PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637 018
(AUTONOMOUS)
B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATIONS 2015

SEMESTER V							
Theory							
1	BS	MA15501	Numerical Methods	3	2	0	4
2	PC	EE15501	Power Electronics	3	0	0	3
3	PC	EE15502	Electrical Machines II	3	0	0	3
4	ES	EE15503	Computer Architecture	3	0	0	3
5	PC	EE15504	Electrical Power Generation	3	2	0	3
6	PE	EE1515*	Elective I	3	0	0	3
Practical							
7	PC	EE15505	Electrical Machines II Laboratory	0	0	4	2
8	PC	EE15506	Power Electronics Laboratory	0	0	4	2
9	EE	GE16501	Career Development Laboratory I	0	0	2	1
			TOTAL	**18**	**2**	**10**	**23**
SEMESTER VI							
Theory							
1	PC	EE15601	Design of Electrical Apparatus	3	2	0	4
2	PC	EE15602	Solid State Drives	3	0	0	3
3	PC	EE15603	Power System Analysis	3	0	0	3
4	PC	EE15604	Microprocessors and Microcontrollers	3	0	0	3
5	PC	EE15605	Digital Signal Processing	3	2	0	4
6	PE	EE1525*	Elective II	3	0	0	3
Practical							
7	PC	EE15606	Electrical Drives Laboratory	0	0	4	2
8	PC	EE15607	Microprocessors and Microcontrollers Laboratory	0	0	4	2
9	EE	GE15601	Career Development Laboratory II	0	0	2	1
			TOTAL	**18**	**4**	**10**	**25**

LIST OF ELECTIVES							
S.No	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
PROGRAMME ELECTIVE I (PE)							
1	PE	EE15151	Bio Medical Engineering	3	0	0	3
2	PE	EE15152	Electrical Safety	3	0	0	3
3	PE	EE15153	Digital Control Engineering	3	0	0	3
4	PE	EE15154	Nano Science	3	0	0	3
5	PE	EE15155	Network Analysis and Synthesis	3	0	0	3
PROGRAMME ELECTIVE II(PE)							
6	PE	EE15251	Micro Electro Mechanical Systems	3	0	0	3
7	PE	EE15252	Industrial Robotics	3	0	0	3
8	PE	EE15253	Soft Computing Techniques	3	0	0	3
9	PE	EE15254	Wind and Solar Energy System	3	0	0	3
10	PE	EE15255	Switched Mode Power Converter	3	0	0	3

SEMESTER V

MA15501 **NUMERICAL METHODS** **3 2 0 4**

(COMMON TO CSE,EEE & CHE)

COURSE OBJECTIVES

- To analyse different methods to find solution for a large system of linear equations
- To find the intermediate values for a series of given data
- To develop efficient algorithms for solving problems in science, engineering and technology
- To solve the non linear differential equations that cannot be solved by regular conventional method.
- To apply finite element method to increase the accuracy of second order differential equations

UNIT I SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 15

Solution of equation –Iteration method : Newton Raphson method – Solution of linear system by Gaussianelimination and Gauss - Jordon method – Iterative method – Gauss-Seidel method – Inverse of a matrix by Gauss Jordon method – Eigenvalue of a matrix by power method.

UNIT II INTERPOLATION AND APPROXIMATION 15

Lagrangian Polynomials – Divided differences – Newton's Divided Difference, Hermite Interpolation Polynomial and Interpolating with a cubic spline – Newton's forward and backward difference formulas.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 15

Differentiation using interpolation formulae –Numerical integration by trapezoidal and Simpson's 1/3– Romberg's method – Two and Three point Gaussian quadrature formulas – Double integrals using trapezoidal and Simpsons' rule.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 15

Single step methods: Taylor series method – Modified Euler method for first order equation – Fourth order Runge – Kutta method for solving first and second order equations – Multistep methods: Milne's and Adam's predictor and corrector methods.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 15

Finite difference solution of second order ordinary differential equation – Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

TOTAL PERIODS 75

COURSE OUTCOMES

At the end of this course, students will be able to

- comprehend the basics of linear equations.
- apply the interpolation methods for constructing approximate polynomials
- demonstrate the knowledge of numerical differential equations in computational and simulation process
- utilize the concept of initial value problems in the field of science and engineering

- describe the computational procedure of the amount of heat emitted or transferred from an object

TEXT BOOKS

1. Erwin Kreyszig., "Advanced Engineering Mathematics" 10th edition, Wiley Publications, 2010.
2. T. Veerarajan. and T .Ramachandran, "Numerical Methods with programming in C", 2nd ed., Tata McGraw-Hill, 2006.
3. Sankar Rao K " Numerical Methods For Scientisits And Engineers –3rd Edition Princtice Hall of India Private, New Delhi, 2007.

REFERENCES

1. P. Kandasamy, K. Thilagavathy and K. Gunavathy, "Numerical Methods", S.Chand Co. Ltd., New Delhi, 2003
2. Gerald C.F. and Wheatley, P.O., "Applied Numerical Analysis" 6th Edition, Pearson Education Asia, New Delhi, 2002.
3. M.K.Jain , S.R.K. Iyangar , R.K.Jain , "Numerical Methods For Scientific & Engineering Computation" New Age International (P) Ltd , New Delhi , 2005.
4. M.B.K. Moorthy and P.Geetha, "Numerical Methods" , Tata McGraw Hill Publications company, New Delhi, 2011.

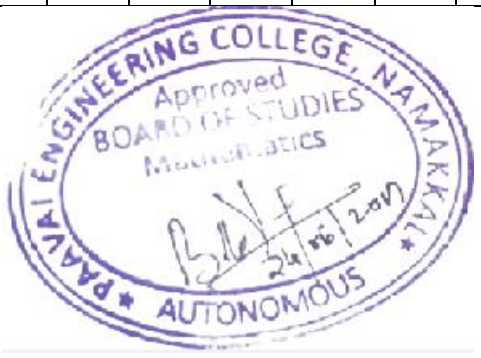
WEB LINKS

1. https://www.youtube.com/watch?v=QTQ8bO1F-Dg
2. https://www.youtube.com/watch?v=AT7Olelic8U
3. https://www.youtube.com/watch?v=TH06N7Q7FJw
4. https://www.youtube.com/watch?v=DnBJLpdVHCY
5. https://www.youtube.com/watch?v=5TccPEz2nB8

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	3	-	-	-	-	-	-	-	1	3	3
CO2	3	3	2	3	-	-	-	-	-	-	-	1	3	3
CO3	3	3	2	3	-	-	-	-	-	-	-	1	3	3
CO4	3	3	2	3	-	-	-	-	-	-	-	1	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	1	3	3



EE15501 **POWER ELECTRONICS** **3 0 0 3**

COURSE OBJECTIVES

- To impart knowledge on different types of power semi-conductor devices and their switching characteristics
- To understand the operation of converter and their firing circuits and different commutation techniques of power converters.
- To know the operation of various chopper conversion techniques and basics of resonance converter.
- To study the mode of inverters and different modulation techniques.
- To learn the types of AC voltage controllers and basics of matrix converters.

UNIT I POWER SEMICONDUCTOR DEVICES **9**

Study of switching devices, Diode, SCR, TRIAC, GTO, BJT, MOSFET, IGBT- Static and Dynamic Characteristics - Commutation: Natural Commutation, Forced commutation. snubber circuit.

UNIT II PHASE - CONTROLLED CONVERTERS **9**

2- pulse, 3-pulse and 6-pulseconverters – performance parameters – Effect of source inductance— gate circuit schemes for phase control–Dual converters.

UNIT III CHOPPER **9**

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

UNIT IV INVERTERS **9**

Single phase and three phase voltage source inverters (both120^0mode and180^0mode) –PWM techniques: Sinusoidal PWM, modified sinusoidal PWM - multi PWM – Introduction to space vector modulation – Current source inverter - Introduction to multilevel inverter.

UNIT V AC TO AC CONVERTORS **9**

Single phase and three phase AC voltage controllers – control strategy - power factor control – multistage sequence control - single phase and three phase cyclo converters – Introduction to matrix converters.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- identify and select the switching devices for different power converter applications.
- apply the different converter based on the application.
- design a suitable DC power supply for given load specification from DC supply.
- describe and analyze the single and three phase inverter.
- explain an AC voltage controller electromagnetic compatibility of power converters.

TEXT BOOKS

1. M.H.Rashid, Power Electronics: Circuits, Devices Applications, Pearson, 2013.
2. M.D. Singh and Khanchandani K.B., Power Electronics, Tata Mc.Graw Hill., 2016

REFERENCES

1. L.Umanand, Power Electronics Essentials and Applications, Wiley India Pvt Ltd,Reprint,2010.
2. G.K. Dubey, S.R. Doradla, A. Joshi and R.M.K. Sinha, Thyristorised Power Controllers, New Age International Publishers, 2012.
3. Ned Mohan,Tore M. Undeland and William P.Robins, Power Electronics – Converters, Applications and Design Third Edition, John Wiley and Sons, 2008.
4. R.S. Ananda Murthy and V. Nattarasu, Power Electronics: A Simplified Approach, Pearson/Sanguine Technical Publishers,2009 .
5. Daniel W.Hart, Power Electronics, McGraw-Hill Publishing Company Ltd, 2011.

WEB LINKS

1. http://www.completepowerelectronics.com/
2. http://www.irf.com/

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
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CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3

EE15502 **ELECTRICAL MACHINES II** **3 0 0 3**

COURSE OBJECTIVES

- To impart knowledge on operation of AC generators and methods for determining regulation of AC generator
- To understand the operation of AC motors and starting methods
- To learn the concepts of operating principle and predetermination of parameters of induction motor.
- To study the starters and speed control methods of various motors.
- To understand the operation of single phase induction motors and special machines.

