Semester – VI (w.e.f. session 2017-2018)

S. N.	Course No.	Course title	Teaching Schedule				Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hrs/ Wk	Theory	Sessional	Practical	Total	
1	EE-302N	Power Electronics-II	3	1		4	75	25		100	3
2	EE-304N	Micro Processor & Interfacing	4	1		5	75	25		100	3
3	EE-306N	Power System Analysis & Protection	4	1		5	75	25		100	3
4	EE-308N	Electrical Machine Design	3	1		4	75	25		100	3
5	EE-310N	Electric Drives & Traction	4	0		4	75	25		100	3
6**	**EEN-312N**	Digital Signal Processing	4	1		5	75	25		100	3
7**	**EEN-314N**	Digital Signal Processing Lab			2	2		40	60	100	3
8	EE-316N	Power System Lab			2	2		40	60	100	3
9	EE-318N	Micro Processor & Interfacing Lab			2	2		40	60	100	3
10	EE-320N	Electric Drives Lab			2	2		40	60	100	3
		Grand Total	**22**	**5**	**8**	**35**	**450**	**310**	**240**	**1000**	

Note: 1. ** Subjects Common with VI Semester. B.Tech. [Electrical & Electronics Engg.] Scheme, K.U.K.

2. The students will have to undergo another six weeks Industrial Training after VI sem and it will be evaluated during VII sem through submission of certified computerized report to the H.O.D. followed by conduct of viva-voce & seminar/presentation.

Code	Nomenclature of Subject	L	T	Int.	Ext.	Total	Time
EE-302N	**Power Electronics-II**	**3**	**1**	**25**	**75**	**100**	**3 Hr**

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

Unit -I

D.C. to D.C. Converter: Choppers
Classification of choppers, principle of operation, steady state analysis of class A choppers, step up chopper, steady state, switching mode regulator: buck, boost, buck-boost, cuk regulators, current commutated and voltage communicated chopper, basic scheme, output voltage control techniques, one, two and four quadrant choppers, step up chopper, voltage commutated chopper, current commutated chopper, MOSFET and transistor based choppers.

Unit-II

D.C. to A.C. Converter:
Classification, basic series and improved series inverter, parallel inverter, single phase voltage source inverter, steady state analysis, half bridge and full bridge inverter: modified Mc Murray and modified Mc Murray Bedford inverter, voltage control in single phase inverters, PWM inverters reduction of harmonics, current source, three phase bridge inverter.
Inverters:
Basic circuit, 120 degree mode and 180 degree mode conduction schemes, modified McMurray-Bedford half bridge and bridge inverters, brief description of parallel and series inverter (CSI), transistor and MOSFET based inverters

Unit-III

A.C. to A.C CONVERTER:
Cycloconvertor
Basic principles of frequency conversion, types of cycloconverters, non-circulating and circulating types of cycloconverters.Classification, principle of operation of step up and step down cycloconverter, single phase to single phase cycloconverter with resistive and inductive load. Three phase to three phase cycloconverter. Output voltage equation of cycloconverter.

Unit-IV

Applications of Power Electronics. (Brief descriptions):
Switched mode power supplies**,** AC Regulators **,** UPS ,static switches ,solid state relays, static circuit breakers A.C. Regulators, electric welding ,electric heating, battery charging, illumination control ,FACTs devices, zero voltage switch, over voltage protection, HVDC System

Text Books:

1. M.H. Rashid, Power Electronics: Circuits Devices and Application, PHI
2. Ned Mohan, Tore m. undeland, William P. Robbins, Power Electronics: Converters, Application and Design, John Wiley & Sons.
3. P.S. Bhimra, Power Electronics.
4. M.Ramamoorthy an introduction to Thyristors & their applications East West Press.
5. A.K. Gupta & L.P. Singh, Power electronics and introduction to Drives Dhanpat Rai Pub. Co.

Code	Nomenclature of Subject	L	T	Int.	Ext.	Total	Time
EE-304N	**Microprocessor & Interfacing**	**4**	**1**	**25**	**75**	**100**	**3 Hr**

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT-I

INTRODUCTION: Evaluation of microprocessors, technological trends in microprocessor development. The Intel family tree, CISC Versus RISC, Applications of Microprocessors.

