Syllabus of

UNDERGRADUATE DEGREE COURSE

B.Tech. V Semester

Electrical And Electronics Engineering

Rajasthan Technical University, Kota

Effective from session: 2019 – 2020

5EX3-01: NEURAL NETWORK

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	HOURS
1.	**Introduction:** Objective, scope and outcome of the course.	01
2.	**Introduction to Neural Networks**: Biological basis for NN, Human brain, Models of a Neuron, Directed Graphs, Feedback, Network architectures, Knowledge representation, Artificial intelligence & Neural Networks.	06
3.	**Learning Processes:** Introduction, Error-Correction learning, Memory -based learning, Hebbian learning, Competitive learning, Boltzmann learning, Learning with a Teacher & without a teacher, learning tasks, Memory, Adaptation.	05
4	**Single Layer Perceptrons:** Introduction, Least-mean-square algorithm, Learning Curves, Learning rate Annealing Techniques, Perceptron, Perceptron Convergence Theorem.	06
5	**Multilayer Perceptrons:** Introduction, Back-Propagation Algorithm, XOR Problem, Output representation and Decision rule, Feature Detection, Back-Propagation and Differentiation, Hessian Matrix, Generalization.	06
6.	**Radial-basis function Networks & Self-organizing Maps:** Introduction to Radial basis function networks, Cover's Theorem on the Separability of Patterns, Interpolation Problem, Generalized Radial-Basis function networks, XOR Problem, Self-Organizing map, Summary of SOM Algorithm, Properties of the feature map.	03
	TOTAL	**27**

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5EX4-02: POWER SYSTEM - I

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Basic Concepts** Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids. Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.	04
3	**Power System Components:** Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines. Transformers: Three-phase connections and Phase-shifts. Three-winding transformers, autotransformers, Neutral Grounding transformers. Tap-Changing in transformers. Transformer Parameters. Single phase equivalent of three-phase transformers. Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. Real and Reactive Power Capability Curve of generators. Typical waveform under balanced terminal short circuit conditions – steady state, transient and sub-transient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations.	15
4	**Over-voltages and Insulation Requirements** Generation of Over-voltages: Lightning and Switching Surges. Protection against Overvoltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.	04

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5	**Fault Analysis and Protection Systems** Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding. Switchgear: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application.	**09**
6	**Introduction to DC Transmission & Renewable Energy Systems** DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators. Power Electronics interfaces of wind generators to the grid	**09**
	TOTAL	**42**

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5EX4-03: CONTROL SYSTEM

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Introduction to control problem** Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra	04
3	**Time Response Analysis:** Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci..	09
4	**Frequency-response analysis** Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.	06
5	**Introduction to Controller Design** Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers	10
6	**State variable Analysis** Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems	06
7	**Introduction to Optimal Control and Nonlinear Control** Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis	05
	TOTAL	**41**

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5EX4-04: MICROPROCESSOR

Credit: 3 **Max. Marks: 150(IA:30, ETE:150)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Fundamentals of Microprocessors** Fundamentals of Microprocessor Architecture. 8-bitMicroprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.	07
3	**The 8051 Architecture:** Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.	08
4	**Instruction Set and Programming** Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools..	08
5	**Memory and I/O Interfacing** Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices.	06
6	**External Communication Interface** Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.	06
7	**Applications** LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing	05
	TOTAL	**41**

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5EX4-05: ANALOG COMMUNICATION

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Noise Effects in Communication Systems:** Resistor noise, Networks with reactive elements, Noise temperature, Noise bandwidth Effective input noise temperature, Noise figure. Noise figure & equivalent noise temperature in cascaded circuits.	08
3	**Amplitude Modulation:** Frequency translation, Recovery of base band signal, Spectrum & power relations in AM systems. Methods of generation & demodulation of AM-DSB, AM-DSB/SC and AM-SSB signals. Modulation & detector circuits for AM systems. AM transmitters & receivers.	08
4	**Frequency Modulation:** Phase & freq. modulation & their relationship, Spectrum & band width of a sinusoidally modulated FM signal, phasor diagram, Narrow band & wide band FM. Generation & demodulation of FM signals. FM transmitters &receivers. Comparison of AM, FM & PM. Pre emphasis & demphasis. Threshold in FM, PLL demodulator.	08
5	**Noise in AM and FM:** Calculation of signal-to-noise ratio in SSB-SC, DSBSC, DSB with carrier, Noise calculation of square law demodulator & envelope detector. Calculation of S/N ratio in FM demodulators, Super heterodyne receivers.	08
6	**Pulse Analog Modulation:**Practical aspects of sampling, Natural and flat top sampling. PAM, PWM, PPM modulation and demodulation methods, PAM-TDM.	08
	TOTAL	**41**

