RK UNIVERSITY

DETAIL TEACHING SCHEME

SCHOOL OF ENGINEERING
PROGRAM: B. TECH – ELECTRICAL ENGINEERING
ACADEMIC YEAR – 2021-22
SEMESTER – IV (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						
EL418	Power System-II	3	2	0	2	4	N	Y	N	
EC421	Engineering Electromagnetics	2	0	0	2	2	N	Y	N	TSEE 50 Marks
El427	Electrical Measurements and Instrumentation	3	0	2	2	4	N	Y	Y	Revised-I
EL416	Rotating AC Machines	4	0	2	2	5	N	Y	Y	-
EL511	Analog Electronics	3	0	2	2	4	N	Y	Y	-
APS411	Complex Variables and Numerical Methods	4	0	0	2	4	N	Y	N	Revised
CPI001	Creativity, Problem Solving and Innovation	2	0	0	1	2	N	Y	N	New Course
NEN001	Orientation Program in Entrepreneurship	2	0	0	1	2	N	Y	N	-
MEN401	Mentoring	-	-	1	-	-	N	N	N	-
	Total	**23**	**2**	**7**	**14**	**27**				
		Total Teaching Hours 32								

N- No
Y – Yes

CIE – Continuous internal evaluation

PSEE – Practical semester end examination including ITD, Dissertation, Industrial project, Industrial training etc.

SSH - Self-study hours

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SYLLABUS

Course Title	**Power System II**
Course Code	**EL418**
Course Credit	Theory :03
	Practical :00
	Tutorial :01
	Credits :04

Course Learning Outcomes:

At the end of semester students will be able to:

- **Describe** the impact of Skin effect, Proximity effect, and Ferranti effect on electrical parameters of transmission lines.
- **Evaluate** the necessity of reactive power compensation with the help of circle diagram.
- **Describe** corona effect on transmission line and its influence on the performance of line.
- **Develop** resistance, inductance, and capacitance model for the short, medium, and long transmission line.
- **Compute** transmission line voltage regulation and transmission efficiency vs loading.
- **Develop** one-line diagrams, circuit's models for major power system components, i.e. three phase generators, transformers lines, and equivalent loads.
- **Use** per unit notation for the system analysis and design.

Detailed Syllabus

Sr. No.	Name of chapter & details	Hours Allotted
	SECTION-I	
1.	**Inductance of Transmission Line** Resistance of transmission line, skin effect, proximity effect, partial flux linkages. Inductance of a conductor- due to an internal flux, flux linkage between two points external to an isolated conductor, inductance of single Phase two wire line, Inductance of 3 Phase overhead Line with symmetrical and unsymmetrical spacing. Inductance of composite conductors- concept of Self GMD and Mutual GMD, examples of Inductance computations. Necessity of bundle conductors for EHV and UHV transmission line. **Corona** Critical disruptive voltage, corona loss, line design based on corona, advantages and disadvantages of corona.	**08**

