

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(Autonomous)**

**Course structure for Four Year Regular B.Tech. Degree Program
(Effective for the batches admitted from 2020-21)**

ELECTRICAL & ELECTRONICS ENGINEERING (EEE)

INDUCTION PROGRAM (3 weeks duration)	
❖	Physical activity
❖	Creative Arts
❖	Universal Human Values
❖	Literary
❖	Proficiency Modules
❖	Lectures by Eminent People
❖	Visits to local Areas
❖	Familiarization to Dept./Branch & Innovations

Semester I (First year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		C	CIE	SEE
1	Basic Science course	20ABS9901	Algebra and Calculus	3	0	0	3	30	70	100
2	Basic Science course	20ABS9902	Applied Physics	3	0	0	3	30	70	100
3	Humanities and Social science	20AHS9901	Communicative English	3	0	0	3	30	70	100
4	*Engineering Science Courses	20AES0304	Engineering Workshop Practice	1	0	4	3	30	70	100
5	Engineering Science Courses	20AES0501	Problem Solving and Programming	3	0	0	3	30	70	100
6	Humanities and Social science LAB	20AHS9902	Communicative English Lab	0	0	3	1.5	30	70	100
7	Basic Science course (LAB)	20ABS9907	Applied Physics Lab	0	0	3	1.5	30	70	100
8	Engineering Science Courses (LAB)	20AES0503	Problem Solving and Programming Lab	0	0	3	1.5	30	70	100
Total credits							19.5	240	560	800

Semester II (First year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		C	CIE	SEE
1	Basic Science courses	20ABS9906	Differential Equations and Vector Calculus	3	0	0	3	30	70	100
2	Basic Science courses	20ABS9904	Chemistry	3	0	0	3	30	70	100
3	Engineering Science Courses	20AES0101	Basics of Civil and Mechanical Engineering	3	0	0	3	30	70	100
4	Engineering Science Courses	20AES0505	Internet of Things (IoT)	3	0	0	3	30	70	100
5	Engineering Science Courses	20AES0301	Engineering Graphics	1	0	4	3	30	70	100
6	Engineering Science Courses (LAB)	20AES0102	Basics of Civil and Mechanical Engineering Lab	0	0	3	1.5	30	70	100
7	Basic Science course (LAB)	20ABS9909	Chemistry Lab	0	0	3	1.5	30	70	100
8	Engineering Science Courses (LAB)	20AES0506	Internet of Things (IoT) Lab	0	0	3	1.5	30	70	100
	Mandatory course (AICTE suggested)	20AMC9902	Constitution of India	2	0	0	0	30	-	30
Total credits							19.5	270	560	830

Semester III (Second year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
1	Basic Science courses	20ABS9912	Transform Techniques and Complex Variables	3	0	0	3	30	70	100
2	Professional Core Course	20APC0201	Electrical Circuits - I	3	0	0	3	30	70	100
3	Professional Core courses	20APC0401	Electronic devices and circuits	3	0	0	3	30	70	100
4	Professional Core courses	20APC0202	Power Systems - I	3	0	0	3	30	70	100
5	Professional Core courses	20APC0203	Electrical Machines-I	3	0	0	3	30	70	100
6	Professional Core courses (LAB)	20APC0204	Electrical Circuits-I Lab	0	0	3	1.5	30	70	100
7	Professional Core courses (LAB)	20APC0404	Electronic Devices and Circuits Lab	0	0	3	1.5	30	70	100
8	Professional Core courses (LAB)	20APC0205	Electrical Machines-I Lab	0	0	3	1.5	30	70	100
	Skill oriented course*	20AHE9902	Principles of Effective Public Speaking	1	0	2	2	100		100
	Mandatory course (AICTE suggested)	20AMC9903	Environmental Studies	2	0	0	0	30		30
Total credits							21.5	370	560	930

Semester IV (Second year)

S.No	Category	Code	Course Title	Hours			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
1	Engineering Science Courses	20AES0509	Basics of Python Programming	3	0	0	3	30	70	100
2	Basic Science Course /Prof core course	20APC0206	Electrical Circuits-II	3	0	0	3	30	70	100
3	Professional Core courses	20APC0207	Electrical Machines-II	3	0	0	3	30	70	100
4	Professional Core courses	20APC0208	Engineering Electromagnetics	3	0	0	3	30	70	100
5	Humanities and Social Sciences	20AHSMB01	Managerial Economics and financial analysis	3	0	0	3	30	70	100
6	Humanities and Social Sciences	20AHS9905	Universal Human Values	3	1	0	3	30	70	100
6	Engineering Science Courses/Prof Core (Interdisciplinary) (LAB)	20AES0510	Basics of Python Programming Lab	0	0	3	1.5	30	70	100
7	Professional Core courses (LAB)	20APC0209	Electrical circuits-II Lab	0	0	3	1.5	30	70	100
8	Professional Core courses (LAB)	20APC0210	Electrical Machines-II Lab	0	0	3	1.5	30	70	100
9	Skill oriented course*	20ASC0201	Programming in MATLAB	1	0	2	2	100		100
Total credits							24.5	370	630	1000
Internship 2 Months (Mandatory) during summer vacation										
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				4	0	0	4	100		100

ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES:: TIRUPATI

AUTONOMOUS

AK 20 Regulations

Year: I B.Tech

Semester: I

Branch of Study: Common to All

Subject Code:20ABS9901	Subject Name: Algebra and Calculus	L 3	T 0	P 0	Credits:3
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Course Outcomes:

1. Develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2. Utilize mean value theorems to real life problems.
3. Familiarize with functions of several variables which is useful in optimization.
4. Students will also learn important tools of calculus in higher dimensions. Students will become familiar with 2- dimensional coordinate systems
5. Students will become familiar with 3- dimensional coordinate systems and also learn the utilization of special functions

Unit I: Matrix Operations and Solving Systems of Linear Equations **12 hrs**

Rank of a matrix by echelon form, solving system of homogeneous and non-homogeneous equations linear equations. Eigen values and Eigen vectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem,

Unit II: Quadratic Forms and Mean Value Theorems **9 hrs**

Diagonalisation of a matrix, quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical forms by orthogonal transformation.

Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders (without proof);

Unit III: Multivariable calculus **9 hrs**

Partial derivatives, total derivatives, chain rule, change of variables, Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

Unit IV: Multiple Integrals **10hrs**

Double integrals, change of order of integration, double integration in polar coordinates, change of Variables in double integration (Cartesian to polar), areas enclosed by plane curves. Evaluation of triple integrals.

Unit V: Special Functions **10 hrs**

Beta and Gamma functions and their properties, relation between beta and gamma functions, Bessel functions, Bessel's equation, Recurrence formulae or $J_n(x)$, Generating function-Orthogonality of Bessels functions.

Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.

References:

1. Dr.T.K.V Iyengar, B.Krishna Gandhi, S. Ranganatham and M.V.S.S.N Prasad, Mathematics – 1, S.Chand publications.
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
3. B.V.Ramana, Higher Engineering Mathematics, Mc Graw Hill Education.
4. N.Bali, M.Goyal, C.Watkins, Advanced Engineering Mathematics, Infinity Science Press.

List of COs	PO no. and keyword	Competency Indicator	Performance Indicator
CO1	PO1: Apply the knowledge of mathematics	1.1	1.1.1
CO2	PO1:Apply the knowledge of mathematics	1.1	1.1.1
CO3	PO1: Apply the knowledge of mathematics	1.1	1.1.1
CO4	Po2 : analyse complex engineering problems	2.1	2.1.3
CO5	Po2 : analyse complex engineering problems	2.1	2.1.3

Common to I Sem EEE

Subject Code:20ABS9902	Subject Name: Applied Physics	L 3	T 0	P 0	Credits:3
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Course Outcomes

1. Analyze the wave properties of light and the interaction of energy with the matter.
2. Apply electromagnetic wave propagation in different guided media.
3. Asses the electromagnetic wave propagation and its power in different media
4. Analyze the conductivity of semiconductors.
5. Interpret the difference between normal conductor and superconductor and apply the nanomaterials for engineering applications.

Unit I : Optics and EM Theory**10 Hrs**

Interference of light -principle of superposition-Conditions for sustained Interference-Interference in thin films (reflected light) - Newton's Rings -Determination of Wavelength.
 Diffraction-Fraunhofer diffraction- Single slit and double slit- Diffraction Grating.
 Divergence and Curl of Electric and Magnetic Fields - Gauss' theorem for divergence and Stokes' theorem for curl - Maxwell's Equations (Quantitative) – Electromagnetic wave - propagation in non-conducting medium - Poynting's Theorem.

Unit II : Lasers and Fiber Optics**10 Hrs**

Lasers – Introduction – Characteristics – Spontaneous and Stimulated Emission – Einstein Coefficients – Population Inversion – Excitation Mechanism and Optical Resonator - He-Ne Laser -Nd:YAG Laser – Semiconductor Diode Laser – Applications of Lasers and Holography.