UNIT I SYNCHRONOUS GENERATOR 9

Constructional details – Types of rotors – emf equation – Synchronous reactance – Armature reaction – Voltage regulation – E.M.F, M.M.F, Z.P.F and A.S.A methods – Synchronizing and parallel operation – Synchronizing torque - Change of excitation and mechanical input – Two reaction theory – Determination of direct and quadrature axis synchronous reactance using slip test – Operating characteristics.

UNIT II SYNCHRONOUS MOTOR 8

Principle of operation – Torque equation – Operation on infinite bus bars – V and inverted V curves – Power input and power Developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed.

UNIT III THREE PHASE INDUCTION MOTOR 12

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

UNIT IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 7

Need for starting – Types of starters – Stator resistance and reactance, rotor resistance, autotransformer and star-Delta starters – Speed control – Change of voltage, torque, number of poles and slip – Cascaded connection – Slip Power recovery scheme.

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Constructional details of single phase induction motor – Double revolving field theory and operation – Equivalent circuit– No load and blocked rotor test – Performance analysis – Starting methods of single- phase induction motors – Special machines - Shaded pole induction motor, reluctance motor, repulsion motor, hysteresis motor, stepper motor and AC series motor.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- determine the regulation of synchronous generator.
- analyze the performance of synchronous motor.
- study the performance of three phase induction motor.
- understand the concept of starting and speed control of induction motors.
- know the operation of single phase induction motor and special machines.

TEXT BOOKS

1. B.L.Theraja, A.K.Theraja, Electrical Technology, Volume 2, S.Chand Publishers, 2009.
2. D.P. Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill Publishing Company Ltd, 2010.

REFERENCES

1. A.E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, "Electric Machinery", Tata McGraw Hill publishingCompany Ltd, 2008.
2. J.B. Gupta, "Theory and Performance of Electrical Machines", S.K.Kataria and Sons, 2015. International Publishers, 2012.
3. K. Murugesh Kumar, "Electric Machines", Vikas publishing house Pvt Ltd, 2002.\
4. Mehta. V.K and Rohit Mehta, "Principle of Electrical Machines", S.Chand Publishers, 2009.
5. Rajput. R.K, "A Text Book of Electrical Machines", Firewall Media, 2008.

WEB LINKS

1. http://www.nptel.ac.in/courses/Webcourse
2. http://geosci.uchicago.edu/~moyer/GEOS24705/Readings/Klempner_Ch1.pdf
3. http://educypedia.karadimov.info/library/eet_ch6.pdf

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	Programme Outcomes PO's												PSO's	
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CO3	3	3	3	-	3	-	-	-	-	-	3	-	3	3
CO4	3	3	-	-	-	-	-	-	-	-	3	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	3	-	3	3

EE15503 **COMPUTER ARCHITECTURE** **3 0 0 3**

COURSE OBJECTIVES

- To impart the knowledge about the basic concepts of computer organization, instruction formats.
- To gain the knowledge about control and central processing unit, various addressing modes.
- To study about computer arithmetic and pipeline processing in computers.
- To learn the different ways of communicating with I/O devices and standard I/O interfaces.
- To obtain the knowledge about the memory organization in computers.

UNIT I DATA REPRESENTATION, ORGANIZATION AND DESIGN 9

Data representation: Data types, complements, fixed–point representation, floating-point representation, other Binary codes, error detection codes. Basic computer organization and design: Instruction codes, computer registers, computer instructions, timing and control, instruction cycle, memory reference instructions, input output and interrupt. Complete computer description, design of basic computer, design of accumulator logic.

UNIT II CONTROL AND CENTRAL PROCESSING UNIT 9

Micro programmed control : Control memory, address sequencing, micro-program example, Design of control unit. Central processing unit: General register organization, stack organization, instruction formats, addressing modes, data transfer and manipulation, program control, reduced instruction set computer.

UNIT III COMPUTER ARITHMETIC, PIPELINE AND VECTOR PROCESSING 9

Computer arithmetic: Addition and subtraction, multiplication algorithms, division algorithms- floating-point-Arithmetic operations: decimal arithmetic unit, decimal arithmetic operations. Pipeline and vector processing: Parallel processing, pipelining, arithmetic pipeline, instruction pipeline, RISC pipeline- vector processing array processors.

UNIT IV INPUT-OUTPUT AND INTERFACES 9

Input - output organization, Peripheral devices - input-output interface, asynchronous data transfer, modes of transfer, priority interrupt, direct memory access, input-output processor, serial communication.

UNIT V MEMORY ORGANIZATION 9

Memory organization: Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, Virtual memory, memory management hardware.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- understand the organization of basic computer.
- know the concept of memory organization and the basic parallel processing.
- analyze the operation of central processing and arithmetic logic units.
- perform pipelining and vector processing operations.
- obtain knowledge on input output organization of computers.

TEXT BOOKS

1. Morris Mano M, "Computer System Architecture", Prentice Hall of India , New Delhi, Third Edition, 2009.
2. B. Parhami, "Computer Architecture", Oxford University Press, 2005.

REFERENCES

1. J.P. Hayes, Sivarama. P. Dandamudi,Computer Architecture, McGraw-Hill 2004.
2. Vincent P.Heuring and Harry F.Jordan, 'Computer Systems Design and Architecture', Pearson Education Asia Publications, 2008.
3. John P.Hayes, 'Computer Architecture and Organization', Tata McGraw Hill, 2012.
4. Andrew S.Tanenbaum, 'Structured Computer Organization', 6th Edition, Prentice Hall of India/Pearson Education, 2012.
5. William stallings, "Computer Organization and Architecture" 6th Edition, Prentice Hall of India/Pearson Education,

WEB LINKS

1. www.inetdaemon.com/tutorials/computers/hardware/cpu
2. http://faculty.qu.edu.qa/malmeer/503263/ch9.pdf
3. http://www.zeepedia.com/read.php?virtual_memory_organization_advance_computer_architecture

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CO2	3	-	3	2	3	-	-	-	-	-	3	-	3	3
CO3	3	3	3	-	-	-	-	-	-	-	3	-	3	3
CO4	3	-	-	-	-	-	-	-	-	-	3	-	3	3
CO5	3	-	-	-	-	-	-	-	-	-	3	-	3	3

EE15504 **ELECTRICAL POWER GENERATION** **3 0 0 3**

COURSE OBJECTIVES

- To understand basic concepts of thermal and hydro power plants.
- To know the basic structure and operation of nuclear and diesel power plants.
- To study basic concepts and applications of solar photovoltaic power conversion systems.
- To understand basic concepts of wind power conversion system and types of power generators.
- To learn the tariff and economic aspects in power generation.

UNIT I THERMAL AND HYDRO POWER STATION 9

Thermal power station: Schematic arrangement , choice of site, efficiency of steam power station, Types of prime movers – Environmental aspects for selecting the sites and locations of thermal power stations. Hydro power station : Schematic arrangement , choice of site constituents of hydro power plant, Hydro turbine. Environmental aspects for selecting the sites and locations of hydro power stations

UNIT II NUCLEAR AND DIESEL POWER STATION 9

Nuclear power station: Schematic arrangement, selection of site, types of reactors, Hazards, Environmental aspects for selecting the sites and locations of nuclear power stations. Diesel power station: Schematic arrangement, Choice and characteristic of diesel engines.

UNIT III SOLAR PHOTOVOLTAIC POWER CONVERSION SYSTEMS 9

Solar Photovoltaic (SPV) systems: Operating principle, Photovoltaic cell concepts, Types of solar cells, fabrication Of SPV cells, Cell, module, array (Series and parallel connections),SPV system components and their characteristics. Applications of solar thermal systems: Heating, Cooling, Drying, Distillation, Power generation. Applications of Solar Photovoltaic systems: Battery charging, Pumping, Lighting.

UNIT IV WIND POWER CONVERSION SYSTEM 9

Introduction to wind energy : basic principles of wind energy conversion - Basic components of wind energy Conversion systems - classifications of WECS-HAWT, VAWT, Geared wind power plants (WPPs) - Schemes of electric generation: Squirrel Cage Induction Generators (SCIG), wound rotor (WRIG), doubly-fed (DFIG), wound rotor synchronous generator (WRSG), Permanent magnet synchronous generator (PMSG) - Site selection considerations

UNIT V TARIFF AND ECONOMIC ASPECTS IN POWER GENERATION 9

Terms commonly used in system operation, various factors affecting cost of generation: Load curves, load Duration. curves, Connected load, maximum load, Peak load, base load and peak load power plants, load factor, Plant capacity factor, Plant use factor, Demand factor, diversity factor, Cost of power plant, Tariffs

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- know the concept of thermal and hydro electric power plants.

- enumerate the operation of nuclear and diesel power plants.
- categorize the advantages of solar photovoltaic power conversion systems
- discriminate the advantages of wind power conversion system.
- obtain knowledge on tariff and economic.

TEXT BOOKS

1. P.K. Nag, "Power Plant Engineering" Tata McGraw Hill, Second Edition , Fourth reprint 2014.
2. G.D. Rai, "An introduction to power plant technology" Khanna Publishers 2016.

REFERENCES

1. Bernhardt G.A.Skrotzki and William A. Vopat, "Power station Engineering and Economy", Tata McGraw Hill, 20th reprint 2002.
2. L.Monition , Mle Nir, J.Roux, " Hydroelectric Power Stations" John Wiley & Sons Publishers 2014.
3. M.M. El-Wakil, "Power Plant Technology" Tata McGraw Hill, 2013.
4. Venugopal K and Prahu Raja V, "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, 2010.
5. Sh. H.Cohen, G.F.C. Rogers. H.I.H.Saravanamuttoo, "Power Plant Engineering" CBS Published 2014.

WEB LINKS

1. electrical4u.com/power-plants-types-of-power-plant
2. castlelab.princeton.edu/EnergyResources/GenerElectPower__Shalaan.pdf
3. www.academia.edu/.../Non_Conventional_Methods_of_Power_Generati...