2.	**Capacitance of Transmission Lines** Introduction, electric field of a long straight conductor, the potential difference between two points due to a charge, Capacitance of single phase two wire line, Capacitance of 3 phase line-symmetrical and unsymmetrical spacing.	**04**
3.	**Performance of Transmission Lines** Classification of overhead transmission lines, Performance of Single-Phase short Transmission lines, 3-Phase short Transmission Lines. Effect of load power factor on Regulation and Efficiency. Medium Transmission Lines- end condenser method, Nominal T method and Nominal π method. Long Transmission Lines – Rigorous Method, generalized circuit constants of Transmission Line, surge impedance loading and factors affecting SIL, Introduction to power circle diagram. **Transients in power system** The Prestriking Voltage after Removal of Short Circuit, Travelling Waves on Transmission Lines, Attenuation of Travelling Waves, Capacitance Switching, Overvoltage due to Arcing Ground	**09**
	Total	**21**
	SECTION-II	
4.	**Representation of Power System Components** One-line diagram, The impedance and reactance diagram, per-unit quantities, selection of base for Per Unit Quantities, per-unit Impedance of three winding transformer, advantages of per-unit computation.	**02**
5.	**Symmetrical Fault Analysis** Symmetrical faults on 3 phase system, Calculation of fault current, percentage reactance and base kVA, reactor control of short circuit currents, location of reactors, Steps for Symmetrical fault calculations.	**03**
6.	**Symmetrical Components** Symmetrical component transformation (voltage and current), phase shift in star-delta transformers, sequence impedance and sequence network of power system. Sequence impedance in transmission lines, Sequence Impedance and Sequence network of synchronous machine, Sequence impedance and network of transformers.	**08**
7.	**Unsymmetrical Fault Analysis** Introduction, Unsymmetrical faults on 3phasesystem, analysis of unsymmetrical faults- single line to ground fault, line-to-line fault, and double line to ground fault, sequence networks, and reference Bus for sequence network. Introduction to Z-bus and Y-bus matrices.	**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. I.J. Nagrath and D.P. Kothari, 'Modern Power System Analysis', Tata McGraw-Hill Publishing Company, New Delhi, 1990.
2. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Publishing Company, New Delhi, 2002.
3. JB Gupta, 'A course in power systems', SK Kataria & sons, New delhi, 2014
4. John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', McGraw Hill International Book Company, 1994.
5. Wadwa. C.L., Electric Power Systems, Wiley Eastern Ltd., New Delhi 2001.
6. Despande M.V., Electrical Power Systems Design, Tata McGraw Hill Publishing Company, New Delhi, 1990.
7. Stevenson W.L., "Elements of Power System Analysis", McGraw Hill, New Delhi, 1999.
8. Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2003.
9. N.V. Raman,"*Power System Analysis",* Pearson Publication.

Additional Resources

- A Course on Power system analysis -http://nptel.ac.in/courses/108105067/

Course Title	Engineering Electromagnetics
Course Code	EC421
Course Credit	Theory :02
	Practical :00
	Tutorial :00
	Credits :02

Course Learning Outcomes:

At the end of the course students will be able to

- **Employ** vector calculus to solve static, quasistatic and dynamic electromagnetics Problems
- **Interpret** Maxwell's equations of electromagnetics in integral and differential forms
- **Apply** the concepts and laws pertaining to Electrostatics, and the solution of electrostatics problems, and polarization of materials.
- **Apply** Electromagnetics boundary conditions to solve for fields at interface between two different charge-free mediums.
- **Evaluate** steady magnetic fields, and magnetization of materials.
- **Formulate** expression for electromagnetic waves to compute reflection and refraction coefficients.

Detailed Syllabus

Sr. No.	Name of chapter & details	Hours Allotted
	SECTION-I	
1.	**Electrostatic fields** Review of vector algebra, Coulomb's law, Electric field intensity –Fields due to different charge distributions, Electric flux density, Gauss law and applications, Electric potential, Relation between E and V, Maxwell's two equations for electrostatic fields, Energy density, Convection and conduction currents, Dielectric constant, Isotropic and homogeneous dielectrics, Continuity equation, Relaxation time, Poisson's and Laplace's equations, Capacitance-Parallel plate, Coaxial, Spherical capacitors	**08**

2.	**Magneto Statics** Biot-Savart law, Ampere's circuital law and applications, Magnetic flux density, Maxwell's two equations for magneto static fields, Magnetic scalar and vector potentials, Forces due to magnetic fields, Ampere's force law, Inductances and magnetic energy.	**06**
	Total	**14**
	SECTION-II	
3.	**Maxwell's Equations** Faraday's law transformer emf, Inconsistency of ampere's law and displacement current density, Maxwell's equations in different final forms. Conditions at a boundary surface: Dielectric- Dielectric and Dielectric – Conductor interfaces.	**08**
4.	**Electromagnetic Wave Propagation** Waves in general, Wave propagation in Lossy Dielectric, Plane wave in lossless dielectrics, Plane wave in free space, Plane waves in good conductors, Power and the Poynting vector, Reflections of a plane wave at normal incidence, reflection of a plane wave at oblique incidence, standing waves ratio.	**06**
	Total	**14**

