

**MAHATMA GANDHI
UNIVERSITY**

B.TECH. DEGREE COURSE

7TH SEMESTER

**SCHEME
&
SYLLABUS**

2002

**ELECTRICAL
&
ELECTRONICS
ENGINEERING BRANCH**

ELECTRICAL & ELECTRONICS ENGINEERING

SCHEME

7TH SEMESTER

Course Code	Course No.	Subject	Teaching Hours				Duration of Univ. Exam(Hrs.)	Maximum Marks		
			L	T	Prac./Proj.	Total		Sessional	University	Total
A	E 701	Electrical Machines -III	3	1		4	3	50	100	150
B	E 702	Electrical Drives and Control	2	1		3	3	50	100	150
C	E 703	Utilisation of Electrical Power	2	1		3	3	50	100	150
D	E 704	Control Systems - II	3	1		4	3	50	100	150
E	E 705	System Design with Microcontrollers	2	1		3	3	50	100	150
F	E 706	Elective - I	3	1		4	3	50	100	150
G	E 707	Electrical Drawing			3	3	3	50	100	150
H	E 708	Control and Power Electronics Lab			4	4	3	50	100	150
I	E 709	Project & Seminar*			2	2				
		Total	15	6	9	30	24	400	800	1200

*The Project Work will be started in the Seventh Semester. Sessional Marks for Seminar will be out of 25 and that for Project will be out of 75.

SYLLABUS

ELECTRICAL MACHINES - III

E 701

3+1+ 0

Module 1

Three phase Induction Motor: Construction – squirrel cage and slip-ring motor – principle of operation – slip and frequency of rotor current – mechanical power and developed torque – Phasor diagram – torque slip curve – pull out torque – losses and efficiency.

No load and locked rotor tests – equivalent circuit – performance calculation from equivalent circuit – circle diagram – operating characteristics from circle diagram – cogging and crawling and methods of elimination

Module 2

Starting of three phase squirrel cage induction motor – direct online starting – auto transformer – star-delta starting – starting of slip-ring motor – design of rotor rheostat – variation of starting torque with rotor resistance.

Speed control – pole changing – rotor resistance control – frequency control – static frequency conversion – Applications of Induction machines – single phasing – analysis using symmetrical components.

Module 3

Induction Generator: Theory – Phasor diagram – equivalent circuit -
Synchronous Induction motor: – construction – rotor winding connections – circle diagram – pulling into step.

Single phase Induction motor: revolving field theory – equivalent circuit – torque slip curve – starting methods – split phase, capacitor start-capacitor run and shaded pole motors.

Module 4

Single phase Series Motor: Theory – Phasor diagram – circle diagram – compensation and interpole winding – Universal motor

Repulsion Motor: torque production – Phasor diagram – compensated type of motors – repulsion start and repulsion run induction motor – applications

Reluctance motor – Hysteresis motor

Module 5

Deep bar and double cage induction motor – equivalent circuit – torque slip curve – Commutator motors – principle and theory – emf induced in a commutator winding - - Poly-phase commutator motors – three phase series and shunt type – Schrage motor – characteristics – applications – use of commutator machines as frequency converters, phase advancers – expedor type and susceptor type – Walker and Scherbius advancers – Linear Induction motor – operation and application

References

1. Performance and Design of AC machines – M.G Say
2. Theory of Alternating Current machines – Alexander Lagnsdorf
3. A.C Commutator motor – Openshaw Taylor
4. Alternating Current machines – Puchstein & Lloyd

ELECTRICAL DRIVES AND CONTROL

E 702

2+1+0

Module 1

DC motors: Methods of Speed control – single phase rectifiers with motor load- single phase fully controlled bridge rectifier drives – half controlled bridge rectifier drives – freewheeling with regeneration – speed torque characteristics – power in load and source circuits

Module 2

3 Phase fully controlled bridge rectifier drives – free wheeling, freewheeling with regeneration – Dual converter fed DC motor drives – chopper fed drives – single, two and four quadrant chopper drives

Module 3

(Qualitative treatment only)

Speed control of 3 Phase induction motors – stator voltage control – principle – controller configurations – operation and applications

Slip power recovery scheme – principle – static Kramer's drive – static Scherbius' drive – applications

V/f control – constant torque and constant power control

Module 4

(Qualitative treatment only)

Voltage Source Inverter – Application to induction motor drives – v/f, e/f, flux weakening schemes of control – applications

PWM inverter drive

Current Source Inverter – application to induction motor drives – operation under fixed frequency – operation under variable frequency – applications

Module 5

(Qualitative treatment only)

Speed control of synchronous motors – adjustable frequency operation of synchronous motors – principles of synchronous motor control – Voltage Source Inverter Drive with open loop control – self controlled synchronous motor with electronic commutation – self controlled synchronous motor drive using load commutated thyristor inverter.

