

**DR. A.P.J. ABDUL KALAM TECHNICAL
UNIVERSITY, UTTAR PRADESH, LUCKNOW**



Evaluation Scheme & Syllabus

For

B. Tech. 4th year

Electrical & Computer Engineering

on

AICTE Model Curriculum & NEP2020

[Effective from the Session: 2025-26]

ELECTRICAL & COMPUTER ENGINEERING

EVALUATION SCHEME - B. TECH 4th YEAR

SEMESTER- VII														
S. No.	Code	Subject	Learning Mode	LTP			Evaluation Scheme						Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	BEEZ701	Power System Faults: Analysis & Protection	Offline	3	0	0	20	10	30	-	70	-	100	3
2	BEEZ**	Departmental Elective-IV	Offline	3	0	0	20	10	30	-	70	-	100	3
3	BOE**	Open Elective-II	Offline/ MOOCs	3	0	0	20	10	30	-	70	-	100	3
4	BEEZ751	Power Systems Faults Analysis & Protection Lab	Offline	0	0	2	-	-	-	50	-	50	100	1
5	BEEZ752	Mini Project or Internship Assessment*		0	0	4	-	-	-	100	-	-	100	2
6	BEEZ753	Project I		0	0	10	-	-	-	150	-	-	150	5
7	BEEZ754	Startup and Entrepreneurial Assessment [#]		0	0	4	-	-	-	100	-	-	100	2
		Total		9	0	20							750	19

*The Mini Project or internship (4 - 6 weeks) conducted during summer break after VI semester and will be assessed during VII semester.

[#] [The Startup and Entrepreneurial activity assessment will be done in 7th semester under which a student will have to undergo a startup/ Entrepreneurial activity of at least 60 hours till 6th semester.](#)

Department Elective – IV

BEE071: Energy Conservation & Auditing.
 BEE075: Utilization Of Electrical Energy & Electric Traction
 BEEZ071: Computer Organization & Architecture.
 BEEZ072: Artificial Intelligence
 BCS071: Cloud Computing

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EVALUATION SCHEME - B. TECH 4th YEAR

SEMESTER- VIII														
S. No.	Code	Subject	Learning Mode	Periods			Evaluation Scheme						Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	BOEM**	Open Elective-III	MOOCs	3	0	0	20	10	30	30	70	-	100	3
2	BOEM**	Open Elective-IV	MOOCs	3	0	0	20	10	30	30	70	-	100	3
3	BEEZ851	Project-II		0	0	18	-	-	-	100	-	350	450	10
		Total		6	0	18							650	16

The Internal Assessment of MOOCs will be done by the respective institute and the External Assessment (End Semester Examination) will be done by the University.

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BEEZ701: POWER SYSTEM FAULTS: ANALYSIS & PROTECTION

Pre-requisites of the course: Power System-I

Course Outcome		Knowledge Level
Upon the completion of the course, the student will be able to:		
CO1	Analyze the behavior of constituent components and sub-systems in power systems and networks under balanced and unbalanced fault conditions.	K4
CO2	Analyze the load flow in an electrical power network and determine load flow solutions.	K4
CO3	Understand steady-state and transient stability concepts in power systems under various operating conditions.	K2
CO4	Describe the operating principles of relays, their applications, and various protective schemes.	K2
CO5	Demonstrate protective schemes for major power system components and equipment and the use, operation, testing, and types of various circuit breakers.	K3

Unit-I: Fault Analysis in Power System

Symmetrical Components: Significance of positive, negative and zero sequence components, Average 3-phase power in terms of symmetrical components, sequence impedances and sequence networks.

Fault Calculations: Fault calculations, sequence network equations, single line to ground fault, line to line fault, double line to ground fault, three-phase faults, faults on power systems, faults with fault impedance, reactors and their location, short circuit capacity of a bus.

Unit-II: Load Flow Analysis

Introduction, Need for load flow, load dispatch centers and operating strategies, Formation of Z_{BUS} and Y_{BUS} , development of load flow equations, load flow solution using Gauss-Seidel and Newton-Raphson method, Comparison of Gauss-Seidel and Newton-Raphson Method, fast decoupled method, introduction to forward backward sweep load flow for radial network.