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.
- **Final Theory Semester End Examination will be of 50 Marks.**

Reference Books:

1. Matthew N.O. Sadiku, "Elements of Electromagnetics", 4/e, Oxford Univ. Press, 2007.
2. William H. Hayt Jr. and John A. Buck, "Engineering Electromagnetics" 7/e, TMH, 2006
3. E.C Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems" 2/e, PHI 2000.
4. Nathan Ida, "Engineering Electromagnetics" 2/e, Springer (India) Pvt.Ltd, New Delhi, 2005.

Additional Resources

- Faradays Electromagnetic Lab- http://phet.colorado.edu/en/simulation/faraday
- Virtual Lab- http://www.vlab.co.in/
- Magnet Lab- http://www.magnet.fsu.edu/
- Microwaves- http://www.microwaves101.com/downloads.cfm
- IEEE Microwave Magazine- http://ieeexplore.ieee.org/xpl/tocresult.jsp?reload=true&isnumber=4629505

Course Title	Electrical Measurements and Instrumentation
Course Code	EL427
Course Credit	Theory :03
	Practical :01
	Tutorial :00
	Credits :04

Course Learning Outcomes:

At the end of the session student will be able to:

- **Recognize** various measuring instruments and its control mechanism.
- **Demonstrate** measuring instruments and their measurement process of physical quantities.
- **Collect** requisite information regarding various types of level measurements adopted in industry environment.
- **Compare** different measuring instruments which measure the same quantity.
- **Measure** various electrical parameters with accuracy, precision and resolution.
- **Identify** different type of errors and characteristics of measuring instrument
- **Evaluate** value of resistance, capacitance and inductance by various bridge circuits.
- **Analyse** the basic concept of instrument transformers.

Detailed Syllabus

Sr. No.	Name of chapter & details	Hours Allotted
	SECTION-I	
1.	**Standard of Measurements** Units and Dimensions, characteristics of instruments-Static characteristics definition of true value, accuracy, precision, error, types of errors sensitivity and resolution. Dynamic characteristics, errors in measurement.	**05**
2.	**Measurement of Resistance, Inductance and Capacitance** Measurement of low resistance-Ammeter-Voltmeter method, Kelvin double bridge method, Measurement of medium resistance- Substitution method, Wheatstone bridge method, Measurement of high resistance- Direct deflection method, Meg ohm bridge, Megger .AC bridges for inductance measurement-Maxwell, capacitance measurement – De -Sauty's, Measurement of frequency by Wien's bridge, Schering Bridge, Q-Factor of the bridges.	**08**

3.	**Introduction to Measuring Instruments:** Classification - deflecting, control and damping torques, Ammeters and Voltmeters, PMMC, moving iron type instruments, expression for the deflecting torque and control torque, Errors and compensations, extension of range using shunts and series resistance, Hot wire instruments, Electrostatic Voltmeters.	**08**
	Total	**21**
	SECTION-II	
4.	**Measurement of Power and Energy** Electrodynamometer type wattmeter, Measurement of power in three phases circuits-Three wattmeter method, Two wattmeter method-balance load, Blondel`s Theorem, one-wattmeter method, (Numerical), Measurement of reactive power, Induction type energy y meter.	**06**
5.	**Transducers** Classification of transducers, Primary and Secondary transducer, Analog and Digital transducer, Active and Passive transducers, LVDT (displacement measurement), Piezoelectric transducers, Strain gauge. **Pressure, Temperature, Flow Measurement** Pressure measurement: Diaphragm, Bellows and Bourdon tube Temperature measurement: Various types of temperature instruments: Thermistor, Thermocouple and RTD. Flow measurement: Hot wire anemometers.	**07**
6.	**Potentiometers and Instrument Transformers.** Basic potentiometer circuit, Standardization, Types of A.C. Potentiometer-Laboratory type (Crompton's) Potentiometer, Multiple-Range Potentiometer, A.C. potentiometer principle, Applications of A.C. and D.C. potentiometers. **Instrument Transformers** Terminologies related to Instruments transformers (C.T. and P.T.), Classification- measuring and protective transformers, Operating principle, Ratio and Phase angle errors, Applications of C.T & P.T.	**07**
7.	**Location of Cable Faults** Voltage drop test, Murray loop test, Varley loop test, Test for open circuit fault In cables.	**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. A.K. Sawhney, “A course in Electrical Measurement and Measuring Instruments”, Delhi: Dhanpat Rai & Co., Nineteenth Revised Edition:2011
2. R. K.Rajput, “Electrical & Electronic Measurements & Instrumentation” ,Third Edition,S. Chand, 2013
3. E W Golding & Widdies, “Electrical Measurements & Measuring Instrument”, London, Pitman, 1968.
4. J.B. Gupta, “Electrical & Electronic Measurements & Instrumentation”,10th Edition,Kataria,1996

