Alternator and **determine** its Voltage regulation at Full load, u.p.f.
72. Conduct proper test on the given 3-phase Alternator and plot the % Voltage regulation Vs power output. Load may be taken as a resistive load.

73. Conduct a load test on a three phase squirrel cage induction motor to obtain the following performance characteristics: Torque vs Output, Efficiency vs Output, Input current vs Output, p.f. vs Output and slip vs Output.
74. Conduct a load test on a three phase Conduct proper test on the given 3-phase Alternator and plot the % Voltage regulation Vs power output. Load may be taken as a resistive load.
75. Conduct a load test on a three phase squirrel cage induction motor and obtain the Input current, p.f. and slip at half full load.
76. Conduct a load test on a three phase squirrel cage induction motor and obtain the Torque and Efficiency at full load.
77. Conduct a load test on a three phase Slip Ring induction motor and obtain the Input current, p.f. and slip at 11 A load.
78. Conduct a load test on a three phase Slip Ring induction motor and obtain the Torque and Efficiency at 11.5 A load.
79. Separate the constant loss of a given three phase squirrel cage induction motor into its components at rated voltage. ie. Iron Loss & Mechanical Loss.

9.5 ADVANCED QUESTIONS

1. Voltage Regulation Of An Alternator By Feeding Back To Mains
2. Cascade Operation Of Induction Motor

10. EE341 DESIGN PROJECT

10.1 COURSE INFORMATION SHEET

PROGRAMME: ELECTRICAL AND ELECTRONICS ENGINEERING	DEGREE: BTECH
COURSE: DESIGN Project	SEMESTER: S5 CREDITS: 2
COURSE CODE: EE341 REGULATION: 2017	COURSE TYPE: CORE
COURSE AREA/DOMAIN: ENGINEERING (All Branches)	CONTACT HOURS: 1 (Tut) + 2(PRACTICAL) HOUR/WEEK
CORRESPONDING LAB COURSE CODE (IF ANY): NIL	LAB COURSE NAME: NIL

SYLLABUS:

MODULE	CONTENTS	HOURS	SEM. EXAM MARKS
I (Study)	Study : Take minimum three simple products, processes or techniques in the area of specialisation, study, analyse and present them. The analysis shall be focused on functionality, strength, material, manufacture/construction, quality, reliability, aesthetics, ergonomics, safety, maintenance, handling, sustainability, cost etc. whichever are applicable. Each student in the group has to present individually; choosing different products, processes or techniques.	**L10**	**50%**
II (Design)	The project team shall identify an innovative product, process or technology and proceed with detailed design. At the end, the team has to document it properly and present and defend it. The design is expected to concentrate on functionality, design for strength is not expected.	**L30**	**50%**

TEXT/REFERENCE BOOKS:

T/R	
T1	Balmer, R. T., Keat, W. D., Wise, G., and Kosky, P., Exploring Engineering, Third Edition: An Introduction to Engineering and Design - [Part 3 - Chapters 17 to 27], ISBN-13: 978-0124158917 ISBN-10: 0124158919
T2	Dym, C. L., Little, P. and Orwin, E. J., Engineering Design - A Project based introduction - Wiley, ISBN-978-1-118-32458-5
T3	Eastman, C. M. (Ed.), Design for X Concurrent engineering imperatives, 1996, XI, 489 p. ISBN 978-94-011-3985-4 Springer
T4	Haik, Y. And Shahin, M. T., Engineering Design Process, Cengage Learning, ISBN-13: 978-0-495-66816-9

T5	Pahl, G., Beitz, W., Feldhusen, J. and Grote, K. H., Engineering Design: A Systematic
T6	Pahl, G., Beitz, W., Feldhusen, J. and Grote, K. H., Engineering Design: A Systematic Approach, 3rd ed. 2007, XXI, 617p., ISBN 978-1-84628-319-2
T7	Voland, G., Engineering by Design, ISBN 978-93-325-3505-3, Pearson India
R1	Michael Luchs, Scott Swan, Abbie Griffin, 2015. Design Thinking. 405 pages, John Wiley & Sons, Inc
R2	E-Book: http://opim.wharton.upenn.edu/~ulrich/designbook.html

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
BE102	Design Engineering	Design Thinking Process	S2

COURSE OBJECTIVES:

1	To understand the engineering aspects of design with reference to simple products
2	To foster innovation in design of products, processes or systems
3	To develop design that add value to products and solve technical problems

COURSE OUTCOMES:

Sl. NO	DESCRIPTION	Blooms' Taxomomy Level
C341.1	Think innovatively on the development of components, products, processes or technologies in the engineering field.	Level 1, Level 3, Level 4
C341.2	Analyse the problem requirements and arrive workable design solutions.	Level 1 Level 2 Level 4
C341.3	Ability to think of different solution to a given problem, compare different solutions and to determine the optimum design solution among them	Level 2 Level 3 Level 6
C341.4	Has the course made you to observe and analyse the different designs around you in your daily life and made you to think creatively	Level 1 Level 4 Level 6