CO-PO MAPPING:

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CO3	3	-	-	3	2	3	-	-	-	-	3	-	3	3
CO4	3	-	-	3	2	3	-	-	-	-	3	-	3	3
CO5	3	3	-	-	-	3	-	-	-	-	3	-	3	3

EE15505 **ELECTRICAL MACHINES II LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

- know the regulation of Three Phase Alternator using various methods.
- understand the parallel operations of alternators.
- obtain the V and inverted V curves of synchronous motors.
- know the performance characteristics of AC motor , know the equivalent circuits of induction motor

LIST OF EXPERIMENTS

1. Regulation of three phase alternator by emf and mmf methods
2. Regulation of three phase alternator by ZPF and ASA methods
3. Regulation of three phase salient pole alternator by slip test
4. Synchronization and parallel operation of alternators
5. V and Inverted V curves of Three Phase Synchronous Motor.
6. Load test on three-phase induction motor.
1. No load and blocked rotor test on three-phase induction motor
2. Separation of No-load losses of three-phase induction motor.
3. Load test on single-phase induction motor
4. No load and blocked rotor test on single-phase induction motor.
5. Load test on three phase Alternator.

TOTAL PERIODS 60

COURSE OUTCOMES

At the end of this course, students will be able to

- compute the regulation of Three Phase Alternator using various methods.
- evaluate the parallel operations of alternators.
- obtain the V and inverted V curves of synchronous motors.
- predict the performance characteristics of AC motors, obtain the equivalent circuits of induction motor.

CO-PO MAPPING:

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CO3	3	3	3	3	3	-	-	-	-	-	3	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	3	-	3	3

EE15506 **POWER ELECTRONICS LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

- understand performance and applications of various power semi converter devices.
- know the various phase controlled rectifiers with different loads.
- study the chopper circuit using MOSFET and IGBT.
- analyze the various PWM inverters, know the performance of AC voltage converters.

LIST OF EXPERIMENTS

1. Characteristics of SCR and TRIAC.
2. Characteristics of MOSFET and IGBT.
3. Gate Pulse Generation using R, RC and UJT.
4. Voltage commutation.
5. Current commutation.
6. AC to DC half controlled converter.
7. AC to DC fully controlled converter.
8. Step down and step up MOSFET based choppers.
9. IGBT based single phase PWM inverter.
10. IGBT based three phase PWM inverter.
11. AC Voltage controller.
12. Cyclo converter.

TOTAL PERIODS 60

COURSE OUTCOMES

At the end of this course, students will be able to

- compare and contrast the performance and applications of various power semi converter devices.
- design the various phase controlled rectifiers with different loads.
- analyze the chopper circuit using MOSFET and IGBT.
- design and analyze the various PWM inverters, evaluate the performance of AC voltage converters.

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CO2	3	3	3	3	3	-	-	-	-	-	3	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	3	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	3	-	3	3

EN15501 CAREER DEVELOPMENT LABORATORY I 0 0 2 1

COURSE OBJECTIVES

- To understand their capabilities & enhance their grooming and showcasing his/ her capabilities to a prospective employer
- To provide opportunity for the students to become acquainted with corporate opportunities relevant to their academic learning
- To articulate their thoughts on a given topic – in english and also to make decent write ups in english on any given topic
- To practice & score well in Aptitude tests conducted by corporates / prospective employers
- To prepare for any group discussion evaluation or presenting their credentials during a face- to-face interview leading to selection and employment

UNIT I PERSONALITY DEVELOPMENT 1 6

Introduction – self explorations – character building – self esteem- self confidence- positive thinking – leadership qualities- time management.

UNIT II PERSONALITY DEVELOPMENT 2 6

Grooming- role play – good etiquettes - extempore - writing skills: email, paragraph – team building- body language - non verbal communication

UNIT III QUANTITATIVE APTITUDE (QA) 1 6

Time , speed & distance -- simple interest & compound interest – percentage – height & distance – time & work – number systems – L.C.M & H.C.F – ratio proportion- area – directions.

UNIT IV LOGICAL REASONING (LR) 1 6

Analogies - letter & symbol series – number series – cause & effect – essential part – verbal reasoning.

UNIT V VERBAL REASONING (VR) 1 6

Blood relation – venn diagrams – analogy – character puzzles – logical sequence – classifiction –verification of truth – seating arrangement

TOTAL PERIODS 30

COURSE OUTCOMES

At the end of this course, students will be able to

- demonstrate aptitude & reasoning skills
- enhance verbal & written ability.
- improve his/her grooming and presentation skills.
- interact effectively on any recent event/happenings/ current affairs.
- be a knowledgeable person on the various evaluation processes leading to employment and face the same with Confidence.

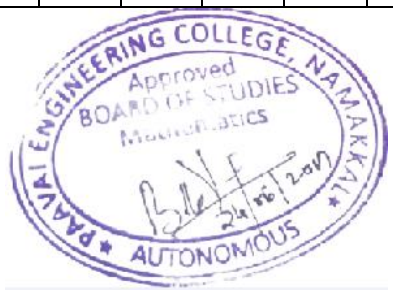
REFERENCES

1. Agarwal, R.S.” A Modern Approach to Verbal & Non Verbal reasoning”, S.Chand & co ltd, New Delhi.
2. Abhijit guha, “Quantitative Aptitude “, Tata-Mcgraw hill.
3. word power made easy by norman lewis ,W.R.Goyal publications.
4. Johnson, D.W. reaching out – interpersonal effectiveness and self actualization.Boston: Allyn and Bacon.
5. Agarwal, R.S.“ objective general English”,S.Chand & co
6. Infosys campus connect program – students’ guide for soft skills.

CO-PO MAPPING:

Mapping of Course Outcome (CO’s) with Programme Outcomes (PO’s) and Programme Specific Outcomes PSO’s (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO’s												PSO’s	
CO’s	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	3	3	1	-	-	-	-	-	-	3	2
CO2	-	2	3	-	2	-	2	-	-	-	-	-	3	2
CO3	3	2	2	2	-	-	1	-	-	-	-	-	2	3
CO4	3	2	2	-	-	1	-	-	-	-	2	-	2	3
CO5	2	3	3	2	1	3	3	1	-	1	2	-	2	3



SEMESTER VI

EE15601 DESIGN OF ELECTRICAL APPARATUS 3 2 0 4

COURSE OBJECTIVES

- To study MMF calculation and thermal rating of various types of electrical machines.
- To design the armature and field systems for D.C. machines.
- To calculate the core, yoke, windings and cooling systems of transformers.
- To design stator and rotor of induction machines
- To analyse stator and rotor of synchronous machines and study their thermal behaviour.

UNIT I MAGNETIC CIRCUITS AND COOLING OF ELECTRICAL MACHINES 15

Concept of magnetic circuit – MMF calculation for various types of electrical machines – real and apparent flux density of rotating machines – leakage reactance calculation for transformers, induction and synchronous machine - thermal rating continuous, short time and intermittent short time rating of electrical machines.

UNIT II D.C. MACHINES 15

Constructional details – output equation – main dimensions - choice of specific loadings – choice of number of poles – armature design – design of field poles and field coil – design of commutator and brushes – losses and Efficiency calculations.

UNIT III TRANSFORMERS 15

Introduction – output rating of single phase and three phase transformers – optimum design of transformers – design of core, yoke and windings for core and shell type transformers – equivalent circuit parameter from designed data – losses and efficiency calculations – design of tank and cooling tubes of transformers.

UNIT IV THREE PHASE INDUCTION MOTORS 15

Introduction – output equation – main dimensions – choice of Specific loadings – design of stator – design of squirrel cage and slip ring rotor – equivalent circuit parameters from designed data – losses and efficiency calculations.

UNIT V SYNCHRONOUS MACHINES 15

Introduction – output equation – choice of specific loadings – main dimensions – short circuit ratio – design of stator and rotor of cylindrical pole and salient pole machines – design of field coil – performance calculation from designed data - introduction to computer aided design.

TOTAL PERIODS 75

COURSE OUTCOMES

At the end of this course, students will be able to

- determine the MMF and thermal rating of electrical machine.
- design of D.C Machines.
- analyze and design the cooling system of transformer.
- design of induction machines.
- design of synchronous machine.

TEXT BOOKS

1. A.K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, New Delhi,2014.
2. S.K. Sen, "Principles of Electrical Machine Design with Computer Programmes", Oxford and IBH Publishing Co.Pvt Ltd., New Delhi, 2007.

REFERENCES

1. R.K. Agarwal, "Principles of Electrical Machine Design", S.K.Kataria and Sons, Delhi, 2014.
2. V.N. Mittle and A. Mittle, "Design of Electrical Machines", Standard Publications and Distributors, Delhi, 2012.
3. A.Shanmuga Sundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint, 2007.
4. M.V.Deshpande ―Design and Testing of Electrical Machine Design Wheeler Publications, 2010.
5. K.G. Upadhyay, 'Design of Electrical Machines', New Age International Publishers, 2008.

WEB LINKS

1. http://www.niceindia.com/qbank/design_of_electrical_apparatus.pdf
2. http://oldquestionpaper.in/category/anna-university-chennai/b-e-b-tech-eee/design-of-electrical-apparatus/

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
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CO3	3	3	-	-	2	-	-	-	-	-	3		3	3
CO4	3	3	-	-	2	-	-	-	-	-	3		3	3
CO5	3	3	-	-	2	-	-	-	-	-	3		3	3

EE15602 **SOLID STATE DRIVES** **3 0 0 3**

COURSE OBJECTIVES

- To understand the stable steady-state operation and transient dynamics of a motor-load system.
- To study and analyze the operation of the converter / chopper fed dc drive and to solve simple problems.
- To learn and understand the operation of both classical and modern induction motor drives.
- To comprehend the differences between synchronous motor drive and induction motor drive and to learn the basics of permanent magnet synchronous motor drives.
- To analyze and design the current and speed controllers for a closed loop solid-state DC motor drive.