Additional Resources

- NPTEL Videos/Web Lecture Series

Course Title	Rotating AC Machines
Course Code	EL416
Course Credit	Theory :04
	Practical :01
	Tutorial :00
	Credits :05

Course Learning Outcomes:

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

- **Understand** construction and operating principle of induction motor and synchronous machine.
- **Acquire** knowledge on characteristics of induction motor and synchronous machine for different operating conditions.
- **Test** and **calculate** performance parameters of induction motor and synchronous machine.
- **Analyze** and **select** machine for specific application.

Detailed Syllabus

Sr. No.	Name of chapter & details	Hours Allotted
	SECTION-I	
1.	**Polyphase Induction Motors:** Rotating magnetic field, Motor construction, Motor specifications, Types of motors, Principle of operation, Basic equations, Operating parameters at different load, No-load & blocked rotor test, Vector diagram, Equivalent circuit, Torque and power equations Torque/slip characteristics, Performance calculations, Circle diagram, High torque motors, Manual and Automatic starting methods. Speed control – conventional and v/f control, crawling and cogging, Unbalanced operation of 3-phase induction motors, Applications, Motor enclosures.	**18**

2.	**Single-phase Induction Motors:** Double field revolving theory, Starting & running performance of 1- phase induction Motor, Equivalent circuit of 1phase induction motor, Types of single-phase motors, Principle and operation of split phase, Resistance start, Capacitor start and capacitor start & run induction motor, Shaded pole induction motor, Fractional horse power motors.	**10**
	Total	**28**
	SECTION-II	
3.	**Alternator:** Principle of operation, Constructional features and types, emf equation, Distributed ac windings, Distribution and coil span factors, Effect of harmonics on emf and its elimination, Armature reaction in cylindrical and salient pole machines, Two reaction theory, Equivalent circuit of cylindrical and salient pole machines, Voltage equation, Output equations, Vector diagrams, Voltage regulation by synchronous impedance, MMF and Zero Power Factor (ZPF) method, Transient and sub-transient reactance, Short circuit ratio (SCR), Concept of reactive power control through excitation system, Condition for maximum power, Synchronizing power and torque, Synchronizing conditions and methods, Operational aspects of alternators on infinite bus.	**16**
4.	**Synchronous Motor**: Principle of reversibility, Voltage equation, Phasor diagram, Torque and power equations, Steady state operating characteristic, 'V' and inverted 'V' curves and 'O' curves, Circle diagram, Starting, hunting, damper windings and its effect, Synchronous condenser, Construction and Working principle of auto synchronous motor	**12**
	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.