8086 CPU ARCHITECHTURE: 8086 Block diagram; description of data registers, address registers; pointer and index registers, PSW, Queue, BIU and EU. 8086 Pin diagram descriptions, Generating 8086 CLK and reset signals using 8284. WAIT state generation, microprocessor BUS types and buffering techniques, 8086 minimum mode and maximum mode CPU module.

UNIT – II

8086 INSTRUCTION SET: Instruction formats, addressing modes, Data transfer instructions, string instructions, logical instructions, arithmetic instructions, transfer of control instructions; process control instructions; Assembler directives.

8086 PROGRAMMING TECHNIQUES: Writing assembly language programs for logical processing, arithmetic processing, timing delays; loops, data conversions, writing procedures: data tables, modular programming and macros.

UNIT – III

MIAN MEMORY SYSTEM DESIGN: Memory devices, 8086 CPU Read/Write timing diagrams in minimum mode and maximum mode. Address decoding techniques. Interfacing SRAMS; ROMS/PROMS. Interfacing and refreshing DRAMS. DRAM Controller – TMS4500.

UNIT – IV

BASIC I/O INTERFACE: Parallel and Serial I/O Port design and address decoding, Memory mapped I/O Vs Isolated I/O Intel's 8255 and 8251 – description and interfacing with 8086. ADCs and DACs, -types, operation and interfacing with 8086. Interfacing keywords, alphanumeric displays, multiplexed displays and high power devices with 8086.

INTERRUPT & DMA: Interrupt driven I/O. 8086 interrupt mechanism; interrupt types and interrupt vector table. Intel's 8259. DMA operation. Intel's 8237. Microcomputer video displays.

Suggested Books:

1. D.V.Hall, Microprocessors and interfacing, McGraw Hill 2nd Edition.
2. J Uffenbeck, The 8086/8088 family, PHI.
3. liu, Gibson, Microcomputer Systems- The 8086/8088 family, (2nd ed- PHI).

Code	Nomenclature of Subject	L	T	Int.	Ext.	Total	Time
EE-306N	**Power System Analysis & Protection**	**4**	**1**	**25**	**75**	**100**	**3 Hr**

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT-I

Introduction Characteristics & representation of components of a power system, synchronous machines, transformers, lines cables & loads. Single line diagram of a power system Flow of zero sequence current , zero sequence impedance diagrams of power system with different types of connections of three phase transformers

Neutral grounding need for neutral grounding, various types of neutral grounding

Flow of zero sequence current, zero sequence impedance diagrams of power system with different types of connections of three phase transformers

UNIT-II

Circuit Interruption : Circuit interruption, theory of arc formation and it's excitation in d.c., a.c. circuits, restriking & recovery voltage, interruption of capacitive & inductive currents. Rupturing capacity & rating of circuit breakers.

Circuit-Breakers : Classification of circuit-breakers, circuit-breakers of low medium, high & extra high voltages. Multibreak & resistance switching. Auto-restoring of high capacity & H.V. circuit breakers.

UNIT-III

Symmetrical faults: calculation of fault currents, use of current limiting reactors. **Unsymmetrical faults**: Types of transformation in power system analysis, symmetrical components transformation, sequence impedance of power system elements, Sequence network of power system analysis of unsymmetrical short faults , Network analysis & it's application to interconnected system.

UNIT-IV

`**Protective System** features of good protective system, elements of relay, terms connected with relay,time grading of over current protection., differential relay, distance or impedence relay, static relays (elementary idea)

Protection of alternators, transformer, bus-bar, lines

Reference Books:

1. Elements of Power System Analysis by W.D. Stevenson.
2. Electric Power System by B.M. Weddy.
3. The transmission & Distribution of Electric Energy by H. Cotton.
4. Power System & Protection by S.S. VADHERA
5. Electrical Power System by C.L. Wadhwa
6. Electrical Power System by Ashfaq,Hussain
7. Power System Protection & Switchgear,Ravinder Nath,New Age
8. Power System Protection & Switchgear,Badri Ram,MGH
9. Protection & Switchgear, Bhalja, Maheshwari,Oxford

Code	Nomenclature of Subject	L	T	Int.	Ext.	Total	Time
EE-308N	**Electrical Machines Design**	**3**	**1**	**25**	**75**	**100**	**3 Hr**

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT I

GENERAL: General features , limitations of electrical machine design, specific loadings **thermal design** types of enclosures, ventilation, heat dissipation, temperature rise, heating & cooling cycles, rating of machines, cooling media used, advantages of hydrogen cooling, effect of size and ventilation.