Introduction to Optical Fibers – Total Internal Reflection – Critical angle of propagation – Acceptance angle – Numerical Aperture – Classification of fibers based on Refractive index profile – Propagation of electromagnetic wave through optical fiber – modes – importance of V-number-Attenuation, Block Diagram of Fiber optic Communication – Industrial Applications – Fiber optic Sensors.

Unit III : Dielectric and Magnetic Materials**8 Hrs**

Introduction—Dielectric polarization-Dielectric polarizability, Susceptibility and Dielectric constant-Types of polarizations : Electronic and Ionic,(Quantitative), Orientation Polarizations (Qualitative) - Frequency dependence of polarization-Lorentz (internal) field-Claussius-Mosotti equation-Applications of Dielectrics: Ferroelectricity.

Introduction-Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability- Origin of permanent magnetic moment – Classification of Magnetic materials - Weiss theory of ferromagnetism (qualitative) – Hysteresis– soft and hard magnetic materials – Magnetic memory device applications .

Unit IV: Semiconductors

8 Hrs

Origin of Energy bands (Qualitative)-Intrinsic and Extrinsic semiconductors –Direct and indirect band gap semiconductors- Density of charge carriers – Fermi energy–Dependence of Fermi energy on carrier concentration and temperature – Electrical conductivity – Drift and Diffusion currents – Continuity equation - Hall effect -Applications of Hall effect and Semiconductors.

Unit V: Superconductors and Nanomaterials

Superconductors-Properties-Meissner’s effect-BCSTheory(Qualitative) - Josephson effect (AC&DC)-Types of Superconductors-Applications of superconductors.
 Nanomaterials–Significance of nanoscale–: Physical, Mechanical, Magnetic, Optical properties of nanomaterials –Synthesis of nanomaterials:Top-down-Ball Milling, Bottom-up-Chemical vapour deposition–Characterization of nanomaterials : X-Ray Diffraction (XRD), Scanning Electron Microscope (SEM)-Applications of Nanomaterials.

Textbooks:

1. M. N. Avadhanulu, P. G. Kshirsagar &TVS Arun Murthy” A Text book of Engineering Physics”-S. Chand Publications,11th Edition2019.
2. B.K.Pandey and S.Chaturvedi, Engineering Physics, Cengage Learning,2012.

References:

1. K Thyagarajan “Engineering Physics”,-Mc Graw Hill Publishing Company Ltd, 2016
2. Shatendra Sharma, Jyotsna Sharma, “ Engineering Physics”, Pearson Education,2018
3. David J.Griffiths,“Introduction to Electrodynamics”-4/e, Pearson Education, 2014
4. T Pradeep, “A Text book of NanoScience and NanoTechnology”-Tata Mc Graw Hill 2013.

List of COs	PO no. and keyword	Competency Indicator	Performance Indicator
CO: 1	PO1 : Apply the knowledge of science	1.2	1.2.1
CO: 2	PO1: Apply the knowledge of science	1.2	1.2.1
CO: 3	PO1: Apply the knowledge of science	1.2	1.2.1
CO: 4	PO1: Apply the knowledge of science	1.2	1.2.1
CO: 5	PO1: Apply the knowledge of science	1.2	1.2.1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES: TIRUPATI

(AUTONOMOUS)

I B.Tech I SEM

Branch: Common to all

AK20 Regulations

Subject Code 20AHS9901	Subject Name COMMUNICATIVE ENGLISH	L 3	T 0	P 0	Credit: 3
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Course Objectives

1. Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
2. Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
3. Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
4. Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
5. Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

UNIT -1

10 Hours (4L+6P)

Lesson: On the Conduct of Life: William Hazlitt

Listening: Identifying the topic, the context and specific pieces of information by listening to short

audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.

Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.

Writing : Beginnings and endings of paragraphs - introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph.

Grammar and Vocabulary- I : Parts of Speech, Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countable and uncountable; singular and plural; basic sentence structures; simple question form – wh questions; word order in sentences.

Vocabulary -2: Formal/academic words and phrases.

UNIT -2

10 Hours (4L+6P)

Lesson: The Brook: Alfred Tennyson

Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts.

Speaking: Discussion in pairs/small groups on specific topics followed by short structured talks.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Writing: Paragraph writing (specific topics) using suitable cohesive devices; mechanics of writing - punctuation, capital letters.

Grammar & Vocabulary building-1: Cohesive devices - linkers, sign posts and transition signals; use of articles and zero article; prepositions.

Vocabulary building:2 Idioms and Phrases, Homonyms, Homophones and Homographs.

UNIT -3

Lesson: The Death Trap: Saki

10 Hours (4L+6P)

Listening: Listening for global comprehension and summarizing what is listened to.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed

Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension.

Writing: Summarizing – identifying main idea/s and rephrasing what is read.

Grammar and Vocabulary building-II: Direct and indirect speech, reporting verbs for academic purposes.

Technical Writing-1: personal experiences, unforgettable incidents, travelogues. (Imaginative, Narrative and Descriptive)

UNIT-4

10 Hours (4L+6P)

Lesson: Innovation: Muhammad Yunus

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions

Reading: Studying the use of graphic elements in texts to convey information, reveal trends / patterns / relationships, communicate processes or display complicated data.

Writing: Letter Writing: Official Letters/Report writing, *e-mail writing*

Grammar and Vocabulary: Quantifying expressions - adjectives and adverbs; comparing and contrasting; Voice - Active & Passive Voice.

Vocabulary:2 : Jigsaw Puzzles, Vocabulary Activities through Web tools

UNIT -5

10 Hours (4L+6P)

Lesson: Politics and the English Language: George Orwell

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.

Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides.

Reading: Reading for comprehension.

Writing: Writing structured essays on specific topics using suitable claims and evidences.

Grammar and Vocabulary: Editing short texts –identifying and correcting common errors in grammar and usage.

Technical Writing-2: Narrative short story, News paper articles on science fiction.

Course Outcomes:

Students will be able to

1. Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English
2. Apply grammatical structures to formulate sentences and correct word forms
3. Analyze discourse markers to speak clearly on a specific topic in informal discussions

4. Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.
5. Create a coherent paragraph interpreting a figure/graph/chart/table

Text Book:

1. Language and Life: A Skills Approach- I Edition 2019, Orient Black Swan

Reference Books:

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
3. Raymond Murphy’s English Grammar in Use Fourth Edition (2012) E-book
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.
5. Oxford Learners Dictionary, 12th Edition, 2011
6. Norman Lewis Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary (2014)
7. Speed Reading with the Right Brain: Learn to Read Ideas Instead of Just Words by David Butler

Web links

- www.englishclub.com
- www.easyworldofenglish.com
- www.languageguide.org/english/
- www.bbc.co.uk/learningenglish
- www.eslpod.com/index.html
- www.myenglishpages.com

List of COs	PO no. and keyword	Competency Indicator: Description	Performance Indicator: Description
CO1.	PO10-Able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	10.1	10.1.1
CO2.	PO9-Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	9.2	9.2.1
CO3.	PO10-Able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	10.1	10.1.1
CO4	PO10-Able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	10.3	10.3.1
CO5.	PO10-Able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	10.2	10.2.1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES: TIRUPATI

(AUTONOMOUS)

I B. Tech I Sem

Branch: Common to all

AK20 Regulations

Subject Code: 20AHS9902	Subject Name: Communicative English Lab	L 0	T 0	P 2	Credits: 1
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Course Objectives:

1. Students will be exposed to a variety of self instructional, learner friendly modes of language learning.
2. Students will learn better pronunciation through Phonetics.
3. Students will be trained to use language effectively to face interviews, group discussions, public speaking .
4. Students will be initiated into greater use of the computer in resume preparation, report writing, format making etc.

Syllabus

Unit 1

1. Phonetics
2. Non - verbal communication
3. Vocabulary (word formation, one word substitutes, words often misused & confused, collocations idioms & phrases)

Unit 2

1. Reading Comprehension
2. JAM
3. Distinction between Native and Indian English accent (Speeches by TED and Kalam).

Unit 3

1. Situational dialogues/Giving Directions
2. Describing objects/places/persons

Unit 4

1. Fun – Buzz (Tongue twisters, riddles, puzzles etc)
2. Formal Presentations

Unit 5

1. Debate (Contemporary / Complex topics)
2. Group Discussion

Course Outcomes

1. Create awareness on mother tongue influence and neutralize it in order to improve fluency in spoken English.
2. Understanding the different aspects of the language with emphasis on LSRW skills and make use of different strategies in discussions.
3. Improve words knowledge and apply skills in various language learning activities.
4. Analyze speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
5. Evaluate and exhibit acceptable etiquette essentials in social and professional presentations.