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5EX5-11: BIOMEDICAL INSTRUMENTATION

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Human Body Subsystems:** Brief description of neural, muscular, cardiovascular and respiratory systems; their electrical, mechanical and chemical activities. **Transducers and Electrodes:** Principles and classification of transducers for Biomedical applications, Electrode theory, different types of electrodes, Selection criteria for transducers and electrodes.	06
3	**Biopotential:** Electrical activity of excitable cells, ENG, EMG, ECG, ERG, EEG. Neurone potential. Cardio Vascular System Measurements: Measurement of blood pressure, blood flow, cardiac output, cardiac rate, Heart sounds, Electrocardiograph, phono-cardiograph, Plethysmograph, Echocardiograph.	05
4	**Instrumentation for Clinical Laboratory**: Measurement of pH valve of blood, ESR measurement, haemoglobin measurement, O2and CO2concentration in blood, GSR measurement. Instrumentation for clinical laboratory: Spectrophotometry, chromatography, Haematology, Measurement of pH value, concentration in blood. Medical Imaging: DiagnosticX-rays, CAT, MRI, thermography, Ultrasonography, medical use of isotopes, endoscopy.	06
5	**Patient Care, Monitoring and Safety Measures:** Elements of Intensive care monitoring basic hospital systems and components, physiological effect of electric current shock hazards from electrical equipment, safety measures, Standards & practices. **Computer Applications and Biotelemetry:** Real time computer applications, data acquisi. tion and processing, remote data recording and management.	06
6	**Therapeutic and Prosthetic Devices:** Introduction to cardiac pacemakers, defibrillators, ventilators, muscle stimulators, diathermy, heart lung machine, Hemodialysis, Applications of Laser.	03
	TOTAL	27

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5EX5-12: PRINCIPLE OF COMMUNICATION SYSTEM

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Noise Effects in Communication Systems:** Resistor noise, Networks with reactive elements, Noise temperature, Noise bandwidth, effective input noise temperature, Noise figure. Noise figure & equivalent noise temperature in cascaded circuits.	06
3	**Amplitude Modulation:** Frequency translation, Recovery of base band signal, Spectrum & power relations in AM systems. Methods of generation & demodulation of AM-DSB, AMDSB/SC and AM-SSB signals. Modulation & detector circuits for AM systems. AM transmitters & receivers.	05
4	**Frequency Modulation:** Phase & freq. modulation & their relationship, Spectrum & bandwidth of a sinusoidally modulated FM signal, phasor diagram, Narrow band & wide band FM. Generation & demodulation of FM signals. FM transmitters & receivers, Comparison of AM, FM & PM. Pre emphasis & de- emphasis. Threshold in FM, PLL demodulator.	06
5	**Noise in AM and FM:** Calculation of signal-to-noise ratio in SSB-SC, DSB- SC, DSB with carrier, Noise calculation of square law demodulator & envelope detector. Calculation of S/N ratio in FM demodulators, Super-heterodyne receivers.	06
6	**Pulse Modulation Systems:** Sampling theorem, Generation and demodulation methods of PAM, PWM, PPM.	03
	TOTAL	27

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5EX5-13: INTRODUCTION TO VLSI

