INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-201** Course Title: **Network Theory**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weight: **CWS** 25 **PRS** 0 **MTE** 25 **ETE** 50 **PRE** 0

5. Credits: 4 6. Semester: **Autumn** 7. Subject Area: **DCC**

8. Pre-requisite: **EE-101**

9. Objective:

To introduce the fundamentals of network analysis using matrices, two-port and multi-port networks, and network synthesis.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Network Theorems:** Review of Thevenin's, Norton's, superposition and maximum power transfer theorems; Compensation, reciprocity and Tellegen's theorems.	3
2.	**Network Topology:** Concept of network graphs, tree, link, cut set, network matrices, node incidence matrix, loop incidence matrix, cut set incidence matrix, network analysis using network incidence matrices.	6
3.	**Transient Network Analysis:** Response of RL, RC and RLC networks using Laplace Transforms for unit step, impulse and ramp inputs.	5
4.	**Two Port Networks and their Characterization:** Open circuit, short circuit, hybrid and transmission parameters; Series, parallel and tandem connections of two-port networks, multi-port networks, multi-terminal networks; Indefinite admittance matrix and its properties.	5
5.	**Three-Phase A.C. Circuit Analysis:** Analysis of balanced and unbalanced three-phase networks; Symmetrical components and their application in analysis of unbalanced networks.	4

S. No.	Contents	Contact Hours
6.	**Analysis of A.C. circuits with non-sinusoidal inputs.**	**2**
7.	**Time Domain Analysis of Networks:** Poles and zeros, stability analysis.	**5**
8.	**Network Functions:** Driving point impedances; Transfer functions of networks.	**3**
9.	**Network Synthesis:** Positive real functions and their properties, tests for positive real functions, Hurwitz polynomials; Driving-point synthesis of LC, RC and RL networks, Foster forms and Cauer forms.	**6**
10.	**Introduction to Computer Aided Network Analysis:** Analysis of linear and non-linear networks, concept of companion network model; Computer aided transient network analysis.	**3**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Desoer C. A. and Kuh E. S., "Basic Circuit Theory", McGraw Hill International Book Company.	**1984**
2.	DeCarlo R. A. and Lin Pen-Min, "Linear Circuit Analysis", 2nd Ed., Oxford University Press.	**2001**
3.	Hayt W. H., Kemmerly J. E. and Durbin S. M., "Engineering Circuit Analysis", 6th Ed., Tata McGraw-Hill Publishing Company Ltd.	**2008**
4.	Director S. W., "Circuit Theory: A Computational Approach", 2nd Ed., John Wiley and Sons Inc.	**1993**
5.	Valkenberg V., "Network Analysis", 3rd Ed., Prentice Hall International Edition.	**2007**
6.	Kuo F. F., "Network Analysis and Synthesis", 2nd Ed., Wiley India.	**2008**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-202** Course Title: **Electrical Machines-I**

2. Contact Hours: **L: 3** **T: 1** **P: 2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 3

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 15 **ETE** 40 **PRE** 15

5. Credits: 5 6. Semester: **Spring** 7. Subject Area: **DCC**

8. Pre-requisite: **EE-101**

9. Objective:

The course aims at giving the fundamentals of energy conversion in electromechanical systems, construction and operation of dc machines in motoring and generating modes. The course also deals with the magnetizing characteristics and operation of three-phase transformers.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Principle of Electromechanical Energy Conversion:** Energy stored in electric and magnetic fields, energy conversion in singly and multiply excited systems and torque production, reluctance torque; Reluctance and hysteresis motors.	6
2.	**General Description of Electrical Machines:** Constructional details of dc and ac machines, description of magnetic and electric circuits in cylindrical rotor and salient pole machine, mmf distribution of current carrying single and multiple coils; Armature winding as a current sheet, associated mmf and flux density waves; Harmonics analysis of induced voltage; Torque as a function of flux and mmf.	6
3.	**DC Machines:** Simplex lap and wave windings, emf and torque equations, interaction of the fields produced by excitation circuit and armature.	5
4.	**Commutation**: Causes of bad commutation, methods of improving commutation, effects of brush shifts; Compensating winding;	4

	Interpole winding.	
5.	**DC Generators**: Methods of excitation, shunt, series and compound generators, characteristics, testing.	**4**
6.	**DC Motors**: Methods of excitation, characteristics, starting methods, effects of armature and field resistances.	**4**
7.	**Efficiency and Losses:** Different losses in dc machines and their estimation.	**2**
8.	**Single-phase Transformers**: Review of single-phase transformers, theory and performance; Parallel operation.	**2**
9.	**Three-phase Transformers**: Various connections and their comparative features, harmonics in emf and magnetizing current, effect of connections and construction on harmonics; Parallel operation of three-phase transformers, sharing of load.	**4**
10.	**Phase Conversion:** 3-phase to 2-phase conversion, 3-phase to 6-phase conversion.	**2**
11.	**Autotransformers:** Principle of operation and comparison with two winding transformer	**3**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Fitzgeraid A. E., Kingsley C. and Kusko A., "Electric Machinery", 6th Ed., McGraw-Hill International Book Company.	**2008**
2.	Say M. G., "The Performance and Design of Alternating Current Machines", CBS Publishers and Distributors.	**2005**
3.	Say M. G. and Taylor E. O., "Direct Current Machines", 3rd Ed., ELBS and Pitman.	**1986**
4.	Nagrath I. J. and Kothari D. P., "Electrical Machines", 3rd Ed., Tata McGraw-Hill Publishing Company Limited.	**2008**
5.	Clayton A. E. and Hancock N., "The Performance and Design of DC Machines", CBS Publishers and Distributors.	**2003**
6.	Langsdorf A. S., "Theory of AC Machines", 2nd Ed., Tata McGraw-Hill Publishing Company Limited.	**2008**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-203** Course Title: **Electrical Measurements and Measuring Instruments**

2. Contact Hours: **L: 3** **T: 0** **P: 2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 2

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 15 **ETE** 40 **PRE** 15

5. Credits: 4 6. Semester: **Autumn** 7. Subject Area: **DCC**

8. Pre-requisite: **EE-101**

9. Objective:

To impart knowledge of principles of measurement of electrical quantities, construction and operating principles of electrical instruments, their static and dynamic characteristics, and errors in measurement.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** SI units, static and dynamic characteristics of electrical instruments.	2
2.	**Galvanometers:** Galvanometer equation in dc and ac measurements; D'Arsonval, vibration and ballistic type galvanometers.	4
3.	**Ammeters and Voltmeters:** PMMC, moving iron, electro-dynamic and electrostatic meters; Long-scale meters.	4
4.	**Wattmeters:** Electrodynamometer and induction wattmeters, errors and their compensation, multi-element wattmeter.	3
5.	**Energy Meters:** Induction energy meter, calibration devices, errors and their compensation, polyphase energy meter, testing.	3
6.	**Special Meters:** Maximum demand indicator, bi-vector and tri-vector meters, power factor and frequency meters.	4
7.	**Potentiometer:** DC potentiometer, polar and coordinate ac potentiometers.	4
8.	**Resistance Measurement:** Measurement of low, medium and high	4

	resistances, measurement of volume and surface resistivity.	
S. No.	**Contents**	**Contact Hours**
9.	**A.C. Bridges :** General principles, sensitivity analysis; Hay, Owen and Heavyside Campbell bridges for inductance; De Sauty and Wein bridges for capacitance; T and P type high-frequency bridges; High-voltage Schering bridge and grounding.	**7**
10.	**Instrument Transformers:** Construction, phasor diagrams, error analysis and compensation, testing and application of measuring CT and VT.	**4**
11.	**Magnetic Measurements:** Determination of hysteresis loop, permeability and iron-loss measurement.	**3**
	Total	**42**

11. Suggested Books:

S. No.	**Name of Authors /Books / Publishers**	**Year of Publication/ Reprint**
1.	Golding E. W. and Widdis F. C., "Electrical Measurements and Measuring Instruments", 5th Ed., A.H. Wheeler and Company.	**1994**
2.	Harris F. K., "Electrical Measurement", Wiley Eastern Private Limited.	**1974**
3.	Stout M. B., "Basic Electrical Measurements", Prentice Hall of India Private Limited.	**1984**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-204** Course Title: **Electromagnetic Field Theory**

2. Contact Hours: **L: 2** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 2 **Practical** 0

4. Relative Weight: **CWS** 25 **PRS** 0 **MTE** 25 **ETE** 50 **PRE** 0

5. Credits: 3 6. Semester: **Spring** 7. Subject Area: **DCC**

8. Pre-requisite: **PH-101**

9. Objective:

To introduce the theory of electromagnetic wave propagation in free space and in various types of guiding structures.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Fundamental Concepts:** Scalar and vector fields; Physical interpretation of gradient, divergence and curl; Coordinate systems; Potential functions for static fields; Current continuity equation; Displacement current; Maxwell's equations.	4
2.	**Static and Quasi-static Fields:** Energy storage in electric and magnetic fields, Poisson's and Laplcae's equations, magnetic circuits, electromechanical energy conversion.	4
3.	**Plane Waves:** Uniform plane waves in time domain in free space, wave equation in an isotropic homogeneous medium and its solution, phasor notation; Uniform plane waves in dielectrics and conductors, polarization of waves, reflection and refraction of plane waves at plane boundaries, Poynting vector, power dissipation.	8
4.	**Transmission Lines:** Transmission line equations and parameters, Time-domain analysis,; Bounce diagrams; Frequency-domain analysis of transmission lines; Standing waves;	6

S. No.	Contents	Contact Hours
5.	**Waveguides:** Electromagnetic fields in parallel-plate, rectangular, and circular waveguides, TE and TM modes, wave impedance, wave velocities, attenuation in waveguides.	**6**
	Total	**28**

