# DETAIL TEACHING SCHEME

SCHOOL OF ENGINEERING
ACADEMIC YEAR – 2021-22
PROGRAM: B. TECH – ELECTRICAL ENGINEERING
SEMESTER – III (Batch – 2020-24)
DEFINATION OF CREDIT: **1. Lecture (L):** 1 hour/week/semester, **2. Practical (P)**: 2 hours/week/semester **3. Tutorial(T):** 2 hours/week/semester

| TEACHING SCHEME | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Course Code | Course Name | Teaching Hours | | | SSH | Credits | Audit course | CIE | PSEE | Remarks if any |
| | | Lecture | Tutorial | Practical | | | | | | |
| EL317 | Energy Sources | 3 | 0 | 0 | 2 | 3 | N | Y | N | - |
| EC310 | Electronics Devices and Circuits-I | 3 | 0 | 2 | 2 | 4 | N | Y | Y | - |
| EL323 | Power System-I | 3 | 4 | 0 | 3 | 5 | N | Y | N | Revised credits |
| EL318 | DC Machine and Transformers | 3 | 0 | 2 | 2 | 4 | N | Y | Y | - |
| EL316 | Network Analysis and Synthesis | 3 | 0 | 2 | 2 | 4 | N | Y | Y | - |
| APS301 | Differential Equations | 4 | 0 | 0 | 2 | 4 | N | Y | N | - |
| MEN301 | Mentoring | 0 | 0 | 1 | - | - | N | N | N | - |
| | **Total** | **19** | **4** | **7** | **15** | **24** | | | | - |
| | | **Total Teaching Hours 30** | | | | | | | | - |

N- No
Y – Yes
etc.

CIE – Continuous internal evaluation
PSEE – Practical semester end examination including ITD, Dissertation, Industrial project, Industrial training

SSH - Self-study hours per week

**HOD** **Director**

RK UNIVERSITY

# SYLLABUS

| | |
|---|---|
| **Course Title** | **Energy Sources** |
| **Course Code** | **EL317** |
| **Course Credit** | Theory :03 |
| | Practical :00 |
| | Tutorial :00 |
| | Credits :03 |

## Course Learning Outcomes:

At the end of the course students will be able to

- **Understand** the concept of renewable and non-renewable energy sources.
- **Describe** the challenges and problems associated with use of various energy sources.
- **Discuss** remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.
- **Illustrate** basic concepts and system components in thermal, hydro and nuclear power plant.

## Detailed Syllabus

| Sr. No. | Name of chapter & details | Hours Allotted |
|---|---|---|
| | **SECTION-I** | |
| **1.** | **Fundamentals of Energy**<br>Classification of Energy Resources, Consumption trend of primary energy resources, Importance of non-conventional energy resources, Energy Chain, Common forms of Energy, Advantages and disadvantages of conventional Energy sources, Salient Features of Non-Conventional Energy sources, Environmental aspects<br>**Availability of Resources and Future Trends**<br>Conventional resources, Non-conventional Resources<br>**Energy Conservation**<br>Salient Features of Energy Conservation Act-2001, Various Aspects of Energy Conservation, Principles of Energy Conservation, Energy conservation opportunities. | **08** |

| | | |
|---|---|---|
| **2.** | **Thermal Power Plants**<br>Basic thermodynamic cycles, Various components of steam power plant, Layout- Pulverized coal burners- Fluidized bed combustion, Coal handling systems, Ash handling systems, forced draft and induced draft fans, Boilers- Feed pumps, Super heater, Regenerator, Condenser, Dearearators, Cooling tower. | **08** |
| **3.** | **Nuclear Energy Conversion**<br>Chemical and nuclear equations, Nuclear reactions- Fission and fusion, Energy from fission and fuel burn-up, Radioactive decay and half-life, Neutron energies, Reflectors, Types of reactors. | **05** |
| | **Total** | **21** |
| | **SECTION-II** | |
| **4.** | **Bio Fuel**<br>Solid, liquid and gaseous fuels, Coal as a source of energy, Carbonization, Gasification and liquefaction of coal and lignite, Testing of liquid fuels, Petroleum refining processes, Inter-conversion of fuels, Natural gases and its derivatives. | **05** |
| **5.** | **Hydro-Energy System**<br>Advantages and disadvantages of water power, Hydrological cycle, Storage and Pondage Layout of micro-hydro scheme, Characteristics, Selection, Selection of hydro-electric power plant.<br>**Hydrogen Energy:**<br>Properties of hydrogen in respect of its use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel, Development of hydrogen cartridge, Economics of hydrogen fuel and its use. | **08** |
| **6.** | **Geothermal energy:**<br>Structure of earth's interior, Geothermal sites, earthquakes & volcanoes, Geothermal resources, Hot springs, Steam ejection, Principal of working, Types of geothermal station with schematic representation, Site selection for geothermal power plants. Advanced concepts, Problems associated with geothermal conversion | **08** |
| | **Total** | **21** |