Unit-III: Stability in Power System

Power flow through a transmission line, Stability and Stability limit, Steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion. Factors affecting steady state and transient stability and methods of improvement.

Unit-IV: Protection Scheme-I

Need for Protective systems, Evolution of protective relays - Zones of protection - Primary and Back -up Protection - Essential qualities of Protection - Classification of Protective schemes

Basic Terminology: Relay, Energizing Quantity, setting, Pickup, drop out, Flag, fault clearing time, Relay time, Breaker time, Overreach, Underreach; Classification of Relays according to applications, according to time. Over current Relay, Distance Protection, Differential Protection.

Relays: Operating Principle of a general relay, Electromagnetic, attracted and induction type relays, thermal relay, gas actuated relay, design considerations of electromagnetic relay. over current relays, directional relay, distance relays, differential relays. Relay Application and Characteristics.

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Unit-V: Protection Scheme-II

Types & detection of faults and their effects, alternator protection scheme (stator, rotor, reverse power protection etc.) - Power transformer protection (external and internal faults protection), generator- transformer unit protection scheme, bus bar protection - Transmission line protection (current/time grading, distance), Pilot relaying schemes, power line carrier protection.

Circuit Breakers: Classification, Arc Phenomenon, Arc Extinction and its Methods, Restriking Voltage & Recovery Voltage.

Text Books:

1. Hadi Sadat, "Power System Analysis", McGraw Hill.
2. D.P. Kothari & I.J. Nagrath, "Modern Power System Analysis" McGraw Hill, 3rd Edition.
3. W. D. Stevenson, "Elements of Power System Analysis", McGraw Hill
4. S. S. Rao, "Switchgear and Protection", Khanna Publishers.
5. B. Ravindranath and M. Chander, Power system Protection and Switchgear, Wiley Eastern Ltd.
6. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", Mc. Graw Hill

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BEEZ751: POWER SYSTEMS FAULTS ANALYSIS & PROTECTION LAB

Pre-requisites of course: Power System-I Lab

Course Outcomes:		Knowledge Level, KL
Upon completion of the course, the student will be able to:		
CO1	Test relays for various characteristics and compare results with the performance characteristics provided by manufacturers.	K4
CO2	Apply Newton-Raphson and Gauss-Seidel methods to solve power flow problems.	K3
CO3	Analyze types of short-circuit faults in power systems.	K4
CO4	Demonstrate different numerical integration methods and factors influencing transient stability	K3
CO5	Analyze power system components, focusing on insulation properties and alternator sync requirements.	K4

Note: - Minimum 10 experiments are to be performed from the following list:

(A) Hardware-Based Experiments:

1. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation.
2. To study the over-current relay and the effect of PSM and TSM.
3. To study the percentage differential relay.
4. To study Impedance, MHO and Reactance type distance relays and zones of protection.
5. To study the Ferranti effect of a transmission line/cable.
6. To measure the dielectric Strength of transformer oil.
7. To study the Synchronization of the alternator with an infinite bus bar.
8. To determine the positive sequence, negative sequence and zero sequence reactance of an alternator.
9. To study the effect of different shapes of electrodes on dielectric (air) breakdown.
10. To study the gas-actuated Buchholz relay for oil-filled transformer.
11. To determine the sub-transient (x_d''), transient (x_d') and steady state reactance (x_d) of a synchronous machine.

*** The available Experiments from above list may be performed on virtual lab on following virtual lab link: <http://vlab.co.in/>**

(B) Simulation-Based Experiments (using Scilab/MATLAB or any other equivalent open-source software platform)

1. To obtain formation of Y-bus.
2. Perform load flow analysis on a 3- Bus System using G-S Method.
3. Perform load flow analysis on a 3- Bus System using N-R Method.
4. To perform symmetrical fault analysis in a power system.
5. To perform unsymmetrical fault analysis in a power system.