Software Source:

K-Van Solutions Software

Reference:

Teaching English - British Council

List of COs	PO No. and keyword	Competency Indicator: Description	Performance Indicator: Description
CO1	PO10: Able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	10.2	10.1.1
CO2	PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	9.2	9.2.1
CO3	PO10: Able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	10.2	10.2.1
CO4	PO10: Able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	10.2	10.2.1
CO5	PO10: Able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	10.2	10.2.1

Common to I Sem ECE, EEE & II Sem CSE

Subject Code:20ABS9907	Subject Name: Applied Physics Lab	L 0	T 0	P 3	Credits:1.5
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Course Outcomes

1. Analyze the wave properties of light and the interaction of energy with the matter.
2. Apply electromagnetic wave propagation in different guided media.
3. Asses the electromagnetic wave propagation and its power in different media
4. Analyze the conductivity of semiconductors.
5. Interpret the difference between normal conductor and superconductor and apply the nanomaterials for engineering applications.

List of Experiments

1. Determination of the thickness of the wire using wedge shape method.
2. Determination of the radius of curvature of the lens by Newton's ring method
3. Determination of wavelength by plane diffraction grating method
4. Dispersive power of a diffraction grating
5. Study of the Magnetic field along the axis of a circular coil carrying current.
6. Study the variation of B versus H of the magnetic material (B-H curve)
7. Determination of the numerical aperture of a given optical fiber and angle of acceptance.
8. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.
9. Determination of the energy gap of a semiconductor
10. Determination of crystallite size using X-Ray diffraction spectra.
11. Determination of Wavelength of LASER using diffraction grating.
12. Determination of particle size using LASER.
13. Determination of the resistivity of semiconductor by Four probe method.
14. Determination of dielectric constant by charging and discharging method.
15. Study the temperature dependence of resistance of a thermister.

References:

1. S. Balasubramanian, M.N.Srinivasan, "A Text book of Practical Physics"-S Chand Publishers, 2017.
2. <http://vlab.amrita.edu/index.php-VirtualLabs, Amrita> University.

List of COs	PO no. and keyword	Competency Indicator	Performance Indicator
CO: 1	PO 4: Analysis and interpretation of data	4.3	4.3.3
CO: 2	PO 4: Analysis and interpretation of data	4.3	4.3.1
CO: 3	PO 4: Analysis and interpretation of data	4.3	4.3.1
CO: 4	PO 4: Analysis and interpretation of data	4.3	4.3.2
CO: 5	PO 4: Analysis and interpretation of data	4.3	4.3.2

Subject Code 20ABS9906	Subject Name: Differential Equations and Vector Calculus	L	T	P	Credits:3
		3	0	0	

Course Outcomes:

1. Apply the mathematical concepts of ordinary differential equations of higher order.
2. Solve the differential equations related to various engineering fields.
3. Identify solution methods for partial differential equations that model physical processes.
4. Interpret the physical meaning of different operators such as gradient, curl and divergence.
5. Estimate the work done against a field, circulation and flux using vector calculus.

UNIT I: Linear Differential Equations of Higher Order

Definitions, complete solution, operator D, rules for finding complimentary function, inverse operator, rules for finding particular integral (e^{ax} , $\sin ax$ (or) $\cos ax$, X^k , $e^{ax}v$, $x v(x)$), method of variation of parameters.

UNIT II: Equations Reducible to Linear Differential Equations and Applications

simultaneous linear equations with constant coefficients, Cauchy's and Legendre's linear equations, Applications to oscillations of a spring, L-C-R Circuit problems and Mass spring system.

UNIT III: Partial Differential Equations of First order and Higher Order

Linear Equations of First order P.D.E: Method of Grouping, Method of Multipliers.

Non-linear Equations of First Order PDE: $f(p, q) = 0$, $f(z, p, q) = 0$, $f(x, p) = F(y, q)$ and $z = px + qy + f(p, q)$ OR Clairaut's Equation.

Homogenous Linear P.D.E with constant coefficients of Higher order: Finding complementary function, Finding Particular Integrals of e^{ax+by} , $\sin(ax+by)$ Or $\cos(ax+by)$, $X^m Y^n$ and for any function of $F(x, y)$. Non-Homogenous Linear P.D.E of constant coefficient

UNIT IV: Vector differentiation

Scalar and vector point functions, vector operator del, del applies to scalar point functions- Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

UNIT V: Vector integration

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and applications of these theorems.

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2011.

References:

1. Dr.T.K.V.Iyengar, Engineering Mathematics-I,S.Chand publishers
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics,Laxmi publication,2008
4. B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education.

List of COs	PO no. and keyword	Competency Indicator	Performance Indicator
CO1	PO1:Apply the knowledge of mathematics	1.1	1.1.1
CO2	PO2:Analyse complex engineering problems	2.1	2.1.3
CO3	PO1:Apply the knowledge of mathematics	1.1	1.1.1
CO4	PO1:Apply the knowledge of mathematics	1.1	1.1.1
CO5	PO2:Analyse complex engineering problems	2.1	2.1.3

Common to II Sem ECE/EEE

Subject Code 20ABS9904	Subject Name CHEMISTRY	L T P 3 0 0	Credits:3
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Course Outcomes:

1. Understand the behaviour of, and interactions between matter and energy at both the atomic and molecular levels
2. Compare the materials of construction for battery and electrochemical sensors
3. Understand the preparation, properties, and applications of thermoplastics & thermosetting, elastomers & conducting polymers.
4. HPLC and GC methods used for separation of gaseous and liquid mixtures.
5. Understand the disadvantages of using hard water and select suitable treatments domestically and industrially.

6.

Unit 1: Structure and Bonding Models**(10****hrs)**

Planck's quantum theory, Schrodinger wave equation, significance of Ψ^1 and Ψ^2 , applications to hydrogen, particle in a box and their applications for conjugated molecules, crystal field theory – salient features – energy level diagrams for transition metal ions – splitting of orbital's in tetrahedral and octahedral complexes, magnetic properties, molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of O_2 , N_2 and CO , calculation of bond order.

Unit 2: Electrochemistry and Applications**(10****hrs)**

Electrodes – concepts, reference electrodes (Calomel electrode, $Ag/AgCl$ electrode and glass electrode) electrochemical cell, Nernst equation, cell potential calculations, numerical problems, concept of pH, pH meter and applications of pH metry (acid-base titrations), potentiometry-potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations), photovoltaic cell – working and applications, photogalvanic cells with specific examples. Electrochemical sensors – potentiometric sensors with examples, amperometric sensors with examples.

Primary cells – Zinc-air battery, alkali metal sulphide batteries, Fuel cells, hydrogen-oxygen, methanol fuel cells – working of the cells.

Secondary cells – lead acid, nickel-metal hydride and lithium ion batteries- working of the batteries including cell reactions, button cells,

Unit 3: Polymer Chemistry**(10****hrs)**

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, copolymerization (stereospecific polymerization) with specific examples and mechanisms of polymer formation.

Plastics - Thermoplastics and Thermosettings, Preparation, properties and applications of – Bakelite, urea-formaldehyde, Nylon-66, carbon fibres, Elastomers–Buna-S, Buna-N–preparation, properties and applications.

Conducting polymers – polyacetylene, polyaniline, polypyrroles – mechanism of conduction and applications.

Unit 4: Instrumental Methods and Applications (10 hrs)

Principle and applications of Colorimetry, AAS, AES, UV-Visible spectrophotometry (Beer-Lambert's law, Instrumentation), Principles and applications of Chromatographic techniques (GC & HPLC), separation of gaseous mixtures and liquid mixtures (GC & HPLC methods).

Unit 5: Water Technology (10 hrs)

Introduction – Soft Water and hardness of water, Estimation of hardness by EDTA Method - Boiler troubles - scale and sludge, Industrial water treatment – specifications for drinking water, Bureau of Indian Standards (BIS) and World health organization (WHO) standards, zeolite and ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electrodialysis.

Text books:

1. Jain and Jain, Engineering Chemistry, 16/e, Dhanpat Rai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference books:

1. J. D. Lee, Concise Inorganic Chemistry, 5/e, Oxford University Press, 2008.
2. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
3. Ben L. Feringa and Wesley R. Browne, Molecular Switches, 2/e, Wiley-VCH, 2011.
4. Willard Merritt Dean Settle, 7th Edition Instrumental methods for analysis
- 5.