UNIT I CHARACTERISTICS OF ELECTRIC DRIVES 9

Electric Drives – Drive classifications – Advantage of Electric Drives – Equations governing motor load dynamics Equilibrium operating point and its steady state stability – Mathematical condition for steady state stability - Selection of drives – Multiquadrant operation

UNIT II SOLID STATE CONTROL OF DC DRIVES 9

DC motor and their performance-Braking – Steady state analysis – Ward Leonard drives – Controlled rectifier fed DC drives – Chopper controlled DC drives – Time ratio control and current limit control – Four quadrant operation – Effect of ripples on the DC motor performance

UNIT III SOLID STATE CONTROL OF INDUCTION MOTOR DRIVES 9

Stator control- Steady state analysis - Stator voltage and frequency control –V/F control – Closed loop control of Voltage Source Inverter, Current Source Inverter and cycloconverter fed induction motor drives – Rotor control – Rotor resistance control and slip power recovery schemes- Sub synchronous and super synchronous operation – Closed loop speed control

UNIT IV SOLID STATE CONTROL OF SYNCHRONOUS MOTOR DRIVES 9

Types of synchronous Motors –Open loop v/f control – Self controlled synchronous motor – Closed loop control Of Voltage Source Inverter, Current Source Inverter and cycloconverter fed synchronous motor drives – Margin angle control and power factor control – – permanent magnet synchronous motor

UNIT V DESIGN OF CONTROLLERS FOR SOLID STATE DRIVES 9

Transfer function for DC motor / load and converter – closed loop control with Current and speed feedback– Armature voltage control and field weakening mode – Design of controllers; current controller and speed controller-converter selection and characteristics.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- obtain the stable steady-state and transient dynamics of a motor-load system.
- analyze the operation of the converter / chopper fed dc drive.
- perform analysis of classical and modern induction motor drives.
- differentiate between synchronous motor drive and induction motor drive.
- design the current and speed controllers for a closed loop solid-state DC motor drive.

TEXT BOOKS

1. Dubey.G.K., "Fundamental of Electrical Drives", Narosa publishing House, New Delhi 2010.
2. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Prentice Hall of India, 2009.

REFERENCES

1. Murphy, J.M.D and Turnbull.F.G. , "Thyristor control of AC Motors", Pergamon Press, New Delhi 2003
2. Vedam Subramanyan, "Thyristor control of Electrical Drives", Tata McGraw Hill Publishing Combany, New Delhi 2007.
3. Gaekward, "Analog and Digital control systems", Wiley Eastern Ltd, New Delhi 2007
4. Shaahin Felizadeh, "Electric Machines and Drives", CRC Press (Taylor and Francis Group), 2013.
5. Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002.

WEB LINKS

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2. http://www.ssd.noaa.gov
3. http://www.shodhganga.inflibnet.ac.in

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes PO's												PSO's	
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CO3	3	3	-	-	2	-	-	-	-	-	3	-	3	3
CO4	3	3	-	-	2	-	-	-	-	-	3	-	3	3
CO5	3	3	-	-	2	-	-	-	-	-	3	-	3	3

EE15603 **POWER SYSTEM ANALYSIS** **3 0 0 3**

COURSE OBJECTIVES

- To familiarize the different aspects of modeling of power system components.
- To solve the power flow problems using efficient simulation and numerical methods.
- To understand the concept of symmetrical and un symmetrical faults in power system studies.
- To study the stability status of Power System under transient condition.
- To perform unsymmetrical fault analysis in power system

UNIT I THE POWER SYSTEM – AN OVERVIEW AND MODELING 9

Modern Power System - Basic Components of a power system - Per Phase Analysis-Generator model - Transformer model - line model - Per unit system -Change of base.

UNIT II POWER FLOW ANALYSIS 9

Introduction - Bus Classification - Bus admittance matrix - Solution of non-linear Algebraic equations - Gauss Seidal method - Newton raphson method - Fast decoupled method - Flow charts and comparison of the three methods.

UNIT III FAULT ANALYSIS-BALANCED FAULT 9

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

UNIT IV FAULT ANALYSIS SYMMETRICAL COMPONENTS AND UNBALANCED FAULT 9

Introduction – Fundamentals of symmetrical components – sequence impedances – sequence networks – single line to ground fault – line-line fault - Double line to ground fault – Unbalanced fault analysis using bus impedance matrix.

UNIT V POWER SYSTEM STABILITY 9

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

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- understand the modeling and analytical concepts of power system components in Power systems.
- perform power flow analysis.
- solve for symmetrical faults in power system.
- compute unsymmetrical faults in power system.
- analyse the stability of power system.

TEXT BOOKS

1. I.J.Nagrath and D.P.Kothari, "Modern Power System Analysis", Tata McGraw-Hill publishing company, New Delhi, 2011.
2. P.Kundur, "Power System Stability and Control", Tata McGraw Hill Publishing Company, New Delhi, 2008.

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1. Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2012.
2. Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
3. J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, 'Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.
4. John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', Tata McGraw-Hill, Sixth reprint, 2010. Education, 2012.
5. P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan, 'Electrical Power Systems Analysis', Security and Deregulation', PHI Learning Private Limited, New Delhi, 2012.

WEB LINKS

1. nptel.ac.in/courses/108105067/
2. http://freevideolectures.com/Course/2353/Power-Systems-Analysis

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

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CO3	3	3	3	3	2	-	-	-	-	-	3	-	3	3
CO4	3	3	3	3	2	-	-	-	-	-	3	-	3	3
CO5	3	3	3	3	2	-	-	-	-	-	3	-	3	3

EE15604 MICROPROCESSOR AND MICROCONTROLLER 3 0 0 3

COURSE OBJECTIVES

- To understand 8085 architecture and memory interacting
- To acquire programming knowledge of 8085.
- To understand peripheral interface with 8085
- To learn 8051 architecture, interrupts and programming.
- To know internal peripheral units of 8051.

UNIT I 8085 PROCESSOR 9

8085 Architecture – Pin diagram - Functional block diagram – Memory Interfacing – Interrupts.

UNIT II INSTRUCTIONS SET OF 8085 9

Interrupts Instruction set – Addressing modes – Timing diagrams – Assembly language programming.

UNIT III PERIPHERAL INTERFACING WITH 8085 9

Architecture and programming of ICs: 8255 PPI, 8259 PIC, 8251 USART, 8279 Key board display controller and 8254 Timer/ Counter – Interfacing with 8085

UNIT IV 8051 MICROCONTROLLER 9

8051 Functional block diagram - Instruction set - addressing modes – Interrupt structure – Timer – I/O ports – Serial communication-Assembly language programming.

UNIT V MICRO CONTROLLER APPLICATIONS 9

Interfacing: LCD, ADC, DAC, Sensors, Stepper Motor, Keyboard and DC motor speed control

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- explain the architecture of 8085 microprocessor and design memory interfacing.
- develop the program 8085 microprocessor.
- Interfacing peripheral device with 8085 prcoessor.
- develop the programming skills of 8051 microcontroller.
- perform investigation on microcontrollers application.

TEXT BOOKS

1. R.S. Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 5th Edition, Prentice Hall, 2012.
2. A.K. Ray and K.M. Bhurchandi, "Advanced Microprocessors and peripherals", 2nd Edition, Tata McGraw-Hill, 2012.

REFERENCES

1. Douglas V.Hall, "Microprocessors and Digital Systems", McGraw Hill Publishing Co. Ltd. 2010
2. Kenneth J Ayala, "The 8051 Micro controller", Thomson Delmer Learning, 2013
3. William Kleitz, 'Microprocessor and Micro Controller Fundamental of 8085 and 8051Hardware and Software',.Pearson Education, 1998
4. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice – Hall of India,. New Delhi , 2007

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2. http://www.soc.napier.ac.uk/~bill/pdf/Io_ch01.PDF

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
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CO1	3	-	3	3	3	-	-	-	-	-	3	-	3	3
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CO3	3	-	-	-	2	-	-	-	-	-	3	-	3	3
CO4	3	3	3	3	2	-	-	-	-	-	3	-	3	3
CO5	3	-	-	3	-	-	-	-	-	-	3	-	3	3

EE15605 **DIGITAL SIGNAL PROCESSING** **3 2 0 4**

COURSE OBJECTIVES

- To understand the classification of signals and systems & their mathematical representation.
- To analyze the discrete time systems using Z transform
- To perform frequency analysis of signals and computation of discrete Fourier transform
- To study the concepts and design of digital IIR filter
- To learn the concepts and design of digital FIR filter

UNIT I DISCRETE TIME SIGNAL AND SYSTEMS 15

Characteristics and classification of signals-discrete time signal-basic definitions – representation of signals, discrete time systems-linear time invariant systems-properties of LTI systems-linear constant coefficient difference equations – Fourier transform of discrete time signals, sampling techniques – Nyquist rate, aliasing effect.

UNIT II Z- TRANSFORM AND FILTER REALIZATION 15

Z Transform and its properties – inverse Z transform – stability – causality – linear difference equations with Constant coefficients and their solutions -digital filter realization: direct form I, II, cascade, parallel types.

UNIT III FREQUENCY ANALYSIS OF SIGNALS 15

Fourier transform – discrete time Fourier series – discrete Fourier transform-properties of discrete Fourier transform- computation of discrete Fourier transform – FFT algorithms- radix-2 FFT algorithm-decimation in time-decimation in frequency.

UNIT IV DIGITAL IIR FILTER 15

Introduction – types of filters, digital filter design-design of IIR filters-impulse invariance and bilinear transform methods- analog to digital transformation.

UNIT V DIGITAL FIR FILTER 15

FIR filter – design of FIR filter using windows: rectangular, triangular, hanning, hamming ,Blackman windows – comparison of IIR and FIR digital filter- Effect of word length and quantization-fixed point and floating point arithmetic .

TOTAL PERIODS 75

COURSE OUTCOMES

At the end of this course, students will be able to

- perform classification of signals and systems.
- apply Z transform and analyze discrete time systems.
- compute DFT and obtain perform frequency response analysis.
- design IIR fliters.
- apply windowing technique to design FIR filters.