Reference Books:

1. Gupta J B, “Electrical Machines”, S K Kataria Publications.
2. Nagrath I J and Kothari D P, “Electric Machines”, Tata McGraw Hill.
3. Theraja B L, “Electrical Technology” – Vol II, S Chand Publications.
4. E. Fitzgerald, “Electric Machinery”, Tata McGraw-Hill.
5. Bhimbra P S, “Electrical Machinery”, Khanna Publishers

Additional Resources

- Website link NPTEL Online Courses- http://www.nptel.iitm.ac.in
- Virtual Lab- http://www.vlab.co.in (for practical simulations)
- A Course on Introduction on Induction Machines- http://nptel.ac.in/courses/108106072/
- A Course on Introduction on Power System Stability- http://nptel.ac.in/courses/108106026/
- A Course on Power System Operation & Control- http://nptel.ac.in/courses/108104052/

Course Title	**Analog Electronics**
Course Code	**EL511**
Course Credit	Theory :03
	Practical :01
	Tutorial :00
	Credits :04

Course Learning Outcomes:

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

- **Formulate** the concept of ideal operational amplifier; identify its major properties and main type of Op-amps circuits
- **Employ** Op-amp in circuits and troubleshoot issues
- **Estimate** and analyse output waveform for integrator and differentiator circuit
- **Synthesize** and **design** active filters and oscillators for engineering application
- **Design** multi-vibrator circuits using timers

Detailed Syllabus

Sr. No.	Name of chapter & details	Hours Allotted
	SECTION-I	
1.	**Differential Amplifier** DC and small signal analysis, CMRR, Current mirrors, Active load and cascade configurations, frequency response.	**04**
2.	**Operational Amplifiers** Block diagram, Parameters of OP-Amps, Ideal properties, Equivalent circuit, Difference amplifiers, Inverting& Non-inverting configuration, Different configuration, Voltage-Series feedback, Voltage Shunt Feedback, Differential Amplifier, Open loop voltage gain, Slew rate.	**05**
3.	**Op-amp Applications** DC amplifier, AC amplifier, Peaking Amplifier, Summing, Scaling and Averaging Amplifiers in inverting and non-inverting configuration, Voltage to current converter, Op-amp as integrator and differentiator, Precision diode, Logarithmic and Anti-logarithmic Amplifier.	**04**
4.	**Active Filter Design** First order and second order filter design-Low pass, High pass, Band pass, Band Reject & All pass.	**04**

5.	**Oscillator** Oscillator principle, Harmonic Oscillators- Phase shift oscillator, Wien bridge oscillator, Hartley Oscillator, Colpitts Oscillator, Relaxation Oscillator- Schmitt Trigger(square wave), Triangular wave oscillator, Saw tooth wave generator.	**04**
	Total	**21**
	SECTION-II	
6.	**Comparator and Converter** Basic Comparator, zero crossing detector, inverting & non-inverting comparator, voltage limiters, positive and negative clippers & clappers, half wave & full wave rectifier using op-amp, Peak detector, Sample and Hold circuit.	**06**
7.	**Voltage Regulators** Voltage Regulators, Design of Series Voltage Regulator, Series regulator with Current Pre-regulator.	**04**
8.	**Timer** Internal circuit diagram, Pin configuration, stable, Monostable and Bi-stable operation of 555 Timer IC.	**05**
9.	**Data Converters** Classification, Digital to Analog Conversion-Binary weighted resistor DAC, R- 2R ladder DAC, Analog to Digital Conversion-Flash type, Counter type, Successive Approximation, Dual slope, Comparison of ADC.	**06**
	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. R. A. Gayakwad, "*Op-Amps and Linear Integrated Circuit*", Prentice Hall of India, 2002.
2. P. E. Allen and D. R. Holberg, "*CMOS Analog Circuit Design*", 2/e, Oxford University Press, 1997
3. D. Johns, K. Martin, "*Analog Integrated Circuit Design*" Wiley, 1997
4. Coughlin Robert, F. Driscoll Rrederick, F," *Operational Amplifiers and Linear Integrated Circuits*",Prentice Hall of India,6/e,2000
5. Millman Jacob Halkias Christos," *Integrated Electronics : Analog and Digital Circuits and Systems*" Tata McGraw-Hill Publishing
6. Robert L. Boylestad and Louis Nashelsky, "*Electronic Devices and Circuit Theory*" , 9th Edition – Pearson Education, International Edition
7. J B Gupta, Electronics Devices and Circuits, S. K. Kataria and Sons

