

Syllabus of  
UNDERGRADUATE DEGREE COURSE

Electrical Engineering



Rajasthan Technical University, Kota  
Effective from session: 2018 – 2019



# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

## SYLLABUS

2<sup>nd</sup> Year - III Semester: B.Tech. (Electrical Engineering)

### 3EE2-01: Advance Mathematics

**Credit: 3**  
**3L+0T+0P**

**Max. Marks: 150 (IA:30, ETE:120)**  
**End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	<b>Numerical Methods:</b> Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Gauss's forward and backward interpolation formulae. Stirling's Formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae. Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Solution of polynomial and transcendental equations-Bisection method, Newton-Raphson method and Regula-Falsi method.	14
2	<b>Transform Calculus:</b> Laplace Transform: Definition and existence of Laplace transform, Properties of Laplace Transform and formulae, Unit Step function, Dirac Delta function, Heaviside function, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Fourier Transform: Fourier Complex, Sine and Cosine transform, properties and formulae, inverse Fourier transforms, Convolution theorem. Z-Transform: Definition, properties and formulae, Convolution theorem, inverse Z-transform, application of Z-transform to difference equation.	20
3	<b>Complex Variable:</b> Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.	06
<b>TOTAL</b>		<b>40</b>

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### 3EE1-02/4EE1-02: Technical Communication

**Credit: 2**  
**2L+0T+0P**

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

**End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1	<b>Introduction to Technical Communication-</b> Definition of technical communication, Aspects of technical communication, forms of technical communication, importance of technical communication, technical communication skills (Listening, speaking, writing, reading writing), linguistic ability, style in technical communication.	4
2	<b>Comprehension of Technical Materials/Texts and Information Design &amp; development-</b> Reading of technical texts, Reading and comprehending instructions and technical manuals, Interpreting and summarizing technical texts, Note-making. Introduction of different kinds of technical documents, Information collection, factors affecting information and document design, Strategies for organization, Information design and writing for print and online media.	6
3	<b>Technical Writing, Grammar and Editing-</b> Technical writing process, forms of technical discourse, Writing, drafts and revising, Basics of grammar, common error in writing and speaking, Study of advanced grammar, Editing strategies to achieve appropriate technical style, Introduction to advanced technical communication. Planning, drafting and writing Official Notes, Letters, E-mail, Resume, Job Application, Minutes of Meetings.	8
4	<b>Advanced Technical Writing-</b> Technical Reports, types of technical reports, Characteristics and formats and structure of technical reports. Technical Project Proposals, types of technical proposals, Characteristics and formats and structure of technical proposals. Technical Articles, types of technical articles, Writing strategies, structure and formats of technical articles.	8
	<b>TOTAL</b>	<b>26</b>

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2<sup>nd</sup> Year - III Semester: B.Tech. (Electrical Engineering)

**3EE1-03/4EE1-03: Managerial Economics and Financial Accounting**

**Credit: 2**  
**2L+0T+0P**

**Max. Marks: 100 (IA:20, ETE:80)**  
**End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1.	<b>Basic economic concepts</b> Meaning, nature and scope of economics, deductive vs inductive methods, static and dynamics, Economic problems: scarcity and choice, circular flow of economic activity, national income-concepts and measurement.	4
2.	<b>Demand and Supply analysis</b> Demand-types of demand, determinants of demand, demand function, elasticity of demand, demand forecasting –purpose, determinants and methods, Supply-determinants of supply, supply function, elasticity of supply.	5
3.	<b>Production and Cost analysis</b> Theory of production- production function, law of variable proportions, laws of returns to scale, production optimization, least cost combination of inputs, isoquants. Cost concepts-explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation.	5
4.	<b>Market structure and pricing theory</b> Perfect competition, Monopoly, Monopolistic competition, Oligopoly.	4
5.	<b>Financial statement analysis</b> Balance sheet and related concepts, profit and loss statement and related concepts, financial ratio analysis, cash-flow analysis, funds-flow analysis, comparative financial statement, analysis and interpretation of financial statements, capital budgeting techniques.	8
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### 3EE3-04: Power Generation Processes