TEXT BOOKS

1. John G.Proakis, Dimitris G.Manolakis, "Digital Signal Processing", Prentice Hall of India, Pvt, Ltd., 3rd edition. 2007.
2. Alan V.Oppenheim, Ronald W.Schafer "Digital Signal Processing", Prentice Hall of India, Pvt Ltd., 2006.

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1. Simon Haykin and Barry Van Veen, "Signals and Systems", 2nd Edition, Willey Publication (Reprint), 2010.
2. Sanjit K.Mitra, "Digital Signal Processing", Tata McGraw Hill, 2009.
3. P. Ramesh Babu and R.Ananda Natarajan, "Signals and Systems", SciTech Publications, 4th Edition, 2010.
4. Poorna Chandra S, Sasikala. B ,Digital Signal Processing, Vijay Nicole/TMH,2013
5. Lonnie C.Ludeman ,"Fundamentals of Digital Signal Processing",Wiley,2013

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2. http://www.mikroe.com/chapters/view/73/chapter-3-iir-filters/

CO-PO MAPPING:

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	Programme Outcomes PO's												PSO's	
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CO3	-	3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	-

EE15606 **ELECTRICAL DRIVES LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

- To understand and analyze the operation of induction and synchronous motor drives through simulation packages.
- To control the speed of electrical drives using DSP and Micro controllers
- To understand about speed control using dual converter
- To know PLC drives

LIST OF EXPERIMENTS

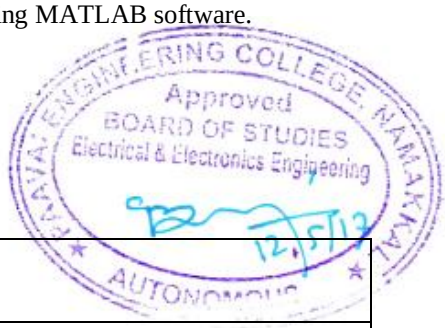
1. Simulation of VSI fed 3 phase induction motor.
2. Simulation of DC motor drive.
3. Speed control of DC motor using 3 phase Rectifier.
4. Speed control of 3 phase induction motor using PWM inverter.
5. DSP based closed loop drive for induction motor.
6. Induction motor speed control using FPGA.
7. Speed control of Brush Less DC motor.
8. DSP based chopper fed DC motor drive.
9. Speed Control of DC Motor using Dual Converter.
10. PLC based drives.

TOTAL PERIODS 60

COURSE OUTCOMES

At the end of this course, students will be able to

- understand the operation of induction and synchronous motor drives using MATLAB software.
- control the speed of electrical drives using DSP and Micro controllers
- analyse speed control using dual converter
- implemenyt PLC drives



CO-PO MAPPING:

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	Programme Outcomes PO's												PSO's	
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CO3	3	3	3	3	3	1	-	-	-	-	3	-	3	3
CO4	3	3	3	3	3	1	-	-	-	-	3	-	3	3

EE15607 **MICROPROCESSOR AND MICROCONTROLLER LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

- To understand 8085 programming and instruction sets.
- To analyze 8085 I/O interfacing peripheral devices such as keyboard, ADC, DAC and stepper motor with 8085.
- To train 8051 programming and instruction sets.
- To understand bit addressing in 8051 programming

LIST OF EXPERIMENTS

I. PROGRAMS USING 8085

- 8 bit Addition, Subtraction, Multiplication and Division
- Arithmetic mean of N Numbers
- Sorting given set of Numbers in Ascending & Descending Order
- Finding largest & smallest of given Numbers
- Code Conversion
- Interfacing with 8255, 8253, 8279
- Interfacing with DAC to generate a. Triangular wave b. Square Wave c. Saw tooth Wave d.Staircase
- Interfacing with Stepper Motor and Traffic Light Controller

II.PROGRAMS USING 8051

- 8 bit Addition, Subtraction, Multiplication and Division
- Arithmetic mean of N Numbers
- Sorting given set of Numbers in Ascending & Descending Order
- Finding largest & smallest of given Numbers
- RAM direct addressing
- Bit Addressing

TOTAL PERIODS 60

COURSE OUTCOMES

At the end of this course, students will be able to

- develop programming skills in 8085 microprocessor and 8051 microcontroller based on its. instruction sets
- build up their programming skills to interface the peripheral devices with 8085 and 8051 hardware components.
- Implement 8051 programming
- Interface devices using programming.

CO-PO MAPPING:

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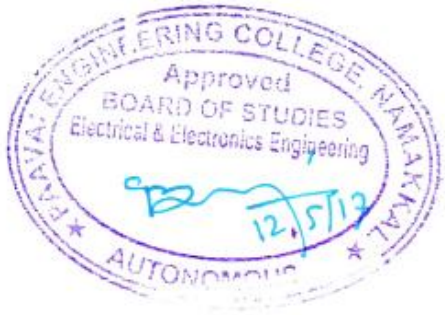
CO4	3	3	3	3	3	1	-	-	-	-	3	-	3	3



EN15601 CAREER DEVELOPMENT LABORATORY II 0 0 2 1

COURSE OBJECTIVES

- To enhance career competency and employability skills
- To demonstrate effective leadership and interpersonal skills
- To improve professional capabilities through advanced study and researching current market strategy.
- To develop problem solving and decision making capabilities
- To improve their reasoning skills to get placed in reputed companies

UNIT I CORPORATE READINESS 6

Business Communication – Inter and Intra Personal skills – Business Etiquettes – Corporate ethics – Communication media Etiquette.

UNIT II INTERVIEW SKILLS 6

Resume building – Group discussions – Presentation skills – Entrepreneur skills – Psychometric assessment – Mock interview.

UNIT III QUANTITATIVE APTITUDE (QA) 2 6

Profit and Loss – Clock – Power and Square roots – Train – Boats and streams – Probability – Calendars – Permutations and Combinations - Partnership – Simplification – Pipes and Cisterns – Puzzles.

UNIT IV LOGICAL REASONING (LR) 2 6

Statements and Assumptions – Matching Definitions – Logical Games – Making judgments – Statements and conclusions – Verbal classifications.

UNIT V VERBAL REASONING (VR) 2 6

Syllogisms – Data sufficiency – Dice – Series completion – Character puzzles – cube and cuboids – Arithmetic Reasoning.

TOTAL PERIODS 30

COURSE OUTCOMES

At the end of this course, students will be able to

- develop team work capabilities
- boost their problem solving skills
- enhance the transformation from college to corporate.
- compute problems based on quantitative aptitude
- reveal their logical and verbal reasoning by scoring the expected percentage to get placed in reputed companies

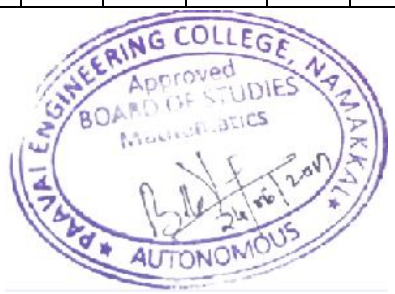
REFERENCES

1. Agarwal, r.s.” a modern approach to verbal & non verbal reasoning”, , S.Chand & co ltd, New Delhi.
2. Abhijit guha, “quantitative aptitude for competitive examinations “, Tata Mcgraw hill
3. Word power made easy by norman lewis ,wr.goyal publications.
4. Johnson, d.w. (1997). Reaching out – interpersonal effectiveness and self Actualization -- Boston: Allyn and bacon.
5. Infosys Campus Connect Program – students’ guide for soft skills.
6. Mitra ,barun.k, “ Personalaity Development & Softskills “ , Oxford University.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	PO's												PSO's	
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	3	3	1	-	-	-	-	-	-	3	2
CO2	-	2	3	-	2	-	2	-	-	-	-	-	3	2
CO3	3	2	2	2	-	-	1	-	-	-	-	-	2	3
CO4	3	2	2	-	-	1	-	-	-	-	2	-	2	3
CO5	2	3	3	2	1	3	3	1	-	1	2	-	2	3



LIST OF ELECTIVES

EE15151 BIO MEDICAL ENGINEERING 3 0 0 3

COURSE OBJECTIVES

- To understand the knowledge about the organs of human body and measure the parameters
- To learn the bio potential electrodes, transducers and their types
- To gain the knowledge about the various measurements of blood pressure.
- To study about the modern imaging systems.
- To know the latest technologies in biomedical engineering.

UNIT I ELECTRO PHYSIOLOGY 9

Cell and Its Structure – Electrical, Mechanical and Chemical Activities – Action and Resting Potential- Organization of Nervous System – CNS – PNS – Neurons – Axons- Synapse – Propagation of Electrical Impulses along the Nerve- Sodium Pump – Cardio Pulmonary System- Physiology of Heart, Lung, Kidney.

UNIT II BIO POTENTIAL ELECTRODES AND TRANSDUCERS 9

Design of Medical Instruments – Components of Biomedical Instrument System – Electrodes: Micro Electrodes, Needle Electrodes, Surface Electrodes – Transducers – Piezo Electric, Ultrasonic, Passive Transducers – Resistive,Capacitive, Inductive – Biomedical Measurements Like PH, PCO2, PO2 of Blood, Isolation Amplifier, Preamplifier,Current Amplifier, Chopper Amplifier.

UNIT III INSTRUMENTS USED FOR DIAGNOSIS 9

ECG, Einthoven Triangle, Leads, Electrodes, Vector Cardiograph, Measurement of Cardiac Output, EEG, EMG, Plethysmography, Blood Flow Measurements, Holter Monitor- Respiratory Rate Measurement – Oximeter, Patient Monitoring System, ICCU.

UNIT IV MODERN IMAGING SYSTEM 9

Ultrasonic Diagnosis, Ultrasonic Scanning, Isotopes in Medical Diagnosis - Pace Makers, Defibrillators, Doppler Monitor(colour), Medical imaging-X-ray generation, Radiographic & Fluoroscopic Techniques – Image Intensifiers-Computer Aided Tomography, PET, SPECT- Laser Applications-Echocardiography-CT Scan-MRI/NMR-Endoscopy.