11. Suggested Books:

S.No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Narayana Rao N., "Elements of Engineering Electromagnetics", 6th Ed., Prentice Hall of India Private Limited.	**2007**
2.	Sadiku M.N.O., "Elements of Electromagnetics", 4th Ed., Oxford University Press.	**2006**
3.	Hayt W.H. and Buck J.A., "Engineering Electromagnetics", 7th Ed., Tata McGraw-Hill Publishing Company Limited.	**2008**
4.	Kraus J.D. and Fleisch D.A., "Electromagnetics with Applications", 5th Ed., McGraw-Hill International Book Company.	**2008**
5.	Cheng D.K., "Field and Wave Electromagnetics", 2nd Ed., Pearson Education.	**2008**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-206** Course Title: **Power Electronics**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 2

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 15 **ETE** 40 **PRE** 15

5. Credits: 4 6. Semester: **Spring** 7. Subject Area: **DCC**

8. Pre-requisite: **EE-101 and EC-102**

9. Objective:

The course aims at familiarizing the students with the operating characteristics of semiconductor devices, triggering circuits and their applications for power control. The course also deals with the detailed analysis and operation of power controllers.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Operational Amplifier:** Differential amplifier, level shifter, output stage and parameters of OPAMP; Applications of OPAMP: inverting and non inverting amplifier, active filters- low pass, high pass, band pass, active diode, active full wave rectifier, clipper, clamper, waveform generator circuits – square, triangular and sine wave generator.	7
2.	**Solid State Power Devices:** Principle of operation of SCR, dynamic characteristic of SCR during turn ON and turn OFF, parameters of SCR, dv/dt and di/dt protection, snubber circuit, commutation circuits; Introduction of modern power devices and their operating characteristics.	5
3.	**Single-phase Converter**: Half wave converter, 2-pulse midpoint converter, half controlled and fully controlled bridge converters, input current and output voltage waveforms, effect of load and source impedance, expressions for input power factor, displacement factor, harmonic factor and output voltage, effect of free-wheeling diode, triggering circuits.	6

S. No.	Contents	Contact Hours
4.	**Dual Converter**: Control principle, circulating current and circulating current free modes of operation of single-phase dual converter.	**2**
5.	**Three-phase Converter:** Half wave, full wave, half controlled and fully controlled bridge converters.	**5**
6.	**Single-phase A.C. Regulator:** Principle of operation, effect of load inductance, firing pulse requirement.	**3**
7.	**Single-phase Cycloconverter**: Principle of operation, waveforms, control technique.	**2**
8.	**Choppers:** Single quadrant chopper, voltage commutated chopper, current commutated chopper, load commutated chopper, design of commutating components, continuous and discontinuous modes of operation, expression for average output voltage and load current.	**5**
9.	**Voltage Source Inverter:** Single-phase half bridge inverter, full bridge inverter, voltage and current waveforms, Mc-Murray commutation circuit, design of commutation circuit, three-phase bridge inverter, voltage and current waveforms with delta connected RL load, voltage and frequency control of inverters, concept of PWM inverters.	**7**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Boylestad R. and Nashelsky L., "Electronic Devices and Circuit Theory", 9th Ed., Prentice Hall of India Private Limited.	**2008**
2.	Gayakward R. A., "OP-AMPs and Linear Integrated Circuit Technology", 4th Ed., Pearson Education.	**2008**
3.	Dubey G. K., Doradla S. R., Joshi A. and Sinha R. M. K., "Thyristorised Power Controllers", New Age International Private Limited.	**2008**
4.	Mohan N., Undeland T. M. and Robbins W. P., "Power Electronics-Converters, Applications and Design", 3rd Ed., Wiley India.	**2008**
5.	Rashid M. H., "Power Electronics Circuits Devices and Applications", 3rd Ed., Pearson Education.	**2008**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-208** Course Title: **Digital Circuits and Systems**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 2

4. Relative Weight**:** **CWS** 15 **PRS** 15 **MTE** 15 **ETE** 40 **PRE** 15

5. Credits**:** 4 6. Semester**: Spring** 7. Subject Area**: DCC**

8. Pre-requisite**: EC-102**

9. Objective:

To familiarize the students with the fundamentals of combinational and sequential logic circuits, and semiconductor memories.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Review of Number System**: Representation of binary, hexadecimal, octal and BCD numbers, conversion from one system to another system, signed number representation, addition and subtraction of signed numbers.	2
2.	**Boolean Algebra**: Theorems and postulates; Logic gates, positive and negative logic gates and their truth tables.	3
3.	**Digital Integrated Circuits:** DTL, TTL, ECL, CMOS. NAND and NOT gates using TTL logic, open collector devices, TTL parameters.	3
4.	**Boolean Function:** Canonical forms of representing Boolean function, VK map, simplification of 3, 4 and 5 variables function using VK map and McCluskey method.	3
5.	**Combinational Logic Circuits:** Design procedure, binary adder, binary subtractor, binary comparator, BCD adder, multiplexers, realisation of Boolean function using mux, decoders.	5
6.	**VHDL Programming:** Introduction of VHDL programming of combinational logic circuit design.	4

S. No.	Contents	Contact Hours
7.	**Sequential Logic Circuits**: Analysis of basic memory element, Mealy and Moore state transition diagram, development of R-S flip flop, asynchronous and synchronous inputs, level triggered and edge triggered flip flops, α-β-0-1 behaviour of flip-flop, development of J-K, D and T flop from R-S flip, conversion of one flip-flop to other flip-flop.	**4**
8.	**Counters**: Principle of operation and application of Schmitt trigger; Monostable multivibrator; Astable multivibrator, expressions for frequency and duty cycle; Synchronous and asynchronous counters, design of counters, state transition diagram, shift register, ring counter and twisted ring counter and their design.	**7**
9.	**A/D and D/A Converters**: Binary weighted and R-2R ladder type DAC, DAC parameters; Flash type, counter ramp type, tracking, single slop and dual slope type ADC, Successive Approximation ADC.	**3**
10.	**Introduction of Microcomputer System**: CPU, I/O devices, clock, memory, bussed architecture, tristate logic, address bus, data bus and control bus.	**5**
11.	**Semiconductor Memories**: MROM, ROM, EPROM, EEPROM, DRAM, internal structure and decoding, memory read and write timing diagrams.	**3**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Malvino A. P. and Leach D. P., "Digital Principles and Applications", 6th Ed., Tata McGraw-Hill Publishing Company Ltd.	**2008**
2.	Mano M. Morris and Ciletti M. D., "Digital Design", 4th Ed., Pearson Education.	**2008**
3.	Tocci R. J., "Digital Systems – Principles and Applications", 9th Ed., Pearson Education.	**2008**
4.	Cook N. P., "A First Course in Digital Electronics", Prentice Hall International Edition.	**1999**
5.	Wakerly J. F., "Digital Design – Principles and Practices", 4th Ed., Pearson Education.	**2008**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-301** Course Title: **Power System Engineering**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 30 **ETE** 40 **PRE** 0

5. Credits: 4 6. Semester: **Autumn** 7. Subject Area: **DCC**

8. Pre-requisite: **EE-201**

9. Objective:

To introduce the design aspects of power system distribution and transmission systems, and to familiarize students with the practical operation of power systems.

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10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Transmission and Distribution Systems:** Introduction, electrical supply system, comparison of AC and DC systems, overhead versus underground systems, choice of working voltages for transmission and distribution, transmission and distribution system architecture, cost comparison of overhead and underground systems.	7
2.	**Overhead Transmission Lines:** Mechanical design, line support, types of conductors; Overhead line insulators, types of insulators-pin, suspension and strain insulators, insulator materials, insulator string; Calculation of voltage distribution and string efficiency, methods of equalizing voltages, use of guard rings.	4
3.	**Corona:** Theory of corona formation, factors affecting corona, calculation of potential gradient, disruptive critical voltage and visual critical voltage, corona power loss, minimizing corona, merits and demerits of corona.	4
4.	**Line Parameters**: Effect of earth on capacitance of overhead transmission lines, short and medium transmission lines, line performance, analysis of long transmission lines.	5

S. No.	Contents	Contact Hours
5.	**Underground Cables and their Characteristics:** Elements of a power cable, properties of the insulation and sheath materials, classification of power cables: belted, screened and pressure cables, dielectric stress in cable insulation, grading of cables: capacitance grading and inter-sheath grading, measuring capacitances and charging current in a cable, HVDC cables.	**4**
6.	**Tariff:** Cost analysis of power plants, types of tariffs- flat rate, block rate, two-part and three-part, fixed and running charges, comparison of tariffs and computation of monthly/annual bill; Economics of power factor improvement.	**4**
7.	**HVDC**: Advantages and limitations of HVDC transmission over HVAC transmission, elementary ideas about converter and inverter operation, classification of HVDC links: mono-polar, bipolar and homopolar, economic comparison of HVDC and ac systems.	**4**
8.	**Surge Performance and Protection:** Switching surges, origin and mechanism of lightening strokes, direct and induced strokes, protection from surges- lightning arrestors (rod gap, horn gap, multi-gap and expulsion type) and surge diverters, evaluation of surge impedance, energy and power of a surge.	**6**
9.	**Introduction to Traveling Waves:** Introduction and mechanism of traveling waves, wave equation, characteristic impedance of a line, incident and reflected waves, transmission and refraction of waves, velocity of traveling waves, behavior of traveling waves for different terminations: inductor, capacitor, open-end, short-end and over the junction of dissimilar lines, attenuation of traveling waves.	**4**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Weedy B.M. and Cory B.J., "Electric Power Systems", 4th Ed., Wiley India.	**2008**
2.	Grainger J. J. and Stevenson W.D., "Elements of Power System Analysis", Tata McGraw-Hill Publishing Company Limited.	**2008**
3.	Gonen T., "Electric Power Transmission System Engineering: Analysis and Design", John Wiley and Sons.	**1990**
4.	Nagrath I. J. and Kothari D. P., "Modern Power System Analysis", 3rd Ed., Tata McGraw-Hill Publishing Company Limited.	**2008**
5.	Roy S., "Electrical Power System- Concepts, Theory and Practices", Prentice Hall of India Private Limited.	**2007**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-302** Course Title: **Power System Analysis and Control**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 30 **ETE** 40 **PRE** 0