## Instructional method and Pedagogy:

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar/ will be conducted.

## Reference Books:

1. B.H.Khan, "*Non – Conventional Energy Resources"*, Tata McGraw Hill.
2. A.W. Culp Jr-, "*Principles of Energy Conversion*", McGraw Hill, 2001.
3. H.A. Sorensen, "*Energy Conversion Systems*", J. Wiley, 1983.
4. P.K.Nag, "*Power plant Engineering*", Tata McGrew Hill, Second Edition, 2003.
5. Arora and Domkundwar,"*A course in power plant engineering*", Dhanpat and Co.
6. T.F. Mors, "*Power Plant Engineering*", Affiliated East West Press, 1978.
7. M.M. E1-Wakil, "*Nuclear Power Engineering*", McGraw Hill, 1962.
8. S. Rao. & B. B Parulekar, "*Energy Technology"*, Khanna Publisher Delhi, 1999.
9. G D Rai, "*Non-conventional Energy Sources*", Khanna Publisher, 2005.

## Additional Resources

- NPTEL Videos/Web Lecture Series

| RKUNIVERSITY | SYLLABUS |
|---|---|

| | | |
|---|---|---|
| **Course Title** | **Electronics Devices and Circuits-I** | |
| **Course Code** | **EC310** | |
| **Course Credit** | Theory | :03 |
| | Practical | :01 |
| | Tutorial | :00 |
| | Credits | :04 |

## Course Learning Outcomes:

At the end of the course students will be able to;

- **Understand** the internal structure and performance of semiconductor devices.
- **Apply** the concept of semiconductor physics.
- **Understand** the basic electronics engineering principles.
- **Design** and **Perform** experimental analysis of various electronic circuits.
- **Compare** mathematical representations of circuit behavior with corresponding practical effects.
- **Develop** proficiency in simulation of basic electronics circuits using simulation tools in Laboratory and verify the same on hardware.
- **Apply** the concepts of basic electronic devices to design various circuits.
- **Understand** operation of diodes, transistors, FETs, MOSFETs in order to design basic circuits.
- **Analyze** electronic circuits.
- **Test** small electronic circuit.
- **Design** small and large signal amplifier circuits for various practical applications.
- **Analyze** the behavior of transistor at low frequency.

## Detailed Syllabus

| Sr. No. | Name of chapter & details | Hours Allotted |
|---|---|---|
| | **SECTION-I** | |
| **1.** | **Transport Phenomena in Semiconductors:**<br>Mobility and Conductivity, Electrons and Holes in an Intrinsic Semiconductor, Donor and Acceptor Impurities, Charge Densities in a Semiconductor, Electrical Properties of Ge and Si, The Hall Effect, Conductivity Modulation, Generation and Recombination of Charges, Diffusion. | **04** |
| **2.** | **Junction –Diode Characteristics:**<br>Open –Circuited p-n Junction, p-n Junction as a Rectifier, Volt-Ampere | **07** |