Course Title	COMPLEX VARIABLES AND NUMERICAL METHODS
Course Code	APS411
Course Credit	Lectures : 04
	Practical : 00
	Tutorial : 00
	Total : 04

Course Learning Outcomes

After Successful completion of the above course, students will be able to:

- **Understand and Demonstrate** basic concepts underlying complex analysis and numerical methods
- **Apply** the methods of complex analysis to evaluate definite integrals and infinite series.
- **Apply** numerical methods to obtain approximate solutions to mathematical problems.

Detailed Syllabus

Sr. No.	Contents	Hours Allotted
	SECTION – I	
1.	**Function of Complex Variable** Limit, Continuity, Differentiability, Analytic functions, Cauchy-Riemann Equations, Necessary and sufficient condition for analyticity, harmonic functions.	**06**
2.	**Integration of Function of Complex Variable** Curves, Line Integrals and its properties. Line integral of single valued functions, Line integral of multiple valued functions. Cauchy-Gaursat Theorem, Cauchy Integral Formulae, Cauchy's inequality –Liouville's and Morera's theorem.	**08**
3.	**Power Series and Applications of Contour Integration** Convergence of power series, Taylor and Laurent Theorems, Laurent series expansions, Zeros of analytic function, Singularities of analytic functions and their classification, Residues: Residues Theorem, Evaluating various type of definite real integrals using contour integration method.	**08**
4.	**Conformal Mapping and Its Applications** Mapping by elementary functions, Mobius transformation: Special transformations.	**06**
	Total	**28**
	SECTION-II	
5.	**Roots of Algebraic and Transcedental Equations**	**04**

	Solution of a nonlinear equation by the methods of Bisection, False position, Secant method, Newton-Raphson method and their rate of convergence.	
6.	**Interpolation and Extrapolation** Newton's Forward, Newton's Backward, Central differences interpolation formulae, Stirlig's, Bessels's, Laplace-Evertt's, Lagrange's, Newton's divided differences interpolation formula and error of the interpolating polynomial.	**08**
7.	**Numerical Integration** Trapezoidal rule and error estimation in Trapezoidal rule, Simpson's 1/3 rule and error estimation in Simpson's 1/3 rule, Simpson's 3/8 rule and error estimation in Simpson's 3/8 rule, Gaussian integration.	**03**
8.	**Solution of a System of Linear Equation** Implementation of Gaussian elimination by partial pivoting, Gauss-Seidel method.	**03**
9.	**Ordinary Differential Equations** Numerical solution of ordinary differential equations, Euler's method, Improved Euler's (Heun's) method, Runge-kutta methods.	**04**
10	**Statistics and Probability** Basic concepts of statistics, Probability, Types of probability.	**06**
	TOTAL	**28**

Instructional Method and Pedagogy:

1. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated regular interval.
2. Surprise tests/Quizzes/Seminar/will be conducted.
3. The course includes tutorials, where students have an opportunity to practice the examples for the concepts being taught in lectures.

Reference Books:

1. Brown James, Ward Churchill Ruel, Complex Variables and Application, V- McGraw Hill International New York (7th Edition).
2. Erwin Kreysing, Higher Engineering Mathematics, Wiley India Publications – 8th edition.
3. Dr. R.C. Shah, Introduction to Complex Variables and Numerical Methods, Books India Publications (1st edition).
4. Grewal B. S., Numerical Methods in Engineering and Science with Programs in Fortran 77, C and C++, Khanna Book Publishing Co. (P) Ltd. Delhi (7th edition).
5. Vedamurthy V. N. & Iyengar S. R. K., Numerical Methods, Vikas publishing house Pvt. Ltd., New Delhi (1st edition).
6. Grewal B. S. and Grewal J. S., Higher Engineering Mathematics, Khanna Book Publishing Co. (P) Ltd. Delhi (39th edition).
7. Chapra Steven, C. Canale Raymond, Numerical Methods for Engineers, P. - Tata Mc Graw-Hill Publishing Company Limited New Delhi (5th edition)
8. Datta N., Computer Oriented Numerical Methods, Vikas publishing house pvt ltd New Delhi (1st edition).