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Introduction to MOS Technology:** Basic MOS transistors, Enhancement Mode transistoraction, Depletion Mode transistor action, NMOS and CMOS fabrication.	06
3	**Basic Electrical Properties of MOS Circuits:** IDS versus VDS relationship, Aspects of threshold voltage, Transistor Trans conductance gm. The NMOS inverter, Pull up to Pull-down ratio for a NMOS Inverter and CMOS Inverter (Bn/Bp), MOS transistor circuit Model, Noise Margin.	05
4	**CMOS Logic Circuits:** The inverter, Combinational Logic, NAND Gate NOR gate, Compound Gates, 2 input CMOS Multiplexer, Memory latches and registers Transmission Gate, Gate delays, CMOS-Gate Transistor sizing, Power dissipation	06
5	**Basic Physical Design of Simple Gates and Layout Issues:** Layout issues for inverter, Layout for NAND and NOR Gates, Complex Logic gates Layout, Layout optimization for performance.	06
6.	**Introduction to VHDL:** Verilog & other design tools. VHDL Code for simple Logic gates, flip-flops, shift-registers, Counters, Multiplexers, adders and subtractors.	03
	TOTAL	27

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5EX4-21: POWER SYSTEM -I LAB

Credit: 1 **Max. Marks: 50(IA:30, ETE:20)**

0L+0T+2P **End Term Exam: 2 Hours**

1) Generating station design: Design considerations, basic schemes and single line diagram of hydro, thermal, nuclear and gas power plants. Electrical equipment for power stations.
2) Distribution system Design: Design of feeders & distributors. Calculation of voltage drops in distributors. Calculation of conductor size using Kelvin's law.
3) Study of short term, medium term and long term load forecasting.
4) Sending end and receiving end power circle diagrams.
5) Substations: Types of substations, various bus–bar arrangements. Electrical equipment for substations.
6) Study high voltage testing of electrical equipment: line insulator, cable, bushing, power capacitor, and power transformer.
7) Design an EHV transmission line
8) Study filtration and Treatment of transformer oil.
9) Determine dielectric strength of transformer oil.
10) Determine capacitance and dielectric loss of an insulating material using Schering bridge.
11) Flash over voltage testing of insulators.

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5EX4-22: CONTROL SYSTEM LAB

Credit: 1 | **Max. Marks: 50(IA:30, ETE:20)**

0L+0T+2P | **End Term Exam: 2 Hours**

1. (a) Plot step response of a given TF and system in state-space. Take different values of damping ratio and w_n natural undamped frequency.

   (b) Plot ramp response.

2. To design 1st order R-C circuits and observe its response with the following inputs and trace the curve.
   (a) Step
   (b) Ramp (c) Impulse

3. To design 2nd order electrical network and study its transient response for step input and following cases.
   (a) Under damped system
   (b) Over damped System.
   (c) Critically damped system.

4. To Study the frequency response of following compensating Networks, plot the graph and final out corner frequencies.
   (a) Leg Network
   (b) Lead Network. (c) Leg-lead Network.

5. Draw the bode plot in real time for a Non-Inverting amplifier.

6. Draw the bode plot in real time for an Inverting amplifier.

7. Draw the bode plot for second order transfer function.

8. Draw the bode plot for first order transfer function.

9. Design and analyse Tow- Thomas biquad filter.

10. Design and calculate Kp, Ki for PI controller.

11. Design PID controller and also calculate Kp, Ki, Kd for it.

5EX4-23: MICROPROCESSOR LAB

Credit: 1 **Max. Marks: 50(IA:30, ETE:20)**

0L+0T+2P **End Term Exam: 2 Hours**

1. Study the hardware, functions, memory structure and operation of 8085-Microprocessor kit.
2. Program to perform integer division: (1) 8-bit by 8-bit (2) 16-bit by 8-bit.
3. Transfer of a block of data in memory to another place in memory
4. Transfer of black to another location in reverse order.
5. Searching a number in an array.
6. Sorting of array in: (1) Ascending order (2) Descending order.
7. Finding party of a 32-bit number.
8. Program to perform following conversion (1) BCD to ASCII (2) BCD to hexadecimal.
9. Program to multiply two 8–bit numbers
10. Program to generate and sum 15 Fibonacci numbers.
11. Program for rolling display of message “India”, “HELLO”.
12. To insert a number at correct place in a sorted array.
13. Reversing bits of an 8-bit number.
14. Fabrication of 8-bit LED interfaces for 8085 kit through 8155 and 8255.
15. Data transfer on output port 8155 & 8255 & implementation of disco light, running light, and sequential lights on the above mentioned hardware.
16. Parallel data transfer between two DYNA-85 kit using 8253 ports.
17. Generation of different waveform on 8253/8254 programmable timer.

5EX4-24: COMMUNICATION LAB

Credit: 1 | **Max. Marks: 50(IA:30, ETE:20)**

0L+0T+2P | **End Term Exam: 2 Hours**

1. Harmonic analysis of a square wave of modulated waveform.
2. Observe the amplitude modulated waveform and measures modulation index. Demodulation of the AM signal.
3. To modulate a high frequency carrier with sinusoidal signal to obtain FM signal. Demodulation of the FM signal.
4. To observe the following in a transmission line demonstrator kit :

   i. The propagation of pulse in non-reflecting Transmission line.

   ii. The effect of losses in Transmission line.

   iii. The resonance characteristics of al half wavelength long x-mission line.
5. To study and observe the operation of a super heterodyne receiver
6. To modulate a pulse carrier with sinusoidal signal to obtain PWM signal and demodulate it.
7. To modulate a pulse carrier with sinusoidal signal to obtain PPM signal and demodulate it.
8. To observe pulse amplitude modulated waveform and its demodulation.
9. To observe the operation of a PCM encoder and decoder .To considers reason for using digital signal x- missions of analog signals.
10. Produce ASK signals, with and without carrier suppression, Examine the different processes required for demodulation in the two cases.
11. To observe the FSK wave forms and demodulate the FSK signals based on the properties of (a) Tuned circuits (b) On PI.L.

Syllabus of

UNDERGRADUATE DEGREE COURSE

B.Tech. VI Semester

Electrical And Electronics Engineering

Rajasthan Technical University, Kota

Effective from session: 2019 – 2020

6EX3-01: COMPUTER ARCHITECTURE

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Introduction to computer organization** Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organisation	05
3	**Memory organization** System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks	04
4	**Input – output Organization** Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.	05
5	**16 and 32 microprocessors** 80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86	05
6	**Pipelining** Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set	04
7	**Different Architectures** VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming	04
	TOTAL	28

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6EX4-02: POWER SYSTEM –II

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Power Flow Analysis** Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of nonlinear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.	08
3	**Stability Constraints in synchronous grids** Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three--phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4th order methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.	10
4	**Control of Frequency and Voltage** Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers. Power flow control using embedded dc links, phase shifters	08
5	**Monitoring and Control** Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State-estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control	08
6	**Power System Economics and Management** Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services. Regulatory framework..	06
	TOTAL	41

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6EX4-03: POWER SYSTEM PROTECTION

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Introduction and Components of a Protection System** Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers.	04
3	**Faults and Over-Current Protection** Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection and overcurrent relay co-ordination.	08
4	**Equipment Protection Schemes** Directional, Distance, Differential protection. Transformer and Generator protection. Bus bar Protection, Bus Bar arrangement schemes.	08
5	**Digital Protection** Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues.	07
6	**Modeling and Simulation of Protection Schemes** CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.	08
7	**System Protection** Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.	06
	TOTAL	42

6EX4-04: DATA BASE MANAGEMENT SYSTEM

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**DBMS:** Introduction, need, purpose and goals of DBMS. DBMS Architecture, Concept of keys, Generalization and specialization, introduction to relational data model, ER modelling, concept of ER diagram	08
3	**Databas Design:** Conceptual Data Base design. Theory of normalization, Primitive and composite data types, concept of physical and logical databases, Data abstraction and data independence, relational algebra and relational calculus.	07
4	**SQL, DDL and DML**. Constraints assertions, views database security. Application Development using SQL: Host Language interface embedded SQL programming. GL's, Forms management and report writers. Stored procedures and triggers. Dynamic SQL, JDBC.	08
5	**Internal of RDBMS:** Physical data organization in sequential, indexed, random and hashed files. Inverted and multilist structures.	08
6	**(i) Transaction Management:** Transaction concept, transaction state, serializability, conflict serializabiltiy, views serializability. **(ii)Concurrency Control:** Lock based protocol **(iii) Deadlock Handling:** Prevention detection, recovery. **(iv)Recovery System:** Log based recovery.	08
	TOTAL	40

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

III Year - VI Semester: B.Tech. (Electrical And Electronics Engineering)

6EX4-05: ELECTRICAL DRIVES

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**DC motor characteristics** Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux weakening for high speed operation	05
3	**Chopper fed DC drive** Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting..	05
4	**Multi-quadrant DC drive** Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking	06
5	**Closed-loop control of DC Drive** Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design	05
6	**Induction motor characteristics** Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation, vector control of IM, Direct torque control of IM.	06
7	**Scalar control or constant V/f control of induction motor** Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation	06
8	**Control of slip ring induction motor** Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery	06
	TOTAL	**40**

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6EX5-11: HIGH VOLTAGE ENGINEERING

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**(i) Breakdown in Gases**: Introduction to mechanism of breakdown in gases, Townsend's breakdown mechanism. Breakdown in electromagnetic gases, Application of gases in power system**(ii)Breakdown in Liquids**: Introduction to mechanism of breakdown in liquids, suspended solid particle mechanism and cavity breakdown. Application of oil in power apparatus **(iii) Breakdown in solids**: Introduction to mechanism of breakdown in solids, electromechanical breakdown, treeing & tracking breakdown and thermal breakdown.	08
3	**(i) High DC Voltage Generation**: Generation of high dc voltage, basic voltage multiplier circuit. (ii) **High AC Voltage Generation**: Cascaded Transformers. (iii)**Impulse Voltage generation**: Impulse voltage, basic impulse circuit, Mark's multistage impulse generator. (iv) **Measurement of High Voltage**: Potential dividers - resistive, capacitive and mixed potential dividers. Sphere gap- Construction and operation. Klydonorgraph.	08
4	**Nondestructive Insulation Tests**: **(i)** Measurement of resistively, dielectric constant and loss factor. High Voltage Schering Bridge-measurement of capacitance and dielectric loss. **(ii) Partial Discharges**: Introduction to partial discharge, partial discharge equivalent circuit. Basic wide-band and narrow band PD detection circuits.	08
5	**(i) Over voltages**: Causes of over voltages, introduction to lightning phenomena, over Voltages due to lighting **(ii) Travelling Waves**: Travelling waves on transmission lines-open end line, short circuited line, line terminated through a resistance, line connected to a cable, reflection and refraction at a T-junction and line terminated through a capacitance. Attenuation of traveling waves.	08
6	**(i)Over Voltage Protection**: Basic construction and operation of ground wires protection angle and protective zone, ground rods, counterpoise, surge absorber, rod gap and arcing horn, lighting arresters - expulsion type, non -linear gap type and metal oxide gapless type **(ii)Insulation Coordination**: Volt-time curves, basic impulse insulation levels, coordination of insulation levels.	08
	TOTAL	41

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6EX5-12: SMART GRID TECHNOLOGY

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Evolution of Electric Grid:** Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits Difference between conventional & Smart Grid, Concept of Resilient &Self-Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives.	08
3	**Smart Grid Technologies:** Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and Control, Distribution Systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).	08
4	**Smart Meters and Advanced Metering Infrastructure:** Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement, Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.	07
5	**Power Quality Management in Smart Grid:** Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.	08
6	**High Performance Computing for Smart Grid Applications:** Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid	08
	TOTAL	**40**

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6EX5-13: POWER SYSTEM INSTRUMENTATION

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	HOURS
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Theory of Errors:** Accuracy and precision, systematic and random errors, limits of error, probable error and standard deviation. Gaussian error curves, combination of errors.	08
3	**Transducers:**Construction & Operating Characteristics of active and digital transducers, Measurement of temperature, pressure, displacement, acceleration, noise level. Instrumentation for strain, displacement, velocity, acceleration, force, torque and temperature.	07
4	**Signal Conditioning:** Instrumentation amplifiers, isolation amplifiers, analog multipliers, analog dividers, function generators, timers, sample and hold, optical and magnetic isolators. Frequency to voltage converters, temperature to current converters. Shielding and grounding.	08
5	**Power System Instrumentation-I:**Measurement of voltage, current, phase angle, frequency, active power and reactive power in power plants. Energy meters and multipart tariff meters. Basic idea of LT & HT panel's.	08
6	**Power System Instrumentation-II:** Capacitive voltage transformers and their transient behaviour, Current Transformers for measurement and protection, composite errors and transient response.	08
	TOTAL	**40**