DC MACHINES: Main parts ,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, commutater.

UNIT II

TRANSFORMERS: Main parts of transformer, Standard specifications, output equation, voltage per turn , optimum design, design of core , design of winding, simplified steps for transformer design, tank and Cooling tubes, **Operating calculations** circuit parameters, magnetizing current, losses and efficiency, Temperature rise and regulations from design data.

SYNCHRONOUS MACHINES: Types of construction, types of synchronous alternators Specifications, output equation , **design of salient pole machines** main dimensions, short circuit ratio , length of air gap, choice of armature slots, turns per phase, conductor section , **design difference between turbo alternator & salient pole generators**, , direct & indirect cooling.

UNIT III

INDUCTION MOTORS:
Three Phase Induction Motor: Standard specifications, output equations, choice of specific loadings, main dimensions, conductor size and turns, no. of slots, slot design, stator core depth, **rotor design**, rotor bars& slots area, end rings .
SINGLE PHASE INDUCTION MOTOR: output equations, specific loadings, main dimensions, design of main and auxiliary winding, capacitor design, equivalent circuit parameters, torque, efficiency.

UNIT IV

COMPUTER AIDED DESIGN: Computerization of design procedures, development of computer programs & performance predictions, optimization techniques & their application to design problems.

TEXT BOOKS/REFERENCES:

1. Electrical Machine Design by A. K. Sawhney Dhanpat Rai & co.
2. M.G.Say, Performance and design of ac machines, CBS Publishers.
3. S.K. Sen., Principles of Electrical Machine Design with Computer Programs, Oxford and IBH.
4. A.E.Clayton, Hencock: Performance and design of dc machines, CBS Publishers.
5. J.H. Kuhlmann, Design of electrical operators, John Willey, 1957 .
6. CG Veinott, Theory and design of small induction machines, MGH, 1959
7. A Shanmugasundarem, Electrical machine design databook, John willey, 1979

Code	Nomenclature of Subject	L	T	Int.	Ext.	Total	Time
EE-310N	**Electric Drives & Traction**	**4**	**0**	**25**	**75**	**100**	**3 Hr**

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT-I

Introduction: Definition & classification of different type of electric drives, its Review characteristics, choice of electric drive ,components of electric drives, advantages and applications.
Dynamics of Electric drives & Rating of motors: - Fundamental load torque equation, types of loads, frequency operation of motor subjected to intermittent loads, pulse loads etc. Determination of motor rating, Heating/cooling curve, Nature of loads and classes of motor duty.
Control of Electrical Drives: Modes of operation, closed loop control of drives, sensing of current and speed.

UNIT-II

D.C. drives: Various methods of braking of D.C. drives, Speed control methods of D.C. drives, 1-∅ fully controlled and half controlled rectifier fed separately excited D.C. motor, 3-∅ fully and half controlled fed separately excited D.C. Motor, Performance and characteristics of 1-∅ and 3-∅ rectifier controlled D.C. drives.

UNIT-III

AC Drives: Various methods of braking of A.C. drives, Speed control methods of A.C. drives, Basic principle of induction motor drives, 3 -∅ A.C. Voltage controller fed I.M drive, Drives using chopper, multi quadrant control of chopper fed motors, Synchronous motor Drives, Automatic starting and pulling operation of synchronous motors

UNIT-IV

Traction Drives: Nature of traction load, A.C. & D.C. motor drives in transportation system and traction & its characteristics, Duty cycle & speed time relationship, Polyphase A.C. motors for traction drives, D.C. traction using chopper controlled D.C. motors.