| | | |
|---|---|---|
| | Characteristic, Temperature Dependence of the V/I Characteristic, Diode Resistance, Space Charge, Transition Capacitance, Diffusion Capacitance, Breakdown Diodes, Tunnel Diode, Semiconductor Photodiode, Photovoltaic Effect, Light –Emitting Diodes | |
| **3.** | **Diode Circuits:**<br>Diode as a Circuit Element, Load-Line Concept, Piecewise Linear Diode Model, Clipping Circuits, Clipping at Two Independent Levels, Rectifiers, Other Full-Wave Circuits, Capacitor Filters | **06** |
| **4.** | **Power Circuits and Systems:**<br>Class A large Signal Amplifiers, Second Harmonic Distortion, Transformer Coupled Audio Power Amplifier, Efficiency, Push-Pull Amplifiers, Class B Amplifiers. | **04** |
| | **Total** | **21** |
| | **SECTION-II** | |
| **5.** | **Transistor Characteristics:**<br>Junction Transistor, Transistor Current Components, Transistor as an Amplifier, Transistor Construction, CB Configuration, CE Configuration, CE Cut-off region, CE Saturation Region, Typical Transistor, CE Current Gain, CC Configuration, Phototransistor. | **06** |
| **6.** | **Transistor Biasing and Thermal Stabilization:**<br>Operating Point, Bias Stability, Self-Bias, Stabilization against Variations in ICO, VBE and, General Remarks on Collector-Current Stability, Bias Compensation, Thermal Runaway, Thermal Stability. | **06** |
| **7.** | **Transistor at Low Frequencies:**<br>Graphical Analysis of the CE configuration, Two-Port Devices and the Hybrid Model, Transistor Hybrid Model, h-Parameters, Conversion Formulas for the Parameters of Three Transistor Configurations, Analysis of a Transistor Amplifier Circuit Using h Parameters, Emitter Follower, Comparison of Transistor Amplifier Configurations, Linear Analysis of a Transistor Circuit, Miller's Theorem and its Dual, Simplified CE Hybrid Model, Simplified Calculations for the CC Configuration, CE amplifier with an Emitter Resistance, High Input Resistance Transistor Circuits | **05** |
| **8.** | **Field Effect Transistors:**<br>Junction FET, Pinch-Off Voltage, JFET Volt-Ampere Characteristics, FET Small-Signal Model, MOSFET, Digital MOSFET Circuits, Low Frequency CS and CD Amplifiers, Biasing the FET, The FET as a Voltage Variable Resistor. | **04** |
| | **Total** | **21** |

## Instructional method and Pedagogy:

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar/ will be conducted.

## Reference Books:

1. Jacob Millman and Christos C. Halkias, Integrated Electronics, TMH.
2. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 9th Edition – Pearson Education, International Edition.
3. J. B. Gupta, Electronics Devices and Circuits, S. K. Kataria and Sons.
4. A. Malvino, “Electronics Principles”, Tata McGraw Hill Publication, 6th Ed, New Delhi

## Additional Resources

- Website for PN Junction- http://pveducation.org/pvcdrom/pn-junction/pn- junction-diodes
- Basic Electronics Tutorial- http://www.electronics-tutorials.ws/
- Website for Electronic Circuits - http://www.engineersgarage.com/electronic-circuits
- Website for Simple Electronic Circuits- http://www.eleccircuit.com/simple-electronic-circuits/
- http://www.nptel.ac.in/courses/Webcourse-contents/IIT-ROORKEE/BASIC ELECTRONICS/home_page.htm

| | |
|---|---|
| **Course Title** | **Power Systems – I** |
| **Course Code** | **EL323** |
| **Course Credit** | Theory :03 |
| | Practical :00 |
| | Tutorial :02 |
| | Credits :05 |

## Course Learning Outcomes:

At the end of the course students will be able to

- **Understand** the various types of transmission and distribution systems.
- **Understand** the types and constructional features of cables and insulation.
- **Explain** the principles of design and operation of electrical distribution feeder.
- **Apply** analytic techniques pertaining to primary distribution systems.
- **Use** basic design principles of sub-station.
- **Understand** the basic concepts in power factor improvement.
- **Explain** the requirement and methods of neutral grounding.
- **Describe** various factors affecting the economics of power generation.

## Detailed Syllabus

| Sr. No. | Name of chapter & details | Hours Allotted |
|---|---|---|
| | **SECTION-I** | |
| 1. | **Supply System**<br>Typical A.C. Power Supply Scheme, Comparison of D.C. and A.C. Transmission, Advantages of High Transmission Voltage, Various Systems of Power Transmission, Comparison of Conductor Material in Overhead System, Comparison of Conductor Material in Underground System, Comparison of Various Systems of Transmission, Elements of a Transmission line, Economics of Power Transmission- Economic Choice of Conductor size, Economic Choice of Transmission Voltage. | **07** |
| 2. | **Distribution System**<br>Primary and secondary distribution systems, concentrated and uniformly distributed loads on distributors fed at one and both ends, ring distribution, tapered or stepped distributor, voltage drop and power loss calculation. | **04** |

| | | |
|---|---|---|
| **3.** | **Insulator Design**<br>Types of insulators, materials of insulators, potential distribution over suspension insulator string, string efficiency, method of improving string efficiency; longer cross arm, grading insulators, guard ring; failure of insulators. | **05** |
| **4.** | **Mechanical design of transmission line**<br>Catenary curve, Calculation of sag and tension, Effects of wind and ice loading, Sag template, Vibration dampers, Types of conductor, most economical diameter of conductor, Grading, Methods of laying, Causes of failures, Calculations of insulation resistance and capacitance. | **05** |
| | **Total** | **21** |
| | **SECTION-II** | |
| **5.** | **Underground cables**<br>Construction of cables, Insulating materials for cables, Classification of cables, Cables for 3-Phase service, Insulation resistance of a single-core cable, Capacitance of a single-core cable, Dielectric stress in a single-core cable, Most Economical conductor size in a cable, Grading of cables, Capacitance grading, Intersheath grading, Capacitance of 3-core cables, Types of cable faults, Application of synthetic material in manufacture of insulator. | **06** |
| **6.** | **Power factor improvement**<br>Power factor, Power triangle, Disadvantages of low power factor, causes of low power factor, Power factor improvement, Power factor improvement equipment, Calculations of power factor correction, Importance of power factor improvement, Most economical power factor, Meeting the increased kW demand on power stations. | **06** |
| **7.** | **Sub-station**<br>Sub-Station, Classification of sub-stations, Comparison between outdoor and indoor sub-stations, Transformer sub-stations, Pole-mounted sub-station, underground sub-station, Symbols for equipment in sub-stations, Equipments in a transformer sub-station, Bus-Bar arrangements in sub-stations, Key diagram of 66/11 kV Sub-Station, Key Diagram of 11kV/400 V indoor sub-station, Introduction to Gas insulated sub-station and hybrid. | **04** |
| **8.** | **Neutral grounding**<br>Necessity of neutral grounding, Various methods of neutral grounding, earthing transformer, Grounding practices, Neutral grounding and application of NGT for generator grounding/ source. | **02** |

| | | |
|---|---|---|
| **9.** | **Economics of Power Generation**<br>Cost of generation: fixed, capital & running cost-running charges Important terms and factors, Load curve, Load duration curve, load factor diversity factor, demand factor etc. tariff, desirable characteristics of tariff, types of tariff. | **03** |
| | **Total** | **21** |

## Instructional method and Pedagogy:

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar/ will be conducted.

## Reference Books:

1. Wadwa. C.L., *"Electric Power Systems",* (4th edition) Wiley Eastern Ltd, New Delhi, 2005.
2. Luces M. Fualkenberry, Walter Coffer, *"Electrical Power Distribution and Transmission"*, Pearson Education, 1996.
3. Deshpande. M. V, *"Electrical Power Systems Design",* Tata McGraw Hill Publishing Company, New Delhi, 2006.
4. Stevenson. W. L., *"Elements of Power System Analysis",* (5th edition) McGraw Hill, New Delhi, 2008.Central Electricity Authority (CEA), *"Guidelines for Transmission System Planning",* New Delhi, February 2012.
5. Singh. S. N, *"Electric Power Generation, Transmission and Distribution",* Prentice Hall of India Pvt. Ltd, New Delhi, 2006.
6. O. I. Elgerd, *"Electric energy systems theory-An Introduction",* (2nd edition), Tata McGraw Hill, New Delhi, 1982.
7. J. D. Glover, M. S. Sarma, *"Power Systems Analysis and Design",* (5th edition) Nelson Engineering, 2012.

## Additional Resources

- A course on Power System Generation and Control
  http://nptel.ac.in/courses/108102047/

| | |
|---|---|
| **Course Title** | **DC Machine and Transformers** |
| **Course Code** | **EL318** |
| **Course Credit** | Theory :03 |
| | Practical :01 |
| | Tutorial :00 |
| | Credits :04 |

## Course Learning Outcomes:

After successful completion of the course, student will be able to

- **Describe** the construction and operating principle of DC machines and transformers
- **Explore** the knowledge gain on characteristics of DC machines and transformers for different operating conditions.
- **Test** and **calculate** performance parameters of DC machines and transformers
- **Select** DC machines and transformers for specific application.

## Detailed Syllabus

| Sr. No. | Name of chapter & details | Hours Allotted |
|---|---|---|
| | **SECTION-I** | |
| **1.** | **Principles of Electromechanical Energy Conversions:**<br>Introduction, Flow of Energy in Electromechanical devices, Energy in Magnetic Systems, Singly Excited System, Determination of Mechanical Force, Mechanical Energy, Torque Equation, Doubly Excited System, energy stored in magnetic field, Electromagnetic Torque, Generated EMF in Machines, Torque in Machines with Cylindrical air-gap. | **05** |
| **2.** | **DC Machines:**<br>D.C. Machines: Working principle, construction and methods of excitation.<br>Armature Winding: Introduction of simplex lap and wave windings.<br>DC generators: EMF equation, methods of excitation, separately and self-excited, shunt, series, compound, armature reaction – effects of armature reaction - demagnetizing &cross magnetizing, ampere-turns, compensating | **16** |

| | | |
|---|---|---|
| | windings, inter poles, commutation, methods to improve commutation, voltage build-up, no load characteristics, load characteristics, losses and efficiency, power flow diagram, parallel operation, applications of DC generators.<br>D.C. Motors: Principle of operation – back EMF – classification –torque equation – losses and efficiency – power flow diagram – performance characteristics of shunt, series and compound motors – starting of DC motors – necessity and types of starters, speed control – methods of speed control – solid state speed control (block diagram) – testing – Swinburne's test – Hopkinson's test – separation of losses – retardation test – field test of dc motors – application of DC motor | |
| | | **Total** **21** |
| | **SECTION-II** | |
| **3.** | **Single Phase Transformer:**<br>Operating principle, classification, emf equation, Ampere current law, Transformer on no load, on load, Vector diagram and equivalent circuit, voltage regulation, Losses, Efficiency – commercial, all day, O.C. and S.C., back-to-back, parallel operation.<br>**Auto Transformer:**<br>Single phase and Three Phase Auto-Transformer, V-I relation, Regulation and Efficiency, advantages and disadvantages over two winding transformers, applications of auto transformer. | **08** |
| **4.** | **Three phase Transformer:**<br>Construction, various types of connection and their comparative features, 3-phase transformer connections - Δ-Δ, Y-Y, Δ-Y, Y-Δ, V-V – vector groupings Yy0, Dd0, Yd1, Yd11, Dy1, Dy11, Scott connection – three winding transformers – tertiary winding – per unit impedance, Parallel operation of single phase and three phase transformers. Excitation phenomenon in transformers, Harmonics in single phase and three phase transformers,<br>Tap changing Transformers - No load and on load tap changing of transformers, Cooling methods of transformers. | **13** |
| | | **Total** **21** |

## Instructional method and Pedagogy:

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.

- Surprise tests/Quizzes/Seminar/ will be conducted.

## Reference Books:

1. I J Nagrath and D.P. Kothari, “Electrical Machines”,3rd Edition, TMH
2. J B Gupta, “Theory and Performance of Electrical Machines”, 4thEdition, S.K. Kataria and Sons.
3. Ashfaq Hussain, “Electrical Machines”, 2ndEdition, Dhanpatrai and Sons.
4. Ghosh, “Electrical Machine”, Pearson Education.
5. P.S. Bhimbra, “Electrical Machinery”, Khanna Publishers.
6. Clayton & Hancock, “Performance & Design of DC machines”, ELBS.
7. M. G. Say, “Theory, Performance & Design of A.C. Machines”, CBS Publishers.
8. Fitzgerald A.E. and Kingsley, “Electrical Machinery”, Tata McGraw Hill.

## Additional Resources

- A course on Electrical Machines-I- http://nptel.ac.in/courses/108105017/
- Couse on Electrical Machine-I- http://nptel.ac.in/courses/108106071/

| RK UNIVERSITY | SYLLABUS |
|---|---|

| | |
|---|---|
| **Course Title** | **Network Analysis and Synthesis** |
| **Course Code** | **EL316** |
| **Course Credit** | Theory :03 |
| | Practical :01 |
| | Tutorial :00 |
| | Credits :04 |

## Course Learning Outcomes:

At the end of this course students will be able to:

- **Acquire** knowledge about various circuit solving methods.
- **Apply** basic laws to analyze various circuits in time domain as well as frequency domain.
- **Analyze** the component behavior under steady state and transient conditions.
- **Derive** and **Differentiate** transient response and steady state response of electrical circuit.
- **Distinguish** time domain and frequency domain analysis.
- **Identify and troubleshoot** electrical circuits.
- **Develop** circuits for modification of input wave forms to desired ones.

## Detailed Syllabus

| Sr. No. | Name of chapter & details | Hours Allotted |
|---|---|---|
| | **SECTION-I** | |
| **1.** | **Introduction:**<br>Introduction, Basic terminology and definitions related to networks, current divider rule and voltage divider rule, Classification of networks, Kirchhoff's laws. | **03** |
| **2.** | **Analysis of resistive Circuits:**<br>Mesh Analysis of Circuits with Dependent and Independent Sources, Concept of Super mesh, Nodal Analysis of Circuits Containing Dependent and Independent Sources, Concept of Super node, Source Transformation technique, Duality**.** | **05** |
| **3.** | **Network Theorems for DC & AC circuits:** | **08** |

| | | |
|---|---|---|
| | Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem, Substitution Theorem, Milliman's Theorem, Application of above theorems in presence of dependent sources. | |
| **4.** | **Network Topology:**<br>Concept of Network Graph and Definitions, The Cut-set Matrix, The Tie-set Matrix, Kirchhoff's Laws in Fundamental Cut-set and Tie-set Matrix | **05** |
| | **Total** | **21** |
| | **SECTION-II** | |
| **5.** | **Initial conditions:**<br>Initial conditions in elements, Procedure for evaluating initial conditions, Solution of circuit equations by using Initial Conditions. | **04** |
| **6.** | **Time domain analysis & transient response of linear circuits:**<br>Mathematical background, first order differential equations, Solution of Non-homogeneous equation using integrating factor, Time-constants, Second order equation, Solution of non-homogeneous differential equation, Examples. | **06** |
| **7.** | **Frequency domain analysis & transient response of linear circuits:**<br>Laplace transformation, Inverse Laplace transformation, Partial fraction expansion, Heaviside's Expansion theorem, the initial and final value theorem Sinusoidal transient analysis using Laplace transform methods, complete response of RL, RC, and RLC circuits to step, sinusoidal, exponential, ramp, impulses and the combinations of excitations. | **05** |
| **8.** | **Two –Port Networks:**<br>Two port Impedance parameters, Two port Admittance Parameters, Two port Hybrid parameters, Two port Transmission parameters, Symmetry and Reciprocity of all parameters, Inter-relationship between all these parameters | **05** |
| | **Total** | **21** |

## Instructional method and Pedagogy:

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar/ will be conducted.

## Reference Books:

1. A. Chakrabarti, "*Network analysis and Synthesis,"* Dhanpat Rai& Co. Pvt. Ltd.

2. Van Valkanburg*,"Network analysis and Synthesis,"* Prentice Hall of India.
3. U. A. Patel, "Network Analysis," Mahajan Publication House.
4. William Hayt, Jack Kemmerly& Steven Durbin, "Engineering circuit analysis", Tata McGraw-Hill Education, 6th edition.
5. Franklin Kuo, "*Network Analysis & Synthesis,"* Wiley International.
6. John O' Malley, "*Basic Circuit Analysis*," Schaum's series.
7. DeCarlo, "*Linear Circuits Analysis*," 2nd edition: Oxford University Press (Indian edition)

## Additional Resources

- Course on Circuit Theory- http://nptel.ac.in/courses/108102042/
- A Course on Network & Systems Introductory Concepts- http://nptel.ac.in/courses/108106075/

| Course Title | Differential Equations |
|---|---|
| Course Code | APS301 |
| Course Credit | Lecture : 04 |
| | Practical : 00 |
| | Tutorial : 00 |
| | Total : 04 |

**Course Learning Outcomes**

At the end of the course the students will be able to

- Formulate and solve differential equations.
- Identify real phenomena as models of partial derivative equations
- Apply the concept of Fourier series, Fourier transform and enhance the problem-solving skill.
- Apply Laplace transforms to solve initial value problem.