5. Credits: 4 6. Semester: **Spring** 7. Subject Area: **DCC**

8. Pre-requisite: **EE-301**

9. Objective:

To provide in-depth knowledge of power system analysis under normal conditions and on fault, and the concepts of power system control and stability.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**System Representation:** Single line representation, review of per unit calculations.	2
2.	**Formation of Network Matrices:** Formation of admittance matrix with and without mutual impedances, Z_{bus} building algorithm with and without mutual impedances.	6
3.	**Load Flow Analysis:** Formation of static load flow equations, solution of load flow problem by Gauss-Seidel, Newton-Raphson (polar and rectangular) and fast decoupled techniques.	10
4.	**Short Circuit Analysis:** Review of symmetrical components, sequence networks, fault calculations for balanced and unbalanced short circuit faults using Z_{BUS}, analysis of open conductor fault.	10
5.	**Power System Stability:** Swing equation, power angle equation, synchronizing power coefficient, basic concepts of steady state, dynamic and transient stability, equal area criterion, solution of the swing equation, multi-machine transient stability studies with classical machine representation.	8
6.	**Power System Control:** Elementary idea of load-frequency control, automatic generation control, reactive power and voltage control.	6
	Total	42

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Saadat H., "Power System Analysis" Tata McGraw-Hill Publishing Company Limited.	**2008**
2.	Pai M. A., "Computer Techniques in Power System Analysis", 2nd Ed., Tata McGraw-Hill Publishing Company Limited.	**2008**
3.	Miller T. J. E., "Reactive Power Control in Electric Systems", John Wiley and Sons.	**1982**
4.	Grainger J. J. and Stevenson W. D., "Power System Analysis", McGraw-Hill International Book Company.	**2008**
5.	Glover J. D. and Sarma M. S., "Power System Analysis and Design", 4th Ed., Cengage Learning.	**2008**
6.	Kothari D. P. and Nagrath I. J., "Modern Power System Analysis", 3rd Ed., Tata McGraw-Hill Publishing Company Limited.	**2008**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-303** Course Title: **Electrical Machines-II**

2. Contact Hours: **L: 3** **T: 1** **P: 2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 3

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 15 **ETE** 40 **PRE** 15

5. Credits: 5 6. Semester: **Autumn** 7. Subject Area: **DCC**

8. Pre-requisite: **EE-202**

9. Objective:

The objective of the course is to impart knowledge of the constructional features and principle of operation of induction and synchronous machines. The course also deals with the methods of starting and speed control of induction motors.

10. Details of Course:

S. No.	Contents	Contact Hours
	Induction Machines	
1.	Constructional features of wound rotor and squirrel cage induction machine.	**2**
2.	Qualitative description of working of poly-phase induction machine from rotating field view point; Coupled circuit model of an idealised three-phase machine, voltage equations of the model, equivalent circuit, phasor diagram, circle diagram.	**5**
3.	Concept of leakage reactance and its importance on machine performance and design; Double-cage and deep-bar squirrel cage rotor induction motor.	**3**
4.	Generator action, methods of excitation, characteristics.	**2**
5.	Space and time harmonics and their effect on motor performance.	**3**
6.	Methods of starting induction motors; Principles of speed control (i) stator voltage control (ii) control of speed of rotating field (iii) control of slip speed (iv) rotor resistance control (v) V/f control.	**4**
7.	Effect of voltage injection in secondary of slip-ring induction motor, action of commutator as a frequency converter.	**3**
8.	Single-phase induction motor working, double revolving field theory, equivalent circuit, torque-speed characteristic, performance.	**3**

S. No.	Contents	Contact Hours
	Synchronous Machines	
9.	Constructional features of salient pole and cylindrical rotor three-phase synchronous machine.	**2**
10.	Generated emf, winding coefficients, harmonics in generated emf, tooth ripples and armature reaction; Coupled circuit model of an idealised salient pole synchronous machine, application of d-q-o transformation, operation under balanced steady state conditions; Power-angle equations of salient pole and cylindrical rotor synchronous machines.	**6**
11.	Voltage regulation of salient pole and cylindrical rotor machine, effect of saturation on voltage regulation.	**3**
12.	Steady state operating characteristic of synchronous motor; V-curves and phasor diagram, hunting.	**3**
13.	Parallel operation of synchronous machines, synchronization and load division, synchronous machine on infinite bus, stability and hunting in synchronous machine.	**3**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Fitzgeraid A. E., Kingsley C. and Kusko A., "Electric Machinery", 6th Ed., McGraw-Hill International Book Company.	**2008**
2.	Say M. G., "The Performance and Design of Alternating Current Machines", CBS Publishers and Distributors.	**2005**
3.	Nagrath I. J. and Kothari D. P., "Electrical Machines", 3rd Ed., Tata McGraw-Hill Publishing Company Limited.	**2004**
4.	Langsdorf A. S., "Theory of AC machines", 2nd Ed., Tata McGraw-Hill Publishing Company Limited.	**2008**
5.	Kimbark E.W., "Power System Stability, Vol. III: Synchronous Machines", Wiley India.	**2008**
6.	Chapman S. J., "Electric Machinery Fundamentals", 4th Ed., McGraw-Hill International Book Company.	**2005**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-304** Course Title: **Electric Drives**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 30 **ETE** 40 **PRE** 0

5. Credits: 4 6. Semester: **Spring** 7. Subject Area: **DCC**

8. Pre-requisite: **EE-206 and EE-303**

9. Objective:

To introduce the fundamentals of electric drives, operation and analysis of solid state control of ac/dc drives and estimation of drive rating for different duty cycle operations.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction**: Definition of electric drive, type of drives; Speed-torque characteristic of driven unit/loads, motors, joint speed-torque characteristic; Classification and components of load torque; Review of power converters used in drives, multi-quadrant operation of electric drive, example of hoist operation in four quadrant.	5
2.	**DC Drives:** Single-phase half controlled and fully controlled converter fed dc motor drives, operation of dc drives with continuous armature current, voltage and current waveforms; Concept of energy utilization and effect of free wheeling diode; Operation of drive under discontinuous current, expression for speed-torque characteristic.	8
3.	**Chopper fed DC Drives**: Principle of operation and control techniques, chopper circuit configurations used in dc drives: Type A, B, C, D and E; Motoring operation of chopper fed separately excited dc motor, steady state analysis of drive with time-ratio control.	4

S. No.	Contents	Contact Hours
4.	**Closed Loop Control of DC Drives:** Drives with current limit control, single-quadrant closed loop drive with inner current control loop, advantage of inner current control loop in drives.	**5**
5.	**AC Drives:** Variable voltage, rotor resistance and slip power recovery control of induction motors, torque-speed characteristics under different control schemes; Variable frequency control of induction motor, analysis of induction machine under constant V/f operation, constant flux operation and controlled current operation.	**6**
6.	**Inverter fed AC Drives**: Voltage source inverter fed induction motor drive in open loop, frequency and voltage control in PWM VSI; Operation of closed loop slip-speed controlled VSI fed induction motor drive; Current source inverter, advantage of CSI fed drives, closed loop slip speed controlled CSI fed drive.	**6**
7.	**Estimation of Drive Motor Rating**: Selection of motor power capacity for continuous duty at constant load and variable loads; Selection of motor capacity for short time and intermittent periodic duty, permissible frequency of starting of squirrel cage motor for different duty cycles.	**4**
8.	**Load Equalization by Flywheel:** Operation of electric drives incorporating fly wheel under shock loading conditions, load sharing between drive motor and flywheel, expression for total referred moment of inertia of the drive system; Drives for different industrial applications.	**4**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Dubey G. K., "Fundamentals of Electric Drives", 2nd Ed., Narosa Publishing House.	**2007**
2.	Pillai S. K., "A First Course in Electric Drives", 2nd Ed., New Age International Private Limited.	**2008**
3.	Sen P. C., "Thyristor DC Drives", John Wiley and Sons.	**1991**
4.	Dubey G. K., "Power Semiconductor Controlled Drives", Prentice Hall International Edition.	**1989**
5.	Murphy J. M. D. and Turnbull F. G., "Power Electronics Control of AC Motors", Peragmon Press.	**1990**
6.	Bose B. K., "Power Electronics and Variable Frequency Drives", IEEE Press, Standard Publisher Distributors.	**2001**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-305** Course Title: **System Engineering**

2. Contact Hours: **L: 2** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 2 **Practical** 0

4. Relative Weight: **CWS** 25 **PRS** 0 **MTE** 25 **ETE** 50 **PRE** 0

5. Credits: 3 6. Semester: **Autumn** 7. Subject Area: **DCC**

8. Pre-requisite: **EE-101**

9. Objective:

To introduce the fundamentals of modeling, analysis and response of control systems in continuous and discrete data systems.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction to System Engineering Concepts:** Open loop and closed loop systems, model classification, performance criterion; Validation and testing of models, mathematical modeling and representation of physical systems and analogous systems, transfer functions for different type of systems, block diagrams; Signal flow graphs and Mason's gain formula reduction algebra.	10
2.	**Time Domain Analysis:** Time domain performance criterion, transient response of first order, second order and higher order systems; Steady state errors: Static and dynamic error constants, system types, steady state errors for unity and non unity feedback systems, performance analysis for P, PI and PID controllers.	6
3.	**Discrete Data Systems:** Introduction to discrete time systems, sample and hold circuits, pulse transfer function, representation by differential equations and its solution using z-transform and inverse-z transforms, analysis of LTI systems, unit circle concepts.	6