List of COs	PO no. and keyword	Competency Indicator	Performance Indicator
CO: 1	PO 1: Apply the knowledge of basic science	1.2	1.2.1
CO: 2	PO 1: Apply the knowledge of basic science	1.4	1.4.1
CO: 3	PO 1: Apply the knowledge of basic science	1.2	1.2.1
CO: 4	PO 4: Analyse complex engineering problems	2.4	2.4.4
CO: 5	PO 1: Apply the knowledge of Basic science	1.2	1.2.1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES: TIRUPATI**(Autonomous)****I. B.Tech****AK20 Regulations****Common to II Sem ECE/EEE**

Subject Code 20ABS9909	Subject Name CHEMISTRY LAB	L T P 0 0 3	Credits:1.5
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Course Outcomes:

1. To familiarize the students with the basic concepts of chemistry of materials
2. Prepare advanced polymer materials
3. Measure the strength of an acid present in secondary batteries
4. To familiarize with digital and instrumental methods of analysis

List of Experiments:

1. Determination of Hardness of a groundwater sample.
2. Estimation of iron (II) using Diphenylamine indicator (Dichrometry – Internal indicator method)
3. Determination of pH metric titration of strong acid vs. strong base,
4. Conductometric titration of strong acid vs. strong base
5. Determination of Fe(II) in Mohr's salt by potentiometric method.
6. Determination of percentage of Iron in Cement sample by colorimetry
7. Determination of Strength of an acid in Pb-Acid battery
8. Preparation of phenol-formaldehyde resin
9. Preparation of TiO₂/ZnO nano particles
10. Estimation of Calcium in port land Cement
11. Adsorption of acetic acid by charcoal
12. Thin layer chromatography

List of COs	PO no. and keyword	Competency Indicator	Performance Indicator
CO:1	PO 4: Analysis and interpretation of data	4.3	4.3.3
CO:2	PO 4: Analysis and interpretation of data	4.3	4.3.1
CO:3	PO 4: Analysis and interpretation of data	4.3	4.3.1
CO:4	PO 4: Analysis and interpretation of data	4.3	4.3.2

Regulations

Subject Code 20AMC9902	Subject Name CONSTITUTION OF INDIA	L 3	T 0	P 0	Credits: 0
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Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the Powers and functions of Governor, President, Judiciary.
5. Discuss the functions of local administration bodies.

Syllabus**Unit: 1****4 hrs**

History of Making of the Indian Constitution - History Drafting Committee, (Composition & Working)

Unit: 2**8 hrs**

Philosophy of the Indian Constitution - Preamble Salient Features

Unit: 3**8hrs**

Contours of Constitutional Rights & Duties - Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation - Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies - Directive Principles of State Policy - Fundamental Duties.

Unit:4**8hrs**

Organs of Governance - Parliament – Composition - Qualifications and Disqualifications - Powers and Functions - Executive, President, Governor - Council of Ministers -Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions.

Unit: 5**8hrs**

Local Administration - District's Administration head: Role and Importance - Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation - Pachayati raj: Introduction, PRI: ZillaPachayat - Elected officials and their roles, CEO ZillaPanchayat: Position and role - Block level: Organizational Hierarchy (Different departments)- Village level: Role of Elected and Appointed officials - Importance of grass root democracy.

Suggested books for reading:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

List of COs	PO no. and keyword	Competency Indicator	Performance Indicator
CO 1	PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health,safety, legal, and cultural issues and the consequent responsibilities relevant to the Professional Engineering Practice	6.2.	6.2.1
CO2	PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health,safety, legal, and cultural issues and the consequent responsibilities relevant to the Professional Engineering Practice	6.2.	6.2.1
CO3	PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health,safety, legal, and cultural issues and the consequent responsibilities relevant to the Professional Engineering Practice	6.2.	6.2.1
CO4	PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health,safety, legal, and cultural issues and the consequent responsibilities relevant to the Professional Engineering Practice	6.2.	6.2.1
CO5	PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health,safety, legal, and cultural issues and the consequent responsibilities relevant to the Professional Engineering Practice	6.2	6.1.1

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

Year: II

Semester: III

Branch of Study: EEE

COURSE CODE	COURSE TITLE	L	T	P	CREDITS
20APC0201	ELECTRICAL CIRCUITS - I	3	0	0	3

COURSE OUTCOMES:

1. Given a network, find the equivalent impedance by using network reduction techniques and determine the current through any element and voltage across and power through any element.
2. Given a circuit and the excitation, determine the real power, reactive power, power factor etc.
3. Apply the network theorems suitably.
4. Determine the Dual of the Network, develop the Cut Set and Tie-set Matrices for a given Circuit. Also understand various basic definitions and concepts.

UNIT- 1 INTRODUCTION TO ELECTRICAL & MAGNETIC CIRCUITS

Electrical Circuits: Circuit Concept – Types of elements - Source Transformation-Voltage - Current Relationship for Passive Elements. Current division and voltage division rule Kirchhoff's Laws – Network Reduction Techniques- Series, Parallel, Series Parallel, Star-to-Delta or Delta-to-Star Transformation. Examples
Definitions – Graph – Tree, Basic Cutset and Basic Tieset Matrices for Planar Networks – Loop and Nodal Methods of Analysis of Networks & Independent Voltage and Current Sources – Duality & Dual Networks. Nodal Analysis, Mesh Analysis

UNIT- 2 MAGNETIC CIRCUITS

Magnetic Circuits: Faraday's Laws of Electromagnetic Induction-Concept of Self and Mutual Inductance-Dot Convention-Coefficient of Coupling-Composite Magnetic Circuit-Analysis of Series and Parallel Magnetic Circuits, MMF Calculations.

UNIT- 3 SINGLE PHASE A.C CIRCUITS

R.M.S, Average Values and Form Factor for Different Periodic Wave Forms – Sinusoidal Alternating Quantities – Phase and Phase Difference – Complex and Polar Forms of Representations, j-Notation, Steady State Analysis of R, L and C (In Series, Parallel and Series Parallel Combinations) with Sinusoidal Excitation- Resonance - Phasor diagrams - Concept of Power Factor- Concept of Reactance, Impedance, Susceptance and Admittance- Apparent Power, Active and Reactive Power, Examples.

UNIT- 4 NETWORK THEOREMS

Superposition, Reciprocity, Thevenin's, Norton's, Maximum Power Transfer, Millmann's, Tellegen's, and Compensation Theorems for D.C and Sinusoidal Excitations.

UNIT- 5 THREE PHASE A.C. CIRCUITS

Introduction - Analysis of Balanced Three Phase Circuits – Phase Sequence- Star and Delta Connection - Relation between Line and Phase Voltages and Currents in Balanced Systems - Measurement of Active and Reactive Power in Balanced and Unbalanced Three Phase Systems. Analysis of Three Phase Unbalanced Circuits - Loop Method - Star Delta Transformation Technique – for balanced and unbalanced circuits - Measurement of Active and reactive Power – Advantages of Three Phase System.

TEXT BOOKS:

1. Fundamentals of Electric Circuits Charles K. Alexander and Matthew. N. O. Sadiku, Mc Graw Hill, 5th Edition, 2013.
2. Engineering circuit analysis William Hayt and Jack E. Kemmerly, Mc Graw Hill Company, 7th Edition, 2006.

REFERENCE BOOKS:

1. Circuit Theory Analysis & Synthesis A. Chakrabarti, Dhanpat Rai & Sons, 7th Revised Edition, 2018.
2. Network Analysis M.E Van Valkenberg, Prentice Hall (India), 3rd Edition, 1999.
3. Electrical Engineering Fundamentals V. Del Toro, Prentice Hall International, 2nd Edition, 2019.
4. Electric Circuits- Schaum's Series, Mc Graw Hill, 5th Edition, 2010.
5. Electrical Circuit Theory and Technology John Bird, Routledge, Taylor & Francis, 5th Edition, 2014.

CO No.	PO No. and keyword	Competency Indicator	Performance Indicator
CO1	PO1: Engineering knowledge	1.3	1.3.1
CO2	PO1: Engineering knowledge	1.3	1.3.1
CO3	PO2: Problem analysis	2.4	2.4.1
CO4	PO1: Engineering knowledge	1.3	1.3.1
		1.4	1.4.1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)

Year: II

Semester: III

Branch of Study: EEE

COURSE CODE	COURSE TITLE	L	T	P	CREDITS
20APC0401	ELECTRONIC DEVICES & CIRCUITS	3	0	0	3

Course Outcomes:

CO1: Understand the operation of diodes and special electronic devices.

CO2: Know operation of different rectifiers without and filters.

CO3: Understand construction, operation of BJT, FET in different configurations

CO4: Know the need of biasing and design of DC biasing circuits.

CO5: Design of amplifiers with BJTs and FETs by using small signal model

UNIT I:

PN JUNCTION DIODE & SPECIAL DIODE CHARACTERISTICS

Review of semiconductor Physics: Intrinsic & Extrinsic Semiconductors and their Fermi Levels, Open circuited p-n junction, Biased p-n junction, Current components in PN junction Diode, Diode Equation, V-I characteristics of p-n junction diode, Temperature dependence on V-I characteristics, Diode resistance, Diode capacitance.