Principle of Vector control

References

1. Power Electronic Control of AC motors – J.M.D Murphy and F.G Turnbull, Pergamon Press 1988
2. Power Semiconductor controlled Drives – G.K Dubey, Prentice hall, 1989
3. Modern Power Electronics and AC Drives – Bose B.K, Pearson Education Asia -2002
4. Electric Drives – N.K De and P.K Sen, PHI New Delhi 2001
5. Power Electronics – M.D Singh and K.B Khanchandani, TMH, 1998
6. Mohammad A and E.L Sharkaw – Fundamentals of Electric Drives – Thomson Learning
7. Power Semiconductor Drives – Vedam Subramaniam, TMH

UTILISATION OF ELECTRICAL POWER

E 703

2+1+0

Module 1

Electric Drives: Advantages of Electric drives – factors affecting choice of motors – mechanical characteristic of DC and AC motors – motors for particular applications like textile mill, steel mill, paper mill, mine, hoists, cranes – size and rating of motors.

Electrical Braking – plugging – dynamic and regenerative braking – energy returned to the mains

Module 2

Electric Traction: Advantages and disadvantage - speed time curves – analysis using trapezoidal speed time curve - mechanics of train movement – tractive effort – specific energy consumption – factors affecting specific energy consumption - train resistance – adhesive weight – coefficient of adhesion - traction motor & characteristics

Series-parallel control of D.C. series motor – shunt and bridge transition - energy saving by series parallel control.

Module 3

Electric Heating and Welding: Electric heating – resistance types – design of heating element – induction heating – types of high frequency heating – dielectric heating – methods of high frequency generation – direct and indirect arc furnaces – power supply and control for different types of arc furnaces – application.

Electric welding – resistance welding – arc welding – electronic welding control

Module 4

Illumination: Review of definitions and laws of illumination – requirements of good lighting -polar curves – Rousseau's construction - lighting calculation – design of interior and exterior lighting system - factory lighting – flood lighting – street lighting.

Refrigeration and Air Conditioning: Types of refrigeration and air conditioning systems – refrigerants – no frost refrigeration – trouble shooting – working of electrical systems – protection of motors.

Module 5

Energy Management: Necessity for Energy Management – Energy Saving – adopting non-conventional sources – Energy Management techniques (case study) applied to 1) Residential Buildings, 2) Industries/Organisations – Energy auditing

References

1. Utilisation of Electrical Energy: Openshaw Taylor
2. A Course in Electrical Power: Soni Gupta
3. Generation, Distribution & Utilization: C.L Wadhwa
4. Utilisation of Electric Power: N.V Suryanarayana, New Age Int'l.
5. Energy Conservation Handbook: Utility publication

CONTROL SYSTEMS - II

E 704

3+1+0

Module 1

Compensation and design of Control Systems: cascade compensation – lag, lead and lag-lead compensators – frequency domain methods – Bode plot method – Root-locus methods

Module 2

Digital Control Systems: the process of sampling – sample and hold circuits – Review of z transforms and its properties – solving difference equation by z transform methods – inverse z transform – the pulse transfer function – response between sampling instants – system characteristic equation – Jury's stability test.

Module 3

Non-Linear Control Systems: Common physical non linearities – the phase plane method – basic concepts – describing functions of saturation, dead zone non linearities – stability analysis using describing functions.

Module 4

State Variable Approach: state space representation – block diagram representation of linear system in state variable form – non uniqueness of the set of state variables – Eigen values of an $n \times n$ matrix – eigen vectors – transfer function – solution of homogeneous state equation – state transition matrix.

Module 5

State equations from transfer function – decomposition of transfer function – controllability and observability - pole placement compensation – state variable approach to discrete data system – vector matrix difference equation – solution of the general linear time invariant systems – vector matrix difference equation

References

1. Modern Control Engineering – Katsuhiko Ogatta, Pearson Education Asia/PHI
2. Modern Control Systems –Dorf and Bishop, Pearson Education Asia
3. Analog and digital Control System Design – Chi Tsong Chen, Oxford University Press
4. Discrete Time Control of Dynamic Systems – Katsuhiko Ogatta, Pearson Education Asia
5. Digital Control of Dynamic Systems – G.F Franklin, J. David Powell and Michael Workman, Pearson Education Asia

SYSTEM DESIGN WITH MICROCONTROLLERS

E 705

2+1+0

Module 1

Microcontrollers and Microprocessors - Comparison.