Additional Resources:

- https://www.utas.edu.au/courses/cse/units/kma382-applied-complex-variables-and-transform-theory
- https://www.maths.ed.ac.uk/~jmf/Teaching/MT3/ComplexAnalysis.pdf
- https://www.math.columbia.edu/~rf/complex2.pdf

Course Title	CREATIVITY, PROBLEM SOLVING & INNOVATION
Course Code	CPI001
Course Credit	Lecture : 02
	Tutorial : 00
	Practical : 00
	Total : 02

Detailed Syllabus:

Sr. No	Name of chapter & Details	Session Allotted
	SECTION-I	
1	**Thinking practices & methods of questioning** Introduction need and impact of the course on the future of students. Psychology of Problem Solving; Vertical versus Lateral Thinking Strategy of Questioning; Method of Questioning; Importance of asking the right questions.	05
2	**Method of learning & visualization** Learning and Its Importance; Sources of Learning; Methods of Learning. Purpose and Value of Education in Future; Creativity in Real Life. Strategy of Knowing How to See; Making your thoughts visible; Visualizing thinking; Mind Mapping; Fishbone Diagram.	05
3	**Systematic thinking with novel combination** Strategy of Thinking Fluency; Generating all possibilities, more the better; Quantity without screening is helpful; SCAMPER Technique; Creative or divergent idea generating thinking versus Critical or convergent idea selection thinking. Strategy of Fusing of Ideas; Making Novel combinations; Connecting the unconnected.	05
	SECTION-II	
4	**Innovation by collaboration** Strategy of Looking at the Other Side, looking in other world, finding what you are not looking for and following it up. Strategy of play, the importance of play; relaxation; break; diversion; Unstructured activities for sheer joy. Stop thinking and activities for JOY. Let subconscious figure it out. Sleep on it. Various puzzles as play or fun. Strategy of Awakening the Collaborative Spirit. Collaborative thinking, Brainstorming, Brain Writing. Innovation requires collaboration to make it happen.	05

5	**Cognitive research trust & problem-solving approach** Review strategies for creative problem-solving methods. Five Building Blocks as per Fogler & Leblanc. Stanford d school approach shown as video. (DT) Strategy for critical thinking for Choosing. Creative or divergent thinking needs follow up by Critical thinking or Convergent thinking in order to choose the solution for implementation. Kepner-Tregoe (K.T.) method with an example. Edward De Bono CoRT thinking process including PMI (Plus, Minus and Interesting). Also Edward de Bono method of decision making called Six thinking hats.	**05**
6	**Idea to innovation** This is Edward de Bono day for the entire 2 hours with himself explaining and teaching his ideas having evolved many years ago consisting as CoRT thinking tool, Lateral thinking and the decision making by Six thinking hats method. Strategy for Making; From idea to innovation	**05**

Instructional Method and Pedagogy:

1. Lecture on the theme with slide presentation
2. Videos for the presentation
3. Individual test on thinking or the theme for 5 minutes
4. Case Study on the theme as per Harvard Business School Method
5. Group Activity & Test during the class for 20-30 minutes
6. Internet search based Many TED talks and other sources for videos, slide shares, problems, etc have been identified and selection will be made from these collections in the final detailed syllabus for the course as per the above outline

Course Learning Outcomes:

After Successful completion of the above course, students will be able to:

1. Improves the quality of problem solving and decision making in both faculties as well as Students.
2. Entails effective communicative abilities and a commitment to overcome our native egocentrism and sociocentrism.
3. Enhances language and presentation skills
4. It provides the tools for the process of self-evaluation
5. It helps one think creatively “outside the box.”
6. Students who rigorously apply the skills will become more independent and self-directed learners.