Special Electronic Devices: Construction, Operation, V-I Characteristics of Zener diode, Breakdown mechanisms, Zener diode applications, Varactor diode, Tunnel diode, SCR, UJT.

UNIT II:

RECTIFIERS & FILTERS

Rectifiers: Introduction to DC Power supply, Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, derivations of rectifier parameters, Rectifier circuits-Operation, Input and Output waveforms.

Filters: Capacitor filter, Inductor filter, L-section filter, π -section filter, Multiple L-section and Multiple π section filter, comparison of various filter circuits in terms of ripple factors.

UNIT III:

TRANSISTOR CHARACTERISTICS

BJT: Bi-polar Junction Transistor, Transistor current components, Transistor as an amplifier, Transistor equation, Transistor configurations, Input- Output Characteristics of Transistor in Common Base, Common Emitter and Common Collector configurations, Punch through-Reach through, Photo transistor, Typical transistor junction voltage values.

FET: BJT Versus FET, Junction Field Effect Transistor JFET Types, Construction, Operation, parameters, Drain and Transfer characteristics, MOSFET Types -Enhancement and Depletion Types-Construction, Operation, Characteristics.

UNIT IV:

TRANSISTOR BIASING & THERMAL STABILIZATION

Need for biasing, operating point, Load line analysis, BJT biasing-Methods, Basic stability Fixed bias, Collector to base bias, Self-bias, Stabilization against variations in V_{BE} , I_C , and β , stability

factors, (S', S'', S'''), Bias compensation, Thermal runaway, Thermal stability.

UNIT V:

SMALL SIGNAL LOW FREQUENCY TRANSISTOR AMPLIFIER MODELS

BJT: Two port network, Transistor hybrid model, determination of h-parameters, generalized analysis of transistor amplifier model using h-parameters, analysis of CB, CE and CC amplifiers using exact analysis, approximate hybrid model, analysis of CB, CE and CC amplifiers using approximate hybrid model, Comparison of transistor amplifiers.

FET: Generalized analysis of small signal model, analysis of CG, CS and CD amplifiers, comparison of FET amplifiers.

Text Books:

1. David A. Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford University Press, 2015.
2. Thomas L. Floyd, “Electronic Devices”, 9th Edition, Pearson Education, 2013
3. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices & Circuit Theory”, 11th Edition, Pearson Education, 2013.

Reference Books:

1. Donald Neamen, “Electronic Circuits: Analysis and Design”, 3rd Edition, McGraw-Hill Education, 2011.
2. Muhammad Rashid, “Microelectronic Circuits: Analysis & Design”, 2nd Edition, Cengage Learning, 2010.
3. S. Salivahanan, N. Suresh Kumar, “Electronic Devices and Circuits”, 4th Edition, McGraw-Hill Education, 2017.

CO No.	PO No. and Keyword	Competency Indicator	Performance Indicator
CO1	PO 1: Engineering knowledge	1.3	1.3.1
	PO 2: Problem analysis	2.3	2.3.1
	PO 3: Design/Development of solutions	3.3	3.3.1
CO2	PO 1: Engineering knowledge	1.3	1.3.1
	PO 2: Problem analysis	2.3	2.3.1
	PO 3: Design/Development of solutions	3.3	3.3.1
CO3	PO 1: Engineering knowledge	1.3	1.3.1
	PO 2: Problem analysis	2.3	2.3.1
	PO 3: Design/Development of solutions	3.3	3.3.1
CO4	PO 1: Engineering knowledge	1.3	1.3.1
	PO 2: Problem analysis	2.3	2.3.1
	PO 3: Design/Development of solutions	3.3	3.3.1
CO5	PO 1: Engineering knowledge	1.3	1.3.1
	PO 2: Problem analysis	2.3	2.3.1
	PO 3: Design/Development of solutions	3.3	3.3.1

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES,
TIRUPATI (AUTONOMOUS)**

Year: II

Semester: III

Branch of Study: EEE

COURSE CODE	COURSE TITLE	L	T	P	CREDITS
20APC0202	Power Systems - I	3	0	0	3

Course Outcomes:

CO1: Acquire knowledge on thermal, gas and nuclear power plants operation.

CO2: Understand the operation of AC and DC distribution systems.

CO3: Understand the operation of Air Insulated & Gas Insulated (GIS) Substations.

CO4: Familiarize with voltage control and power factor improvement techniques.

CO5: Analyze economic aspects of power generation and different types of tariff methods.

UNIT-I:

Power Stations:

Thermal Power Station: Brief description of thermal power plant components - Line diagram of Thermal Power Station (TPS) showing paths of coal, steam, water, air, ash and flue gasses.

Nuclear Power Stations: Nuclear Fission and Chain reaction, Nuclear fuels, Principle of operation of Nuclear reactor, Reactor Components-Moderators, Control rods, Reflectors and Coolants, Radiation hazards- Shielding and Safety precautions, Types of Nuclear reactor and brief description of PWR, BWR and FBR.

Gas Power Stations: Principle of Operation and Components (Block Diagram Approach Only).

UNIT-II:

General Aspects of D.C & A.C Distribution Systems: Bulk Power Grids and Micro-grids. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Classification of Distribution Systems - Comparison of DC vs. AC and Under-Ground vs. Over - Head Distribution Systems.

UNIT-III:

Air Insulated & Gas Insulated (GIS) Substations: Classification of substations: - Indoor & Outdoor substations: Substations layout showing the location of all the substation equipment. Bus bar arrangements in the Sub-Stations: Simple arrangements like single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams. Advantages of Gas insulated substations, different types of gas insulated substations, single line diagram of gas insulated substations construction aspects of GIS, Installation and maintenance of GIS, Comparison of Air insulated substations and Gas insulated substations.

UNIT-IV:

Power Factor & Voltage Control: Causes of low power factor -Methods of Improving power factor -Phase advancing and generation of reactive KVAR using static Capacitors-Most economical power factor for constant KW load and constant KVA type loads, Numerical Problems. Methods of Voltage Control: ShuntCapacitors, SeriesCapacitors, Synchronous Capacitors, Tapchanging and BoosterTransformers.

UNIT-V:

Economic Aspects of Power Generation& Tariff: Load curve, load duration and integrated load duration curves-load, demand, diversity, capacity, utilization and plant use factors- Numerical Problems. Costs of Generation and their division into Fixed, Semi-fixed and Running Costs.

Desirable Characteristics of a Tariff Method-Tariff Methods: Flat Rate, Block- Rate, two-part, three –part, and power factor tariff methods and Numerical Problems.

TEXT BOOKS:

1. Principles of PowerSystems by V.KMehta and RohitMehta ,S.Chand Company Pvt. Ltd, New Delhi2004.
2. Electrical Power Systems, PSR. Murty, BS Publications.

REFERENCE BOOKS:

1. A Text book of Power system Engineering, R. K. Rajput, Laxmi Publications (P)Limited.
2. Electrical Power Generation, Transmission and Distribution, S.N.Singh.,PHI.
3. Electrical Power Systems by C.L.Wadhawa New Age International(P) Limited, Publishers.
4. Generation of Electrical Energy, Dr. B. R. Gupta, S.Chand.

CO No.	PO No. and keyword	Competency Indicator	Performance Indicator
CO1	PO1:Engineering knowledge	1.3	1.3.1
CO2	PO1: Engineering knowledge	1.3	1.3.1
CO3	PO2: Problem analysis	2.4	2.4.1
	PO4: Conduct investigations of complex problems	4.3	4.3.1
CO4	PO1:Engineering knowledge	1.3	1.3.1
		1.4	1.4.1
CO5	PO4: Conduct investigations of complex problems	4.3	4.3.1

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES::TIRUPATI
(AUTONOMOUS)**

Year: II

Semester: III

Branch : EEE

Course Code	Course Title	L	T	P	Credits
20APC0203	Electrical Machines-I	3	0	0	3

COURSE OUTCOMES:

CO1: Apply the concepts of magnetic circuits to compute induced EMF and force in Electro-magnetic systems.

CO2: Analyze the operation, conditions required of self excitation of DC Generators and parallel operation of DC Generators.

CO3: Distinguish the operation of various dc motors and determine the performance of DC machine using the results of tests.

CO4: Explain the principle, constructional features and evaluate the performance characteristics of single-phase transformers by conducting various tests.

CO5: Analyze the operations of Auto Transformer, Three Phase Transformer and parallel operation of Transformers.

UNIT-I: Electromechanical Energy Conversion:

Electromechanical Energy Conversion - Forces and torques in magnetic field system, Energy balance, singly excited and multiple excited magnetic systems, MMF, Flux, Reluctance, Series and Parallel Magnetic Circuits, B-H curve of magnetic materials.