S. No.	Contents	Contact Hours
4.	**State Variable Approach:** Derivation of state model of linear time invariant (LTI) continuous and discrete time systems, transfer function from ordinary differential equations, canonical variable diagonalization, system analysis by transfer function and state space methods for continuous and discrete time systems convolution integral; State transition matrices and solution of state equations for continuous and discrete time systems.	**6**
	Total	**28**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Nagrath I. J. and Gopal M., "Control System Engineering", 5th Ed., New Age International Private Limited Publishers.	**2008**
2.	Kuo B. C., "Automatic Control Systems", 8th Ed., Wiley India.	**2008**
3.	Ogata K., "Modern Control Engineering", 4th Ed., Pearson Education.	**2008**
4.	Dorf R. C. and Bishop R. H., "Modern Control Systems", 8th Ed., Pearson Education.	**2008**
5.	Norman S. N., "Control Systems Engineering", 4th Ed., Wiley India.	**2008**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-306** Course Title: **Control Systems**

2. Contact Hours: **L: 3** **T: 1** **P: 2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 3

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 15 **ETE** 40 **PRE** 15

5. Credits: 5 6. Semester: **Spring** 7. Subject Area: **DCC**

8. Pre-requisite: **EE-305**

9. Objective:

To familiarize students with classical and modern control systems including non-linear systems.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Review of Control System Components:** Potentiometers, synchros, principles and applications of dc and ac servomotors, analysis and transfer function, servo amplifiers, modulators and demodulators, magnetic amplifiers, hydraulic and pneumatic components; Models of physical systems, position control systems and speed control system.	6
2.	**Stability Analysis:** Concept of stability by Routh stability criterion, stability of discrete system, polar and inverse polar plots, logarithmic plots, Bode plots, Nyquist stability criterion, gain and phase margins, relative stability, frequency response specifications, correlation with time domain M and N circles, Nichol's chart, closed loop frequency response from open loop response, root-loci and root contours, sensitivity analysis.	14
3.	**Non Linear Systems:** Types of non linearity, limit cycles, jump resonance, linearization techniques; Perturbation methods: phase plane and describing function analysis; Stability concepts, Lyapunov functions for linear and non linear systems.	8

S. No.	Contents	Contact Hours
4.	**Compensation Techniques:** Introduction of compensation techniques, lag, lead and lag-lead networks, design of compensation network using time response and frequency response of the system; Feedback compensation using P, PI, PID controllers, ON-OFF control.	**6**
5.	**Controllability and Observability:** Concept of controllability and observability, definitions, state and output controllability and observability tests for continuous and discrete systems, controllability and observability of time varying systems.	**4**
6.	**Model Control:** Introduction, effect of state feedback on controllability and observability, design via state feedback full order observer, reduced order observers design of state observers and controllers.	**4**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Nagrath I. J. and Gopal M., "Control System Engineering", 5th Ed., New Age International Private Ltd. Publishers.	**2008**
2.	Kuo B. C., "Automatic Control Systems", 8th Ed., Wiley India.	**2008**
3.	Ogata K., "Modern Control Engineering", 4th Ed., Pearson Education.	**2008**
4.	Dorf R. C. and Bishop R. H., "Modern Control Systems" Pearson Education.	**2008**
5.	Norman S. N., "Control Systems Engineering", 4th Ed., Wiley India.	**2008**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-307** Course Title: **Microprocessors and Peripheral Devices**

2. Contact Hours: **L: 3** **T: 1** **P: 2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 3

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 15 **ETE** 40 **PRE** 15

5. Credits: 5 6. Semester: **Autumn** 7. Subject Area: **DCC**

8. Pre-requisite: **EE-208**

9. Objective:

To provide in-depth knowledge of the architecture, instruction set and programming of typical 8-bit microprocessor and programmable support chips used in microprocessor-based systems.

.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** Review of microprocessor concepts, Intel 8085A microprocessor: Pin description and internal architecture.	3
2.	**Operation and Control of Microprocessor:** Timing and control unit, op-code fetch machine cycle, memory read/write machine cycles, I/O read/write machine cycles, interrupt acknowledge machine cycle, state-transition diagram.	5
3.	**Instruction Set:** Addressing modes; Data transfer, arithmetic, logical, branch, stack and machine control groups of instruction set, macro RTL and micro RTL flow chart of few typical instructions; Unspecified flags and instructions.	6
4.	**Assembly Language Programming:** Assembler directives, simple examples; Subroutines, parameter passing to subroutines.	4
5.	**Interfacing:** Interfacing of memory chips, address allocation technique and decoding; Interfacing of I/O devices, LEDs and toggle-switches as examples, memory mapped and isolated I/O structure; Input/Output techniques: CPU initiated unconditional and conditional I/O transfer, device initiated interrupt I/O transfer.	5
S. No.	**Contents**	**Contact Hours**

6.	**Interrupts:** Interrupt structure of 8085A microprocessor, processing of vectored and non-vectored interrupts, latency time and response time.	**4**
7.	**Programmable Peripheral Interface:** Intel 8255, pin configuration, internal structure of a port bit, modes of operation, bit SET/RESET feature, programming; ADC and DAC chips and their interfacing.	**4**
8.	**Programmable Interval Timer:** Intel 8253, pin configuration, internal block diagram of counter, modes of operation, counter read methods, programming, READ-BACK command of Intel 8254.	**3**
9.	**Programmable Interrupt Controller**: Intel 8259, pin configuration, functional description and operation in 8-bit and 16-bit environment, initialization and operation control words, operating modes: AEOI, automatic rotation, specific rotation, special mask mode, cascade mode, buffered mode, poll mode, programming.	**5**
10.	**Keyboard and Display Interface:** Intel 8279, concept of display interface and keyboard interface, pin configuration of Intel 8279, functional description, scanned keyboard matrix mode, sensor matrix mode, strobed mode, left entry and right entry display, interfacing, programming.	**3**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Hall D. V., "Microprocessor and Interfacing –Programming and Hardware", 2nd Ed., Tata McGraw-Hill Publishing Company Limited.	**2008**
2.	Gaonkar R. S., "Microprocessor Architecture, Programming and Applications", 5th Ed., Penram International.	**2007**
3.	Stewart J, "Microprocessor Systems- Hardware, Software and Programming", Prentice Hall International Edition.	**1990**
4.	Short K. L., "Microprocessors and Programmed Logic", 2nd Ed., Pearson Education.	**2008**
5.	Intel Manual on 8-bit Processors	**--**
6.	Intel Manual on Peripheral Devices	**--**

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-308** Course Title: **Electronic Instrumentation**

2. Contact Hours: **L: 2** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory** 2 **Practical** 0

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 30 **ETE** 40 **PRE** 0

5. Credits: 3 6. Semester: **Spring** 7. Subject Area: **DCC**

8. Pre-requisite: **EE-203 and EE-208**

9. Objective:

To familiarize students with the working of analog and digital electronic instruments for the measurement of voltage, current, power, energy, frequency, time and phase.

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10. Details of Course:

S. No.	Contents	Contact Hours
	Analog Electronic Instrumentation	
1.	Analog electronic voltmeters, tuned and sampling voltmeters	**4**
2.	AC and DC current probes.	**2**
3.	Analog electronic wattmeter and energy meter.	**3**
4.	Frequency and phase measurement with CRO, direct reading frequency and phase meters.	**4**
5.	Wave analyzer, harmonic distortion meter, harmonic analyzer, spectrum analyzer.	**5**
	Digital Electronic Instrumentation	
6.	Digital displays, digital counter-timer and frequency meter, time standards, digital voltmeter and multimeter, accuracy and resolution considerations, comparison with analog electronic instruments.	**10**
	Total	**28**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Cooper W. D. and Helfrick A. D, "Modern Electronic Instrumentation and Measurement Techniques", Pearson Education.	**2008**
2.	Oliver B. M. and Cage J. M., "Electronic Measurement and Instrumentation", McGraw-Hill International Book Company.	**1983**
3.	Anand M. M. S., "Electronic Instruments and Instrumentation Technology", Pearson Education.	**2008**

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-309** Course Title: **Applied Instrumentation**

2. Contact Hours: **L: 2** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory** 2 **Practical** 0

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 30 **ETE** 40 **PRE** 0

5. Credits: 3 6. Semester: **Autumn** 7. Subject Area: **DCC**

8. Pre-requisite: **EE-203 and EE-208**

9. Objective:

To impart knowledge of the principles, working and characteristics of transducers and the associated signal conditioning circuits for industrial applications.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** Basics of transducer, sensor and actuator; Active and passive transducers, generating and parametric transducers; Analog, digital and pulse outputs of sensors; Static characteristics of transducer and transducer system; Dynamic characteristics of n^{th}, 0^{th}, first and second order transducers.	3
2.	**Measurement of Displacement and Strain:** Resistive, inductive and capacitive transducers for displacement; Wire, metal film and semiconductor strain gauges; Wheatstone-bridge circuit with one, two and four active elements, temperature compensation.	3
3.	**Measurement of Force and Pressure:** Column, ring and cantilever-beam type load cells; Elastic elements for pressure sensing; Using displacement sensors and strain gauges with elastic elements.	3
4.	**Measurement of Temperature:** Resistance temperature detector, NTC and PTC thermistors, Seebeck effect, thermocouple and thermopile.	2