UNIT V RECENT TRENDS & INSTRUMENTS FOR THERAPY 9

Dialysers – Surgical Diathermy – Electro Anaesthetic and Surgical Techniques, Sources of Electric Hazards and Safety Techniques. Single Channel Telemetry, Multi channel Telemetry, Implantable Telemetry, Wireless Telemetry, Telemedicine, Telemedicine Applications.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- acquaint the physiology of the heart, lung, blood circulations, respirations, patient monitoring and electrical safety in clinical environment.
- apply the proper electrodes and transducers based on the application.
- obtain the knowledge in various electrical origins of recording methods of ECG, EEG, EMG, ERG

- know how to use the latest medical equipments available for measurement of non-electrical parameters in the physiological systems of the human body and also the modern methods of imaging techniques used for. diagnostic purpose in the health care centre
- Identify the latest procedure adopted for providing Medical assistance through Telemedicine and the Therapeutic equipments used for diagnostic and surgery purposes.

TEXT BOOKS

1. Khandpur, "Handbook of Biomedical Instrumentation" 2nd Edition, Tata McGraw Hill, 2003.
2. M.Arumugam, "Biomedical Instrumentation", Anuradha Publications, Reprint 2009.

REFERENCES

1. Leslie Cromwell, Fred J. Werbell and Eruch A. Pfeigger, "Biomedical Instrumentation and Measurements" 2nd Edition 2011
2. 2. WQ. J.Tompskins and J.G. Webster, Design of Microcomputer Based Medical Instrumentation Prentice-Hall, 2000.
3. Geddes and Baker, Principle of Applied Biomedical Instrumentation John Wiley and Sons, New York,2001.
4. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, India, 3rd Edition, 2013.
5. Geddes L.A. and Baker L.E., "Principles of Applied Bio-Medical Instrumentation", John Wiley & Sons, 3rd. Edition, 2013

WEB LINKS

1. http://www.medcom.dk/dwn1177
2. http://www.artannlabs.com/bone-ultrasonic.html#

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	PO's												PSO's	
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CO4	3	2	2	-	-	2	-	-	-	-	2	2	2	2
CO5	3	2	2	-	-	2	-	-	-	-	2	2	2	2

EE15152 **ELECTRICAL SAFETY** **3 0 0 3**

COURSE OBJECTIVES

- To impart knowledge on the basic concepts of electrical safety
- To acquaint to the concepts of electrical safety.
- To understand the protection systems for electrical equipments.
- To learn the installation, operation and maintenance of electrical circuits.
- To gain knowledge on the hazards and issues.

UNIT I CONCEPTS AND STATUTORY REQUIREMENTS **9**

Introduction–electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act and rules- statutory requirements from electrical inspectorate-international standards on electrical safety–first aid-cardio pulmonary resuscitation(CPR).

UNIT II ELECTRICAL HAZARDS **9**

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation -voltage classifications- excess energy -current surges-Safety in handling of war equipments-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect- static electricity–definition, sources, hazardous conditions, control, electrical causes of fire and explosion-ionization spark and arc - ignition energy -national electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance.

UNIT III PROTECTION SYSTEMS **9**

Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage –voltage – safe distance from lines - capacity and protection of conductor – joints – and connections, Over load and short circuit protection - no load protection - earth fault protection. FRLS insulation -insulation and continuity test - system grounding – equipment grounding - earth leakage circuit breaker (ELCB) - cable wires - maintenance of ground - ground fault circuit interrupter - use of low voltage-electrical guards – Personal protective equipment – safety in handling hand held electrical appliances tools and medical equipments

UNIT IV SELECTION, INSTALLATION, OPERATION AND MAINTENANCE **9**

Role of environment in selection -safety aspects in application-protection and interlock-self diagnostic features and fail safe concepts - lock out and work permit system-discharge rod and earthing devices - safety in the use of portable tools- cabling and cable joints -preventive maintenance.

UNIT V HAZARDOUS ZONES **9**

Classification of hazardous zones - intrinsically safe and explosion proof electrical apparatus -increase safe equipment - their selection for different zones - temperature classification - grouping of gases - use of barriers and isolators - equipment certifying agencies.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- apply the basic concepts of electrical safety during practical's
- explain concepts of electrical safety.
- use the appropriate protection systems for electrical equipments.
- enumerate the installation, operation and maintenance of electrical circuits.
- discuss on the hazards and issues.

TEXT BOOKS

1. Fordham Cooper, W., "Electrical Safety Engineering" Butterworth and Company, London, 1994.

REFERENCES

1. N.S.C.,Chicago, "Accident prevention manual for industrial operations", 1982.
2. Indian Electricity Act and Rules, Government of India.
3. Power Engineers–Handbook of TNEB, Chennai, 1989.
4. Martin Glov, Electrostatic Hazards in powder handling, Research Studies Pvt.Ltd.,England, 1988.

WEB LINKS

1. https://www.osha.gov/dte/grant_materials/fy09/sh-18794-09/electrical_safety_manual.pdf
2. https://www.osha.gov/dte/grant_materials/fy07/sh-16615-07/train-the-trainer_manual2.pdf

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CO4	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO5	3	2	3	-	-	2	-	-	-	-	2	2	2	2

EE15153 **DIGITAL CONTROL ENGINEERING** **3 0 0 3**

COURSE OBJECTIVES

- To impart knowledge on the digital control systems and pulse transfer function
- To acquaint to the concepts of state variable approach for the analysis of discrete time systems
- To understand the concepts of stability analysis of discrete time systems
- To obtain the solutions of state equations.
- To gain knowledge on the design of controllers for digital design

UNIT I INTRODUCTION **9**

Introduction – closed loop sampled data control system – typical digital control systems – sampling theorem – sample and hold operation – advantages of sampling -pulse transfer function – Z-domain equivalence to S- domain.

UNIT II STATE SPACE ANALYSIS **9**

Advantages of State model – State Space model-Companion Canonical Form, Canonical form, Jordan Canonical form – State diagram

UNIT III STABILITY ANALYSIS **9**

Stability analysis – Jury stability test –Bilinear transformation method – root locus method – effect of pole zeroconfiguration in Z-plane – dominant pole concept – transient response of sampled data control systems

UNIT IV SOLUTIONS TO STATE EQUATIONS **9**

Eigen values and eigen vectors-Solutions of State equations- Laplace transformation technique, Cayley Hamilton Method – Transfer function from State equations-concepts of controllability and observability

UNIT V DESIGN **9**

Transform of digital control system – Design specifications - Design on the W plane- Digital PID controller – Introduction to design on the Z plane.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- understand the digital control systems and pulse transfer function
- obtain the state model of systems.
- determine the stability of discrete time systems
- obtain the solutions of state equations.
- design controllers for digital design.

TEXT BOOKS

1. Gopal M, Digital Control Engineering Wiley Eastern Publishers, 1997.
2. Kuo B C, Digital control system, Prentice Hall.PA, 1996

REFERENCES

1. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006
2. Farzad Nekoogar,Genemoriarty, "Digital control using DSP",Prentice Hall Pvt.Ltd,1999.
3. Richard C.Dorf, Robert H.Bishop, "Modern Control systems", Addison Wesley,1999.
4. Michael P Lukas, "Distributed Control Systems", Van Nostrand Reinhold Company, New York, 1995.
5. K. Ogata, Modern Control Engineering, Pearson Education, New Delhi, 2009.

WEB LINKS

1. http://nptel.ac.in/courses/108103008/15
2. http://lorien.ncl.ac.uk/ming/digicont/control/digital3.htm

CO-PO MAPPING:

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	Programme Outcomes PO's												PSO's	
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CO3	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO4	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO5	3	2	3	-	-	2	-	-	-	-	2	2	2	2

EE15154 **NANO SCIENCE** **3 0 0 3**

COURSE OBJECTIVES

- To impart knowledge on the basics about the semiconductor & optoelectronic materials.
- To know about the nano structured semiconducting materials.
- To understand the different applications of nano semiconductor & nanomagnetic particles in different area
- To have an insight on the characteristics of nano composites and zeolites.
- To comprehend the characterization of polymers.

UNIT I CONCEPTS OF NANOSTRUCTURES 9

Electronic states in crystal energy bands, Concepts of 2D nanostructures (quantum wells), 1 D nanostructures (quantum wires) OD nanostructures (quantum dots), artificial atomic clusters.

UNIT II PROPERTIES AND ANALYSIS OF NANOSTRUCTURES 9

Size dependent properties, Size dependent absorption spectra, Blue shift with smaller sizes, Phonons in nanostructures, Contacts at Nano level, AFM.lSTM tip on a surface.

UNIT III ANALYSIS OF QUANTUM TECHNIQUES 9

Charging of quantum dots, Coulomb blockade, Quantum mechanical treatment of quantum wells, wires and dots, Widening of bandgap in quantum dots, Strong and weak confinement, Properties of coupled quantum dots, Optical scattering from Nan defects.

UNIT IV CHARACTERISTIC OF NANO COMPOSITES AND ZEOLITES 9

Nanocomposites Electronic and atomic structure of aggregates and nanoparticles Theory and modeling of nanoparticles fictionalization processes.