TEXT BOOKS:

1. Fundamentals of Electrical Drives, G.K.Dubey, Narosa Publishing House

REFERENCE BOOKS:

1. Power Semiconductor controlled drives, G.K.Dubey, Prentice Hall.
2. Electric Drives: V.Subrahmaniyam TMH
3. Electric Drives: Leonard, Narosa Pub.
4. Electric Drives: Diwan
5. Power Electonics : M.D.Singh, K.B.Knanchandani : Mc Graw Hill
6. Electric Motor Drives by Krishnan,PHI
7. Electric Drives: S.K.Pillai,New Age

Code	Nomenclature of Subject	L	T	Int.	Ext.	Total	Time
EEN-312N	**Digital Signal Processing**	**4**	**1**	**25**	**75**	**100**	**3 Hr**

Paper Setter Note: 8 questions of 15 marks each distributed in four sections are to be set taking two from each unit. The candidate is required to attempt five questions in all, taking at least one from each of the four sections.

UNIT I

Introduction: Basic elements of DSP system, Advantages and disadvantage of DSP over analog processing, Application of Digital signal processing.

Z-Transform: Direct Z-Transform and importance of ROC, properties of Z-Transform, Inverse Z-transform methods, Rational Z-transform function representation, system function of LTI systems in Z-domain, one sided Z –Transform. Solution of difference equations. Analysis of LTI system in Z- domain, transient and steady- state response. Causality and stability. Pole- Zero Cancellations.

UNIT II

FREQUENCY TRANSFORMATIONS

Introduction to DFT, Direct Computation of DFT ,Properties of DFT, Circular Convolution , Fast fourier Transform(FFT),decimation in time ,decimation in frequency algorithm, Use of FFT in Linear Filtering , Goetzel Algorithm, Chirp-Z Transform algorithm.

UNIT III

Structure of Discrete-Time Systems: Structure for FIR Systems-direct form, Linear Phase, Cascade form, Frequency-Sampling structures, Structures for IIR- Direct, Cascade, Parallel & transposed structure, signal flow graphs .

Design for Digital Filters:- Symmetric and anti-symmetric FIR filters; Design of Linear Phase FIR using windowing techniques (Rectangular Window, Hamming Window, Hanning Window), Frequency Sampling Method of FIR design, Impulse Invariance transformation, Bilinear transformation and its use in design of Butterworth and Chebyshev IIR Filters; Frequency transformation in Digital Domain, Matched Z-Transformation.

UNIT IV

Implementation of Discrete Time Systems:

Lattice, Ladder and Lattice-Ladder Structures, Shur- Cohn Stability test. Jury Test, Shur-Cohn-fuzzivera stability criterion for IIR filters, Discrete Hilbert Transform.

DSP processor architecture fundamentals: Study of ADSP and TMS series of processor architectures.

References:

1. Digital Signal Processing by J.G. Proakis and D.G. Manalakis-PHI
2. Digital Signal Processing by: A.V. Oppenheim and R.W. Schafer-PHI
3. Element of Digital Signal Processing by N. Sarkar Khanna Publishers.
4. Digital Signal Processing by S. K. Mitra –TMH.
5. Digital Signal Processing by Rabinar, Gold-PHI
6. Digital Signal Processing by S. Salivahanan- TMH
7. Digital Signal Processing by IFecher

Code	Nomenclature of Lab	P	Int.	Ext.	Total	Time
EEN-314N	**Digital Signal Processing Lab**	**2**	**40**	**60**	**100**	**3 Hr**

LIST OF EXPERIMENTS / PROGRAMS:

1. Write a program in MATLAB to study the basic operation on the discrete time signals. (Amplitude and time manipulation).
2. Write a MATLAB program to perform discrete convolution (linear and circular) for a given two sequences.
3. Write a MATLAB program to perform the DFT for a given sequence.
4. Write a MATLAB program to compute DFT and IDFT for a given sequence using FFT algorithem.
5. Write a MATLAB program to perform sampling rate conversion for any given arbitrary sequence by interpolation, decimation, upsampling, downsampling and resampling.
6. Write a MATLAB program to find the time domain response (Impulse response and phase response) for a given FIR and IIR systems.
7. Write a MATLAB program to find the frequency domain response (magnitude response and phase response) for a given FIR and IIR systems.
8. Write a MATLAB program to design a low pass filler using window method for the given specification.
9. Write a MATLAB program to design Butterworth and Chebyshev low pass filler using bilinear transformation and Impulse Invariant Transformation.