S. No.	Contents	Contact Hours
5.	**Measurement of Vibrations:** Importance of vibration	3

	measurement, frequency range of vibrations; Absolute displacement, velocity and acceleration pick-ups; Mass-spring-damper system as absolute acceleration to relative displacement converter; Strain-gauge and piezoelectric type acceleration pickups.	
6.	**Measurement of Speed and Torque:** Electro-magnetic and photo-electric tachometers; Torque shaft, strain-gauge, electromagnetic and radio type torque meters.	**3**
7.	**Noise and Interference in Instrumentation:** Sources and effects of noise and interference; SNR and its improvement; Introduction to noise suppression methods; Grounding and shielding.	**2**
8.	**Telemetry:** Meaning and basic scheme of telemetry; Sources of error, line or transmission error; DC voltage and current telemetry schemes; Radio telemetry; PWM and digital telemetry schemes.	**3**
9.	**Pneumatic Instrumentation:** Types and roles of pneumatic devices in instrumentation; Principle, construction, working and transfer function of pneumatic valve and electrical-to-pneumatic and pneumatic-to-electric converters.	**3**
10.	**Graphical Recorders:** Use of graphical recorders; Principle, construction and characteristics of potentiometric (servo) and galvanometric strip-chart recorders.	**3**
	Total	**28**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Rangan C. S., Sarma G. R. and Mani V. S. V., "Instrumentation Devices and Systems", 2nd Ed., Tata McGraw-Hill Publishing Company Limited.	**2008**
2.	Doebelin E. O. and Manik D. N., "Measurement Systems", 5th Ed., Tata McGraw-Hill Publishing Company Limited.	**2008**
3.	Johnson C. D., "Process Control Instrumentation Technology", 8th Ed., Prentice Hall of India Private Limited.	**2008**

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-401** Course Title: **Protection and Switchgear**

2. Contact Hours: **L: 3** **T: 0** **P: 2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 3

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 15 **ETE** 40 **PRE** 15

5. Credits: 4 6. Semester: **Autumn** 7. Subject Area: **DCC**

8. Pre-requisite: **EE-301**

9. Objective:

To introduce the concept and necessity of protection in generation and transmission, and applications of switchgears including internal operation of different types of circuit breakers.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Various types of electromechanical relays, construction and principle of operation and characteristic, applications and limitations; Over and under current, directional, differential, distance and other types of relay; Concept of static relays; Protection system and properties.	**11**
2.	Protection of generators against short circuit and turn-to-turn fault, stator ground fault, field ground fault, loss of excitation, loss of synchronism using different types of relays.	**5**
3.	Protection of transformers against internal faults such as short circuit and turn-to-turn fault, and external abnormal conditions using differential and overcurrent relays.	**5**
4.	Protection of transmission lines and busbars using differential, directional-overcurrent and distance relays, back-up protection, carrier relaying.	**5**
3.	Switchgear, arc and interruption theory, application in different conditions, ratings and selection, principle of operation of air break, oil filled, air blast, SF_6 and vacuum circuit breakers, elementary idea of testing methods.	**12**
S. No.	**Contents**	**Contact Hours**

4.	Necessity of grounding of system neutral and sub station equipments, methods of grounding.	**4**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Van A. R. and Warrington C., "Protective Relays - Theory and Practice", Vol. I and II, 3rd Ed., Chapman and Hall.	**1982**
2.	Mason C. R., "The Art and Science of Protective Relaying", Wiley Eastern Limited.	**1987**
3.	Ray S., "Electrical Power Systems: Concepts, Theory and Practice", Prentice Hall of India Private Limited.	**2008**
4.	Ravindranath B. and Chander M., "Power System Protection and Switchgear", New Age International Private Limited.	**2008**
5.	Paithankar Y. G. and Bhide S. R., "Fundamentals of Power System Protection", Prentice Hall of India Private Limited.	**2007**

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-540** Course Title: **Advanced Power Electronics**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 30 **ETE** 40 **PRE** 0

5. Credits: 4 6. Semester: **Autumn** 7. Subject Area: **MSC**

8. Pre-requisite: **EE-206 or equivalent**

9. Objective:

To impart knowledge of modern semiconductor devices and their applications in power electronic controllers for rectification, inversion and frequency conversion with improved performance.

10. Details of Course:

S.No.	Contents	Contact Hours
1.	Review of SCR, driving circuits and protection; Modern semiconductor devices: MOSFET, GTO, IGBT, GTO, SIT, SITH, MCT, their operating characteristics; Heat sink design.	**3**
2.	Three-phase converters, effect of load and source impedances; Dual converter, twelve-step converter, multi-pulse converters.	**5**
3.	PWM converter, power factor improvement techniques.	**5**
4.	Voltage and current commutated choppers, dc-dc converters: buck converter, boost converter, Cuk converter.	**4**
5.	Three-phase ac regulators, operation with resistive load.	**3**
6.	Single-phase and three-phase Cyclo-converters; Matrix converters.	**2**
7.	Review of line commutated and forced commutated inverters, three-phase voltage source inverters, voltage and frequency control.	**2**
8.	Harmonic reduction techniques, PWM inverters, Space Vector Modulation.	**6**
9.	Multi-level inverters, advantages, configurations: Diode clamped, flying capacitor and cascade multi-level inverters, applications.	**3**

S.No.	Contents	Contact Hours

10.	Current source inverters, commutation circuits, transient voltage suppressing techniques	**3**
11.	DC link resonant converters, operation and control.	**3**
12.	MATLAB simulation of power electronic converters.	**3**
	Total	**42**

11. Suggested Books:

S.No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Dubey G. K., Doradla S. R., Joshi A. and Sinha R. M. K., "Thyristorised Power Controllers", New Age International Private Limited.	**2008**
2.	Mohan N., Underland T.M. and Robbins W.P., "Power Electronics – Converters, Applications and Design", 3rd Ed., Wiley India.	**2008**
3.	Bose B.K., "Power Electronics and Variable Frequency Drives – Technology and Applications", IEEE Press, Standard Publisher Distributors	**2001**
4.	Lander C. W., "Power Electronics", 3rd Ed., McGraw-Hill International Book Company.	**2007**
5.	Rashid M., "Power Electronics- Circuits, Devices and Applications", 3rd Ed., Pearson Education.	**2008**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-541** Course Title: **Electric Drives-I**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 30 **ETE** 40 **PRE** 0

5. Credits: 4 6. Semester: **Autumn** 7. Subject Area: **MSC**

8. Pre-requisite: **EE-206 and EE-303 or equivalent**

9. Objective:

To familiarize students with the concepts of electric drives, and to provide in-depth knowledge of power converters fed dc and ac drives in open and closed loop, and mathematical modeling of drives.

10. Details of Course:

S.No.	Contents	Contact Hours
1.	**Introduction:** Definition of electric drive, types of load; Speed-torque characteristic of driven unit/loads, motors, steady state and transient stability of drives; Classification and components of load torque; Selection of motor power capacity for different duty cycles.	3
2.	**Speed Control of Motors:** Review of braking and speed control of dc motor and induction motor, multi-quadrant operation, loss minimization in adjustable speed drives.	3
3.	**Converter fed DC Drives:** Principle of operation of converter fed separately excited dc motor drives, operation of dc drive under continuous and discontinuous armature current, armature voltage and current waveforms, effect of free wheeling diode, analysis and performance evaluation, expression for speed-torque characteristic; Dual converter fed dc drives, MATLAB simulation.	6
4.	**Chopper fed DC Drives**: Principle of operation, control techniques, steady state analysis of time ratio control and current limit control, closed loop control of dc drives; current control techniques, mathematical model of chopper fed dc drive, stability analysis.	5

S.No.	Contents	Contact Hours
5.	**Inverter fed AC Drives:** Constant V/f controlled induction motors, controlled current and controlled slip operations; variable frequency controlled induction motor drives; PWM inverter drives, operation of closed loop slip-speed controlled VSI and CSI fed ac drives, multi-quadrant operation, MATLAB simulation.	**6**
6.	**Slip Power Controlled AC Drives:** Static rotor resistance control, static Kramer drive.	**4**
7.	**Stability Analysis:** Mathematical modeling of induction motor drives, transient response and stability analysis.	**5**
8.	**Advanced Control Techniques:** Adaptive control, field oriented control of induction motor drives.	**5**
9.	**Synchronous Motor Drives:** Adjustable frequency operations, voltage fed and current fed self controlled drives.	**5**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Dubey G. K., "Fundamentals of Electric Drives", 2nd Ed., Narosa Publishing House.	**2007**
2.	Pillai S. K., "A First Course in Electric Drives", 2nd Ed., New Age International Private Limited.	**2008**
3.	Mohan N., Undeland T.M. and Robbins W.P., "Power Electronics-Converters, Applications and Design", 3rd Ed., Wiley India.	**2008**
4.	Dubey G. K., "Power Semiconductor Controlled Drives", Prentice-Hall International Editions.	**2001**
5.	Murphy J. M. D. and Turnbull F. G., "Power Electronics Control of AC Motors", Pregamon Press.	**1990**
6.	Bose B. K., "Power Electronics and Variable Frequency Drives", IEEE Press, Standard Publisher Distributors.	**2001**
7.	Krishnan R., "Electric Motor Drives – Modeling, Analysis and Control", Prentice Hall of India Private Limited.	**2007**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-543** Course Title: **Electric Drives-II**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 30 **ETE** 40 **PRE** 0

5. Credits: 4 6. Semester: **Spring** 7. Subject Area: **MSC**

8. Pre-requisite: **EE-541 or equivalent**

9. Objective:

To provide state-of-the-art speed control techniques used in modern ac drives, fed from LCI/VSI/CSI, for superior high-performance requirements.

