# *Chhattisgarh Swami Vivekanand Technical University, Bhilai*

## SCHEME OF EXAMINATION

## M.E. (POWER ELECTRONICS) in the Department of Electrical Engg.

**IInd SEMESTER**

| SN | Board of study | Subject code | Subject Name | Periods per week | | | Scheme of exam | | | Total Marks | Credit L+(T+P)/2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Theory/Practical | | | | |
| | | | | L | T | P | ESE | CT | TA | | |
| 1 | Electrical Engg. | 562211(24) | Switched mode Power Conversion | 3 | 1 | - | 100 | 20 | 20 | 140 | 4 |
| 2 | Electrical Engg. | 562212(24) | Power Electronics Drives | 3 | 1 | - | 100 | 20 | 20 | 140 | 4 |
| 3 | Electrical Engg. | 562213(24) | PWM Converters & Applications | 3 | 1 | - | 100 | 20 | 20 | 140 | 4 |
| 4 | Electrical Engg. | 559211(24) | EHV AC & DC | 3 | 1 | - | 100 | 20 | 20 | 140 | 4 |
| 5 | Refer table 2 | | Elective – 2 | 3 | 1 | - | 100 | 20 | 20 | 140 | 4 |
| 6 | Electrical Engg. | 562221(24) | Power Modules Lab | - | - | 3 | 75 | - | 75 | 150 | 2 |
| 7 | Electrical Engg. | 562222(24) | Power Electronics Simulation Lab | - | - | 3 | 75 | - | 75 | 150 | 2 |
| **TOTAL** | | | | **15** | **5** | **6** | **650** | **100** | **250** | **1000** | **24** |

L- Lecture, T- Tutorial, P- Practical, ESE- End Semester Examination,
CT - Class Test, TA- Teacher's Assessment.

Note : Duration of all theory papers will be of Three Hours.

| **Table – 2** | | |
|---|---|---|
| **Elective – 2** | | |
| **Board of Study** | **Code** | **Subject** |
| Electrical Engg. | 562231(24) | Fuzzy Systems |
| Electrical Engg. | 562232(24) | Optimization Techniques |

**Note (1) –** 1/4th of total strength of students subject to minimum of twenty students is required to offer an elective in the college in a Particular academic session .

**Note (2) –** Choice of elective course once made for an examination cannot be changed in future examinations.

# Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: **M. E. II** Branch: **Electrical Engg.**
Subject: **Switched Mode Power Conversion** Code: **562211 (24)**
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

**Unit :I**

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

**Unit :II**

Basic concepts of Switched Mode power converters, DC-DC converters Characteristics, constituent elements, operating principles.

**Unit : III**

Steady state analysis, stress and sizing of elements, control methods, duty ratio, current programmed, frequency programmed and sliding mode control, Dynamic analysis and frequency domain models.

**Unit :IV**

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

**Unit :V**

Design of feed back compensators, unity power factor rectifiers, resistor emulation principle and applications to rectifiers.

**Reference Book**

*1. Switched Mode Power Conversion, Course Notes, CCE, IISc, 2004.*

*2. Issa Batarseh, 'Power Electronic Circuits', John Wiley, 2004.*

3. *Philip T Krein,' Elements of Power Electronics ',Oxford Press,1997.*

# Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: **M. E. II** Branch: **Electrical Engg.**
Subject: **Power Electronics Drives** Code: **562212 (24)**
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

**Unit :I**

Basic power electronic drive system, components. Different types of loads, shaft-load coupling systems. Stability of power electronic drive.

**Unit :II**

Conventional methods of D.C.motor speed control, single phase and three phase converter fed D.C motor drive. Power factor improvement techniques, four quadrant operation.

**Unit :III**

Chopper fed drives, input filter design. Step-up chopper for photovoltaic systems. Braking and speed reversal of DC motor drives using choppers, multiphase choppers.

**Unit :IV**

Conventional methods of induction motor speed control.. Solid state controllers for Stator voltage control, soft starting of induction motors, Rotor side speed control of wound rotor induction motors. Voltage source and Current source inverter fed induction motor drives.

**Unit :V**

Speed control of synchronous motors, field oriented control, load commutated inverter drives, switched reluctance motors and permanent magnet motor drives.

**Reference Book**

*1. P.C Sen, 'Thyristor DC Drives', John wiely and sons, New York, 1981.*

*2. R.Krishnan, 'Electric Motor Drives – Modeling, Analysis and Control', Prentice-Hall of India Pvt Ltd., New Delhi, 2003.*

*3. Bimal K.Bose, 'Modern Power Electronics and AC Drives', Pearson Education (Singapore) Pte. Ltd., New Delhi, 2003.*

# Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: **M. E. II** Branch: **Electrical Engg.**
Subject: **PWM Converters And Applications** Code: **562213 (24)**
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

**Unit :I**

AC/DC and DC/AC power conversion, overview of applications of voltage source converters, pulse modulation techniques for bridge converters.

**Unit :II**

Bus clamping PWM, space vector based PWM, advanced PWM techniques, practical devices in converter; calculation of switching and conduction losses.

**Unit :III**

Compensation for dead time and DC voltage regulation; dynamic model of a PWM converter, multilevel converters; constant V/F induction motor drives.

**Unit :IV**

Estimation of current ripple and torque ripple in inverter fed drives; line – side converters with power factor compensation.

**Unit :V**

Active power filtering, reactive power compensation; harmonic current compensation.

## Reference Book


1. *Mohan, Undeland and Robbins,' Power Electronics; Converters, Applications and Design',John Wiley and Sons,2nd edition , 1995.*
2. *Erickson R W,' Fundamentals of Power Electronics', Chapman and Hall, 2001.*
3. *Vithyathil J,'Power Electronics: Principles and Applications ', McGraw Hill, 1995.*

# Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: **M. E. II** Branch: **Electrical Engg.**
Subject: **EHV-AC&DC** Code: **559211 (24)**
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

**UNIT-1**
Sequential impedances of AC systems EHVAC transmission over voltages, insulation design of lightning and switching over voltages, High voltage testing of AC equipments, Reactive Power compensation of EHV AC lines.

**UNIT-2**
**DC Power Transmission Technology:** Application of DC Transmission, Description of DC Transmission System, Planning for HVDC Transmission, Modern Trends in DC Transmission, Thyristor Device, Thyristor Valve, Valve Tests, Recent Trends in valves. Comparison of EHV AC & DC transmission.

**UNIT-3**
**HVDC Converters:** Pulse Number, Choice of Converter Configuration, Simplified Analysis of Graetz Circuit, Converter Bridge Characteristics. Characteristics of a Twelve Pulse Converter, Detailed Analysis of Converters

**HVDC System Control:** Principal of DC Link Control, Converter Control Characteristics, System Control Hierarchy, Firing Angle Control, Current and Extinction Angle Control, Starting and Stopping of DC Link, Power Control, Higher Level Controllers, Telecommunication Requirements

**UNIT-4**
**Converter Faults and Protection:** Converter Faults , Protection Against Overcurrents, Over voltages in a Converter Station , Surge Arresters, Protection Against Over voltages.
**Smoothing Reactor and DC Line**: Smoothing Reactors, DC Line, Transient over Voltages In DC Line, Protection of DC Line, DC Breakers, Monopolar Operation, Effects of Proximity of AC and DC Transmission Lines

**UNIT-5**
**Reactive Power Control:** Reactive Power Requirements in Steady State, Sources of Reactive Power, Static Var Systems, Reactive Power Control during Transients
**Harmonics and Filters:** Generation of Harmonics, Design of AC Filters, DC Filters, Carrier Frequency and RI Noise

**Text:**
1. HVDC Power Transmission System: K.R. Padiyar , Wiley Eastern Limited.
**Reference:**
**1.** Power System Stability and Control by Prabha Kundur- EPRI. Mc Graw Hill Inc.

# Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: **M. E. II** Branch: **Electrical Engg.**
Subject: **Fuzzy System** Code: **562231 (24)**
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

**Unit :I**
Different faces of imprecision – inexactness, Ambiguity, Undecidability, Fuzziness and certainty, Probability and fuzzy logic, Intelligent systems.

**Unit :II**
Fuzzy sets and crisp sets - Intersections of Fuzzy sets, Union of Fuzzy sets, the complement of Fuzzy sets.

**Unit :III**
Fuzzy reasoning - Linguistic variables, Fuzzy propositions, Fuzzy compositional rules of inference- Methods of decompositions, Defuzzification.

**Unit :IV**
Methodology of fuzzy design - Direct & Indirect methods with single and multiple experts, Adaptive fuzzy control, Rule base design using dynamic response.

**Unit :V**
Fuzzy logic applications to engineering, Fuzzy decision making, Neuro-Fuzzy systems, Fuzzy Genetic Algorithms.

**Reference Book**

1. *Zimmermann, H.J., 'Fuzzy set theory and its applications', Allied publishers limited, Madras,2001*

2. *Klir, G.J., and Folge., T., 'Fuzzy sets, uncertainty and information', PHI, New Delhi,1997.*

*3. EarlCox,,'The Fuzzy Systems Handbook', AP professional Cambridge, MA 02139, 1998.*

# Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: **M. E. II** Branch: **Electrical Engg.**
Subject: **Optimization Techniques** Code: **562232 (24)**
Total Theory Periods**: 40** Total Tutorial Periods: **12**
Total Marks in End Semester Exam. : **100**
Minimum number of class test to be conducted: 02

**Unit :I**

Linear programming –formulation-Graphical and simplex methods-Big-M method-Two phase method-Dual simplex method-Primal Dual problems.

**Unit :II**

Unconstrained one dimensional optimization techniques -Necessary and sufficient conditions –Unrestricted search methods-Fibonacci and golden section method- Quadratic Interpolation methods, cubic interpolation and direct root methods.

**Unit :III**

Unconstrained n dimensional optimization techniques – direct search methods –Random search –pattern search and Rosen brooch's hill claiming method- Descent methods- Steepest descent, conjugate gradient, quasi -Newton method.

**Unit :IV**

Constrained optimization Techniques- Necessary and sufficient conditions –Equality and inequality constraints-Kuhn-Tucker conditions-Gradient projection method-cutting plane method- penalty function method.

**Unit :V**

Dynamic programming- principle of optimality- recursive equation approach- application to shortest route, cargo-loading, allocation and production schedule problems.

## Reference Book


1. *Rao,S.S.,'Optimization :Theory and Application' Wiley Eastern Press, 2nd edition, 1984.*
2. *Taha,H.A., Operations Research –An Introduction, Prentice Hall of India,2003.*
3. *Fox, R.L.,'Optimization methods for Engineering Design', Addition Welsey, 1971.*

# Chhattisgarh Swami Vivekanand Technical University, Bhilai

## POWER MODULES LABORATORY

Semester: **M. E. II** Branch: **Electrical Engineering**
Subject: **Power Modules Laboratory** Code: **562221 (24)**
Total Practical Periods**: 40**
Total Marks in End Semester Exam. : **75**

- Development of various configurations of power modules using SCRs, IGBTs, power transistors and power MOSFETs. Practical converter design considerations- Snubber design, gate and base drive circuits.

- DC to DC converters of various configurations using SCRs, IGBTs, power transistors and power MOSFETs.

- DC to AC converters of various configurations using SCRs, IGBTs, power transistors and power MOSFETs.

- AC to AC converters of various configurations using SCRs, IGBTs, power transistors and power MOSFETs..

- Practical implementation of control techniques for voltage control, speed control and harmonic minimization.

### Reference Book

1. *Ned Mohan, Undeland and Robbin, 'Power Electronics: converters, Application and design', John Wileyand sons.Inc, Newyork, 2002.*
2. *M.H. Rashid, 'Power Electronics Handbook', Elseiver Press, 2003.*
3. *John D. Lenk ,'Simplified Design of Switching Power Supplies', Butterworth-Heinemann, 1996.*

# Chhattisgarh Swami Vivekanand Technical University, Bhilai

Semester: **M. E. I**
Branch: **Electrical Engineering**
Subject: **Power Electronics Simulation Lab**
Code: **562222 (24)**
Total Practical Periods**: 40**
Total Marks in End Semester Exam. : **75**

1. Solution of transcendental equation by numerical techniques.
2. Computing the conduction angle for selective reduction of harmonics by Newton –Raphson method.
3. Solution of Matrices using Runge Kutta method.
4. Simulation of Solid State Circuits by PSPICE / MATLAB & SIMULINK.
5. Simulation of Controlled rectifiers by PSPICE / MATLAB & SIMULINK.
6. Simulation of Diode rectifiers, using PSPICE / MATLAB & SIMULINK.
7. Simulation of AC voltage controllers using PSPICE / MATLAB & SIMULINK.
8. Simulation of DC voltage controllers using PSPICE / MATLAB & SIMULINK.
9. Simulation of speed control schemes for DC and AC motors.
10. Mathematical modeling of Power Electronic Systems.

**References**


1. Rashid, M.H.,"SPICE for Power Electronics and Electric Power". Prentice Hall, New Jersey, 1993.
2. Rashid,M.H.,"SPICE for circuits and electronics using PSPICE", Prentice Hall of India, New Delhi, 1995.
3. Ned Mohan, "Power Electronics, Computer Simulation Analysis and Education using PSPICE", Minnesota Power Electronics Research and Education, USA, 1992
4. Giuseppa Mossobreio, "Semiconductor Device Modelling with SPICE", McGraw Hill Inc, New York, 1993
5. Bimal K.Bose, "Power Electronics and Variable Frequency Drives", IEEE Press, New Jersey, 1996.
6. Chee-Mun-Ong,"Dynamic simulation of Electric Machinery using MATLAB/SIMULINK", Prentice Hall PTR, New Jersey, 1998.
7. "The PSPICE User's Guide", Math works Inc, 1994.
8. "The SIMULINK User's Guide", Math works Inc, 1994.