Code	Nomenclature of Lab	P	Int.	Ext.	Total	Time
EE-316N	**Power System Lab**	**2**	**40**	**60**	**100**	**3 Hr**

LIST OF EXPERIMENTS

1. Experiment to find out the dielectric strength of transformer oil.
2 Experiment to find zero sequence component of three phase line.
3 Draw the characteristics of thermal overload relay.
4. Experiment to study an IDMT over current relay & plot it's characteristic curves i.e. graph between current & time.
5 Experiment to study differential relay characteristics.
6 Experiment to measure the ABCD parameters of a given transmission line, also study Ferranti effect.
7 Experiment to study Parallel operation of two alternators.
8 Experiment to plot the power angle characteristics of given transmission line.
9 Experiment to find the string efficiency of a string insulator with/without guard rings.
10 Experiment to study the characteristics of transmission line for t-network & pie- network.
11 Testing of a current transformer & find Ratio Error & Phase angle error for various burdens.
12 To study various types of distance relay.
13 Experiment to study fault current using sequence impedance network.

NOTE: At least 10 experiments are to be performed with at least 8 from above list, remaining 2 may either be performed from the above list or designed & set by concerned institution as per the scope.

Code	Nomenclature of Lab	P	Int.	Ext.	Total	Time
EE-318N	**Micro-Processor & Interfacing Lab**	**2**	**40**	**60**	**100**	**3 Hr**

Before starting with the experiments, teacher should make the students conversant with the following theoretical concept:

A. i) Programming Modes of Intel's 8086.
   ii) Addressing Modes of Intel's 8086.
   iii) Instruction Formats of Intel's 8086.
B. Instruction Set of Intel's 8086.
C. Assembler and Debugger.

LIST OF EXPERIMENTS

I. a) Familiarization with 8086 Trainer Kit.
   b) Familiarization with Digital I/O, ADC and DAC Cards.
   c) Familiarization with Turbo Assembler and Debugger S/Ws.

II. Write a program to arrange block of data in

   a) Ascending and b) Descending order.

III. i) Program for finding largest number from an array. ii) Program for finding smallest number from an array.

IV. Write a program to find out any power of a number such that $Z = X^N$ Where N is programmable and X is unsigned number.

V. Write a program to measure to generate:

   (i) Sine Waveform (ii) Ramp Waveform (iii) Triangular Waveform using DAC Card.

VI. Write a program to measure frequency/Time period of the following functions:
   (i) Sine Waveform (ii) Square Waveform (iii) Triangular Waveform using DAC Card.

VII. Write a program to increase, decrease the speed of a stepper motor and reverse its direction of rotation using stepper motor controller card.

VIII. Write a programmable delay routine to cause a minimum delay = 2MS and a maximum delay = 20 minutes in the increments of 2MS.

IX. I) Use DOS interrupt to read keyboard string/character.
   ii) Use BIOS interrupt to send a string/character to printer.

X Write a program to :
   i) Create disk File
   ii) Open, write to and close a disk file
   iii) Open, Read from and close a disk file
   iv) Reading data stamp of a file using BIOS interrupt

XI i) Erasing UVPROMs and EPROM's
   ii) Reprogramming PROMs using computer compatible EPROM Programmer

XII Studying and Using 8086 In-Circuit Emulator.

XIII Write a Program to interface a two digit number using seven segment LEDs Using 8086 & 8255 PPI

Note: At least 10 experiments are to be performed, 8 from the above list, , remaining experiments may be performed depending upon the scope.

Code	Nomenclature of Lab	P	Int.	Ext.	Total	Time
EE-320N	**Electric Drives Lab**	**2**	**40**	**60**	**100**	**3 Hr**

LIST OF EXPERIMENTS

1. Study of Industrial Applications of various mills.
2. Variable Torque Control of Induction Motor.
3. Breaking of DC Motor by using Mechanical & Electrical Methods.
4. Rotor resistance control of 3 phases Slip Ring Induction Motor.
5. Chopper Control of DC Motor.
6. Chopper Control of separately excited DC motor.
7. Study of different types of a loading on a particular load.
   (a) Intermediate Loading
   (b) Continuous Loading
8. Methods of starting Induction Motor.
9. Variable Voltage Control of Induction Motor.
10. Microprocessor Based Control of any Motor.
11. To study direct torque control of DC motor in MATLAB.

NOTE: Ten experiments are to be performed, out of which at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution.