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

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

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

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

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

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

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

6EX4-21: POWER SYSTEM -II LAB

Credit: 2
0L+0T+4P

Max. Marks: 100(IA:60, ETE:40)
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.

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.

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