**Detailed Syllabus**

| Sr. No. | Contents | Hours Allotted |
|---|---|---|
| | **SECTION – 1** | |
| 1. | **Higher order ODE:** Linear differential equations of second and higher order, Superposition principle, Initial value problems, Linear dependence and independence of functions- Wronskians, Abel-Liouville formula, Method of obtaining general solution of non homogeneous linear differential equation with constant coefficients, Method of obtaining Particular Integral – Shorter methods for finding P. I. for special form of R(x), Method of undetermined coefficients, Method of variation of parameter, Linear ODEs of higher order with variable coefficients, Cauchy-Euler equation, Legendre's Linear differential equation with variable coefficients and its applications. | 12 |
| 2. | **Introduction, Basic concepts and definitions,** Formation of partial differential equation, Discussion about solutions of P.D.Es, Partial differential equation of first order, Linear partial differential equation of first order, Nonlinear partial differential equation of first order, Method of separation of variables, Classification of partial equations of mathematical physics and their origins(vibrating strings, vibrating membranes heat conduction in solids etc.), Solving PDEs via the method of separation of variables, The Laplace operator in cylindrical and spherical coordinates, Brief discussion of Fourier Bessel series, Solution via Fourier | 8 |

| | | |
|---|---|---|
| | series/Fourier-Bessel series for rectangular and circular domains in $R^2$ and spherical and cylindrical domains in $R^3$. | |
| 3. | **Series solution of ODEs:**<br>Ordinary differential equations with regular singular points and the method of Frobenious and power series, Illustrative examples as the equations of Legendre. | **08** |
| | **Total** | **28** |
| | **SECTION – 2** | |
| 5. | **Laplace Transforms**<br>Laplace transform of and, Convolution theorem, Use of Laplace transform for solving IVP for ODEs and systems of ODEs, Heaviside unit step function and second shifting theorem, Applications of Laplace transforms. | 10 |
| 6. | **Fourier Series**<br>Basic formulae in Fourier series, Theorem of existence of Fourier series, Fourier series for discontinuous function, Fourier series of even and odd functions, Half range Fourier series, Parseval's formula (statement only) and Bessel's inequality with examples, Applications of Fourier series. | 8 |
| 7. | **Fourier Transforms**<br>Fourier transforms and its basic properties, Fourier transform of the Gaussian and the Fourier inversion theorem (statement only), Riemann Lebesgue lemma for Fourier series and Fourier transforms (statement only). | 4 |
| 8. | **Legendre and Bessel's functions**<br>Legendre polynomial, Rodrigue's formula, generating function of the Legendre polynomial and their orthogonality, Recurrence relation for , Bessel's equation and Bessel's function of first kind only, Basic properties of the recurrence relation and Integral representation. | 6 |
| | **Total** | **28** |

**Instructional Method and Pedagogy:**

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar/ will be conducted. The course includes tutorials, where students have an opportunity to practice the examples for the concepts being taught in lectures.

**Reference Books:**

1. Erwin Kreyzig, Higher Engineering Mathematics, Wiley India Publications – 8th Edition.
2. Dr. R.C. Shah, Differential equations, Books India Publications – 5th Edition.

3. Elementary Differential Equations, W. E. Boyce and R. Di Prima and John Wiley, (2005), 8th Edition.
4. R. V. Churchill and J. W. Brown, Fourier series and boundary value problems, Mc Graw-Hill (2006), 7th Edition.
5. T. M. Apostol, Calculus, Volume-2, , Wiley Eastern, 1980, 2nd Edition.
6. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers Co. Ltd., New Delhi – 39th Edition.
7. Thomas George, B. weir Maurice, D. Hass Joel Giordano Frank,
8. Prajapati Jyotindra, Calculus, Pearson Education, Delhi – 1st Edition.

**Additional Resources:**

- http://www.math.canterbury.ac.nz/php/resources/math100/differential-equations/
- http://www.math.chalmers.se/Math/Grundutb/CTH/mve030/1617/mve290-PDEs.pdf
- https://nptel.ac.in/courses/111103021/15.pdf
- https://math.mit.edu/~jorloff/18.04/notes/topic12.pdf
- https://www.math24.net/higher-order-linear-homogeneous-differential-equations-constant-coefficients/