Intel 8051: Architecture–Block diagram-Oscillator and Clock-Internal Registers-Program Counter-PSW-Register Banks-Input and Output ports-Internal and External memory, Counters and Timers, Serial data I/O- Interrupts-SFRs.

Module 2

Programming of 8051: Instruction syntax-Types of instructions–Moving data-Arithmetic Instructions-Jump and Call Instructions-Logical Instructions-Single Bit Instructions.

Arithmetic programs. Timing subroutines –Software time delay- Software polled timer- Addressing Modes

Module 3

I/O Programming: Timer/Counter Programming-Interrupts Programming- Timer and external Interrupts- Serial Communication- Different character transmission techniques using time delay, polling and interrupt driven-Receiving serial data – polling for received data, interrupt driven data reception.

Module 4

Microcontroller system design: External memory and Memory Address Decoding for EPROM and RAM. Interfacing keyboard. 7 segment display and LCD display. Interfacing of ADC (0808) and DAC (808) to 8051.

Module 5

Designing a stand alone Microcontroller system: Typical system design examples (Block-Diagram level only) - Data acquisition system- Measurement of frequency - Temperature control

Introduction to PLCs: Basic configuration of PLCs

Text Books

1. The 8051 Microcontroller and Embedded Systems – Muhammad Ali Mazidi and Janice Gillispie Mazidi, Pearson Education Asia.
2. The 8051 Microcontroller – Architecture, Programming and Applications – Kenneth J. Ayala, Penram International Publishing (India), Second Ed.

Reference

1. Intel Data Book on MCS 51 family

Web Reference

1. www.intel.com

ELECTIVE - I

E 706

3+1+0

List of Electives

- E 706.1 CMELR Optimisation Techniques (Common to all branches)
- E 706.2 HVDC Engineering
- E 706.3 Neural Networks
- E 706.4 Object Oriented Programming
- E 706.5 Biomedical Instrumentation

Note

New Electives may be added according to the needs of emerging fields of technology. The name of the elective and its syllabus should be submitted to the University before the course is offered.

OPTIMIZATION TECHNIQUES

CMLRTA 706-1

Module 1

Classical optimization techniques: Single variable optimization - Multivariable optimization with no constraints - Hessian matrix - Multivariable saddle point - Optimization with equality constraints - Lagrange multiplier method.

Module 2

Constrained multivariable optimization: Multivariable optimization with inequality constraints - Kuhn-Tucker conditions - Convex programming problem - Quadratic programming.

Module 3

One-dimensional unconstrained minimization: Elimination methods - unrestricted search method - Fibonacci method - Interpolation methods - Quadratic interpolation and cubic interpolation methods.

Module 4

Unconstrained minimization: Gradient of a function - Steepest descent method - Newton's method - Powells method - Hooke and Jeeve's method.

Module 5

Integer - Linear programming problem: Gomory's cutting plane method - Gomory's method for all integer programming problems, mixed integer programming problems.

References

1. Optimization theory and application - S.S. Rao, New Age International P. Ltd.
2. Optimization Concepts and applications in Engineering - A. D. Belegundu, T.R. Chandrupatla, Pearson Education Asia.
3. Principles of Operations Research for Management - F. S. Budnick, D. McLeavey, R. Mojena, Richard D. Irwin, INC.
4. Operation Research an introduction - H. A Taha, Eastern Economy Edition.

HVDC ENGINEERING

E 706-2

Module 1

Introduction: Comparison of AC, DC transmission – Description of DC transmission systems – modern trends in thyristor valves – Pulse number of converters – choice of converter configuration – Review of Graetz circuit – Valve rating – Transformer rating – Simplified analysis of Graetz circuit without overlap only.

Module 2

HVDC System Control: principles of DC link control – converter control characteristics – system control hierarchy – firing angle control – individual phase control and equidistant phase control – comparison – advantages and disadvantages – current and extinction angle control – starting and stopping of DC link – power control

Module 3

Converter faults and protection: types of faults – commutation failure – arc through and misfire – protection against over currents – over voltages – surge arresters – protection against over voltages

Module 4

Harmonics and filters: Sources of harmonics in HVDC systems - Smoothing reactors – Corona and radio interference effects – harmonic distortion factor (derivation not required) – types of AC filters – DC filters (design not required)

Module 5

Multi-terminal DC systems: applications of MTDC systems – types – comparison.

Reactive power control: sources of reactive power – static VAR systems – TCR configuration (analysis not required) – Typical control system (block diagram only) for a TCR – operation of Thyristor switched capacitor

Text Book

1. HVDC Power Transmission Systems-Technology and System Interactions: K.R Padiyar, New Age Int'l.

Reference

1. Direct Current Transmission Vol 1: E.W Kimbark, Wiley

NEURAL NETWORKS

E 706-3

Module 1

Introduction: Principles -Artificial neuron - activation functions -Single layer and Multilayer networks - Training artificial neural networks - Perception - Representation - Linear Separability - Learning - Training algorithms.

Module 2

Back propagation: Training Algorithm - Application - Network Configurations - Network Paralysis - Local Minima - Temporal instability.

Module 3

Counter Propagation Networks: Kohonen layer - Training the Kohonen layer - Pre initialising the weight vectors - statistical properties Training the Grossberg layer - Full counter propagation network - Application.

Module 4

Statistical Methods: Boltzmann's Training - Cauchy training - Artificial neural network methods - applications to general non-linear optimization problems

Module 5

Hopfield nets: Recurrent networks - stability - Associative memory-applications - Thermo dynamic systems - Statistical Hopfield networks - Bidirectional associative memories - Continuous BAM - Adaptive resonance theory - Architecture classification - implementation.

Text Book

1. Neural Computing & Practice - Philip D. Wasserman,

References

1. Adaptive pattern Recognition & Neural Networks - Pay Y.H.
2. An Introduction to neural computing - Chaoman & Hall
3. Artificial Neural Networks - Kishan Mehrota and Etal

OBJECT ORIENTED PROGRAMMING

E 706-4

Module 1

OOP concepts: Objects-classes-data abstraction-data encapsulation-inheritance-polymorphism-dynamic binding-comparison of OOP and Procedure oriented programming-object oriented languages.

OOP using C++: Classes and objects-class declaration-data members and member functions-private and public members-member function definition-inline functions-creating objects-accessing class members.

Module 2

Arrays of objects-objects as function arguments-pass by value-reference variables/aliases-pass by reference-function returning objects-static class members.

Constructors and destructors -declaration, definition and use-default, parameterized and copy constructors-constructor overloading.

Module 3

Polymorphism: function overloading-declaration and definition-calling overloaded functions. Friend classes-friend functions-operator overloading-overloading unary - overloading binary operators- use of friend functions

Module 4

Inheritance: different forms of inheritance-base class-derived class-visibility modes-single inheritance-characteristics of derived class-abstract class

File handling in C++: file stream classes-file pointers-open (), close (), read (), write () functions-detecting end of file.

Module 5

Dynamic memory allocation: pointer variables-pointers to objects-new and delete operators-accessing member functions using object pointers-'this' pointer. **Run time**

polymorphism: pointers to base class-pointers to derived class-virtual functions-dynamic binding.

References

1. Object Oriented Programming with C++ - Balagurusamy, McGraw Hill
2. Object Oriented Programming in Turbo C++ - Robert Lafore ,Galgotia Publications
3. C++Programming Language - Bjame Stroustrup, Addison Wesley
4. C++ primer -Stanely B.Lippman, PearsonEducation,Asia
5. Data Abstraction and OOP in C++ - Gordenkeith
6. Object Oriented Analysis & Design - Grady Booch, Addison Wesley

BIOMEDICAL INSTRUMENTATION

E706-5

Module 1

Physiology and generation of bio electric potential Cell Potentials stimulation and thresholds-Action potentials-propagation of action potentials-sodium pump-electro physiology of cardio pulmonary systems - Respiration and circulation - Cardio vascular system - Heart electro cardiogram - Measurement and analysis of EGG waveform-ECG recorder principles-block schematic of ECG recorder.

Module 2

Blood pressure-Characteristics of blood flow-Heart sounds Measurement of blood pressure-Direct and indirect methods-Pacemakers defibrillators- PH of blood- ESR and GSR- Temperature measurement of various parts.

Module 3

Respiratory system-measurement of respiration rate-Measurement of CO₂ and O₂ of exhaled air-Respiratory therapy equipment-inhalators, ventilators and respirators.

Module 4

Central Nervous systems-Anatomy of Nervous system-neuronal communication-Organisation of brain-Neuronal receptors-somatic nervous systems and spinal reflexes-EEG measurement and characteristic of sleep.

Module 5

Modern imaging systems – X ray machine – computer tomography – magnetic resonance imaging system – NMR components – ultrasonic imaging systems – Therapeutic equipments – dialysers – surgical diathermy machines – laser applications – physiotherapy and electro therapy equipments

References

1. Handbook of Biomedical instrumentation – R.S Khandpur
2. Medical and Clinical Engg. – Brtil Jacobson and John G
3. Biomedical Instrumentation and Measurements – Leslic Cromwell, F.J Weibel

ELECTRICAL DRAWING

E 707

0+0+3

PART A

DC Winding

1. Lap winding with equalizer rings.
2. Wave winding, dummy coils.

DC Machines

1. Dimensioned sketches of (a) front and end views of armature (b) commutator (c) brush holders (d) slot details.
2. Dimensioned sketches of yoke and pole assembly.
3. Dimensioned sketches of front and side views of an assembled medium size D.C machine.

Transformers

1. Sections of core type transformer limbs.
2. Dimensioned sketch (external view) of a distribution transformer with all accessories.
3. (a) Dimensioned sketch of sections of transformer limb.
(b) Assembled sectional view of Power transformer.

PART B

AC Winding

Three – phase AC winding

1. Integral slot lap winding
2. Short chorded winding
3. Fractional slot winding
4. Mush winding

AC machines

Dimensioned sketches of parts and assembled views of

1. Salient pole alternator
2. Cylindrical rotor alternator
3. Dimensioned sketches of parts and assembled views of
4. Squirrel cage induction motor
5. Slip ring Induction motor

References

1. Electrical Engineering Drawing - S. K Bhattacharya
2. Electrical Engineering Drawing – K.L. Narang
3. Electrical Machine Design – A.K Sawhney

(University Examination Pattern: 3 questions from Part A, of which any two must be answered, and 3 questions from part B of which any two must be answered. All questions carry 25 marks each).

CONTROL AND POWER ELECTRONICS LAB

E 708

0+0+4

Part A: Control Systems Lab

1. Transfer Function of Separately excited DC generator
2. Transfer Function of Field-Controlled DC motor
3. Transfer Function of Armature-Controlled DC motor
4. Amplidyne characteristics and transfer function
5. Voltage regulation of DC generator using Amplidyne
6. Synchro characteristics, error detection and data transmission, differential Synchro
7. AC servo motor – speed transfer characteristics
8. Step and sinusoidal response of RLC circuits
9. Study of PID controller – design and experimental determination of frequency response of lag and lead networks
10. D.C servo motor position control system
11. Use of MATLAB for simulating transfer functions, closed-loop systems etc.

Part B: Power Electronics Lab

1. Study of V-I characteristic of SCRS triac.
2. Study of BJT, IGBT, GTO & MOSFET.
3. R, RC and UJT firing circuits for the control of SCRS.
4. Design and implementation of Ramp-Comparator and digital firing scheme for simple SCR circuits.
5. Automatic lighting control with SCRs and optoelectronic components.
6. AC phase control using SCR and Triac.
7. Speed control of DC motor using choppers and converters.
8. Generation and study the PWM control signal for Single phase dc to ac inverter.
9. Study and use of the single phase half controlled & fully controlled AC to DC Converter and effect of firing angle control on load voltage & wave Forms.
10. Study and use of back to back connected SCR/ triac Controlled AC Voltage controller and its wave forms with Variation of firing angle.
11. Study & use chopper circuit for the control of DC Voltage using (1) Pulse width control (2) Frequency Control.
12. Study of Single Phase inverter and its wave form.
13. Study of Three Phase firing circuit with synchronisation, and testing with three phase AC to DC bridge converter. Testing of wave forms of digital firing modules.
14. Study and Testing of a Three Phase bridge inverter with different types of loads.
15. Simulation of gating circuits and simple converter circuits.

PROJECT AND SEMINAR

E 709/E808

Each student is required to present a technical paper on a subject approved by the department. The paper should be in general reflecting the state-of-the-art. He/she shall submit a report of the paper presented to the department.

In addition to the seminar he/she shall undertake a project work (as a team or individually) in the 7th semester itself in consultation with the Guides. On completion of the project work, he/she shall present the work done before a panel of staff members, and submit a report of the project work, and submit a report of the project work done to the department.

