M.D. UNIVERSITY, ROHTAK

(NAAC Accredited 'A+' Grade)

SCHEME OF STUDIES AND EXAMINATION
B.TECH (Electrical & Electronics Engineering)
SEMESTER 5th AND 6th
Scheme effective from 2020-21

COURSE CODE AND DEFINITIONS:

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar
TH	Theory
Pr	Practical

General Notes:

1. Mandatory courses are non credit courses in which students will be required passing marks in internal assessments.
2. Students will be allowed to use non programmable scientific calculator. However, sharing of calculator will not be permitted in the examination.
3. Students will be permitted to opt for any elective course run by the department. However, the department shall offer those electives for which they have expertise. The choice of the students for any elective shall not be binding for the department to offer, if the department does not have expertise. To run the elective course a minimum of 1/3rd students of the class should opt for it.

Scheme of Studies and Examination
B.TECH (Electrical & Electronics Engineering) – 5th Semester
w.e.f. 2020-21

Sl. No.	Course Code	Course Title	Teaching Schedule L	T	P	Marks of class work	Examination marks Theory	Practical	Total Marks	Credit	Duration of examination in hour
1.	PCC-EE-301G	Power Systems–I	3	0	0	25	75	0	100	3	3
2.	LC -EE-303G	Power Systems–I Laboratory	0	0	2	25	0	25	50	1	2
3.	PCC - EE-305G	Control System	3	0	0	25	75	0	100	3	3
4.	LC-EE-307G	Control System LAB	0	0	2	25	0	25	50	1	2
5.	PCC - EE-309G	Microprocessor & Microcontroller	3	0	0	25	75	0	100	3	3
6.	LC EE-311G	Microprocessor & Microcontroller Lab	0	0	2	25	0	25	50	1	2
7.	PCC-EEE-313G	Electronic Measurement and Instrumentation	3	1	0	25	75	0	100	3	3
8.	LC-EEE-315G	Electronic Measurement and Instrumentation Lab	0	0	2	25	0	25	50	1	2
9.	PEC-I	Program Elective-I refer in List-I	3	0	0	25	75	0	100	3	3
10.	OEC-I	Open Elective – I refer in List-II	3	0	0	25	75	0	100	3	3
11.	HSMC-01G	Economics for Engineers	3	0	0	25	75	0	100	3	3
12.	PT-EEE317G	Practical Training-1	-	-	-	-	-	-	* Refer Note 1		
	Total								**900**	**25**	

Note:

1. The evaluation of Practical Training-I will be based on seminar, viva-voce, report submitted by the students. According to performance, the students are awarded grades A, B, C, F. A student who is awarded 'F' grade is required to repeat Practical Training.
   Excellent: A; Good : B; Satisfactory: C; Not Satisfactory: F.

List-I: PROGRAMM ELECTIVE (Semester-V)

Sr. No	Code	Subject	Credit
1	PEC-EEE-01G	Digital system design	3
2	PEC-EEE-03G	Scientific computing	3
3	PEC-EE-05G	HVDC Transmission system	3
4	PEC-EE-07G	High voltage engineering	3
5	PEC-EEE-09G	Biomedical Electronics	3
6	PEC-EEE-11G	Speech and audio processing	3

List-II: OPEN ELECTIVE-V (SEMESTER)

Sr.No	Code	Subject	Credit
1	OEC-EE01G	Electrical Engineering Materials	3
2	OEC-ECE332G	Additive manufacturing	3
3	OEC-EEE05G	Intelligent Instrumentation	3
4	OEC-EE07G	Power plant engineering	3

Scheme of Studies and Examination
B.TECH (Electrical & Electronics Engineering) – 6th Semester
w.e.f. 2020-21

Sl. No.	Course Code	Course Title	Teaching Schedule L	T	P	Marks of class work	Examination marks Theory	Practical	Total Marks	Credit	Duration of examination in hour
1.	PCC - EE-302G	Power Systems–II	3	0	0	25	75	0	100	3	3
2.	LC -EE-304G	Power Systems–II Laboratory	0	0	2	25	0	25	50	1	2
3.	PCC - EEE-306G	Digital Signal Processing	3	0	0	25	75	0	100	3	3
4.	LC - EEE-308G	Digital Signal Processing Laboratory	0	0	2	25	0	25	50	1	2
5.	PCC - EEE-310G	VLSI Design	3	0	0	25	75	0	100	3	3
6.	LC - EEE-312G	VLSI Design Lab	0	0	2	25	0	25	50	3	3
7.	PEC-II	Program Elective-II refer in List-III	3	0	0	25	75	0	100	3	3
8.	OEC-II	Open Elective –II refer in List-IV	3	0	0	25	75	0	100	3	3
9.	HSMC-02G	Organisational Behaviour	3	0	0	25	75	0	100	3	3
	Total								750	23	

Note:

Each student has to undergo practical training of 6 weeks during summer vacation after 6th semester and its evaluation shall be carried out in 7th Semester.

List-III

PROGRAMM ELECTIVE (Semester-VI)			
Sr. No	**Code**	**Subject**	**Credit**
1.	PEC-EE-04G	Electrical and hybrid vehicle	3
2.	PEC-EE-06G	Power system protection	3
3.	PEC-EE-08G	Advance Electric Drives	3
4.	PEC-EE-10G	Electrical Machine Design	3
5.	PEC-EEE-12G	Computer organization and architecture	3

List-IV

OPEN ELECTIVE-I [Semester-VI]			
Sr.No	Code	Subject	Credit
1.	OEC-EE-04G	Python programming	3
2.	OEC-EE-06G	Introduction to MEMS	3
3.	OEC-EE-08G	Conventional and Renewable Energy Resources	3
4.	OEC-EE-10G	Soft Computing	3

POWER SYSTEM-I

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PCC- EE-301G		
Category	Program Core Course		
Course title	Power System-I (Theory)		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the concepts of power systems.
- Understand the various power system components.
- Evaluate fault currents for different types of faults.
- Understand basic protection schemes and circuit breakers.
- Understand concepts of HVDC power transmission and renewable energy generation.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Section-A

Basic concepts : Introduction, Review of Three-phase systems. Analysis of simple three-phase circuits. Single-phase representation of balance three-phase network, The one-line diagram and the impedance or reactance diagram, Per unit (PU) system, Complex power, The steady state model of synchronous machine, Transmission of electric power, Representation of loads.

Section-B

Fault Analysis : Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding.

Section-C

Switchgear and protection: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application

Section-D

Introduction to DC Transmission & Solar PV System : DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission.

Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators.

Text/References:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012
6. EHV-AC/DC Transmission System ;S.Rao : Khanna Pub.
7. C.L Wadhwa, " Electrical Power system" new age publication.
8. Transmission & Distribution of Electrical Engineering: Westing House & Oxford Univ. Press, New Delhi8. Power System Protection & Switchgear By B. Ram, McGraw Hill

Power System-I Laboratory

Class Work: 25
Exam : 25
Total : 50

Course Code	**PCC-EE-303G**		
Category	Program Core Course		
Course title	Power system-I (Laboratory)		
Scheme	**L**	**T**	**P**
	-	**-**	**2**

Notes:

At least 10 experiments are to be performed by students in the semester.

At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

LIST OF EXPERIMENTS:

(A) Hardware Based:

1. To determine negative and zero sequence reactances of an alternator.
2. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation
3. To study the IDMT over current relay and determine the time current characteristics
4. To study percentage differential relay
5. To study Impedance, MHO and Reactance type distance relays
6. To study ferranti effect and voltage distribution in H.V. long transmission line using transmission line model.
7. To study operation of oil testing set.
8. To understand PV modules and their characteristics like open circuit voltage, short circuit current, Fill factor, Efficiency,
9. To understand I-V and P-V characteristics of PV module with varying radiation and temperature level
10. To understand the I-V and P-V characteristics of series and parallel combination of PV modules.
11. To understand wind energy generation concepts like tip speed, torque and power relationship, wind speed versus power generation

(B) Simulation Based Experiments (using MATLAB or any other software)

12. To obtain steady state, transient and sub-transient short circuit currents in an alternator
13. To perform symmetrical fault analysis in a power system
14. To perform unsymmetrical fault analysis in a power system

Note:

1. Each laboratory group shall not be more than about 20 students.

2. To allow fair opportunity of practical hands on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Control system

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	**PCC-EE-305G**		
Category	**Program Core Course**		
Course title	**Control Systems**		
Scheme	**L**	**T**	**P**
	03	**-**	**-**

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the modellingof linear-time-invariant systems using transfer function and state-space representations.
- Understandthe concept of stability and its assessment for linear-time invariant systems.
- Design simple feedback controllers.

Section-A

Introduction to control problem (4 hours)

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra, Signal flow graph.

Time Response Analysis (10 hours)

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Section-B

Frequency-response analysis (6 hours)

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Section-C

Introduction to Controller Design (10 hours)

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

Section-D

State variable Analysis (6 hours)

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability.

Text/References:

1. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

2. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.

3. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009.

4. B.S.Manke, "Linear Control Systems: with MATLAB application", Khanna Publication.

5. https://nptel.ac.in/courses/107/106/107106081/ by Prof.C.S Shankar Ram, IIT Madras.

Control Systems Laboratory

Theory : 25
Class Work : 25
Total : 50

Course Code	**PCC-EE-307G**		
Category	**Program Core Course**		
Course title	**Control SystemsLaboratory**		
Scheme	**L**	**T**	**P**
	-	**-**	**02**

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.

(iii) Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS: ANY SIX EXPERIEMENTS

1. To study speed Torque characteristics of

a) A.C. servo motor b) DC servo motor.

2. (a) To demonstrate simple motor driven closed loop DC position control system.

(b) To study and demonstrate simple closed loop speed control system.

3. To study the lead, lag, lead-lag compensators and to draw their magnitude and phase plots.

4. To study a stepper motor & to execute microprocessor or computer-based control of the same by changing number of steps, direction of rotation & speed.

5. To implement a PID controller for temperature control of a pilot plant.

6. To study behavior of 1^{st} order, 2^{nd} order type 0, type 1 system.

7. To study control action of light control device.

8. To study water level control using a industrial PLC.

9. To study motion control of a conveyor belt using a industrial PLC

SOFTWARE BASED (ANY FOUR EXPT.)

10. Introduction to SOFTWARE (Control System Toolbox), Implement at least any

- Different Toolboxes in SOFTWARE, Introduction to Control Systems Toolbox.
- Determine transpose, inverse values of given matrix.
- Plot the pole-zero configuration in s-plane for the given transfer function. Plot unit step response of given transfer function and find peak overshoot, peak time.
- Plot unit step response and to find rise time and delay time.
- Plot locus of given transfer function, locate closed loop poles for different values of k.
- Plot root locus of given transfer function and to find out S, Wd, Wn at given root & to discuss stability.
- Plot bode plot of given transfer function and find gain and phase margins Plot the Nyquist plot for given transfer function and to discuss closed loop stability, gain and phase margin.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Microprocessor and Microcontroller

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	**PCC-EE-309G**		
Category	**Program Core Course**		
Course title	**Microprocessor and Microcontroller**		
Scheme	**L**	**T**	**P**
	03	**-**	**-**

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Objective:

1. To develop an in-depth understanding of the operation of microprocessors.

2. To master the assembly language programming using concepts like assembler directives, procedures, macros, software interrupts etc.

3. To create an exposure to basic peripherals, its programming and interfacing techniques

4. To understand the concept of Interrupts and interfacing details of 8086.

5. To impart the basic concepts of serial communication in 8086.

Section-A

8086 MICROPROCESSORS

Introduction to 8086 Architecture, Features, Signals, I/O & Memory Interfacing, Addressing Modes, Interrupts, Minimum Mode & Maximum Mode Operation, Instruction Set, Assembly Language Programming.

Section-B

PERIPHERAL DEVICES

Parallel Peripheral Interface (8255), A/D & D/A Interface, Timer / Counter (8253), Keyboard and Display Controller (8279), USART (8251), Interrupt Controller (8259), DMA Controller (8237)

Section-C

INTRODUCTION OF MICROCONTROLLER

Different types of microcontrollers: Embedded microcontrollers, External memory microcontrollers; Processor Architectures: Harvard V/S Princeton , CISC V/S RISC; microcontrollers memory types; microcontrollers features : clocking, i/o pins, interrupts,timers, peripherals.

Section-D

8051 ARCHITECTURE

Microcontroller 8051- Architecture, Pin Diagram, I/O Ports, Internal RAM and Registers, Interrupts, Addressing Modes, Memory Organization and External Addressing, Instruction Set, Assembly Language Programming, Real Time Applications of Microcontroller- Interfacing with LCD, ADC, DAC, Stepper Motor, Key Board and Sensors.

Reference Books:

1. Mazidi and Mazidi: The 8051 Microcontroller and Embedded Systems, Pearson Education.
2. A. V. Deshmukh: Microcontroller (Theory and Application), TMH.
3. D. V. Hall: Microprocessors and Interfacing, TMH
4. Programming and Customizing the 8051 Microcontroller :Predko ; TMH.

Microprocessor and Microcontroller Lab

Theory :	25
Class Work :	25
Total :	50

Course Code	**PCC-EE-311G**		
Category	**Program Core Course**		
Course title	**Microprocessor and Microcontroller Lab**		
Scheme	**L**	**T**	**P**
	-	**-**	**02**

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.

(iii) Group of students for practical should be 15 to 20 in number.

List of Experiments:

1. Write a program using 8085 and verify for :
   a. Addition of two 8-bit numbers.
   b. Addition of two 8-bit numbers (with carry).
2. Write a program using 8085 and verify for :
   a. 8-bit subtraction (display borrow)
   b. 16-bit subtraction (display borrow)
3. Write a program using 8085 for multiplication of two 8- bit numbers by repeated addition method. Check for minimum number of additions and test for typical data.
4. Write a program using 8085 for multiplication of two 8- bit numbers by bit rotation method and verify.
5. Write a program using 8086 for finding the square root of a given number and Verify.
6. Write a program using 8086 for copying 12 bytes of data from source to destination and verify.
7. Write a program using 8086 and verify for:
   a. Finding the largest number from an array.
   b. Finding the smallest number from an array.
8. Write a program using 8086 for arranging an array of numbers in descending

order and verify.

9. Write a program using 8086 for arranging an array of numbers in ascending order and verify.

10. Write a program to interface a two digit number using seven-segment LEDs. Use 8085/8086 microprocessor and 8255 PPI.

11. Write a program to control the operation of stepper motor using 8085/8086 microprocessor and 8255 PPI.

12. To study implementation & interfacing of Display devices Like LCD, LED Bar graph & seven segment display with Microcontroller 8051/AT89C51

13. To study implementation & interfacing of Different motors like stepper motor, DC motor & servo Motors.

14. Write an ALP for temperature & pressure measurement

15. Write a program to interface a graphical LCD with 89C51

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

ELECTRONIC MEASUREMENT AND INSTRUMENTATION

Theory : 75
Class Work : 25
Total : 100
Duration of Exam : 3 Hrs.

Course Code	**PCC-EEE-313G**		
Category	**Program Core Course**		
Course title	**ELECTRONIC MEASUREMENT AND INSTRUMENTATION**		
Scheme	**L**	**T**	**P**
	03	**-**	**-**

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcome:

1.Analyze the performance characteristics of each instrument
2. Illustrate basic meters such as voltmeters and ammeters.
3. Explain about different types of signal analyzers.
4. Explain the basic features of oscilloscope and different types of oscilloscopes
5. Identify the various parameters that are measurable in electronic instrumentation.
6. Employ appropriate instruments to measure given sets of parameters.

Section-A

OSCILLOSCOPE:

Block diagram, study of various stages in brief, high frequency CRO considerations. Sampling and storage oscilloscope.

GENERATION & ANALYSIS OF WAVEFORMS:
Block diagram of pulse generators, signal generators, function generators wave analysers, distortion analysers, spectrum analyser, Harmonic analyser, introduction to power analyser.

Section-B

ELECTRONIC INSTRUMENTS:
Instruments for measurement of voltage, current & other circuit parameters, Q meters, R.F. power measurements, introduction to digital meters.
FREQUENCY & TIME MEASUREMENT:
Study of decade counting Assembly(DCA), frequency measurements, period measurements, universal counter, introduction to digital meters.

Section-C

DISPLAY DEVICES:

Nixie tubes, LED's LCD's, discharge devices.

TRANSDUCERS:
Classification, Transducers of types: RLC photocell, thermocouples etc. basic schemes of

measurement of displacement, velocity, acceleration, strain, pressure, liquid level & temperature.

Section-D

INTRODUCTION TO SIGNAL CONDITIONING:
DC signal conditioning system, AC signal conditioning system, data acquisition and conversion system

TEXT BOOK:

1. A course in Electrical & Electronics Measurements & Instrumentation : A.K.Sawhney; Dhanpat Rai & Sons.

REFERENCE BOOKS.

1. Electronics Instrumentation & Measurement Techniques : Cooper; PHI.

ELECTRONIC MEASUREMENT AND INSTRUMENTATION-LAB

Theory : 25
Class Work : 25
Total : 50

Course Code	**PCC-EEE-315G**		
Category	**Program Core Course**		
Course title	**ELECTRONIC MEASUREMENT AND INSTRUMENTATION-LAB**		
Scheme	**L**	**T**	**P**
	-	**-**	**02**

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.

(iii) Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS

1) Study blocks wise construction of a analog oscilloscope & Function generator.
2) Study blocks wise construction of a Multimeter & frequency counter.
3) Study Measurement of different components & parameters like Q of a coil etc using LCRQ meter.
4) Study of distortion factor meter and determination of the % distortion of the given oscillator
5) Determine output characteristics of a LVDT and Measure displacement using LVDT
6) Study characteristics of temperature transducer like Thermocouple, Thermistor & RTD with implementation of a small project using signal conditioning circuits like instrumentation amplifier.
7) Measurement of Strain using Strain Guage.
8) To study differential pressure transducer & signal conditioning of output signal.
9) Measurement of level using capacitive transducer..
10) Study of Distance measurement using ultrasonic transducer.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

DIGITAL SYSTEM DESIGN

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PEC- EEE-01G		
Category	PROGRAMM ELECTIVE		
Course title	DIGITAL SYSTEM DESIGN		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcome: After the completion of the course the student will be able to:

1. Understand the need & application of hardware description language.
2. Modeling & simulations of various basic & advanced digital systems using VHDL.
3. Implementation of various basic & advanced digital systems using FPGAs.
4. Apply knowledge to design & implement combinational circuits & sequential circuits related to research & industry applications.

Section-A

INTRODUCTION :Introduction to Computer-aided design tools for digital systems. Hardware description languages; introduction to VHDL data objects, classes and data types, Operators, Overloading, logical operators. Types of delays Entity and Architecture declaration. Introduction to behavioral dataflow and structural models.

Section-B

VHDL STATEMENTS : Assignment statements, sequential statements and process, conditional statements, case statement Array and loops, resolution functions, Packages and Libraries, concurrent statements. Subprograms: Application of Functions and Procedures, Structural Modelling, component declaration, structural layout and generics.

Section-C

COMBINATIONAL & SEQUENTIAL CIRCUIT DESIGN:VHDL Models and Simulation of combinational circuits such as Multiplexers, Demultiplexers, encoders, decoders , code converters, comparators, implementation of Boolean functions etc. VHDL Models and Simulation of Sequential Circuits Shift Registers, Counters etc.

Section-D

DESIGN OF MICROCOMPUTER & PROGRAMMABLE DEVICE: Basic components of a computer, specifications, architecture of a simple microcomputer system, implementation of a simple microcomputer system using VHDL Programmable logic devices : ROM, PLAs, PALs, GAL, PEEL, CPLDs and FPGA. Design implementation using CPLDs and FPGAs

REFERENCE BOOKS:

1. Ashenden - Digital design,Elsevier

2. IEEE Standard VHDL Language Reference Manual (1993).
3. Digital Design and Modelling with VHDL and Synthesis : KC Chang; IEEE Computer Society Press.
4. "A VHDL Primmer" : Bhasker; Prentice Hall 1995.
5. "Digital System Design using VHDL" : Charles. H.Roth ; PWS (1998).
6. "VHDL-Analysis & Modelling of Digital Systems" : Navabi Z; McGraw Hill.
7. VHDL-IV Edition :Perry; TMH (2002)
8. "Introduction to Digital Systems" : Ercegovac. Lang & Moreno; John Wiley (1999).
9. Fundamentals of Digital Logic with VHDL Design : Brown and Vranesic; TMH (2000)
10. Modern Digital Electronics- III Edition: R.P Jain; TMH (2003).
11. Grout - Digital system Design using FPGA & CPLD 'S,Elsevier

Scientific computing

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PEC-EEE-03G		
Category	PROGRAMM ELECTIVE		
Course title	Scientific computing		
Scheme	L	T	P
	3	-	-

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the significance of computing methods, their strengths and application areas.
2. Perform the computations on various data using appropriate computation tools.
3. Analyze, design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.
4. Understanding of the connection between the description of a concrete problem and the mathem
atical model that describes it.
5. Good theoretical insight and the ability to apply theory to the development of methods and techniques for problem solving.

Section-A

Introduction: Sources of Approximations, Data Error and Computational, Truncation Error and Rounding Error, Absolute Error and Relative Error, Sensitivity and Conditioning, Backward Error Analysis, Stability and Accuracy

Computer Arithmetic: Floating Point Numbers, Normalization, Properties of Floating Point System, Rounding, Machine Precision, Subnormal and Gradual Underflow, Exceptional Values, Floating-Point Arithmetic, Cancellation

Section-B

System of liner equations: Linear Systems, Solving Linear Systems, Gaussian elimination,Pivoting, Gauss-Jordan, Norms and Condition Numbers, Symmetric Positive Definite Systems and Indefinite System, Iterative Methods for Linear Systems

Linear least squares: Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, QR factorization, Gram-Schmidt Orthogonalization, Rank Deficiency, and Column Pivoting

Eigenvalues and singular values:Eigenvalues and Eigenvectors, Methods for Computing All Eigenvalues, Jacobi Method, Methods for Computing Selected Eigenvalues, Singular Values Decomposition, Application of SVD

Section-C

Nonlinear equations: Fixed Point Iteration, Newton's Method, Inverse Interpolation Method

Optimization: One-Dimensional Optimization, Multidimensional Unconstrained Optimization, Nonlinear Least Squares

Interpolation:Purpose for Interpolation, Choice of Interpolating, Function, Polynomial Interpolation, Piecewise Polynomial Interpolation Numerical Integration And Differentiation: Quadrature Rule, Newton-Cotes Rule, Gaussian Quadrature Rule, Finite Difference Approximation,

Section-D

Initial Value Problems for ODES, Euler's Method, Taylor Series Method, Runga-Kutta Method, Extrapolation Methods, Boundary Value Problems For ODES, Finite Difference Methods, Finite Element Method, Eigen value Problems Partial Differential Equations, Time Dependent Problems, Time Independent Problems, Solution for Sparse Linear Systems, Iterative Methods Fast Fourier Transform, FFT Algorithm, Limitations, DFT, Fast polynomial Multiplication, Wavelets, Random Numbers And Simulation, Stochastic Simulation, Random Number Generators, Quasi-Random Sequences

Text/ Reference Books:

1. Heath Michael T., " Scientific Computing: An Introductory Survey", McGraw-Hill, 2nd Ed., 2002
2. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", Cambridge University Press, 3rd Ed., 2007
3. Xin-she Yang (Ed.)., " Introduction To Computational Mathematics", World Scientific Publishing Co., 2nd Ed., 2008
4. Kiryanov D. and Kiryanova E., " Computational Science", Infinity Science Press, 1st Ed., 2006
5. Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, " Scientific Computing With MATLAB And Octave", Springer, 3rd Ed., 2010

HVDC Transmission Systems

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PEC-EE-05G		
Category	PROGRAM ELECTIVE		
Course title	HVDC Transmission Systems		
Scheme	L	T	P
	3	-	-

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes:

1. Develop the knowledge of HVDC transmission and HVDC converters and the applicability and advantage of HVDC transmission over conventional AC transmission.
2. Formulate and solve mathematical problems related to rectifier and inverter control methods and learn about different control schemes as well as starting and stopping of DC links
3. Analyze the different harmonics generated by the converters and their variation with the change in firing angles.
4. Develop harmonic models and use the knowledge of circuit theory to develop filters and assess the requirement and type of protection for the filters.
5. Study and understand the nature of faults happening on both the AC and DC sides of the converters and formulate protection schemes for the same.
6. Review the existing HVDC systems along with MTDC systems and their controls and recognize the need to follow the advancements in both the existing systems and HVDC systems and determine the most economic coexistence of both.

Section A

BASIC CONCEPTS

Economics & Terminal equipment of HVDC transmission systems: Types of HVDC Links – Apparatus required for HVDC Systems – Comparison of AC &DC Transmission, Application of DC Transmission System – Planning & Modern trends in D.C. Transmission.

ANALYSIS OF HVDC CONVERTERS

Choice of Converter configuration – analysis of Graetz – characteristics of 6 Pulse & 12 Pulse converters – Cases of two 3 phase converters in star –star mode – their performance.

Section B

CONVERTER & HVDC SYSTEM CONTROL

Principle of DC Link Control – Converters Control Characteristics – Firing angle control Current and extinction angle control – Effect of source inductance on the system; Starting and

stopping of DC link; Power Control.

REACTIVE POWER CONTROL IN HVDC

Reactive Power Requirements in steady state-Conventional control strategies-Alternate control strategies sources of reactive power-AC Filters – shunt capacitors-synchronous condensers.

Section C

POWER FLOW ANALYSIS IN AC/DC SYSTEMS

Modelling of DC Links-DC Network-DC Converter-Controller Equations-Solution of DC load flow – P.U. System for d.c. quantities-solution of AC-DC Power flow-Simultaneous method-Sequential method.

CONVERTER FAULT & PROTECTION

Converter faults – protection against over current and over voltage in converter station – surge arresters – smoothing reactors – DC breakers –Audible noise-space charge field-corona effects on DC lines-Radio interference.

Section D

HARMONICS

Generation of Harmonics –Characteristics harmonics,calculation of AC Harmonics, Non-Characteristics harmonics, adverse effects of harmonics – Calculation of voltage & Current harmonics – Effect of Pulse number on harmonics

FILTERS

Types of AC filters,Design of Single tuned filters –Design of High pass filters.

TEXT BOOKS:

1. HVDC Power Transmission Systems: Technology and system Interactions – by K.R.Padiyar,
New Age International (P) Limited, and Publishers.
2. EHVAC and HVDC Transmission Engineering and Practice – S.Rao.

REFERENCE BOOKS:

1. HVDC Transmission – J.Arrillaga.
2. Direct Current Transmission – by E.W.Kimbark, John Wiley & Sons.
3. Power Transmission by Direct Current – by E.Uhlmann, B.S.Publications.

3. *Arrillaga, J., HVDC Transmission, IEE Press (2007).*

High Voltage Engineering

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PEC-EE-07G		
Category	PROGRAM ELECTIVE		
Course title	High Voltage Engineering		
Scheme	L	T	P
	3	-	-

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course outcomes:

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

- Explain conduction and breakdown phenomenon in gases, liquid dielectrics.
- Analyze breakdown phenomenon in solid dielectrics.
- Explain generation of high voltages and currents
- Analyze measurement techniques for high voltages and currents.
- Discuss overvoltage phenomenon and insulation coordination in electric power systems.
- Perform non-destructive testing of materials and electric apparatus and high-voltage testing of electric apparatus.

Section A

Conduction and Breakdown in Gases:

Collision Process, Ionization Processes, Townsend's Current Growth Equation, Current Growth in the Presence of Secondary Processes, Townsend's Criterion for Breakdown, Experimental Determination of Coefficients α and γ, Breakdown in Electronegative Gases, Time Lags for Breakdown, Streamer Theory of Breakdown in Gases, Paschen's Law, Breakdown in Non-Uniform Fields and Corona Discharges.

Conduction and Breakdown in Liquid Dielectrics:

Liquids as Insulators, Pure Liquids and Commercial Liquids, Conduction and Breakdown in Pure Liquids, Conduction and Breakdown in Commercial Liquids.

Breakdown in Solid Dielectrics:

Introduction, Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown.

Section B

Generation of High Voltages and Currents:

Generation of High Direct Current Voltages, Generation of High Alternating Voltages, Generation of Impulse Voltages, Generation of Impulse Currents, Tripping and Control of Impulse Generators.

Measurement of High Voltages and Currents:

Measurement of High Direct Current Voltages, Measurement of High AC and Impulse Voltages, Measurement of High Currents – Direct, Alternating and Impulse, Cathode Ray Oscillographs for Impulse Voltage and Current Measurements.

Section C

Overvoltage Phenomenon and Insulation Coordination in Electric Power Systems:

National Causes for Overvoltages - Lightning Phenomenon, Overvoltage due to Switching Surges, System Faults and Other Abnormal, Principles of Insulation Coordination on High Voltage and Extra High Voltage Power Systems.

Non-Destructive Testing of Materials and Electrical Apparatus:

Introduction, Measurement of Dielectric Constant and Loss Factor, Partial Discharge Measurements.

Section D

HV Testing of Electrical Apparatus:

Testing of Insulators and Bushings, Testing of Isolators and Circuit Breakers, Testing of Cables, Testing of Transformers, Testing of Surge Arrestors, Radio Interference Measurements, Testing of HVDC Valves and Equipment.

Reference Books

- High Voltage Engineering M.S. Naidu, V.Kamaraju McGraw Hill 5 th Edition, 2013.
- High Voltage Engineering Fundamentals E. Kuffel, W.S. Zaengl, J. KuffelNewnes 2 nd Edition, 2000
- High Voltage Engineering Wadhwa C.L. New Age International 3 rd Edition, 2012
- High-Voltage Test and Measuring Techniques Wolfgang Hauschild • Eberhard Lemke Springer 1 st Edition2014
- High Voltage Engineering Farouk A.M. Rizk CRC Press 1 st Edition2014

Bio-Medical Electronics

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PEC-EEE-09G		
Category	PROGRAM ELECTIVE		
Course title	**Bio-Medical Electronics**		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the application of the electronic systems in biological and medical applications.
2. Understand the practical limitations on the electronic components while handling bio-substances.
3. Understand and analyze the biological processes like other electronic processes.
4. Understand the impact of engineering solutions in a societal context and to be able to respond effectively to the needs for sustainable development.
5. Identify, formulate, research through relevant literature review, and solve engineering problems reaching substantiated conclusions.

Section: A

PHYSIOLOGY AND TRANSDUCERS

Brief introduction to human physiology: Cell and its structure; Resting and Action Potential; Nervous system: Functional organization of the nervous system ; Structure of nervous system, neurons; synapse; transmitters and neural communication; Cardiovascular system; respiratory system; Basic components of a biomedical system. Biomedical transducers: Transducers selection criteria; Piezoelectric; ultrasonic; displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases; Temperature measurements; Fibre optic temperature sensors;

Section: B

ELECTRO – PHYSIOLOGICAL MEASUREMENTS

Bio-electrodes and Biopotential amplifiers for ECG, EMG, EEG, etc.: Limb electrodes; floating electrodes; pregelled disposable electrodes ;Micro, needle and surface electrodes; Preamplifiers, differential amplifiers, chopper amplifiers ;Isolation amplifier. ECG; EEG; EMG; ERG; Lead systems and recording methods

Section: C

NON-ELECTRICAL PARAMETER MEASUREMENTS

Measurement of blood temperature, pressure and flow; ; Cardiac output ; Heart rate ; Heart sound ;Pulmonary function measurements ; spirometer ; Impedance plethysmography; Photo Plethysmography, Body Plethysmography

Section: D

MEDICAL IMAGING

Ultrasonic, X-ray and nuclear imaging: Radio graphic and fluoroscopic techniques; Computer tomography; MRI; Ultrasonography

ASSISTING AND THERAPEUTIC EQUIPMENTS

Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped; Safety aspects: safety parameters of biomedical equipments

TextReferencebooks:

1. W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
2. J.G. Websster, ed., Medical Instrumentation, Houghton Mifflin, 1978.
3. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.
4. R.S.Khander, Handbook of Biomedical Instrumentation‖, TATA Mc Graw-Hill, New Delhi, 2003.
5. Leslie Cromwell, ―Biomedical Instrumentation and Measurement‖, Prentice Hall of India, New Delhi, 2007

Speech and Audio Processing

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PEC-EEE-11G		
Category	PROGRAM ELECTIVE		
Course title	Speech and Audio Processing		
Scheme	L	T	P
	3	-	-

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Mathematically model the speech signal
2. Analyze the quality and properties of speech signal.
3. Modify and enhance the speech and audio signals.
4. Present and discuss research, both orally and in writing, to other students and scientists
5. Locate, interpret, and synthesize scientific literature.

Section: A

Introduction- Speech production and modeling - Human Auditory System;General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness.

Section: B

Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters,convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Linear Prediction of Speech- Basic concepts of linear prediction; LinearPrediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer,logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Section: C

Scalar Quantization of LPC- Spectral distortion measures, Quantization based onreflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and

decoders; Voicing detection; Limitations of the LPC model.

Section: D

Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero- state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards

Text/Reference
Books:

1. "Digital Speech" by A.M.Kondoz, Second Edition (Wiley Students *Edition), 2004.*
2. "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, WileyInter science, 2003.

ELECTRICAL ENGINEERING MATERIALS

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	**OEC-EE-01G**		
Category	OPEN ELECTIVE		
Course title	**ELECTRICAL ENGINEERING MATERIALS**		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

COURSE OUTCOME:

After the completion of the course, the students will be able to:

- Learn the basics of materials used in electrical engineering.
- Realize the dielectric properties of insulators in static and alternating fields.
- Explain the importance of magnetic properties and superconductivity.
- Explain the behavior of conductivity of metals and classifications of semiconductor material.

SECTION A

Conductivity of Metal: Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, Equation of motion of an electron, current carried by electrons, mobility, thermionic emission, photo electric emission, field emission, effect of temperature on electrical conductivity of metals, electrical conducting materials, thermal properties, thermal conductivity of metals, thermoelectric effects.

SECTION B

Dielectric Properties: Introduction, effect of a dielectric on the behavior of a capacitor, polarization, the dielectric constant of monatomic gases, dielectric losses, significance of the loss tangent, frequency and temperature dependence of the dielectric constant, dielectric properties of polymeric system, ionic conductivity in insulators, insulating materials, ferroelectricity, piezoelectricity

SECTION C

Magnetic properties of Materials: Introduction, Classification of magnetic materials, diamagnetism, paramagnetism, ferromagnetism, magnetization curve, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials, magnetic resonance.

SECTION D

Semiconductors: energy band in solids, conductors, semiconductors and insulators, types of semiconductors, Intrinsic semiconductors, impurity type semiconductor, diffusion, the Einstein relation, hall effect, thermal conductivity of semiconductors, electrical conductivity of doped materials.

REFERENCE BOOKS

[1] C.S.Indulkar and S. Thiruvengadam, S., "An Introduction to Electrical Engineering

[2] Kenneth G. Budinski,, "Engineering Materials: Prentice Hall of India, New Delhi

ADDITIVE MANUFACTURING

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	OEC-ECE332G		
Category	OPEN ELECTIVE		
Course title	ADDITIVE MANUFACTURING		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

COURSE OUTCOMES:

Upon completion of this course the student will be able to:

1. Demonstrate the knowledge of Additive Manufacturing and Rapid Prototyping technologies. 2. Describe different RP techniques.
3. Discuss fundamentals of Reverse Engineering.
4. Describe the effects of surface finish and micro structural properties on behaviour for components produced using additive manufacturing
5. Display an awareness of residual stresses that may occur during additive manufacturing and their effects.

Section: A

Introduction and basic principles: Definition , Generic Additive Manufacturing (AM) Process, Terms related to AM, Benefits of AM, Distinction between AM and CNC machining, Additive manufacturing process chain: Variation between different AM machines, Metal systems, Maintenance of Equipment, Material Handling Issues.

Section: B

Introduction to rapid prototyping (RP), Need of RP in context of batch production, Basic principles of RP, Steps in RP, Process chain in RP in integrated CAD- CAM environment, Advantages of RP, Medical applications.

Section: C

Classification of different RP techniques – based on raw materials, layering technique (2-D or 3-D) and energy sources: Process technology, Stereo-lithography (SL), photo polymerization, liquid thermal polymerization, Solid foil polymerization

Section: D

Selective laser sintering, Selective powder binding, ballistic particle manufacturing – both 2-D and 3-D, Fused deposition modeling, Shape melting, Laminated object manufacturing, Solid ground curing, 3 D printing

Introduction to reverse engineering Meaning, Use, RE-The generic process, Phase of RE– scanning, Contact Scanners, Noncontact Scanners, Point Processing, Application Geometric Model, Development. Learning Resources

Text Books:

1. Ian Gibson, David W. Rosen, Brent Stucker , "Additive Manufacturing Technologies" ,Springer,2009

2. Chua C. K., Leong K. F., and Lim C. S., "Rapid Prototyping: Principles and Applications", Second Edition, World Scientific Publishers (2003),.

3. Patri K. Venuvinod, Weiyin Ma "Rapid Prototyping: Laser-Based and Other Technologies" Springer , 2004

Reference Books :

1. Peter D. Hilton, Hilton/Jacobs, Paul F. Jacobs, "Rapid Tooling: Technologies and Industrial Applications", CRC Press,2000.

2. Burns. M, "Automated fabrication", Prentice-Hall,1993.

Intelligent Instrumentation

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	OEC- EEE05G		
Category	Open Elective Course		
Course title	Intelligent Instrumentation(Theory)		
Scheme	L	T	P
	3		-

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes:

At the end of this course, students will demonstrate the

1. Understand the basic characteristic of intelligent instrumentation system Knowledge of new sensor technology
2. Understand the data acquisition system in intelligent instrumentation system
3. Understand the Signal amplification & attenuation.
4. To develop the design methodologies for measurement and instrumentation of real world problems.
5. To be study the concepts of intelligent sensor devices, their performance characteristics and signal and system dynamics.

Section-A

Intelligence, features characterizing intelligence, intelligent instrumentation system: features of intelligent instrumentation, components of intelligent instrumentation, block diagram of intelligent instrumentation.

Section-B

Signal amplification & attenuation (OP-AMP based), instrumentation amplifier (circuit diagram, high CMRR & other features), signal linearization(different types such as diode resistor combination, OP-AMP based etc.), bias removal signal filtering (output from ideal filters, output from constant – k filters, matching of filter sections, active analog filters).

Section-C

OP-AMP based voltage to current converter, current to voltage conversion, signal integration, voltage follower (pre amplifier), voltage comparator, phase locked loop, signal addition, signal multiplication, signal transmission, description of spike filter.

Smart sensors : Primary sensors, excitation, compensation, information coding/processing, data compensation, standard for smart sensor interface.

Section-D

Interfacing instruments and computers : basic issues of interfacing, address decoding, data transfer control, A/D convertor, D/A convertors, sample & hold circuit, other interface considerations.

Text Books :

1. Principles of measurements and instrumentation by Alan S Morris, PHI

2. Intelligent instrumentation by Bamay, G.C.Prentice Hall

Reference Books :

1. Sensors and transducers by Parranabis, PHI

2. Introduction to digital signal processing: MGH

Power Plant Engineering

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	OEC-EE07G		
Category	OPEN ELECTIVE		
Course title	Power Plant Engineering		
Scheme	L	T	P
	3	-	-

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes:

Upon completion of the course:

1. Understand the basics of Power Plants.
2. Understand the idea about the power generation by renewable and non-renewable energy resources.
3. Understand about the different types of cycles and natural resources used in power plants and their applications.
4. Understand the principal components and types of nuclear reactors.
5. Estimate different efficiencies associated with power plant systems.

Section-A

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam andheating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

Section-B

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Section-C

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized

Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Section-D

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Text Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.

2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.

3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

ECONOMICS FOR ENGINEERS

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	HSMC-01G		
Category	HS		
Course title	ECONOMICS FOR ENGINEERS		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Objectives:

1. Acquaint the students to basic concepts of economics and their operational significance.
2. To stimulate the students to think systematically and objectively about contemporary economic problems.

COURSE OUTCOMES:

1. The students will able to understand the basic concept of economics.
2. The student will able to understand the concept of production and cost.
3. The student will able to understand the concept of market.
4. The student will able to understand the concept of privatization, globalization and banks.

UNIT-1

Definition of Economics- Various definitions, types of economics- Micro and Macro Economics, nature of economic problem, Production Possibility Curve, Economic laws and their nature, Relationship between Science, Engineering, Technology and Economic Development.

Demand- Meaning of Demand, Law of Demand, **Elasticity of Demand**- meaning, factors effecting it, its practical application and importance.

UNIT-2

Production- Meaning of Production and factors of production, Law of variable proportions, Returns to scale, Internal and external economies and diseconomies of scale.

Various concepts of cost of production- Fixed cost, Variable cost, Money cost, Real cost, Accounting cost, Marginal cost, Opportunity cost. Shape of Average cost, Marginal cost, Total cost etc. in short run and long run.

UNIT-3

Market- Meaning of Market, Types of Market- Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly (main features).

Supply- Supply and law of supply, Role of demand & supply in price determination and effect of changes in demand and supply on prices.

UNIT-4

Indian Economy- Nature and characteristics of Indian economy as under developed, developing and mixed economy (brief and elementary introduction), **Privatization** - meaning, merits and demerits.

Globalization of Indian economy - merits and demerits.

Banking- Concept of a Bank, Commercial Bank- functions, Central Bank- functions, Difference between Commercial & Central Bank.

REFERENCES:

1. Jain T.R., Economics for Engineers, VK Publication.
2. Chopra P. N., Principle of Economics, Kalyani Publishers.
3. Dewett K. K., Modern economic theory, S. Chand.
4. H. L. Ahuja., Modern economic theory, S. Chand.
5. Dutt Rudar & Sundhram K. P. M., Indian Economy.
6. Mishra S. K., Modern Micro Economics, Pragati Publications.
7. Singh Jaswinder, Managerial Economics, dreamtech press.
8. A Text Book of Economic Theory Stonier and Hague (Longman's Landon).
9. Micro Economic Theory – M.L. Jhingan (S.Chand).
10. Micro Economic Theory - H.L. Ahuja (S.Chand).
11. Modern Micro Economics : S.K. Mishra (Pragati Publications).
12. Economic Theory - A.B.N. Kulkarni & A.B. Kalkundrikar (R.Chand & Co).

POWER SYSTEM-II

Theory : 75

Class Work : 25

Total : 100

Duration of Exam : 3 Hrs.

Course Code	**PCC- EE-302G**		
Category	**Program Core Course**		
Course title	**Power System – II (Theory)**		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes:

At the end of this course, students will demonstrate the ability to;

- Use numerical methods to analyse a power system in steady state.
- Understand stability constraints in a synchronous grid.
- Understand methods to control the voltage, frequency and power flow.
- Understand the basics of power system economics

SECTION-A

Power Flow Analysis : Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Application of numerical methods for solution of nonlinear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations.

Section -B

Economic Operation of Power Systems: Distribution of loads between units within a plant. Distribution of loads between plants, Transmission loss equation, Classical Economic dispatch with losses. Optimal unit commitment problems and their solutions.

Section -C

Voltage and Load Frequency Control: Introduction to control of active and reactive power flow, control of voltage, Excitation systems. Introduction to Load Frequency Control and Automatic generation control, Single area and modelling of AGC, Concept of multi area AGC.

Section -D

Power System Stability: Concepts, steady state and transient stability, swing equations, equal area criterion. Solution of Swing Equation, Transient stability algorithm using modified Euler‘s method and fourth order RungeKutta method,– multi-machine stability analysis

Text/References:

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.

2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.

3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.

4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.

5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

Power system-II (Lab)

Theory : 25

Class Work : 25

Total : 50

Course Code	**PCC-EE-304G**		
Category	**Program Core Course**		
Course title	**Power system-II**(Laboratory)		
Scheme	**L**	**T**	**P**
	-	**-**	**2**

Notes: At least 10 experiments are to be performed by students in the semester.

(i) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

(ii) Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS:

1. Draw the flow chart and develop the computer program for the formation of the Y Bus of a generalized network.

2. Draw the flow chart and develop the computer program for the formation of the Z Bus of a generalized network.

3. To plot the swing curve and observe the stability.

4. To perform load flow analysis using Gauss Seidel method.

5. To perform load flow analysis using Newton-Raphson method.

6. To study comparison of different load flow methods

7. To develop the program for stability analysis.

8. To observe transmission losses and efficiency with variations in power for the given example.

9. Simulation study on LFC of two area interconnected power system.

10. Simulation study on voltage control in multi area interconnected power system.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Digital Signal Processing

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PCC-EEE-306G		
Category	Engineering Science Course		
Course title	Digital Signal Processing		
Scheme	L	T	P
	3	-	-

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Use concepts of trigonometry, complex algebra, Fourier transform, z-transform to analyze the operations on signals and acquire knowledge about Systems
2. Select proper tools for analog-to-digital and digital-to-analog conversion. Also select proper tools for time domain and frequency domain implementation.
3. Design, implementation, analysis and comparison of digital filters for processing of discrete time signals
4. Integrate computer-based tools for engineering applications
5. Employ signal processing strategies at multidisciplinary team activities.
6. Assess the techniques, skills, and modern engineering tools necessary for analysis of different electrical signals and filtering out noise signals in engineering practice. Also develop creative and innovative designs that achieve desired performance criteria within specified objectives and constraints, understand the need for lifelong learning and continuing professional education

UNIT I

Discrete-Time Signals and Systems: Sequences; representation of signals on orthogonal basis; representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

Z-Transform: Z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z- transforms, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

UNIT II

Frequency Representation of Signal and Systems: Frequency Domain analysis concept, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Circular convolution, Linear Filtering using DFT, Fast Fourier Transform Algorithm, Decimation in

time and Decimation in frequency algorithms, Computations Complexity Calculations, Parsevals Identity.

UNIT III

Design of Digital Filter : Ideal Filter vs Practical Filters, General Specifications and Design Steps, Comparison of FIR & IIR Filters, Design of FIR Filters using Window technique, Park-McClellan's method, Design of IIR Filters using Impulse Invariance technique, Bilinear Transformation, Design of IIR Filters using Butterworth, Chebyshev and Elliptic filter, Digital frequency transformation.

UNIT IV

Implementation of Discrete Time Systems: Block diagrams and signal flow graphs for FIR and IIR systems, Direct form, Cascade form, Frequency Sampling Structures, and Lattice structures for FIR systems, Direct form, Cascade form, Parallel form, and Lattice and Lattice-Ladder Structures for IIR systems, Representation of fixed point and floating point numbers, Finite word length effects, Parametric and non-parametric spectral estimation. Applications of Digital Signal Processing

Multirate Digital Signal Processing: Introduction to multirate digital signal processing, Multi rate structures for sampling rate conversion, Multistage decimator and interpolators, Polyphase decomposition, Digital Filter Banks.

Text/Reference
Books:

1 John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
4. Digital Signal Processing: Salivahanan, Vallavaraj and Gnanapriya;TMH
5. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
6. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
7. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

Digital Signal Processing Laboratory

Course Code	PCC-EE-308G		
Category	Engineering Science Course		
Course title	Digital Signal Processing Laboratory		
Scheme	L	T	P
	-	-	2

Notes:

1. At least 10 experiments are to be performed by students in the semester.
2. At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.
3. Group of students for practical should be 15 to 20 in number.

List of Experiments

1. Introduction to MATLAB.
2. Represent basic signals (unit step, unit impulse, ramp, exponential, sine and cosine)
3. To develop program for Z-Transform in MATLAB
4. To develop program for Convolution of sequences in MATLAB
5. To develop program for Correlation of sequences in MATLAB
6. To develop program for DFT & IDFT of two sequences
7. To develop program for FFT of two Sequences
8. To develop program for Circular Convolution
9. To design analog filter (low-pass, high pass, band-pass, band-stop).
10. To design digital IIR filters (low-pass, high pass, band-pass, band-stop).
11. To develop program for Interpolation and Decimation of sequences
12. To design FIR filters using windows technique.
13. Detection of Signals buried in Noise
14. Effect of noise on signals in MATLAB

VLSI DESIGN

Class Work: 25

Exam : 75

Total : 100

Course Code	**PCC -EEE-310G**		
Category	**Engineering Science Course**		
Course title	**VLSI DESIGN**		
Scheme	**L**	**T**	**P**
	3	**-**	**0**

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

COURSE OUTCOMES:

1. Identify the various IC fabrication methods.
2. Express the Layout of simple MOS circuit using Lambda based design rules.
3. Apply the Lambda based design rules for subsystem design
4. Differentiate various FPGA architectures.
5. Design an application using Verilog HDL.
6. Concepts of modeling a digital system using Hardware Description Language.

Section-A

BASIC MOS TRANSISTOR : Enhancement mode & Depletion mode – Fabrication (NMOS, PMOS, CMOS, BiCMOS) Technology – NMOS transistor current equation – Second order effects – MOS Transistor Model.

Section-B

NMOS & CMOS INVERTER AND GATES : NMOS & CMOS inverter – Determination of pull up / pull down ratios – Stick diagram – Lamda based rules – Super buffers – BiCMOS & steering logic.

Section-C

SUB SYSTEM DESIGN & LAYOUT: Structured design of combinational circuits – Dynamic CMOS & clocking – Tally circuits – (NAND-NAND, NOR-NOR and AOI logic) – EXOR structure – Multiplexer structures – Barrel shifter.

Section-D

DESIGN OF COMBINATIONAL ELEMENTS & REGULAR ARRAY LOGIC : NMOS PLA – Programmable Logic Devices - Finite State Machine PLA – Introduction to FPGA**.**

VHDL PROGRAMMING: RTL Design – Combinational logic – Types – Operators – Packages – Sequential circuit – Sub-programs – Test benches. (Examples: address, counters, flipflops, FSM, Multiplexers / De-multiplexers).

TEXT BOOKS

1. D.A.Pucknell, K.Eshraghian, 'Basic VLSI Design', 3rd Edition, Prentice Hall of India, New
Delhi, 2003.
2. Introduction to Digital Integrated Circuits : Rabaey,Chandrakasan & Nikolic.
3. Principles of CMOS VLSI Design : Neil H.E. Weste and Kamran Eshraghian; Pearson.

REFERENCE BOOKS

1. N.H.Weste, 'Principles of CMOS VLSI Design', Pearson Education, India, 2002
2. VLSI Technology: S.M. Sze; McGraw-Hill.

VLSI DESIGN Laboratory

Course Code	PCC-EEE-312G		
Category	Engineering Science Course		
Course title	VLSI DESIGN Laboratory		
Scheme	L	T	P
	-	-	2

Note: 1. At least 10 experiments are to be performed by students in the semest

2. At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.

3. Group of students for practical should be 15 to 20 in number.

List of Experiments

Combinational & Sequential Design Exercises using FPGA (Spartan 3) & CPLD

1) Design of Half-Adder, Full Adder, Half Subtractor, Full Subtractor
2) Design a parity generator
3) Design a 4 Bit comparator
4) Design a RS & JK Flip flop
5) Design a 4: 1 Multiplexer
6) Design a 4 Bit Up / Down Counter with Loadable Count
7) Design a 3: 8 decoder
8) Design a 8 bit shift register
9) Design a arithmetic unit
10) Implement ADC & DAC interface with FPGA
11) Implement a serial communication interface with FPGA
12) Implement a Telephone keypad interface with FPGA
13) Implement a VGA interface with FPGA
14) Implement a PS2 keypad interface with FPGA
15) Implement a 4 digit seven segment display

Electrical and hybrid vehicle

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PEC-EE-04G		
Category	Program Elective		
Course title	Electrical and hybrid vehicle (Theory)		
Scheme	L	T	P
	3	-	-

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals
2. Analyse the use of different power electronics devices and electrical machines in hybrid electric vehicles.
3. Explain the use of different energy storage devices used for hybrid electric vehicles, their technologies and control and select appropriate technology
4. Interpret working of different configurations of electric vehicles and its components, hybrid vehicle configuration, performance analysis and Energy Management strategies in HEVs.

SECTION - A

ELECTRICVEHICLES

Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

SECTION - B

BATTERY

Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

SECTION - C

DC & AC ELECTRICAL MACHINES

Motor and Engine rating, Requirements, DC machines, Three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines.

SECTION – D

ELECTRIC VEHICLE DRIVETRAIN

Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

HYBRID ELECTRIC VEHICLES

Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components.

Reference Books:

1. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2011.
2. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010.
3. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003.
4. Sandeep Dhameja, "Electric Vehicle Battery Systems", Newnes, 2000

Power system protection

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PEC-EE-06G		
Category	Program Elective		
Course title	Power system protection (Theory)		
Scheme	L	T	P
	3	-	-

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the different components of a protection system.
- Evaluate fault current due to different types of fault in a network.
- Understand the protection schemes for different power system components.
- Understand the basic principles of digital protection.
- Understand system protection schemes, and the use of wide-area measurements.

Section A

Introduction and Components of a Protection System

Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers , Generator Protection: External and internal faults – differential protection – biased circulating current protection – self balance system – over-current and earth fault protection – protection against failure of excitation

Section B

Faults and Over-Current Protection

Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection and overcurrent relay co-ordination.

Transformer protection: Differential protection – self-balance system of protection – over-current and earth fault protection – buchholz' s relay and its operation.

Section C

Equipment Protection Schemes

Directional, Distance, Differential protection. Bus bar Protection, Bus Bar arrangement schemes.

Modeling and Simulation of Protection Schemes

CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.

Section D

System Protection

Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

Text/References :

1. J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 1987.

2. Y. G.Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, India, 2010. 3. A. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.

4. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.

5. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.

Advance Electric Drives

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	**PEC-EE-08G**		
Category	**Program Elective**		
Course title	**Advance Electric Drives** (Theory)		
Scheme	**L**	**T**	**P**
	3	-	**-**

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the operation of power electronic converters and their control strategies.
- Understand the vector control strategies for ac motor drives
- Understand the implementation of the control strategies using digital signal processors.

Section A

Power Converters for AC drives

PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive.

Section B

Induction motor drives

Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control(DTC)

Section C

Synchronous motor drives

Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

Permanent magnet motor drives

Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.

Section D

Switched reluctance motor drives

Evolution of switched reluctance motors, various topologies for SRM drives, comparison,

Closed loop speed and torque control of SRM.

DSP based motion control

Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motion control.

Text / Reference Books:

1. B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education, Asia, 2003.

2. P.C. Krause, O. Wasynczuk and S.D. Sudhoff, “Analysis of Electric Machinery and Drive Systems”, John Wiley & Sons, 2013.

3. H. A. Taliyat and S. G. Campbell, “DSP based Electromechanical Motion Control”, CRC press, 2003.

4. R. Krishnan, “Permanent Magnet Synchronous and Brushless DC motor Drives”, CRC Press, 2009.

ELECTRICAL MACHINE DESIGN

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	**PEC-EE-10G**		
Category	**Program Core Course**		
Course title	**ELECTRICAL MACHINE DESIGN**		
Scheme	**L**	**T**	**P**
	03	**-**	**-**

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

COURSE OUTCOMES:

- To understand the specified limits for Specific electric and magnetic loading.
- To understand about magnetic current of transformer and rotating machine.
- To understand the basic design procedure for transformer, d.c. machine, induction motor and synchronous machine individually.
- To explain the complete detailed design of all static and rotating machine and their performance with problems.
- To understand about the computerization of the design procedure.
- Analyze the design procedure and performance of various algorithms.

SECTION A

FUNDAMENTAL ASPPECTS OF ELECTRICAL MACHINE DESIGN: Design of Machines, Design Factors, Limitations in design, Modern Trends in design, manufacturing Techniques.

BASIC DESIGN PRINCIPLES: Output equation and output coefficient, Specific electric and magnetic
loading. Relation between rating and main dimension of rotating machine, Effect of size and ventilation/Factors affecting size of a rotating machine.

SECTION B

DESIGN OF INDUCTION MOTORS: Three Phase Induction Motor: Standard specifications, output equations, choice of specific loadings, main dimensions, conductor size and turns, air gap length, no. of slots, slot design, stator core depth, rotor design, rotor bars& slots area, end rings .

SECTION C

DESIGN OF TRANSFORMER: Output Equations of Single Phase and Three Phase Transformers, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings, Main Dimensions - kVA output for single and three phase transformers, Window space factor, Design of core, yoke and winding, overall dimensions.

DESIGN OF SYNCHRONOUS MACHINE: Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient and non- salient Pole Rotors. Magnetic Circuit and Field Winding, design difference between turbo alternator & salient pole generators.

SECTION D

DESIGN OF DC MACHINES: Output equation, choice of specific loadings, choice of poles and speed, Design of core length, armature diameter, depth of armature core,air gap length, cross section of armature conductors, armature slots ,design of field system field poles, field coils, commutator.

COMPUTER AIDED DESIGN: Computerization of design Procedures. Development of Computer program and performance prediction. Optimization techniques and their applications to design Problems.

TEXT BOOKS:

1. A course in Electrical Machine Design by A.K. Sawhney, Khanna Pub.
2. Princilplesof Electrical Machine Design by R. K. Aggarwal.

REFERENCE BOOKS:

1. Theory, performance and Design of alternating current machines by MG Say, ELBS, 15th Ed. 1986.
2. Theory, Performance and Design of Direct Current machines by A.E. Clayton, 3rd Ed. 1967.
3. Optimization Techniques, S.S. Rao

Python Programming

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	**OEC-EE-04G**		
Category	**Open Elective**		
Course title	**Python Programming**		
Scheme	**L**	**T**	**P**
	3	-	**-**

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course outcomes

• For a given conceptual problem student will able to analyze the problem and write a program in python with basic concepts.

• For a given problem of Strings and texts, student will able to analyze the problem and write a program in python with basic concepts involving strings and texts.

• The knowledge of list and dictionary will enable student to implement in python language and analyze the same.

• Student will able to write a program using functions to implement the basic concepts of object oriented programming language

Section:A

Introduction: Fundamental ideas in computer science; modern computer systems, installing Python; basic syntax, interactive shell, editing, saving, and running a script; The concept of data types; variables, assignments; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages; Control statements: if-else, loops (for, while)

Section: B

Strings, text files: String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Text files:

reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated).

Section: C

Lists, dictionary and Design with functions: Basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding, and removing keys, accessing and replacing values; traversing dictionaries, arguments and return values. Recursive functions.

Section:D

Object Oriented concepts: Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data modelling; persistent storage of objects, Inheritance, polymorphism, operator overloading; abstract classes.

Text books:

"Fundamentals of Python: First Programs" Kenneth Lambert, Course Technology, Cengage Learning, 2012

Reference books:

"Introduction to Computer Science Using Python: A Computational Problem-Solving Focus", By Charles Dierbach, John Wiley & Sons, December 2012,

Introduction to MEMS

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	OEC-EE-06G		
Category	Open Elective		
Course title	Introduction to MEMS (Theory)		
Scheme	L	T	P
	3	-	-

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes:

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

1.Be introduced to the field of micro/nanosystems
2. Grain a knowledge of basic approaches for micro/nanosystem design
3. Gain a knowledge of state-of-the-art lithography techniques for micro/nanosystems
4. Learn new materials, science and technology for micro/nanosystem applications
5. Understand materials science for micro/nanosystem applications
6. Understand state-of-the-art micromachining and packaging technologies

Section:A

Overview of MEMS and Microsystems: Introduction Microsystems vs. MEMS, Microsystems and Microelectronics, the Multidisciplinary Nature of Microsystems design and manufacture, Application of MEMS in various industries. MEMS and Miniaturization: Scaling laws in miniaturization: Introduction to Scaling, Scaling in Geometry, Rigid Body dynamics, Electrostatic forces, Electromagnetic forces, Electricity, Fluid Mechanics, Heat Transfer, Over view of Micro/Nano Sensors, Actuators and Systems.

Section: B

Review of Basic MEMS fabrication modules: Oxidation, Deposition Techniques, Lithography (LIGA),and Etching. Micromachining:Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding.

Section: C

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods.

Section: D

Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems: electrostatics, coupled electro mechanics.

Text/Reference Book:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano- and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

Conventional and Renewable Energy Resources

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	OEC-EE-08G		
Category	Open Elective		
Course title	Conventional and Renewable Energy Resources(Theory)		
Scheme	L	T	P
	3	-	-

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

1. Understand the need of energy conversion and the various methods of energy storage
2. Explain the field applications of solar energy
3. Identify Winds energy as alternate form of energy and to know how it can be tapped
4. Explain bio gas generation and its impact on environment
5. Understand the Geothermal &Tidal energy, its mechanism of production and its applications
6. Illustrate the concepts of Direct Energy Conversion systems & their applications.

Section A

INTRODUCTION: Energy sources, their availability, recent trends in Power Generation, Amount of generation of electric power from Conventional and non conventional sources of energy in Haryana, India and some developed countries of the world. Interconnected Generation of Power Plants.

Section-B

POWER GENERATION PLANNING: Load forecasting, load curves, load duration curve, Base load and Peak load Power Plants, connected Load, maximum demand, demand factor, Group diversity factor, load factor, significance of load factor, plant factor, capacity factor, selection of unit size, No. of Units, reserves, cost of powergeneration, Depreciation, tariff.

Section-C

CONVENTIONAL ENERGY SOURCES: Selection of site, capacity calculations, classification, Schematic diagram and working of Thermal Power Stations(TPS), HydroElectric Plant and Nuclear Power Plant .

NON-CONVENTIONAL ENERGY SOURCES: Wind, Solar, fuel cell, Magneto Hydro Dynamic (MHD) system.

Section-D

ELECTRIC ENERGY CONSERVATION & MANAGEMENT: Energy management, Energy Audit, Energy Efficient Motors, Co-generation.

TEXT BOOKS:

1. Renewable Energy Sources and Emerging Technologies : D.P Kothari, K.C.Singla, Rakesh

Ranjan- PHI Publications.

2.Electric Power Generation, B.R.Gupta

3. Power Generation, Operation and Control, Wood and Wollenberg, John Wiley &

Sons,1984.

REF. BOOKS:

1. A Course in Electric Power System, Soni, Gupta, Bhatnagar, Dhanpat Rai & Sons

2. Power System Engineering, Nagrath& Kothari, Tata Mc-Graw Hill, New Delhi

3. Power Plant Engg: G.D. Rai

4. Electric Power: S.L. Uppal (Khanna Publishing)

Soft Computing

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	**OEC-EE-10G**		
Category	**Open Elective**		
Course title	**Soft Computing**(Theory)		
Scheme	**L**	**T**	**P**
	3	-	**-**

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes: At the end of this course, students will demonstrate the ability to

- To understand the concepts of soft computing vis-à-vis hard computing
- To introduce the ideas of fuzzy logic, neural networks, genetic algorithm.
- To introduce the concepts of hybrid intelligent systems
- To introduce application areas of soft computing and the criteria to select appropriate soft computing

Section A

Soft Computing: Introduction, requirement, different soft computing techniques and their characteristics, comparison with hard computing, applications.

Section B

Fuzzy sets and Fuzzy logic: Introduction, Fuzzy sets versus crisp sets, properties of fuzzy sets, operations on fuzzy sets, Extension principle, Fuzzy relations, Linguistic variables, linguistic terms, Linguistic hedges, Fuzzy reasoning, Mamdani and TSK fuzzy inference systems, Applications, fuzzy controllers, Theoretical and implementation issues.

Section C

Artificial Neural Network: Introduction, comparison with biological neural network, basic models of artificial neuron, different architectures of ANN, Learning techniques, ANN based system modeling, ANN based controller design, theoretical and implementation issues, Applications.

Section D

Evolutionary algorithms and hybrid systems: Genetic Algorithm (GA), different operators of GA, convergence of Genetic Algorithm, Particle swarm optimization algorithm, Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design, Fuzzy Logic design, other Applications of GA.

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