UNIT-II: DC Generators:

Constructional details of a DC machine, principle of operation, armature windings and its types, EMF equation, armature reaction and its effects, commutation, methods of improving commutation, methods of excitation and classification of DC Generators, voltage build-up in a shunt generator, critical field resistance and critical speed, generator characteristics, parallel operation of DC shunt and series generators, applications of DC Generators.

UNIT-III: DC Motors:

Principle of operation, significance of back EMF, torque equations, types of DC Motors, characteristics, speed control of DC Motors, necessity of starter, 3-point and 4- point starters, Losses and efficiency, applications of DC Motors.

Testing of DC machines: Brake test, Swinburne's test, Hopkinson's test, Fields test, Separation of iron and frictional losses.

UNIT-IV : Transformers:

Constructional features, principle of operation, EMF equation, ideal transformer, transformer on No load and ON load and its phasor diagrams, equivalent circuit, voltage regulation, losses and efficiency. Testing of transformer - polarity test, open circuit and short circuit tests, Sumpner's test, separation losses.

UNIT-V:

Parallel operation of single-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer.

Three-phase transformer – construction, types of connection and their comparative features, Phase conversion - Scott connection, three-phase to six-phase conversion.

TEXT BOOKS:

1. P.S. Bimbhra, Electrical Machinery, Khanna Publishers, 7th Edition, Delhi, 2011.
2. R.K. Rajput, Electrical Machines in S.I. Units, Laxmi Publications (P) Ltd, 6th Edition, New Delhi, 2017.
3. JB Gupta, Theory and performance of Electrical Machines(DC machines, Poly phase Circuits & AC machines) in SI Units, S.K. Kataria & Sons, New Delhi, 15th Edition, 2015.

REFERENCE BOOKS:

1. Electrical Machines by U A Bakshi and M V Bakshi, Technical Publications.
2. B.L. Theraja and A.K. Theraja, *A Text Book of Electrical Technology (in S. I. Units)*, Vol.2, S. Chand & Company Ltd, Multicolour illustrative Edition, New Delhi, 2014.

ADDITIONAL LEARNING RESOURCES:

1. <http://www.nptelvideos.in/2012/11/electrical-machines-i.html>
2. <https://nptel.ac.in/courses/108/102/108102146/>
3. <https://freevidelectures.com/course/3085/electrical-machines-i>
4. <https://www.youtube.com/playlist?list=PL9RcWoqXmzaJpnkjoNleyFNgGk9-znOji>

CO No.	PO No. and keyword	Competency Indicator	Performance Indicator
CO1	PO1: Engineering knowledge	1.3	1.3.1
CO2	PO1: Engineering knowledge	1.3	1.3.1
CO3	PO2: Problem analysis	2.4	2.4.1
	PO4: Conduct investigations of complex problems	4.3	4.3.1
CO4	PO1: Engineering knowledge	1.3	1.3.1
		1.4	1.4.1
CO5	PO4: Conduct investigations of complex problems	4.3	4.3.1

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

Year: II

Semester: III

Branch of Study: EEE

COURSE CODE	COURSE TITLE	L	T	P	CREDITS
20APC0204	ELECTRICAL CIRCUITS-I LAB	0	0	3	1.5

COURSE OUTCOMES:

1. Remember, understand and apply various theorems and verify practically.
2. Understand and analyze active, reactive power measurements in three phase balanced & un balanced circuits.

List of Experiments:

1. Verification of Ohm law.
2. Verification of KVL and KCL.
3. Verification of Mesh and Nodal Analysis.
4. Verification of Thevenin's and Norton's Theorems
5. Verification of Superposition Theorem for average and rms values.
6. Maximum Power Transfer Theorem for DC circuits.
7. Verification of Reciprocity Theorem for DC circuits.
8. Verification of Compensation Theorem for DC circuits.
9. Verification of, Millmann's Theorems for DC circuits
10. Determination of Self, Mutual Inductances and Coefficient of Coupling.
11. Measurement of Active Power for Star Connected Balanced Loads.
12. Measurement of Reactive Power for Star Connected Balanced Loads.
13. Measurement of Active Power for Delta Connected Balanced Loads.
14. Measurement of Reactive Power for Delta Connected Balanced Loads.

REFERENCE BOOKS:

1. Circuit Theory Analysis & Synthesis A. Chakrabarti, Dhanpat Rai & Sons, 7th Revised Edition, 2018.
2. Network Analysis M.E Van Valkenberg, Prentice Hall (India), 3rd Edition, 1999.
3. Electrical Engineering Fundamentals V. Del Toro, Prentice Hall International, 2nd Edition, 2019.
4. Electric Circuits- Schaum's Series, Mc Graw Hill, 5th Edition, 2010.
5. Electrical Circuit Theory and Technology John Bird, Routledge, Taylor & Francis, 5th Edition, 2014.

CO No.	PO No. and keyword	Competency Indicator	Performance Indicator
			2.3.2
CO1	PO1: Engineering knowledge	1.3	1.3.1
	PO4: Conduct investigations of complex problems	4.3	4.3.1
CO2	PO4: Conduct investigations of complex problems	4.3	4.3.1

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES,
TIRUPATI (AUTONOMOUS)**

Year: II

Semester: III

Branch of Study: EEE

COURSE CODE	COURSE TITLE	L	T	P	CREDITS
20APC0404	ELECTRONIC DEVICES & CIRCUITS LAB	0	0	3	1.5

Course Outcomes:

- CO1:** Test and operate diodes and special electronic devices.
CO2: Construct and operate rectifiers without and with filters.
CO3: Construct and operate BJT, FET in different configurations.
CO4: Design DC biasing circuits for Transistors.
CO5: Design amplifiers using BJTs and FETs.

LIST OF EXPERIMENTS:

1. PN Junction Diode Characteristics
2. Zener Diode Characteristics and Zener Diode as Voltage Regulator.
3. Rectifiers (With and Without Filter).
4. BJT Characteristics (CB Configuration).
5. BJT Characteristics (CE Configuration).
6. FET Characteristics (CS Configuration).
7. SCR Characteristics
8. Transistor Biasing
9. BJT-CE Amplifier
10. Emitter Follower-CC Amplifier
11. FET-CS Amplifier
12. UJT Characteristics

EQUIPMENT REQUIRED FOR LABORATORY

1. Regulated Power supplies
2. Analog/Digital Storage Oscilloscopes
3. Analog/Digital Function Generators
4. Digital Multimeters
5. Decade Résistance Boxes/Rheostats
6. Decade Capacitance Boxes
7. Ammeters (Analog or Digital)
8. Voltmeters (Analog or Digital)
9. Active & Passive Electronic Components
10. Bread Boards
11. Connecting Wires
12. CRO Probes etc.

CO No.	PO No. and Keyword	Competency Indicator	Performance Indicator
CO1	PO 1: Engineering knowledge	1.3	1.3.1
CO2	PO 2: Problem analysis	2.3	2.3.1
CO3	PO 2: Problem analysis	2.3	2.3.1
CO4	PO 3: Design/Development of solutions	3.3	3.3.1
CO5	PO 3: Design/Development of solutions	3.3	3.3.1

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES::TIRUPATI
(AUTONOMOUS)**

Year: II

Semester: III

Branch: EEE

Course Code	Course Title	L	T	P	Credits
20APC0205	Electrical Machines-I Lab	0	0	3	1.5

Course Outcomes:

1. Conduct and analyze load test on DC shunt generator.
2. Understand and analyze magnetization characteristics of DC shunt generator.
3. Understand and analyze speed control techniques and efficiency of DC machines.
4. Understand to predetermine efficiency and regulation of single-phase Transformers.