UNIT V CHARACTERIZATION OF NANOPOLYMERS 9

Nanosystems: Synthesis and chacterization Methods of Synthesis: Molecular beam epitaxy, MOCVD, chemical routes, nanoparticles on polymers, pulsed laser deposition, ion beam assisted techniques including embedded nanoparticles, RF sputtering.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- explain concept of nano physics anf quantum dots.
- understand the behavior of materials at nano scale
- analyze the energy level to different materials
- know the characteristics of nano composite materials.
- give details about the synthesis of polymer and their characteristics

TEXT BOOKS

1. K.Bamam and D.Vvedensky ,Low Dimensional Semiconductor Structures, 2011.
2. B. H. Bransden, Charles Jean Joachain “Quantum Mechanics” Prentice Hall, 2010

REFERENCES

1. L.Banyai and S.W.Koch ,Semiconductor Quantum Dots, (World Scientific) 1993,
2. J.H. Davies, An introduction to the physics-af low dimensional semiconductors, Cambridge Press,2008.
3. Karl Goser, Peter Glosekotter, Jan Dienstuhl Nanoelectronics and Nanosystems , Springer, 2004
4. Krause P. C. and Wasynczuk O., Electromechanical Motion Devices, McGraw-Hill, New York, 2009.
5. Lyshevski S. E., "Integrated control of microactuators and integrated circuits: a new turning approach in MEMS \technology,"Proceedings Conference Decision and Control, Phoenix, AZ, pp. 2611-2616, 2009.

WEB LINKS

1. http://www.acclab.helsinki.fi/~knordlun/nanotiede/nanosc1nc.pdf
2. https://www.ttu.ee/public/m/Mehaanikateaduskond/Instituudid/Materjalitehnika _NanoMat.pdf

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	Programme Outcomes PO's												PSO's	
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CO4	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO5	3	2	3	-	-	2	-	-	-	-	2	2	2	2

EE15155 **NETWORK ANALYSIS AND SYNTHESIS** **3 0 0 3**

COURSE OBJECTIVES

- To understand the concept of S-domain network.
- To know the concept of frequency response.
- To learn the concept of network topology.
- To have an indepth knowledge on the design of two-port networks & Filters.
- To synthesize an electrical network from a given impedance/admittance function.

UNIT I S-DOMAIN ANALYSIS 9

S-domain network -driving point and transfer impedances and their properties - transform network analysis – Time response of series RC, RL and RLC circuits

UNIT II FREQUENCY DOMAIN ANALYSIS 9

Immittance -loci of RLC network - Frequency response of 3phase RLC networks -frequency response from pole- zero- Bode plots

UNIT III NETWORK TOPOLOGY 9

Network graph, tree and cut-sets -tie set and cut - set schedules – v - shift and I – shift - Primitive impedance and admittance matrices -Application to network solutions.

UNIT IV TWO-PORT NETWORKS & FILTERS 9

Characterization of two-port networks in terms of z, -y, h-and T –parameters - Network Equivalents -Relations between network parameters - Analysis of T, ladder, bridged - T and lattice networks -Transfer function of terminated two - port networks. Filters and attenuators - Design of constant -k, m-derived and composite filters - qualitative treatment of active filters -Butterworth and Chebyshev filters.

UNIT V ELEMENTS OF NETWORK SYNTHESIS 9

Realisability of one-port network - Hurwitz polynomials and properties –Positive real functions and properties - synthesis of RL, RC and LC one-port networks

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- perform analysis of electrical circuits in s domain
- analyze electric circuits in frequency domain.
- apply network topology to find the electrical parameters.
- examine two port networks and design constant K and m derived filters.
- synthesize one port electrical circuits.

TEXT BOOKS

1. Kuo. F.F., 'Network Analysis and Synthesis', Wiley International Edition, Second Edition, 1966.
2. Wadhwa C L ‘Network analysis and synthesis’ New Age International publishers (P) ltd., Second edition, Delhi., 2016.

REFERENCES

1. Paranjothi,S.R., 'Electric Circuit Analysis', New age International Publishers, Second Edition, 2017. Karunya University Division of Electrical & Electronics Engineering
2. Van Valkenburg, M.E., 'Network Analysis', Prentice-Hall of India Private Ltd., New Delhi, Third Edition. 1974.
3. ShyamMohan S.P., Sudhakar A, "Circuits and Network Analysis &Synthesis", Tata McGraw Hill, 2011.
4. Arumugam .M and Premkumar .N, Electric circuit theory, Khanna & Publishers, 2006.
5. Soni M.L and Gupta J.C, "Electrical circuit Analysis", Dhanpat Rai and Sons, Delhi, 1990.

WEB LINKS

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2. https://books.google.co.in/books

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CO5	3	2	3	-	-	2	-	-	-	-	2	2	2	2

EE15251 MICRO ELECTRO MECHANICAL SYSTEM 3 0 0 3

COURSE OBJECTIVES

- To study the basics of MEMS and parts of MEMS
- To understand the sensors and transducers used in MEMS.
- To know design methodology of MEMS for various mechanics
- To learn the process of lithography in MEMS
- To identify the applications of optical and RF based MEMS.

UNIT I INTRODUCTION 9

MEMS-Micro fabrications for MEMS - Surface micromachining of silicon - Wafer bonding for MEMS - LIGA process- Micromachining of polymeric MEMS devices -Three-dimensional microfabrications. Materials: Materials for MEMS - Metal and metal alloys for MEMS - Polymers for MEMS – Other materials for MEMS .Metals : Evaporation –Sputtering. Semiconductors :Electrical and chemical properties-Growth and deposition.Thin films for MEMS and their deposition techniques.

UNIT II MICROSENSING FOR MEMS 9

Piezoresistive sensing – Capacitive sensing – Piezoelectric sensing - Resonant sensing – Surface acoustic wave sensors.Transducers: Electromechanical transducers - Piezoelectric transducers - Electrostrictive transducers - Magnetostrictive transducers – Electrostatic actuators-Electromagnetic transducers - Electrodynamic transducers-Actuators: Electrothermal actuators-Comparison of electromechanical actuation schemes.

UNIT III MICRO MACHINING 9

Micromachning : Bulk micromachining for silicon-based MEMS -Isotropic and orientation-dependent wet etching - Dry etching - Buried oxide process - Silicon fusion bonding - Anodic bonding - Silicon surface micromachining Sacrificial layer technology - Material systems in sacrificial layer technology - Surface micromachining using plasma etching -Combined integrated-circuit technology and anisotropic wet etching

UNIT IV LITHOGRAPHY 9

Micro stereo lithography for polymer MEMS - Scanning method -Two-photon micro stereo lithography Surface micromachining of polymer MEMS - Projection method - Polymeric MEMS architecture with silicon, metal and. ceramics -Microstereolithography integrated with thick film lithography

UNIT V APPLICATIONS 9

Switching: Introduction - Switch parameters - Basics of switching - Mechanical switches – Electronic switches-Switches for RF and microwave applications – Mechanical RF switches - PIN diode RF switches - Metal oxide semiconductor field effect transistors and monolithic microwave integrated circuits. RF MEMS switches: Integration and biasing issues for RF switches -Actuation mechanisms for MEMS devices-Electrostatic switching.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- integrate the knowledge of semiconductors and solid mechanics MEMS device fabrication.
- understand the rudiments of micro fabrication techniques

- identify and understand the various sensors and actuators
- select different materials used for MEMS
- apply MEMS to various disciplines

TEXT BOOKS

1. Vijay K.Varadan, K.J.Vinoy and K.A.Jose, "RF MEMS and Their Applications(ISBN 0-470-84308-X)", 1st Edition, John Wiley & SonsLtd., West Sussex, England, 2003.
2. James J.Allen, "Micro electro mechanical system design', CRC Press published in 2005

REFERENCES

1. P. Rai-choudhury, "MEMS and MEMS Technology and Applications", 1st Edition PHI, 2009.
2. S. Senturia, "Microsystem Design", Kluwer, 2001.
3. J.W. Gardner, V.K. Varadan, O.O. Awadelkarim, "Microsensors, MEMS & Smart Devices"John Wiley,2013.
4. S. Campbell, The Science and Engineering of Microelectronic Fabrication, Oxford Univ. Press, 2001
5. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2007.

WEB LINKS

1. http://www.lboro.ac.uk/microsites/mechman/research/ipm-ktn/pdf/Technology_an-introduction-to-mems.pdf
2. http://eelinux.ee.usm.maine.edu/courses/ele498/Lecture%20Material/MEMS-Overview.PDF

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CO5	3	2	3	-	-	2	-	-	-	-	2	2	2	2

EE15252 **INDUSTRIAL ROBOTICS** **3 0 0 3**

COURSE OBJECTIVES

- To learn Robotic technology
- To understand about the Peripherals used and vision process
- To get idea about Programming of robots.
- To know the Robotic applications in different industrial domains.
- To know robot manufacturing

UNIT I INTRODUCTION **9**

Automation & robotics, Robotic System & Anatomy Classification, Future Prospects – Drive: Control Loops, Basic. Control System Concepts & Models, Control System Analysis, Robot Activation & Feedback Components, Position &Velocity Sensors, Actuators , Power Transmission Systems

UNIT II PERIPHERAL, SENSORS &MACHINE VISION **9**

End Effecters - types, Mechanical & other grippers, Tool as end effecter - sensors: Sensors in Robotics, Tactile Sensors, Proximity & Range Sensors, Sensor Based Systems, Uses Vision Systems – Equipment- introduction, Low level & High level vision, Sensing & Digitising, Image processing & analysis, Segmentation, Edge detection, Object description & recognition, Interpretation, Applications

UNIT III PROGRAMMING FOR ROBOTS **9**

Methods, Robot programme as a path in space, Motion interpolation, level & task level languages, Robot languages; Programming in suitable languages Characteristics of robot.

UNIT IV ROBOT KINEMATICS& APPLICATION **9**

Forward, Reverse - & Homogeneous Transformations, Manipulator Path Control, Robot Dynamics

UNIT V ROBOTIC APPLICATION IN MANUFACTURING **9**

Material transfer, Machine loading & unloading, Processing operations, Assembly & Inspectors, Robotic Cell Design & Control.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- explain the basic principles of robotic technology, configurations, control and programming of robots.
- design an industrial robot which can meet kinematic and dynamic constraints.
- choose the appropriate sensor and machine vision system for a given application.
- clarify the basic principles of programming and apply it for typical Pick & place, loading & unloading and palletizing applications.
- Analyze the concept of robot manufacturing.