10. Details of Course:

S.No.	Contents	Contact Hours
1.	**Review**: Power electronic converters for ac drive control, voltage source and current source inverters.	3
2.	**LCI-IM Drive:** Drive configuration, commutation at different speeds, mathematical modeling, control structure, resonance problem and performance.	5
3.	**FOC-IM Drive:** Drive configuration, mathematical modeling, direct and indirect FOC, influence of parameters, VSI and CSI fed schemes, adaptive drive control.	7
4.	**Brushless DC Drive:** Self control, CSI with load commutation, low speed commutation, inverter control strategies and performance.	5
5.	**Permanent Magnet SM Drive:** Principle of operation, converter configuration, synchronization, trapezoidal and sinusoidal drive control structures and performance.	6
6.	**Switched Reluctance Motor Drive:** Principle of operation, converter circuits, sensors, speed control and performance.	5
7.	**Resonant-Link Converter fed Drive:** Principle of soft switching in inverters and converters utilizing resonant circuits, modulation strategies and application in IM drives.	5

S.No.	Contents	Contact Hours
8.	**Advanced Control Techniques:** Application of modern and evolutionary techniques in drives such as fuzzy and ANN control.	**6**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Dubey G. K., "Power Semiconductor Controlled Drives", Prentice-Hall International Editions.	**1989**
2.	Murphy J. M. D. and Turnbull F. G., "Power Electronics Control of AC Motors", Peragmon Press.	**1990**
3.	Bose B. K., "Power Electronics and Variable Frequency Drives", IEEE Press, Standard Publisher Distributors.	**2001**
4.	Krishnan R., "Electric Motor Drives – Modeling, Analysis and Control", Prentice Hall of India Private Limited.	**2007**
5.	Bose B. K., "Modern Power Electronics and AC Drives", Pearson Education.	**2008**
6.	Leonard W., "Control of Electric Drives", Springer Press.	**2007**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-554** Course Title: **FACTS Devices**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weight: **CWS** 25 **PRS** 0 **MTE** 25 **ETE** 50 **PRE** 0

5. Credits: 4 6. Semester: **Spring** 7. Subject Area: **MSC**

8. Pre-requisite: **EE-206 and EE-301 or equivalent**

9. Objective:

To familiarize students with FACTS devices, their control techniques and applications in enhancement of system dynamic and transient stability.

10. Details of Course:

S.No.	Contents	Contact Hours
1.	**FACTS**: Concept, power flow and stability, basic theory of line compensation	4
2.	**Power Electronic Controllers:** Review of PWM voltage source inverters used in FACTS, classifications of FACTS controllers.	4
3.	**Static Shunt Compensators:** SVC and STATCOM - TCR, TSC, system stability.	6
4.	**Static Series Compensators:** GCSC, TSSC, TCSC and SSSC, control techniques.	6
5.	**Static Voltage and Phase Angle Regulators**: Power flow control, TCVR and TCPAR.	4
6.	**Unified Power Flow Controller (UPFC)**: Concept of power flow control, operation and control of UPFC, Interline Power Flow Controller.	4
7.	**Stability Analysis:** Modeling of FACTS devices, optimization of FACTS, transient and dynamic stability enhancement	8
8.	**Applications:** Principle of control of FACTS in HVDC links, co-ordination of FACTS devices with HVDC links.	3

S.No.	Contents	Contact Hours
9.	**Other Topics:** Advanced FACTS devices, case studies and other applications of FACTS controllers.	**3**
	Total	**42**

11. Suggested Books:

S.No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Miller T. J. E., "Reactive Power Control in Electric Systems," Wiley-Interscience.	**1982**
2.	Song Y. H. and Johns A. T., "Flexible AC Transmission Systems (FACTS)", IEE Press.	**2000**
3.	Hingorani N. G. and Gyugyi L., "Understanding FACTS", IEEE Press, Standard Publishers Distributors.	**2001**
4.	Ghosh A. and Ledwich G., "Power Quality Enhancement Using Custom Power Devices," Kluwer Academic Publishers.	**2002**
5.	Mathur R. M. and Varma R. K., "Thyristor – Based FACTS Controllers for Electrical Transmission Systems," John Wiley and Sons.	**2002**
6.	Padiyar K. R., "FACTS Controller in Power Transmission and Distribution", New Age International Private Limited.	**2008**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **EE-567** Course Title: **HVDC Systems**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weight: **CWS** 25 **PRS** 0 **MTE** 25 **ETE** 50 **PRE** 0

5. Credits: 4 6. Semester: **Spring** 7. Subject Area: **MSC**

8. Pre-requisite: **EE-206 and EE-301 or equivalent**

9. Objective:

To provide an in-depth understanding of different aspects of high voltage direct current power transmission system.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Converter Operation (Normal And Abnormal):** 6-pulse and 12-pulse rectifiers and inverters; Equivalent circuits of rectifier and inverter, relations between ac and dc quantities.	12
2.	**Converter Charts:** Charts with dc voltage and current as rectangular coordinates, charts with active and reactive powers as rectangular coordinates and their relation.	2
3.	**Harmonics and Filters:** Characteristic and non-characteristic harmonics, input harmonics, output harmonics, problems due to harmonics, ac and dc filters.	4
4.	**HVDC Control Systems:** Constant current control, constant excitation angle control, VDCOL, constant ignition angle control, Individual phase control and equidistant pulse control; Valve blocking and by-passing; Starting, stopping and power flow reversal.	8
5.	**Mis-operation of Converters:** Arcback, short circuit on a rectifier, commutation failure, by-pass valves.	6
6.	**Faults in HVDC System and their Protection:** DC line faults, clearing line faults, converter faults, ac system faults, rectifier side and inverter side faults; DC circuit breakers, overvoltage protection.	3

S. No.	Contents	Contact Hours
7.	**Measurements:** Measurement of voltage and current for fault detection.	**2**
8.	**Parallel Operation of AC-DC Systems:** Influence of ac system strength on ac-dc interaction, effective short-circuit ratio (ESCR), problems with low ESCR systems.	**3**
9.	**DC Transmission Systems:** Monopolar, bipolar and homopolar lines, back-to-back HVDC systems, advantages of dc transmission.	**2**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Kimbark E. W., "Power System Stability: Vol. I: Direct Current Transmission", Wiley India.	**1971**
2.	Ulmann E., "Power Transmission by Direct Current", Springer-Verlag.	**1975**
3.	Padiyar K. R., "HVDC Power Transmission System", New Age International Private Limited.	**2008**
4.	Kundur P., "Power System Stability and Control", Tata McGraw-Hill Publishing Company Limited.	**2008**

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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code**: IEE- 01** Course Title**: Advanced Microprocessors and Interfacing**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weight**:** **CWS** 15 **PRS** 15 **MTE** 30 **ETE** 40 **PRE** 0

5. Credits**:** 4 6. Semester**: Both** 7. Subject Area**: ESEC**

8. Pre-requisite**: Basic course on 8-bit Microprocessors.**

9. Objective:

The aim is to expose the students to the architecture, instruction set and assembly language programming of typical 16-bit microprocessors. The course also provides interfacing details of I/O devices with the processor.

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10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Evolution of Microprocessors:** 8-bit and 16-bit microprocessors, Intel, Zilog and Motorola processors.	2
2.	**Architecture of a 16-bit Microprocessor**: Intel 8086 and 8088 processor, concept of pipelining and memory segmentation, logical address, offset address and physical address; Bus Interface Unit (BIU); Execution Unit (EU), segment registers.	3
3.	**Operation of 16-bit Microprocessor:** Pin configuration of Intel 8086/8088; Minimum and maximum modes of operation; Address bus, data bus and control bus; Clock generator Intel 8284; Memory organization, memory address space.	6
4.	**Interfacing:** Interfacing concepts, interfacing memory; Input-output techniques, interfacing of I/O devices to the processor.	2
5.	**Addressing Modes:** Data related addressing modes- register, immediate, direct, register indirect, based relative, indexed relative	3

	and based indexed, branch related addressing modes- intrasegment direct and indirect, intersegment direct and indirect.	
6.	**Instruction Set of 16-Bit Microprocessor**: Machine cycles, data transfer, arithmetic, bit manipulation, string, program execution transfer and processor control instructions.	**8**
S. No.	**Contents**	**Contact Hours**
7.	**Assembler Directives:** ASSUME, DB, DD, DQ, DT, DW, DUP, END, EQU, EVEN, ORG, OFFSET, PROC, ENDP, LABEL and PTR.	**2**
8.	**Assembly Language Programming:** Macro-assembler, segment definition and models.	**4**
9.	**Interrupt Structure:** Interrupt pointer, type numbers, processing of interrupt, internal and external interrupts, interrupt priorities, BIOS routines.	**3**
10.	**Programmable Support Chips**: Interfacing of programmable parallel interface Intel 8255, programmable interval timer Intel 8253, programmable interrupt controller Intel 8259 with 16-bit processor.	**5**
11.	**Coprocessors and Multiprocessing.**	**4**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Hall D. V., "Microprocessor and Interfacing –Programming and Hardware", Tata McGraw-Hill Publishing Company Limited.	**2006**
2.	Liu Yu-Cheng and Gibson G. A., "Microcomputer Systems; The 808618088 Family", 2nd Ed., Prentice Hall of India Private Limited.	**2007**
3.	Brey B. B., "Intel 8086, 8088, 80186, 80187, 80286, 80386, 80486, Pentium and Pentium Pro Processors, Architecture, Design and Application", Prentice Hall of India Private Limited.	**2006**
4.	Mazidi M. A. and Mazidi J. G., "The 80x86 IBM PC and Compatible Computers (Vol. I and II), Assembly Language, Design and Interfacing", Prentice Hall International Edition.	**2003**
5.	Triebel W. A. and Singh A., "The 8088 and 8086 Microprocessors, Programming Interfacing, Software, Hardware and Applications", 4th Ed., Prentice Hall of India Private Limited.	**2007**
6.	Intel Manual on 16-bit Microprocessor.	**--**