Credit: 2

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

2L+0T+0P

End Term Exam: 2 Hours

SN	CONTENTS	Hours
1.	<b>Conventional Energy Generation Methods</b> Thermal Power plants: Basic schemes and working principle. (ii) Gas Power Plants: open cycle and closed cycle gas turbine plants, combined gas & steam plants-basic schemes. Hydro Power Plants: Classification of hydroelectric plants. Basic schemes of hydroelectric and pumped storage plants. (iv) Nuclear Power Plants: Nuclear fission and nuclear fusion. Fissile and fertile materials. Basic plant schemes with boiling water reactor, heavy water reactor and fast breeder reactor. Efficiencies of various power plants.	6
3.	<b>New Energy Sources</b> Impact of thermal, gas, hydro and nuclear power stations on environment. Green House Effect (Global Warming).Renewable and nonrenewable energy sources. Conservation of natural resources and sustainable energy systems. Indian energy scene. Introduction to electric energy generation by wind, solar and tidal.	6
4.	<b>Loads and Load Curves</b> Types of load, chronological load curve, load duration curve, energy load curve and mass curve. Maximum demand, demand factor, load factor, diversity factor, capacity factor and utilization.	2
5.	<b>Power Factor Improvement</b> Causes and effects of low power factor and advantages of power factor improvement. Power factor improvement using shunt capacitors and synchronous condensers.	3
6.	<b>Power Plant Economics</b> Capital cost of plants, annual fixed and operating costs of plants, generation cost and depreciation. Effect of load factor on unit energy cost. Role of load diversity in power system economics. Calculation of most economic power factor when (a) kW demand is constant and (b) kVA demand is constant. (iii) Energy cost reduction: off peak energy utilization, co-generation, and energy conservation.	5
7.	<b>Tariff</b> Objectives of tariffs. General tariff form. Flat demand rate, straight meter rate, block meter rate. Two part tariff, power factor dependent tariffs, three part tariff. Spot - (time differentiated) pricing.	3

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<b>8. Selection of Power Plants</b> Comparative study of thermal, hydro, nuclear and gas power plants. Base load and peak load plants. Size and types of generating units, types of reserve and size of plant. Selection and location of power plants.	<b>4</b>
<b>Total</b>	<b>28</b>

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### 3EE4-05 Electrical Circuit Analysis

Credit: 3  
3L+0T+0P

Max. Marks: 150 (IA:30, ETE:120)  
End Term Exam: 3 Hours

SN	CONTENTS	Hours
1.	<b>Network Theorems</b> Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.	10
2.	<b>Solution of First and Second order networks</b> Solution of first and second order differential equations for Series and parallel R-L, R-C, RL- C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.	8
3.	<b>Sinusoidal steady state analysis</b> Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.	8
4.	<b>Electrical Circuit Analysis Using Laplace Transforms</b> Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances	8
5.	<b>Two Port Network and Network Functions</b> Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.	6
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### 3EE4-06: Analog Electronics

**Credit: 3**  
**3L+0T+0P**

**Max. Marks: 150 (IA:30, ETE:120)**  
**End Term Exam: 3 Hours**

SN		Hours
1.	<b>Diode circuits</b> P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.	4
2.	<b>BJT circuits</b> Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits.	8
3.	<b>MOSFET circuits</b> MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high frequency equivalent circuit.	8
4.	<b>Differential, multi-stage and operational amplifiers</b> Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)	8
5.	<b>Linear applications of op-amp</b> Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.	8
6.	<b>Nonlinear applications of op-amp</b> Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators, Precision rectifier, peak detector. Monoshot	6
<b>TOTAL</b>		<b>42</b>

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### 3EE4-07: Electrical Machine-I

Credit: 3  
3L+0T+0P

Max. Marks: 150 (IA:30, ETE:120)  
End Term Exam: 3 Hours

SN	CONTENTS	Hours
1.	<b>Magnetic fields and magnetic circuits</b> Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.	6
2.	<b>Electromagnetic force and torque</b> B-H curve of magnetic materials; flux-linkage v/s current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency	9
3.	<b>DC machines</b> Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation – Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.	8
4.	<b>DC machine - motoring and generation</b> Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines.	7

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<b>5.</b>	<b>Transformers</b> Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase. transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.	<b>12</b>
<b>TOTAL</b>		<b>42</b>



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### 3EE4-08: Electromagnetic Fields

Credit: 2  
2L+0T+0P

Max. Marks: 100 (IA:20, ETE:80)  
End Term Exam: 2 Hours

SN	CONTENTS	Hours
1.	<b>Review of Vector Calculus</b> Vector algebra- addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.	4
2.	<b>Static Electric Field</b> Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.	4
3.	<b>Conductors, Dielectrics and Capacitance</b> Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.	4
4.	<b>Static Magnetic Fields</b> Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.	4
5.	<b>Magnetic Forces, Materials and Inductance</b> Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.	4
6.	<b>Time Varying Fields and Maxwell's Equations</b> Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.	4
7.	<b>Electromagnetic Waves</b> Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.	4
<b>TOTAL</b>		<b>28</b>

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### 3EE4-21: Analog Electronics Lab

**Credit: 1**  
**OL+OT+2P**

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

- 1) Plot gain-frequency characteristics of BJT amplifier with and without negative feedback in the emitter circuit and determine bandwidths, gain bandwidth products and gains at 1 kHz with and without negative feedback.
- 2) Study of series and shunt voltage regulators and measurement of line and load regulation and ripple factor.
- 3) Plot and study the characteristics of small signal amplifier using FET.
- 4) Study of push pull amplifier. Measure variation of output power & distortion with load.
- 5) Study Wein bridge oscillator and observe the effect of variation in R & C on oscillator frequency.
- 6) Study transistor phase shift oscillator and observe the effect of variation in R & C on oscillator frequency and compare with theoretical value.
- 7) Study the following oscillators and observe the effect of variation of C on oscillator frequency:
  - (a) Hartley (b) Colpitts.
- 8) To plot the characteristics of UJT and UJT as relaxation.



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### 3EE4-22: Electrical Machines-I Lab

**Credit: 2**  
**OL+OT+4P**

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

- 1) To perform O.C. and S.C. test on a 1-phase transformer and to determine the parameters of its equivalent circuit its voltage regulation and efficiency.
- 2) To perform sumpner's test on two identical 1-phase transformers and find their efficiency & parameters of the equivalent circuit.
- 3) To determine the efficiency and voltage regulation of a single-phase transformer by direct loading.
- 4) To perform the heat run test on a delta/delta connected 3-phase transformer and determine the parameters for its equivalent circuit.
- 5) To perform the parallel operation of the transformer to obtain data to study the load sharing.
- 6) Separation of no load losses in single phase transformer.
- 7) To study conversion of three-phase supply to two-phase supply using Scott-Connection.
- 8) Speed control of D.C. shunt motor by field current control method & plot the curve for speed verses field current.
- 9) Speed control of D.C. shunt motor by armature voltage control method & plot the curve for speed verses armature voltage.
- 10) To determine the efficiency at full load of a D.C shunt machine considering it as a motor by performing Swinburne's test.
- 11) To perform Hopkinson's test on two similar DC shunt machines and hence obtain their efficiencies at various loads.



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### 3EE4-23: Electrical Circuit Design Lab

**Credit: 2**

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

**OL+OT+4P**

- 1) Introduction to Datasheet Reading.
- 2) Introduction to Soldering - Desoldering process and tools.
- 3) Simulate characteristic of BJT and UJT. Validate on Bread Board or PCB.
- 4) Simulate Bridge Rectifier Circuit and validate on Bread Board or PCB.
  - a) Half Bridge.
  - b) Full Bridge.
- 5) Simulate Regulated Power Supply and validate on Bread Board or PCB.
  - a) Positive Regulation (03 Volt to 15 Volt).
  - b) Negative Regulation (03 Volt to 15 Volt).
  - c) 25 Volt, 1-10 A Power Supply.
- 6) Simulate Multivibrator circuit using IC 555 and BJT separately. Validate on Bread Board or PCB.
  - a) Astable Mode.
  - b) Bistable Mode.
  - c) Monostable Mode.
- 7) Introduction to Sensors to measure real time quantities and their implementation in different processes.  
(Proximity, Accelerometer, Pressure, Photo-detector, Ultrasonic Transducer, Smoke, Temperature, IR, Color, Humidity, etc.).
- 8) Hardware implementation of temperature control circuit using Thermistor.
- 9) Simulate Frequency divider circuit and validate it on Bread Board or PCB.
- 10) Hardware implementation of 6/12 V DC Motor Speed Control (Bidirectional)
- 11) Simulate Buck, Boost, Buck-Boost circuit and validate on Bread Board or PCB.
- 12) Simulate Battery Voltage Level Indicator Circuit and validate on Bread Board or PCB.

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