TEXT BOOKS

1. Robotics, control vision and intelligence-Fu, Lee and Gonzalez. McGraw Hill International, 2nd edition, 2007.
2. Introduction to Robotics- John J. Craig, Addison Wesley Publishing, 3rd edition, 2010.

REFERENCES

1. M.P. Groover , M. Weiss, R.N. Nagel, N.G. Odrey "INDUSTRIAL ROBOTICS,"Mcgra – Hill International. 2007
2. Robotics for Engineers -YoramKoren, McGraw Hill International, 1st edition, 1985.
3. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012.
4. Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1st edition, 2009.
5. Robotics for Engineers - Yorem Koren 2009.

WEB LINKS

1. https://eprints.usq.edu.au/3997/1/Industrial_Robotics.pdf
2. http://zums.ac.ir/files/research/site/ebooks/Robotics/Industrial.pdf

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	-	2	-	-	-	-	2	2	2	2
CO2	3	2	3	-	-	2	2	-	-	-	2	2	2	2
CO3	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO4	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO5	3	2	3	-	-	2	-	-	-	-	2	2	2	2

EE15253 **SOFT COMPUTING TECHNIQUES** **3 0 0 3**

COURSE OBJECTIVES

- To understand the artificial intelligence, various types of production systems, characteristics of production systems.
- To expose the neural networks, architecture, functions and various algorithms involved.
- To learn the basic Fuzzy logic functions, various fuzzy systems and their functions.
- To study the fuzzy set theory based on applications.
- To know the genetic algorithms, its applications and advances.

UNIT I NEURAL NETWORKS-I **9**

Artificial neural networks – definition and fundamental concepts – engineering approaches to neural computing-biological neural networks – Artificial neural activation functions – setting of weights – typical architectures – biases and thresholds – learning and its methods – LMS learning rule – MADALINE – XOR Problem - training algorithm. Supervised Learning Neural Networks – Perceptrons - Adaline – Back propagation Mutilayer Perceptrons

UNIT II NEURAL NETWORKS-II **9**

Radial Basis Function Networks – Support Vector Machines - Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hebbian Learning.

UNIT III FUZZY SET THEORY-I **9**

Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations –Fuzzification & Defuzzification

UNIT IV FUZZY SET THEORY-II **9**

Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

UNIT V GENETIC ALGORITHM **9**

Introduction to genetic algorithm-history – basic concepts-creation of offspring-working principle-encoding-binary encoding-octal encoding - hexadecimal encoding – permutation encoding – value encoding - tree encoding-fitness function. Application of GA in power system optimization problems, AC drives, DC drives, neuro – GA applications, GA based optimal weight training for neural networks

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- explain about soft computing techniques and their applications
- analyze various neural network architectures
- define the fuzzy systems
- perform analysis of systems based on fuzzy set theory.
- examine the genetic algorithms and their applications.

TEXT BOOKS

1. Laurance Fausett, Englewood cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education,2008.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 2007.

REFERENCES

1. Simon Haykin, 'Neural Networks', Pearson Education, 2003.
2. John Yen & Reza Langari, 'Fuzzy Logic – Intelligence Control & Information', Pearson Education, New Delhi, 2003
3. M.Gen and R,Cheng, Genetic algorithms and Optimization, Wiley Series in Engineering Design and Automation, 2000
4. Hagan, Demuth, Beale, " Neural Network Design", Cengage Learning, 2012.
5. N.P.Padhy, " Artificial Intelligence and Intelligent Systems", Oxford, 2013.

WEB LINKS

1. http://users.du.se/~jwe/fuzzy/NFL/F9.PDF
2. https://www.vssut.ac.in/lecture_notes/lecture1423723637.pdf

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CO5	3	-	-	-	2	3	1	-	1	-	2	1	-	2

EE15254 **WIND AND SOLAR ENERGY SYSTEMS** **3 0 0 3**

COURSE OBJECTIVES

- To impart knowledge on the energy availability in the field renewable energy.
- To acquire knowledge about the wind generators and about wind hybrid technology
- To understand the developing processes involved in wind energy system
- To impart detailed knowledge On photovoltaic System and role of power electronics in PV system
- To get basic idea of hybrid wind and solar system

UNIT I INTRODUCTION **9**

Recent trends in energy consumption - World energy scenario – Energy sources and their availability - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems - need to develop new energy technologies

UNIT II WIND ENERGY CONVERSION SYSTEMS **9**

Basic principle of wind energy conversion - nature of wind - Wind survey in India - Power in the wind - components of a wind energy - conversion system - Performance of induction generators for WECS - classification of WECS - Analysis of different wind power generators - IG - PMSG - DFIG – SEIG.

UNIT III GRID CONNECTED WIND ENERGY SYSTEMS **9**

Grid Connected WECS: Grid connectors concepts - wind farm and its accessories - Systems for Feeding into the Grid - Induction Generators for Direct Grid Coupling - Asynchronous Generators in Static Cascades - Synchronous. Generators Grid related problems - Generator control - Performance improvements - Different schemes - AC voltage controllers - Harmonics and PF improvement

UNIT IV SOLAR ENERGY CONVERSION SYSTEMS **9**

Photovoltaic Energy Conversion: Solar radiation and measurement - solar cells and their characteristics - PV arrays - Electrical storage with batteries - Switching devices for solar energy conversion Grid connection Issues - Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing. PV Applications: Stand alone inverters - Charge controllers - Water pumping, audio visual. equipments, street lighting - analysis of PV systems

UNIT V OPERATION OF POWER SYSTEM WITH WIND AND SOLAR ENERGY SYSTEMS **9**

Interface requirement – synchronizing with grid – operating limit – energy storage and load scheduling – utility Resource planning – electrical performance – voltage, current and power efficiency – component design for maximum efficiency – static bus impedance and voltage regulation – quality of power – renewable capacity limit – Plant economy

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- understand about the fundamentals of wind & solar energy and the requirements of renewable energy in India
- obtain knowledge of various wind turbines and importance of hybrid wind energy system
- know the design procedure of wind energy systems
- gather knowledge about the principle of conversion of solar energy through power electronics converters
- acquire knowledge about the importance of hybrid wind and solar system

TEXT BOOKS

1. Rai ,G.D., "Non- conventional resources of energy" , Khanna publishers ,Fourth edition , 2010.

REFERENCES

1. Rashid. M. H, "Power Electronics Handbook", Academic press, 2001.\
2. Erickson. R., Angkrtitrakul. S, Al – Nasean. O and Lujan. G, "Novel power electronics systems for wind energy applications" – Final report, National Renewable Energy Laboratory, Colorado, US. – Aug 24, 1999 Nov 30, 2002.
3. Rai. G. D, "Non conventional energy sources", Khanna publishers, 4th Edition 2000.
4. B.H.Khan, "Non Conventional Energy Resources", Tata Mc GrawHill, 2nd Edition 2006.
5. J.K.Manwell, J.G.McGowan, A.L.Rogers, "Wind energy explained – Theory Design and applications", John Wiley & Sons, 2nd Edition 2009.

WEB LINKS

1. http://prod.sandia.gov/
2. http://electrical4u.com/
3. http://www.icrepq.com/

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CO5	3	3	3	2	2	1	-	-	-	-	3	-	3	3

EE15255 **SWITCHED MODE POWER CONVERTERS** **3 0 0 3**

COURSE OBJECTIVES

- To instigate on reactive elements in power electronic systems.
- To understand the concepts of Switched Mode power converters.
- To introduce the Isolated and non-isolated topologies and modelling of dc-to-dc converters
- To implicit the awareness of resonant converters.
- To study the closed loop control of switching converters with compensator design and applications of rectifiers

UNIT I REACTIVE CIRCUIT ELEMENTS **9**

Reactive Elements in Power Electronic Systems, Design of inductor, Design of transformer, Capacitors for power electronic applications.

UNIT II DC-TO-DC CONVERTERS **9**

Basic concepts of Switched Mode power converters. Primitive DC to DC Power Converter-Operating Principle, Exact and Approximate Analysis.

UNIT III TOPOLOGIES OF DC-TO-DC CONVERTERS **9**

Non-isolated DC to DC Power Converter- Buck, Boost, Buck-Boost, Cuk, Sepic and Quadratic Converters. Isolated DC to DC Power Converter - Forward, Flyback, Half/Full Bridge Converters. - Steady - state model, dynamic model, analysis, modeling and performance functions of switching power converters

UNIT IV RESONANT CONVERTERS **9**

Classification of resonant converters, Basic resonant circuit concepts, Load resonant converters, resonant switch converters, Zero voltage and current switching.

UNIT V CLOSED LOOP CONTROL OF POWER CONVERTERS **9**

Closed Loop Control of Switching Converters- Steady State Error, Control Bandwidth, and Compensator Design- Closed Loop Dynamic Performance Functions- Design of feed- back compensators. Unity power factor rectifiers, resistor emulation principle - applications of rectifiers.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end of this course, students will be able to

- design the reactive elements in power electronic systems.
- explain the functions of various DC to DC power converters.
- perform analysis of DC-DC converters.
- design and analyze the resonant converters.
- apply the concept of feed- back to power converters.

TEXT BOOKS

1. Ramanarayanan V., “Course Material on Switched Mode Power Conversion”, IISc , Bangalore, 2007
2. Umanand L., Bhat S.R., “Design of magnetic components for Switched Mode Power Converters” , Wiley Eastern Ltd.,2002

REFERENCES

1. Ned Mohan, Tore M. Undeland, William P.Robbins, "Power Electronics: Converters, Applications andDesign", John Wiley and Sons, Third edition, 2003.
2. Philip T. Krein, "Elements of Power Electronics", Oxford University Press, 2004.
3. Simon S. Ang, "Power Switching Converter", Marcel Dekker Inc., 1995.
4. Issa Batarseh, 'Power Electronic Circuits', John Wiley, 2004.

WEB LINKS

1. file:///C:/Users/Paavai/Downloads/Topologije%20prekidackih%20izvora%20napajanja.pdf
2. http://www.smps.us/topologies.html

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