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6EX4-21: POWER SYSTEM -II LAB

Credit: 2 | **Max. Marks: 100(IA:60, ETE:40)**
0L+0T+4P | **End Term Exam: 3 Hours**

1. Fault analysis (for 3 to 6 bus) and verify the results using MATLAB or any available software for the cases: (i) LG Fault (ii) LLG Fault (iii) LL Fault and (iv) 3-Phase Fault
2. Load flow analysis for a given system (for 3 to 6 bus) using (i) Gauss Seidal (ii) Newton Raphson (iii) Fast Decoupled Method and verify results using MATLAB or any available software
3. Three phase short circuit analysis in a synchronous machine(symmetrical fault analysis)
4. Study of voltage security analysis
5. Study of overload security analysis and obtain results for the given problem using MATLAB or any software.
6. Study of economic load dispatch problem with different methods.
7. Study of transient stability analysis using MATLAB/ETAP Software
8. Power flow analysis of a slack bus connected to different loads.

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6EX4-22: ELECTRIC DRIVE LAB

Credit: 2 **Max. Marks: 100(IA:60, ETE:40)**
0L+0T+4P **End Term Exam: 3 Hours**

1. Study and test the firing circuit of three phase half controlled bridge converter.
2. Power quality analysis of 3 phase half controlled bridge converter with R and RL loads.
3. Power Quality analysis of 3-phase full controlled bridge converter feeding R and RL load.
4. Study and obtain waveforms of 3-phase full controlled bridge converter with R and RL loads.
5. Experimental analysis of 3-phase AC voltage regulator with delta connected, star connected (with floating load), R& RL load
6. Control speed of dc motor using 3-phase half controlled bridge converter. Plot armature voltage versus speed characteristic.
7. Control speed of dc motor using 3-phase full controlled bridge converter. Plot armature voltage versus speed characteristic.
8. Control speed of a 3-phase induction motor in variable stator voltage mode using 3-phase AC voltage regulator.
9. Control speed of a 3-phase BLDC motor.
10. Control speed of a 3-phase PMSM motor using frequency and voltage control
11. Control speed of universal motor using AC voltage regulator.
12. Study 3-phase dual converter.
13. Study speed control of dc motor using 3-phase dual converter.
14. Study three-phase cyclo-converter and speed control of synchronous motor using cyclo-converter.
15. Control of 3-Phase Induction Motor in variable frequency V/f constant mode using 3-phase inverter.

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6EX4-23: POWER SYSTEM PROTECTION LAB

Credit: 1 | **Max. Marks: 50(IA:30, ETE:20)**

0L+0T+2P | **End Term Exam: 2 Hours**

1. To determine fault type, fault impedance and fault location during single line to ground fault.
2. To determine fault type, fault impedance and fault location during single line-to-line fault.
3. To determine fault type, fault impedance and fault location during double line to ground fault.
4. To study the operation of micro-controller based over current relay in DMT type and IDMT type.
5. To analyse the operation of micro-controller based directional over current relay in DMT type and IDMT type.
6. To study the micro-controller based under voltage relay.
7. To study the micro-controller based over voltage relay.
8. To study the operation of micro-controller based un-biased single-phase differential relay.
9. To study the operation of micro-controller based biased single-phase differential relay.
10. To study the operation of micro-controller un-based biased three phase differential relay
11. To study the operation of micro-controller based biased three phase differential relay.

6EX4-24: MODELLING AND SIMULATION LAB

Credit: 1 | **Max. Marks: 50(IA:30, ETE:20)**

0L+0T+2P | **End Term Exam: 2 Hours**

1. Simulate Swing Equation in Simulink (MATLAB)
2. Modeling of Synchronous Machine.
3. Modeling of Induction Machine.
4. Modeling of DC Machine.
5. Simulate simple circuits .
6. (a) Modeling of Synchronous Machine with PSS (b) Simulation of Synchronous Machine with FACTS device.
7. (a) Modeling of Synchronous Machine with FACTS device (b) Simulation of Synchronous Machine with FACTS devices.
8. FACTS Controller designs with FACT devices for SMIB system