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6. Swing Curve by Step-by-Step Method.
7. Determination of the stability of a SMIB system in occurrence of a fault by solving the Swing equation by Euler's Method.

Text Books: -

1. Haadi Sadat, "Power System Analysis" Tata McGraw Hill.
2. T.K. Nagsarskar & M.S. Sukhija, Power System Analysis' Oxford University Press.
3. K. Umarao, "Computer Techniques and Models in Power System", Wiley

DEPARTMENT
ELECTIVE – IV
[L T P: 3 0 0]

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BEE071: ENERGY CONSERVATION AND AUDITING

Pre-requisites of course: Basic Electrical Engineering, Power System-I

Course Outcomes:		Knowledge Level, KL
Upon the completion of the course, the student will be able to:		
CO1	Recognize the energy conservation/saving opportunities in different electric system and understand related legislations.	K2
CO2	Understand the energy-saving behavior of utilities through the implementation of DSM and EMIS.	K2
CO3	Explain energy audit & management and to prepare energy audit report for different energy conservation instances.	K2
CO4	Demonstrate the energy audit for Mechanical Utilities.	K3
CO5	Describe cost-effective measures towards improving energy efficiency and energy conservation by the implementation of energy-efficient technologies.	K2

UNIT-1: Energy Scenario: Classification of Energy, Indian energy scenario, Sectorial energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance, energy strategy for the future.

Energy Conservation Act 2001 and related policies: Energy conservation Act 2001 and its features, notifications under the Act, Schemes of Bureau of Energy Efficiency (BEE) including Designated consumers, State Designated Agencies, Electricity Act 2003, Integrated energy policy, National action plan on climate change, ECBC code for Building Construction.

UNIT-2: Demand Side Management (DSM): Concept and Scope of Demand Side Management, Difference between Energy Efficiency and DSM, Evolution of Demand Side Management, DSM Strategy, Planning, Implementation and its application, Customer Acceptance & its implementation issues, National and International Experiences with DSM, UDAY scheme and other government initiatives for DISCOMs.

Energy Monitoring and Targeting: Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques –energy consumption, production, cumulative sum of differences (CUSUM). Energy Management Information Systems (EMIS)

UNIT-3: Energy Audit: Aim of energy Audit, Strategies of Energy Audit, Energy management Team Consideration in implementing energy conservation Programme, Process flow diagram, Energy Audit report format, Benchmarking and Energy Performance, Instruments for energy audit, Economic analysis.

UNIT-4: System Audit of Mechanical Utilities: Pumps, types and application, unit assessment, improvement option, parallel and series operating pump performance. Energy Saving in Pumps & Pumping Systems. Blowers (Blowers) types & application, its performance assessment, series & parallel operation applications & advantages. Energy Saving in Blowers Compressors, types & applications, specific power consumption, compressed air system & economic of system changes. Energy Saving in Compressors & Compressed Air Systems Cooling towers, its types and performance assessment & limitations, water loss in cooling tower. Case studies related to Energy Audit & Management in Industries

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UNIT-5: Energy Efficient Technology: Need for Energy Efficient Devices, Life Cycle Assessment, Comparison between simple pay-back and life cycle cost assessment, Energy Efficient Motors-motor losses and loss reduction techniques, determining and comparing motor efficiencies, motor efficiency testing standards, BIS specification for Energy Efficient Motors, efficiency as a function of load, Energy Efficient Lighting Sources-compact fluorescent lamp, light emitting diode, LED lamp, role of voltage on the efficiency of lighting system, Importance of Automatic power factor controllers, Variable Frequency Drives.

Reference Books:

1. Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, 2nd Edition, CRC Press.
2. Handbook of Energy Audits, Albert Thumann, 6th Edition, The Fairmont Press
3. Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Interscience publication
4. Carbon Capture and Sequestration: Integrating Technology, Monitoring, and Regulation edited by E J Wilson and D Gerard, Blackwell Publishing
5. Heating and Cooling of Buildings -Design for Efficiency, J. Krieder and A. Rabl, McGraw Hill Publication, 1994.

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BEE075: UTILIZATION OF ELECTRICAL ENERGY & ELECTRIC TRACTION

Pre-requisites of course: Basic Electrical Engineering, Electrical Machines-I & II

Course Outcomes:		Knowledge Level, KL
Upon the completion of the course, the student will be able to:		
CO1	Describe the methods of electric heating and their advantages.	K2
CO2	Explain the types of Electric welding and the principle of Electro-deposition laws of electrolysis and its applications	K2
CO3	Explain the laws of illumination and the principles of refrigeration and air-conditioning.	K2
CO4	Describe the different types of Electric traction, the system of track electrification and its related mechanics	K2
CO5	Describe the salient features of the traction drive and the concept of energy saving using power electronic control of AC and DC drives	K2

Unit-I: Electric Heating: Advantages and methods of electric heating, Resistance heating, Electric arc heating, Induction heating and Dielectric heating

Unit-II: Electric Welding: Electric Arc Welding Electric Resistance Welding Electronic welding controls Electrolyte Process: Principles of electro deposition, Laws of electrolysis, and applications of electrolysis

Unit-III: Illumination: Various definitions, Laws of illumination, requirements of good lighting Design of indoor lighting and outdoor lighting systems Refrigeration and Air Conditioning: Refrigeration systems, domestic refrigerator, water cooler Types of air conditioning, Window air conditioner

Unit-IV: Electric Traction – I: Types of electric traction, Review of existing electric traction systems in India, systems of track electrification Traction mechanics- types of services, speed time curve and its simplification, average and schedule speeds Tractive effort, specific energy consumption, mechanics of train movement, coefficient of adhesion and its influence

Unit-V: Electric Traction – II: Salient features of traction drives Series – parallel control of dc traction drives (bridge transition) and energy saving Power Electronic control of dc and ac traction drives Diesel electric traction.

Text Books:

1. H. Partab, “Art and Science of Electrical Energy” Dhanpat Rai & Sons.
2. J.B. Gupta, “Utilization of Electric Power and Electric Traction”, Kataria & Sons publishers, Delhi, IX Edition, 2004.
3. C.L. Wadhwa, “Generation, Distribution and Utilization of electrical Energy”, New Age International (P) Limited Publishers, 3rd Edition, 2010.

Reference Books:

1. H. Partab, “Modern Electric Traction” Dhanpat Rai & Sons.
2. G.K. Dubey, “Fundamentals of Electric Drives” Narosa Publishing House.

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BEEZ071: COMPUTER ORGANIZATION AND ARCHITECTURE

Course Outcome (CO)		Bloom's Knowledge Level (KL)
At the end of course, the student will be able to understand		
CO1	Study of the basic structure and operation of a digital computer system.	K2
CO2	Analysis of the design of arithmetic & logic unit and understanding of the fixed point and floating-point arithmetic operations.	K4
CO3	Implementation of control unit techniques and the concept of Pipelining	K3
CO4	Understanding the hierarchical memory system, cache memories and virtual memory	K2
CO5	Understanding the different ways of communicating with I/O devices and standard I/O interfaces	K2

Unit-1: Introduction:

Functional units of digital system and their interconnections, buses, bus architecture, types of buses and bus arbitration. Register, bus and memory transfer. Processor organization, general registers organization, stack organization and addressing modes.

Unit-2: Arithmetic and logic unit:

Look ahead carries adders. Multiplication: Signed operand multiplication, Booths algorithm and array multiplier. Division and logic operations. Floating point arithmetic operation, Arithmetic & logic unit design. IEEE Standard for Floating Point Numbers

Unit-3: Control Unit:

Instruction types, formats, instruction cycles and sub cycles (fetch and execute etc), micro operations, execution of a complete instruction. Program Control, Reduced Instruction Set Computer, Pipelining. Hardwire and micro programmed control: micro programme sequencing, concept of horizontal and vertical microprogramming.

Unit-4: Memory:

Basic concept and hierarchy, semiconductor RAM memories, 2D & 2 1/2D memory organization. ROM memories. Cache memories: concept and design issues & performance, address mapping and replacement Auxiliary memories: magnetic disk, magnetic tape and optical disks Virtual memory: concept implementation.

Unit-5: Input / Output:

Peripheral devices, I/O interface, I/O ports, Interrupts: interrupt hardware, types of interrupts and exceptions. Modes of Data Transfer: Programmed I/O, interrupt initiated I/O and Direct Memory Access., I/O channels and processors. Serial Communication: Synchronous & asynchronous communication, standard communication interfaces.

Text books:

1. Computer System Architecture - M. Mano
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky Computer Organization, McGraw-Hill, Fifth Edition, Reprint 2012
3. John P. Hayes, Computer Architecture and Organization, Tata McGraw-Hill, Third Edition, 1998. Reference books

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4. William Stallings, Computer Organization and Architecture-Designing for Performance, Pearson Education, Seventh edition, 2006.
5. Behrooz Parahami, “Computer Architecture”, Oxford University Press, Eighth Impression, 2011.
6. David A. Patterson and John L. Hennessy, “Computer Architecture-A Quantitative Approach”, Elsevier, a division of reed India Private Limited, Fifth edition, 2012 Structured Computer Organization, Tannenbaum(PHI)

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BEEZ072: ARTIFICIAL INTELLIGENCE

Course Outcome (CO)		Bloom's Knowledge Level (KL)
At the end of course , the student will be able to:		
CO1	Understand the basics of the theory and practice of Artificial Intelligence as a discipline and about intelligent agents.	K2
CO2	Understand search techniques and gaming theory.	K2
CO3	Apply knowledge representation techniques and problem-solving strategies to common AI applications.	K3
CO4	Aware of techniques used for classification and clustering.	K2
CO5	Understand the basics of pattern recognition and steps required for it.	K2

Unit-1: INTRODUCTION:

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

Unit-2: PROBLEM SOLVING METHODS:

Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – Stochastic Games

Unit-3: KNOWLEDGE REPRESENTATION:

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories – Reasoning with Default Information

Unit-4: SOFTWARE AGENTS:

Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining –Argumentation among Agents – Trust and Reputation in Multi-agent systems.

Unit-5: APPLICATIONS:

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing – Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving

Text books:

1. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, Third Edition, 2009.
2. Bratko, “Prolog: Programming for Artificial Intelligence”, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. M. Tim Jones, —Artificial Intelligence: A Systems Approach(Computer Science), Jones and Bartlett Publishers, Inc.First Edition, 2008
4. Nils J. Nilsson, —The Quest for Artificial Intelligence, Cambridge University Press, 2009.
5. William F. Clocksin and Christopher S. Mellish, Programming in Prolog: Using the ISO Standard, Fifth Edition, Springer, 2003.
6. Gerhard Weiss, —Multi Agent Systems, Second Edition, MIT Press, 2013.
7. David L. Poole and Alan K. Mackworth, —Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.

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BCS071: CLOUD COMPUTING

Course Outcome (CO)		Bloom's Knowledge Level (KL)
At the end of course , the student will be able to understand		
CO1	Describe the architecture and underlying principles of cloud computing.	K2
CO2	Explain the need, types, and tools of Virtualization for cloud.	K2
CO3	Describe Services Oriented Architecture and various types of cloud services.	K2
CO4	Analyze Inter cloud resources management, cloud storage services and their providers; assess security services and standards for cloud computing.	K4
CO5	Analyze advanced cloud technologies.	K4

Unit-1: Introduction To Cloud Computing

Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

Unit-2: Cloud Enabling Technologies Service Oriented Architecture

REST and Systems of Systems – Web Services – Publish, Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support and Disaster Recovery.

Unit-3: Cloud Architecture, Services And Storage

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

Unit-4: Resource Management And Security In Cloud

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.

Unit-5: Cloud Technologies And Advancements Hadoop

MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine — Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation.

Text books:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, —Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
5. George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O’Reilly, 2009.