List of Experiments:

Minimum ten experiments from the following list are required to be conducted

1. Magnetization characteristics of DC shunt generator. Determination of critical field resistance and critical speed.
2. Load test on DC shunt generator. Determination of characteristics.
3. Brake test on DC shunt motor. Determination of performance curves.
4. Swinburne's test on DC shunt motor, Predetermination of efficiency.
5. Speed control of DC shunt motor (Armature control and Field control method).
6. Hopkinson's tests on DC shunt machines. Predetermination of efficiency.
7. OC and SC test on single phase transformer.
8. Parallel operation of single phase transformers.
9. Sumpner's test on single phase transformers.
10. Load test on DC long shunt compound generator. Determination of characteristics.
11. Load test on DC short shunt compound generator. Determination of characteristics.
12. Separation of losses in DC shunt motor.
13. Separation of losses of single phase transformer

References:

D. P. Kothari and B. S. Umre, Laboratory Manual for Electrical Machines, I.K International Publishing House Pvt. Ltd., 2017

Online Learning Resources/Virtual Labs:

[http://em-coep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical Engineering](http://em-coep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical%20Engineering)

http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/experimentlist.html

CO No.	PO No. and keyword	Competency Indicator	Performance Indicator
CO1	PO1: Engineering knowledge	1.3	1.3.1
		1.4	1.4.1
CO2	PO2: Problem analysis	2.3	2.3.1
			2.3.2
CO3	PO1: Engineering knowledge	1.3	1.3.1
	PO4: Conduct investigations of complex problems	4.3	4.3.1
CO4	PO4: Conduct investigations of complex problems	4.3	4.3.1

COURSE CODE	COURSE TITLE	L	T	P	CREDITS
20AMC9902	ENVIRONMENTAL STUDIES	3	0	0	0

Course Outcomes

1. Students get sufficient information that clarifies modern environmental concepts like equitable use of natural resources, more sustainable life styles etc.
2. Students realize the need to change their approach, so as to perceive our own environmental issues correctly, using practical approach based on observation and self learning.
3. Students become conversant with the fact that there is a need to create a concern for our environment that will trigger pro-environmental action; including simple activities we can do in our daily life to protect it.
4. . Interpretation of different types of environmental pollution problems and designing of new solid waste management techniques usage
5. To get knowledge on various environmental acts and to engage all the students life - long learning of rain water harvesting

UNIT – I**18Hr**

Multidisciplinary Nature of Environmental Studies: Introduction – Multidisciplinary Nature of Environmental Studies – Definition, Scope and Importance – Need for Public Awareness.

Natural Resources: Renewable and non-renewable energy resources – Natural resources and associated problems.

Forest resources: Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people.

Water resources: Use and over utilization of surface and sub-surface – Floods, drought, conflicts over water, dams – benefits and problems.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticides problems, water logging, salinity, case studies.

Energy resources: Renewable and non-renewable energy resources.

UNIT – II**20Hr**

Ecosystems: Concept of an ecosystem. – Structure and functions of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Biodiversity And Its Conservation : Introduction- Definition: genetic, species and ecosystem diversity – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man – wildlife conflicts – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III**10Hr**

Environmental Pollution: Definition, Causes, effects and its control measures of : Air Pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and Nuclear hazards.

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone, Tsunami and landslides.

UNIT – IV**15Hr**

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting and watershed management – Resettlement and rehabilitation of people – Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies– Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Public awareness.

UNIT – V**10Hr**

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmed. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

TEXT BOOKS:

1. Text book of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, Universities Press.
2. Environmental Studies by Kaushik, New Age Publishers.
3. Environmental Studies by Sri Krishna Hitech publishing Pvt. Ltd.

REFERENCES:

1. Environmental studies by R.Rajagopalan, Oxford University Press.
2. Comprehensive Environmental studies by J.P.Sharma, Laxmi publications.
3. Introduction to Environmental engineering and science by Gilbert M. Masters and Wendell P. Ela - Printice hall of India Private limited.
4. Environmental studies by A. Ravi Krishnan, G. Sujatha Sri Krishna Hitech publications.

List of COs	PO no. and keyword	Competency Indicator	Performance Indicator
CO:1	PO1:Apply the knowledge of Basic science	1.2	1.2.1
CO:2	PO1:Apply the knowledge of Basic science	1.2	1.2.1
CO:3	PO1:Apply the knowledge of Basic science	1.2	1.2.1
CO:4	PO1:Apply the knowledge of Basic science	1.2	1.2.1
CO:5	PO1:Apply the knowledge of Basic science	1.2	1.2.1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES::TIRUPATI
(Autonomous)

Year: II

Semester: IV

Branch: EEE

COURSE CODE	COURSE TITLE	L	T	P	CREDITS
20AES0509	BASICS OF PYTHON PROGRAMMING	3	0	0	0

Course Outcomes (CO):

CO1: Apply the features of Python language in various real applications.

- Select appropriate data structure of Python for solving a problem.
- Design object oriented programs using Python for solving real-world problems.

CO2: Apply modularity to programs.

UNIT – I

9 Hrs

Introduction: What is a program, Running python, Arithmetic operators, Value and Types.

Variables, Assignments and Statements: Assignment statements, Script mode, Order of operations, string operations, comments. Functions: Function calls, Math functions,

Composition, Adding new Functions, Definitions and Uses, Flow of Execution, Parameters and Arguments, Variables and Parameters are local, Stack diagrams, Fruitful Functions and Void Functions, Why Functions.

UNIT – II

9 Hrs

Case study: The turtle module, Simple Repetition, Encapsulation, Generalization, Interface design, Refactoring, docstring. Conditionals and Recursion: floor division and modulus, Boolean expressions, Logical operators, Conditional execution, Alternative execution, Chained conditionals, Nested conditionals, Recursion, Infinite Recursion, Keyboard input. Fruitful Functions: Return values, Incremental development, Composition, Boolean functions, more recursion, Leap of Faith, Checking types

UNIT – III

8 Hrs

Iteration: Reassignment, Updating variables, The while statement, Break, Square roots, Algorithms. Strings: A string is a sequence, len, Traversal with a for loop, String slices, Strings are immutable, Searching, Looping and Counting, String methods, The in operator, String comparison. Case Study: Reading word lists, Search, Looping with indices. Lists: List is a sequence, Lists are mutable, Traversing a list, List operations, List slices, List methods, Map filter and reduce, Deleting elements, Lists and Strings, Objects and values, Aliasing, List arguments.

UNIT – IV

8 Hrs

Dictionaries: A dictionary is a mapping, Dictionary as a collection of counters, Looping and dictionaries, Reverse Lookup, Dictionaries and lists, Memos, Global Variables. Tuples: Tuples are immutable, Tuple Assignment, Tuple as Return values, Variable-length argument tuples, Lists and tuples, Dictionaries and tuples, Sequences of sequences. Files: Persistence, Reading and writing, Format operator, Filename and paths, Catching exceptions, Databases, Pickling, Pipes, Writing modules. Classes and Objects: Programmer-defined types, Attributes, Instances as Return values, Objects are mutable, Copying.

UNIT – V

10 Hrs

Classes and Functions: Time, Pure functions, Modifiers, Prototyping versus Planning Classes and Methods: Object oriented features, Printing objects, The init method, The __str__ method, Operator overloading, Type-based Dispatch, Polymorphism, Interface and Implementation Inheritance: Card objects, Class attributes, Comparing cards, decks, Printing the Deck, Add Remove shuffle and sort, Inheritance, Class diagrams, Data encapsulation. The Goodies: Conditional expressions, List comprehensions, Generator expressions, any and all, Sets, Counters, defaultdict, Named tuples, Gathering keyword Args

Textbooks:

1. Allen B. Downey, “Think Python”, 2nd edition, SPD/O’Reilly, 2016.

Reference Books:

1. Martin C.Brown, “The Complete Reference: Python”, McGraw-Hill, 2018.
2. Kenneth A. Lambert, B.L. Juneja, “Fundamentals of Python”, CENGAGE, 2015.
3. R. Nageswara Rao, “Core Python Programming”, 2nd edition, Dreamtech Press, 2019

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES,
TIRUPATI (AUTONOMOUS)**

Year: II

Semester: IV

Branch of Study: EEE

COURSE CODE	COURSE TITLE	L	T	P	CREDITS
20APC0209	ELECTRICAL CIRCUITS-II LAB	0	0	3	1.5

COURSE OUTCOMES:

1. Able to understand simulation programs for DC circuit analysis using PSPICE.
2. Understand and compare basic electric circuit theorems with actual working circuits.
3. Design and understand RLC series and parallel circuits and its resonance condition.
4. Able to measure power in three phase circuits in day to day life.
5. Characterize and model the network in terms of all network parameters.

List of Experiments

1. Simulation of DC Circuits
2. DC Transient Response
3. Mesh Analysis in p-spice
4. Nodal Analysis in p-spice
5. Measure and calculate RC time constant for a given RC circuit.
6. Measure and calculate RL time constant for a given RL circuit.
7. Frequency response of RLC Series Circuits
8. Analysis of RL and RC Series circuits for DC Excitation
9. Analysis of RL and RC Series circuits for AC Excitation
10. Verification of the maximum power dissipation (plot the power dissipated versus the load).
11. Measure and calculate Z, Y parameters of two-port network.
12. Measure and calculate ABCD & h parameters of two-port network.

REFERENCES:

1. Simulation of Power Electronics Circuit, M B Patil, V Ramanarayan and V T Ranganat, Alpha Science International Ltd., 2009.
2. Public Domain Simulator: [http:// www.ee.iitb.ac.in/~sequel](http://www.ee.iitb.ac.in/~sequel)
3. PSPICE A/D user's manual – Microsim, USA.
4. PSPICE reference guide – Microsim, USA.