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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code**: IEE-02** Course Title**: Embedded Systems**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory** **3** **Practical** **0**

4. Relative Weight**:** **CWS** **15** **PRS** **15** **MTE** **30** **ETE** **40** **PRE** **0**

5. Credits**:** **4** 6. Semester**: Both** 7. Subject Area**: ESEC**

8. Pre-requisite**: Basic course on 8-bit Microprocessors**

9. Objective:

To familiarize the students with the fundamentals of embedded system architecture, its basic hardware and software elements, programming models and software engineering practices that are used during the system development process.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction:** Embedded system, processor in the system, hardware and software components, system-on chip.	**2**
2.	**Review of Processor and Memory**: General-purpose processors, single-purpose processors, application specific processors, CISC and RISC processor architecture, arm processors, memory devices, processor and memory selection for an embedded system, interfacing processor, memory and I/O devices, 8/16 bit microcontrollers.	**8**
3.	**Devices and Buses**: Review of I/O and timer devices, parallel communications using ISA, PCI and other buses, serial communication using I^2C, CAN, USB and advanced buses, interrupt serving mechanism, device drivers.	**8**
4.	**Embedded Programming**: Review of programming in ALP and in	**6**

	C, embedded programming in C++, memory organization, compiler and cross compiler.	
5.	**Embedded Software Development:** Program modelling concepts, modelling processes for software analysis, response time constraint for real time programs, multi-processor systems.	**6**
S. No.	**Contents**	**Contact Hours**
7.	**Real Time Operating Systems:** Operating system services, i/o subsystems, network operating systems, embedded system operating systems, interrupt routines in RTOS environment.	**7**
8.	**Hardware-Software Co-design**: Embedded system design and co-design issues, software tools for development of an embedded system	**5**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Kamal R., "Embedded Systems – Architecture, Programming and Design", Tata McGraw-Hill Publishing Company Limited.	**2008**
2.	Vahid F. and Givargis T., "Embedded System Design – A Unified Hardware/Software Introduction", Wiley India.	**2008**
3.	Maxfield C. M., "The Design Warrior's Guide to FPGAs – Devices, Tools and Flows", Newnes.	**2006**
4.	Berger A. S., "Embedded System Design – An Introduction to Processes, Tools and Techniques", CMP Books.	**2001**
5.	Labrosse J. J., "Embedded Systems Building Blocks", 2nd Ed., CMP Books.	**1999**
6.	Barr M., "Programming Embedded Systems in C and C++", O'Reilly.	**1999**

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INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **IEE-03** Course Title: **Artificial Neural Networks and Applications**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weight: **CWS** 25 **PRS** 0 **MTE** 25 **ETE** 50 **PRE** 0

5. Credits: 4 6. Semester: **Both** 7. Subject Area: **ESEC**

8. Pre-requisite: **NIL**

9. Objective:

To familiarize students with the concepts of artificial neural networks and their use in engineering applications.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	Review of linear algebra, norms and distance concepts, classical optimization techniques, Lagrange multiplier method, derivative free optimization methods, no free lunch theorem, basics of probability theory, state variable analysis of dynamical systems.	**3**
2.	Introduction to neural networks, biological neurons and information processing in biological neurons, neural networks, single neuron models, learning and generalization in single layer perceptrons, convergence of perceptron learning rule, Hebbian learning, gradient descent learning, least mean square learning rule, concept of decision boundaries, generalized delta rule, practical considerations, Adaline and Madaline adaptive filtering.	**5**
3.	Multi-Layer perceptrons (MLP), back-propagation, learning with momentum, problems with back-propagation networks under-fitting and over-fitting, methods to improve generalization, applications of multi-layer perceptrons, computational power of multi-layer	**5**

	perceptrons.	
4.	Radial basis function networks (RBFN), learning in RBF networks, probabilistic neural networks (PNN) and general regression neural networks.	**3**
S. No.	**Contents**	**Contact Hours**
5.	Performance of neural networks, error measures, the Hessian matrix, bias and variance in NN design, network complexity, risk minimization.	**3**
6.	Attractor type networks, Hopfield networks, dynamics of Hopfield networks, energy concepts, Brain-state-in a box (BSB) networks, generalized BSB networks, attractor type networks for content addressable memories (CAM), solving optimization problem using attractor type networks, simulated annealing application.	**5**
7.	Support Vector Machines (SVM), concept of statistical learning, concept of VC dimension, linear SVM, Kernels, nonlinear SVM, classification and function approximation using SVM.	**5**
8.	Unsupervised learning, Maxnet, Hamming network, competitive learning, self-organizing feature maps, ART networks, learning vector quantizers (LVQ).	**4**
9.	Hybrid approaches in neural networks, fuzzy logic and genetic algorithm (GA) applications in neural networks, adaptive neuro-fuzzy inference system (ANFIS), evolving neural networks, hardware and optical implementation of neural networks.	**5**
10.	Applications and case studies	**4**
	Total	**42**

11. Suggested Books:

S. No.	**Name of Authors /Books / Publishers**	**Year of Publication/ Reprint**
1.	Haykin S., "Neural Networks - A Comprehensive Foundation", 2nd Ed., Prentice Hall International Edition.	**2007**
2.	Bishop C. M., "Neural Networks for Pattern Recognition", Oxford: Oxford University Press.	**1995**
3.	Mehrotra K., Mohan C. K. and Ranka S., "Elements of Artificial Neural Networks", Penram International.	**2007**
4.	Jacek M. Z., "Introduction to Artificial Neural Systems", Jaico Publishing House.	**2003**
5.	Anderson J.A., "An Introduction to Neural Networks", Prentice Hall of India Private Limited.	**2007**
6.	Hassoun M. H., "Fundamentals of Artificial Neural Networks", Prentice Hall of India Private Limited.	**2007**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE **:** **Department of Electrical Engineering**

1. Subject Code**:** **IEE-04** Course Title**:** **Database Management**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** **3** **Practical** **0**

4. Relative Weight**:** **CWS** **25** **PRS** **0** **MTE** **25** **ETE** **50** **PRE** **0**

5. Credits**:** **4** 6. Semester**: Both** 7. Subject Area**: ESEC**

8. Pre-requisite**: EC-101A/EC-101B or equivalent**

9. Objective of course:

To develop skills in accession, modeling, analyzing, designing, using and implementing database systems.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Introduction**: Collection, growth and management of data, database approach, level of abstraction, integrity, consistency, security and recovery issues, data independence, mappings, transition management, structure of a database management, relational network and hierarchical data models, design methodology.	**5**
2.	**Entity-Relationship Approach:** Database design and ER diagram, identifying entities, attributes and relationships; Key constants, participation constraints, weak entities, class hierarchies, aggregation, conceptual design of large enterprises, case studies**.**	**4**
3.	**Relational Network and Hierarchical Data Models:** Domain, relation, relation variables, relational algebra, creating and modifying relations using S2L, integrity constraints over relations, logical database diagram; ER to relational model, views and queries in S2L, case studies.	**4**
4.	**Schema Refinement and Normal Forms (NF):** Problems caused by redundancy, functional dependencies (FU), closure of a set of	**8**

	FDs, attribute closure, 1NF, 2NF, 3NF and Boycee-Codd normal form (BCNF); Properties of decompositions, schema refinement in database design, multivalue dependency and 4NF, join dependency and 5NF, case studies.	
S. No.	**Contents**	**Contact Hours**
5.	**Physical Storage Media, Blocking and Buffering:** Classification of storage, secondary storage devices, types of records, design of record formats, overall running time, blocking, block activity, completing single buffered and multi-buffered files.	**2**
6.	**File Organization:** Heap, sorted and index files, comparison of file organizations, tree-structured, and hashed based indexing; External sorting.	**4**
7.	**System Implementation Techniques:** System catalog, query processing and optimization concepts, transaction processing concepts, concurrency control, serializability, lock management, dead lock, data security and integrity, crash recovery techniques, distributed databases, case studies, **a**dvance data models and emerging trends, use of DBMS like DB2/ ORACLE/ACCESS.	**15**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Silberschatz A., Korth H.F. and Sudarshan S., "Database System Concepts", McGraw-Hill International Book Company.	**2008**
2.	Ramez E. and Shamkant B. M., "Fundamentals of Database Systems", 2nd Ed., Pearson Education.	**2008**
3.	Date C. J. and Kannan, "An Introduction to Database Systems", 8th Ed., Pearson Education.	**2008**
4.	Ullman J. D., 'Principle of Database and Knowledge Base Systems – Vol.1: Classical Database Systems", Computer Science Press	**1995**

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Electrical Engineering**

1. Subject Code: **IEE-05** Course Title: **Introduction to Microprocessors**

2. Contact Hours: **L: 3** **T: 1** **P: 2/2**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weight: **CWS** 15 **PRS** 15 **MTE** 30 **ETE** 40 **PRE** 0

5. Credits: 4 6. Semester: **Both** 7. Subject Area: **ESEC**

8. Pre-requisite: **EC-102 or equivalent**

9. Objective:

The objective of the course is to familiarize students with the architecture, instruction set, programming and applications of a typical 8-bit microprocessor.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Review Of Number System Representation:** Binary, hexadecimal, octal and BCD numbers, conversion from one system to another system, signed number representation, addition and subtraction of signed numbers.	2
2.	**Boolean Function:** Canonical forms of representing Boolean function, VK map, combinational logic circuits: binary adder, binary subtractor.	4
3.	**Sequential Logic Circuits:** Analysis of basic memory element, development of r-s flip flop, asynchronous and synchronous inputs, level triggered and edge triggered flip flops, J-K, D and T- flip-flops.	4
4.	**Semiconductor Memories:** MROM, ROM, EPROM, EEPROM, DRAM, internal structure and decoding, memory read and write timing diagrams.	3
5.	**Introduction of Microcomputer System:** CPU, I/O devices, clock, memory, bussed architecture, tristate logic, address bus, data bus	2

	and control bus.	
6.	**Intel 8085A Microprocessor:** Pin description, internal architecture, general purpose registers, ALU, flag register.	**3**
S. No.	**Contents**	**Contact Hours**
7.	**Internal Operation and Control of Microprocessor:** Timing and control, op-code fetch machine cycle, memory read/write machine cycles, i/o read/write machine cycles, interrupt acknowledge machine cycle, state-transition diagram.	**5**
8.	**Instruction Set:** Addressing modes, instructions, macro RTL and micro RTL flow chart of few typical instructions.	**5**
9.	**Assembly Language Programming**: Assembler directives, simple examples, subroutines, parameter passing to subroutines.	**5**
10.	**Interfacing:** Interfacing of memory chips, Input/Output techniques: CPU initiated unconditional and conditional I/O transfer, device initiated interrupt I/O transfer, interfacing LEDs and toggle-switches, address allocation technique and decoding, memory mapped and isolated I/O structure., ADC and DAC chips and their interfacing.	**5**
11.	**Interrupt Structure:** Types of interrupts, vectored and non-vectored interrupts, maskable interrupts, processing of an interrupt, latency time, response time.	**4**
	Total	**42**

11. Suggested Books:

S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Malvino A. P. and Leach D. P., "Digital Principles and Applications", 6th Ed., Tata McGraw-Hill Publishing Company Limited.	**2008**
2.	Mano M. M. S. and Ciletti M. D., "Digital Design", 4th Ed., Pearson Education.	**2008**
3.	Tocci R. J., "Digital Systems – Principles and Applications", 9th Ed., Pearson Education.	**2008**
4.	Gaonkar R. S., "Microprocessor Architecture, Programming and Applications", 5th Ed., Penram International.	**2007**
5.	Short K. L., "Microprocessors and Programmed Logic", 2nd Ed., Pearson Education.	**2008**
6.	Intel Manual on 8-bit Microprocessor.	**--**

List of Departmental Electives

(Autumn/Spring Semester)

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weight (%)				
S. No.	Subject Code	Course Title	AreaSubject	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
1.	EE-601	Artificial Neural Networks	DEC	3	3	0	0	3	-	15	-	35	50	-
2.	EE-602	Utilization and Traction	DEC	3	3	0	0	3	-	15	-	35	50	-
3.	EE-603	Testing and Commissioning of Electrical Equipment	DEC	3	3	0	0	3	-	15	-	35	50	-
4.	EE-604	Introduction to Robotics	DEC	3	3	0	0	3	-	15	-	35	50	-
5.	EE-605	Power System Operation and Control	DEC	3	3	0	0	3	-	15	-	35	50	-
6.	EE-606	Digital Image Processing	DEC	4	3	1	0	3	-	25	-	25	50	-
7.	EE-607	Digital Design with VHDL	DEC	4	3	0	2	3	-	15	15	30	40	-
8.	EE-608	Digital Control Systems	DEC	4	3	1	0	3	-	25	-	25	50	
9.	EE-609	Substation Automation	DEC	4	3	1	0	3	-	25	-	25	50	-
10.	EE-610	Power System Deregulation	DEC	4	3	1	0	3	-	25	-	25	50	-
11.	EE-611	Embedded Controllers	DEC	4	3	0	2	3	-	15	15	30	40	-

M.Tech. Courses Open to Undergraduate Students as Departmental Electives

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weight (%)				
S. No.	Subject Code	Course Title	AreaSubject	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
12.	EE-522	Biomedical Instrumentation	DEC	4	3	1	0	3	-	25	-	25	50	-
13.	EE-523	Process Instrumentation & Control	DEC	4	3	1	0	3	-	25	-	25	50	-

14.	EE-524	Telemetry and Remote Control	DEC	4	3	1	0	3	-	25	-	25	50	-
15.	EE-530	Power System Instrumentation	DEC	4	3	1	0	3	-	25	-	25	50	-
16.	EE-532	Intelligent Sensors and Instrumentation	DEC	4	3	1	0	3	-	25	-	25	50	-
17.	EE-544	Microprocessor Controlled Electric Drives	DEC	4	3	0	2	3	-	15	15	30	40	-
18.	EE-546	Design of Electric Drives	DEC	4	3	1	0	3	-	25	-	25	50	-
19.	EE-547	Instrumentation in Electric Drives	DEC	4	3	1	0	3	-	25	-	25	50	-
20.	EE-551	Enhanced Power Quality AC-DC Converters	DEC	4	3	0	2	3	-	15	15	30	40	-
21.	EE-552	Switch Mode Power Supply	DEC	4	3	1	0	3	-	25	-	25	50	-
22.	EE-553	Power Quality Improvement Techniques	DEC	4	3	0	2	3	-	15	15	30	40	-
23.	EE-554	FACTS Devices	DEC	4	3	1	0	3	-	25	-	25	50	-
24.	EE-555	CAD of Power Apparatus	DEC	4	3	1	0	3	-	25	-	25	50	-
25.	EE-561	EHV AC and DC Transmission	DEC	4	3	1	0	3	-	25	-	25	50	-
26.	EE-567	HVDC Systems	DEC	4	3	1	0	3	-	25	-	25	50	-
27.	EE-568	Power System Reliability	DEC	4	3	1	0	3	-	25	-	25	50	-
28.	EE-587	Data Structures	DEC	4	3	0	2	3	-	15	15	30	40	-

List of Institute Electives

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weightage (%)				
S. No.	**Subject Code**	**Course Title**	**AreaSubject**	**Credits**	**L**	**T**	**P**	**Theory**	**Practical**	**CWS**	**PRS**	**MTE**	**ETE**	**PRE**
Autumn/Spring Semester														
1.	IEE-01	Advanced Microprocessors and Interfacing	ESEC	4	3	1	2/2	3	-	15	15	30	40	-

2.	IEE-02	Embedded System	ESEC	4	3	1	2/2	3	-	15	15	30	40	-
3.	IEE-03	Artificial Neural Network and Applications	ESEC	4	3	1	0	3	-	25	-	25	50	-
4.	IEE-04	Database Management	ESEC	4	3	1	0	3	-	25	-	25	50	-
5.	IEE-05	Introduction to Microprocessors	ESEC	4	3	1	2/2	3	-	15	15	30	40	-

List of Departmental Electives For B.Tech.(Electrical)

Departmental Elective-I

Course Code	Course Title
EE-601	Artificial Neural Networks
EE-602	Utilization and Traction
EE-603	Testing and Commissioning of Electrical Equipment
EE-604	Introduction to Robotics
EE-605	Power System Operation and Control

Departmental Elective-II
Departmental Elective-III
Departmental Elective-IV

Course Code	Course Title
EE-606	Digital Image Processing
EE-607	Digital Design with VHDL
EE-608	Digital Control Systems
EE-609	Substation Automation
EE-610	Power System Deregulation
EE-611	Embedded Controllers
M.Tech. Courses Open to Undergraduates	
EE-522	Biomedical Instrumentation
EE-523	Process Instrumentation and Control
EE-524	Telemetry and Remote Control
EE-530	Power System Instrumentation
EE-532	Intelligent Sensors and Instrumentation
EE-544	Microprocessor Controlled Electric Drives
EE-540	Advanced Power Electronics
EE-546	Design of Electric Drives
EE-547	Instrumentation in Electric Drives
EE-551	Enhanced Power Quality AC-DC Converters
EE-552	Switch Mode Power Supply
EE-553	Power Quality Improvement Techniques
EE-554	FACTS Devices
EE-555	CAD of Power Apparatus
EE-561	EHV AC and DC Transmission
EE-567	HVDC Systems
EE-568	Power System Reliability
EE-587	Data Structures

List of Departmental Electives For Integrated Dual Degree B.Tech. (Electrical) & M.Tech.(Power Electronics)

Departmental Elective-I
Departmental Elective-II
Departmental Elective-III

Course Code	Course Title
EE-606	Digital Image Processing
EE-607	Digital Design with VHDL
EE-608	Digital Control Systems
EE-609	Substation Automation
EE-610	Power System Deregulation
EE-611	Embedded Controllers
EE-522	Biomedical Instrumentation
EE-523	Process Instrumentation and Control
EE-524	Telemetry and Remote Control
EE-530	Power System Instrumentation
EE-532	Intelligent Sensors and Instrumentation
EE-544	Microprocessor Controlled Electric Drives
EE-546	Design of Electric Drives
EE-547	Instrumentation in Electric Drives
EE-551	Enhanced Power Quality AC-DC Converters
EE-552	Switch Mode Power Supply
EE-553	Power Quality Improvement Techniques
EE-555	CAD of Power Apparatus
EE-561	EHV AC and DC Transmission
EE-568	Power System Reliability
EE-587	Data Structures

Institute Electives

Course Code	Course Title
IEE-01	Advanced Microprocessors and Interfacing
IEE-02	Embedded System
IEE-03	Artificial Neural Network and Applications
IEE-04	Database Management
IEE-05	Introduction to Microprocessors