Reference Books:

1. Zig Zag, The surprising path to greater creativity by R. Keith Sawyer. 2013.
2. Group Genius by Keith Sawyer, the creative power of Collaboration. 2007
3. Crackling Creativity, The secrets of creative genius by Michael Michalko. 2001
4. Thinkertoys by Michael Michalko, second edition 2006
5. De Bono’s Thinking Course by Edward De Bono, Revised Edition 1994
6. Six Thinking Hats by Edward De Bono Revised and updated edition 1999

7. Lateral thinking, Creativity Step by Step by Edward De Bono. 1973
8. How to Mind Map by Tony Buzan. 2002
9. Mapping Inner Space by Nancy Margulies with Nusa Maal. Second edition.2002
10. The Myths of Innovation by Scott Berkun. Expanded and revised edition 2010
11. The art of Innovation by Tom Kelly with Jonathan Littman. 2001
12. Creative Confidence: Unleashing the Creative Potential Within Us All by Tom Kelly and David Kelly. 2013
13. A Whack on the side of the head by Roger von Oech. Revised edition 1998
14. A Kick in the seat of the pants by Roger von Oech.1986
15. They all laughed by Ira Flatow. 1992
16. Imagine, How creativity works by Jonah Lehrer. 2012
17. 101 Creative problem-solving techniques by James m Higgins.1994
18. Creative approach to problem solving by Scott G Isaksen, K Brian Dorval, Donald J Treffinger. 2000
19. Creative problem solving An Introduction by Donald J. Treffinger, Scott G Isaksen and K. Brian Stead=Dorval. 4th edition, 2006
20. Strategies for creative problem solving by H. Scott Fogler & Steven E. LeBlanc. Second edition 2008
21. Game storming by Dave Gray, Sunni Brown and James Macanufo.2010
22. Creating minds by Howard Gardner. 1993
23. Creativity –Flow and Psychology of Discovery and Invention by Mihaly Csikzentmihalyi.1996
24. Aha! Insight by Martin Gardner. 1978
25. The Ultimate Lateral & Critical Thinking Puzzle book by Paul Sloane, Des MacHale & M. A. DiSpezio. 2002
26. Test your Lateral Thinking IQ by Paul Sloane. 1994
27. Intriguing Lateral Thinking Puzzles by Paul Sloane & Des MacHale.1996.

Course Title	**Orientation Program in Entrepreneurship**
Course Code	**NEN001**
Course Credit	Theory :02
	Practical :00
	Tutorial :00
	Credits :02

Course Learning Outcomes:

After Successful completion of the above course, students will be able to:

- **Understand** how E-Cell can transform individuals into Successful Leaders.
- **Understand** how ordinary people become Entrepreneurs.
- **Understand** the need of Customers and Learn Selling effort to keep Customer centric.
- **Build** and **Demonstrate** the elevator pitch to sell effectively**.**

Detailed Syllabus

Sr. No.	Name of chapter & details	Hours Allotted
	SECTION-I	
1.	**Let's Get Started:** Discover Yourself	**3**
2.	**Explore E – Cell on Campus**	**4**
3.	**Listen to Some Success Stories:**	**4**
4.	**Characteristics of a Successful Entrepreneurs**	**4**
5.	**Communicate Effectively**	**4**
6.	**Design Thinking for Customer Delight**	**4**
7.	**Sales Skills to Become an Effective Entrepreneur**	**4**
8.	**Managing Risks & Learning from Failures**	**3**
9.	**Are You Ready to Be an Entrepreneur**	**5**
10.	**Capstone Project & Assignments**	**10**
	Total	**45**

Instructional method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, use of White Board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- 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.
- Quizzes will be conducted.

Reference Books:

1. Traction: A Startup Guide to Getting Customers by Gabriel Weinberg and Justin Mares.

Additional Resources

- https://learnwise.org/#//en/user/redirection