C341.5	Have you identified and prioritized the different features (expected, normal and exciting) that needs to be chosen while designing a product.	Level 1 Level 4 Level 6
C341.6	Has the course Design and Engineering developed your ability to adapt to different groups and to propose your ideas to the success of the group?	Level 6

CO-PO AND CO-PSO MAPPING

	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**
C341.1	-	-	-	-	-	-	-	-	**3**	**2**	**3**	-	-	-	-
C341.2	-	**3**	-	-	-	-	-	-	-	-	-	**2**	-	-	-
C341.3	**3**	**3**	**2**	**2**	-	-	-	-	-	-	-	**2**	-	-	-
C341.4	**2**	-	-	**1**	-	**1**	-	-	-	-	-	**3**	-	-	**2**
C341.5	-	**1**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
C341.6	-	-	-	-	-	-		-	**3**	**3**	**3**	**3**	-	-	-

1- Low correlation (Low), 2- Medium correlation(Medium) , 3-High correlation(High)

JUSTIFATIONS FOR CO-PO MAPPING

MAPPING	LOW/MEDIUM/HIGH	JUSTIFICATION
C341.1 – PO9	H	Students should use the knowledge to develop solutions for problems
C341.1 - PO10	M	Students could use the knowledge to for implementation of their Ideas
C341.1– PO11	H	Students need to Identify the problem to solve it
C341.2 – PO2	H	Need to analyze different solutions to a problem
C341.2 – PO12	M	Review/ Research is required to identify different features
C341.3-PO1	H	To Find the optimum solution
C341.3-PO2	H	To provide features to a product after considering all aspects
C341.3-PO3	M	To think of different solutions
C341.3-PO4	M	Creative thoughts
C341.3-PO12	M	To observe the need of the society
C341.4-PO1	M	Increase the ability to work in a team
C341.4-PO4	L	Increase the ability to work in a team
C341.4-PO6	L	Increased the communication within the group
C341.4-PO12	H	Increased the communication within the group
C341.5-PO2	L	Skills to lead a team
C341.5-PO3	H	Skills to lead a team
C341.6-PO9	H	Skills to identify the need
C341.6-PO10	H	Identify different solutions to a problem
C341.6-PO11	H	Increase observational skills

C341.6-PO12	H	Increase the ability to work in a team

JUSTIFATIONS FOR CO-PSO MAPPING

MAPPING	LOW/MEDIUM/HIGH	JUSTIFICATION
C341.4-PSO3	M	Continued Learning

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SI NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Market survey	Activity to prepare questionnaire on market survey, HOQ	1, 6	2

WEB SOURCE REFERENCES:

1	E-Book: http://opim.wharton.upenn.edu/~ulrich/designbook.html
2	http://www2.warwick.ac.uk/fac/sci/wmg/ftmsc/modules/modulelist/peuss/designforx/design_for_x_notes

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☐ **CHALK & TALK**	☐ **STUD. ASSIGNMENT**	☐ WEB RESOURCES
☐ LCD/SMART BOARDS	☐ STUD. SEMINARS	☐ ADD-ON COURSES

ASSESSMENT METHODOLOGIES-DIRECT

☐ **ASSIGNMENTS** √	☐ STUD. SEMINARS √	☐ **TESTS/MODEL EXAMS** √	☐ **UNIV. EXAMINATION** √
☐ STUD. LAB PRACTICES √	☐ STUD. VIVA √	☐ MINI/MAJOR PROJECTS √	☐ CERTIFICATIONS √
☐ ADD-ON COURSES √	☐ OTHERS (Skill Development) √		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	☐ **STUDENT FEEDBACK ON FACULTY (TWICE)**
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

Prepared by **Approved by**

Mr.Unnikrishnan L **Dr. Unnikrishnan P.C.**

(Faculty) **(HOD)**

10.2 COURSE PLAN

Sl.No	Module	Planned Date	Planned
1	1	Aug-18	Discussion of Design Project , Team building, Problem identification.
2	1	Aug-18	Brain Storming Session 1
3	1	Aug-18	Brain Storming Session 2, Activities to have result oriented Thinking.
4	1	Sep-18	Submission of Study Part Team Wise.
5	1	Sep-18	Presentation 1
6	1	Sep-18	Presentation 2
7	1	Oct-18	Presentation 3
8	1	Oct-18	Presentation 4
9	1	Oct-18	Presentation A
10	1	Oct-18	Presentation B
11	1	Nov-18	Presentation C
12	1	Nov-18	Presentation D
13	1	Nov-18	Final Report Submission