CO No.	PO No. and keyword	Competency Indicator	Performance Indicator
CO1	PO1: Engineering knowledge	1.3	1.3.1
CO2	PO1: Engineering knowledge	1.3	1.3.1
CO3	PO2: Problem analysis	2.4	2.4.1
	PO4: Conduct investigations of complex problems	4.3	4.3.1
CO4	PO1: Engineering knowledge	1.3	1.3.1
		1.4	1.4.1
CO5	PO4: Conduct investigations of complex problems	4.3	4.3.1

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES::TIRUPATI
(AUTONOMOUS)**

Year: II

Semester: IV

Branch: EEE

Course Code	Course Title	L	T	P	Credits
20APC0210	Electrical Machines-II Lab	0	0	3	1.5

Course Outcomes:

1. Analyze and apply load test, no-load and blocked-rotor tests for construction of circle diagram and equivalent circuit determination in a single-phase induction motor.
2. Predetermine regulation of a three-phase alternator by synchronous impedance & m.m.f methods.
3. Predetermine the regulation of Alternator by Zero Power Factor method X_d and X_q determination of salient pole synchronous machine.
4. Evaluate and analyze V and inverted V curves of 3 phase synchronous motor.

List of Experiments:

All the following ten experiments are required to be conducted:

1. No-load & Blocked-rotor tests on 3- ϕ Induction motor.
2. Brake Test on Three Phase Induction Motor.
3. Speed control of three phase induction motor.
4. Separation of no-load losses of three phase induction motor.
5. Determination of Equivalent circuit of a single phase induction motor.
6. Load test on single phase induction motor.
7. Predetermination of Regulation of a three phase alternator by synchronous impedance & m.m.f methods.
8. Predetermination of Regulation of three-phase alternator by Z.P.F. method.
9. Determination of X_d and X_q of a salient pole synchronous machine by slip test.
10. V and inverted V curves of a 3-phase synchronous motor.

References:

1. D. P.Kothari and B. S. Umre, "Laboratory Manual for Electrical Machines" I.K International Publishing House Pvt. Ltd, 2017.
2. D.R. Kohli and S.K. Jain, "A Laboratory Course in Electrical Machines" NEM Chand & Bros.

Online Learning Resources/Virtual Labs:

<http://vem-iitg.vlabs.ac.in/>

[http://em-coep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical Engineering](http://em-coep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical%20Engineering)

http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/experimentlist.html.

CO No.	PO No. and keyword	Competency Indicator	Performance Indicator
CO1	PO1: Engineering knowledge	1.3	1.3.1
CO2	PO1: Engineering knowledge	1.3	1.3.1
CO3	PO2: Problem analysis	2.4	2.4.1
	PO4: Conduct investigations of complex problems	4.3	4.3.1
CO4	PO4: Conduct investigations of complex problems	4.3	4.3.1

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

Year:II

Semester:IV

Branch of Study :EEE

COURSE CODE	COURSE TITLE	L	T	P	CREDITS
20APC0208	Engineering Electromagnetics	3	0	0	3

Course Outcomes:

1. Analyze the different aspects related to Static Electric Fields equations.
2. Understand the concept of Conductors, Dipole, Dielectric & Capacitance.
3. Learns the fundamental laws related to Magneto statics.
4. Understand the concepts of Magnetic forces and Magnetic potential.
5. Learns the fundamentals of Time Varying Fields.

UNIT – I

Electrostatics:

Electrostatic Fields -Coulomb's Law – Electric Field Intensity (EFI) – EFI due to a line and a surface charge –Electric flux density – Gauss's law – Application of Gauss's Law –Work done in moving a point charge in an electric field – Electric Potential – Potential gradient – Energy density in electric field - Related Problems. Maxwell's First Law – Numerical Problems-

UNIT – II

Conductors, Dipole, Dielectric & Capacitance:

Laplace's and Poisson's equations – electric dipole – Conduction current and current density – Ohm's law in point form – Conductors and Insulators - Electric field inside a dielectric material – Polarization – Dielectric – Conductor and Dielectric – Dielectric boundary conditions - Capacitance – Capacitance of parallel plate , co-axial and spherical capacitors with composite dielectrics - Related Problems.

UNIT – III

Magneto Statics:

Biot-Savart's law – Magnetic field intensity (MFI) – MFI due to a straight current carrying filament – MFI due to circular, square and solenoid current – Carrying wire – Relation between magnetic flux, magnetic flux density and MFI – Maxwell's second Equation, $\text{div}(\mathbf{B})=0$. Ampere's circuital law and its applications viz. MFI due to an infinite sheet of current and a long current carrying filament – Point form of Ampere's circuital law - Related Problems.

UNIT – IV

Magnetic Forces:

Forces due to magnetic field – force on a charged particle – force on a current element – force between two current element – magnetic torque and moment – Magnetic Dipole - Related Problems.

Magnetic Potential:

Scalar magnetic potential and vector magnetic potential – classification of magnetic materials – Self and Mutual inductances – Self inductances of a coaxial cable, solenoid, toroid and two wire transmission line – Mutual inductance between a two co-axial solenoids and two coils wound on the same magnetic circuit – Energy stored in a magnetic field - Related Problems.

UNIT – V

Time Varying Fields

Faraday's law in integral form and in differential form –Maxwell's fourth equation. Statically and Dynamically Induced E.M.F'S-simple problems–Modification of Maxwell's equations for time varying fields – Displacement current- Poynting Theorem and Poynting vector - Related Problems.

TEXT BOOKS:

1. Elements of Electromagnetics – by Matthew N O Sadiku, Oxford University Press, 3rd Edition 2004 .
2. Engineering Electromagnetic – by W H hayt and J A Buck, TATA Mc-graw-hill Education – 7th Edition 2006.

REFERENCE BOOKS:

- 1 Engineering Electromagnetics – by Nathan Ida, Springer (India) Pvt. Ltd., New Delhi, 2nd Edition 2005
- 2 Introduction to Electro Dynamics - by D.J. Griffiths, PHI.
- 3 Electromagnetics – Theory and problems by Joseph A. Edminister, 2nd edition.,1993, Schaum's outline series, Mc-Graw Hill

CO No.	PO No. and keyword	Competency Indicator	Performance Indicator
CO1	PO1: Engineering knowledge	1.3	1.3.1
CO2	PO1: Engineering knowledge	1.3	1.3.1
CO3	PO2: Problem analysis	2.4	2.4.1
CO4	PO1: Engineering knowledge	1.3	1.3.1
		1.4	1.4.1
CO5	PO1: Engineering knowledge	1.4	1.4.1

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

Year: II

Semester: IV

Branch of Study: Common to all

Course Code	MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS	L	T	P	C
20HSMB01		3	0	0	3
Course Outcomes (CO):					
CO1: Understand the fundamentals of Economics and Managerial economics viz., Demand, Production, cost, revenue and markets. CO2: Apply the Concept of Production cost and revenues for effective Business decision CO3: Analyze how to invest their capital and maximize returns. CO4: Evaluate the capital budgeting techniques. CO5: Define the concepts related to financial accounting and management and able to develop the Accounting statements and evaluate the financial performance of business entity.					
UNIT - I	Managerial Economics				
Introduction – meaning, nature, significance, functions, and advantages, ME and its role in other fields. Demand - Concept, Function, Law of Demand - Demand Elasticity- Types – Measurement. Demand Forecasting- Factors governing forecasting, Methods.					
UNIT - II	Production and Cost Analysis				
Introduction – Nature, meaning, significance, functions and advantages. Production Function– Least-cost combination– Short run and Long run Production Function- Isoquants and Isocosts, MRTS - Cobb-Douglas Production Function - Laws of Returns - Internal and External Economies of scale. Cost & Break-Even Analysis - Cost concepts and Cost behavior- Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems)-Managerial significance and limitations of Break-Even Analysis.					
UNIT - III	Business Organizations and Markets				
Introduction – Nature, meaning, significance, functions and advantages. Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises. Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition Monopoly- Monopolistic Competition–Oligopoly-Price-Output Determination - Pricing Methods and Strategies.					
UNIT - IV	Capital Budgeting				
Introduction to Capital, Sources of Capital. Short-term and Long-term Capital : Working capital, types, Estimating Working capital requirements. Capital Budgeting – Features, Proposals, Time value of money. Methods and Evaluation of Projects – Pay Back Method, Accounting Rate of Return (ARR), Net Present Value (NPV), and Internal Rate Return (IRR) Method (simple problems).					
UNIT - V	Financial Accounting and Analysis				
Introduction – Nature, meaning, significance, functions and advantages. Concepts and Conventions- Double-Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). <i>Financial Analysis</i> - Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.					

Textbooks:

1. Varshney&Maheswari: Managerial Economics, Sultan Chand, 2013.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH, 2019

Reference Books:

1. Ahuja HI Managerial economics Schand,3/e,2013
2. S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International, 2013.
3. Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4. Domnick Salvatore: Managerial Economics in a Global Economy, Cengage,2013.

Online Learning Resources:

<https://www.slideshare.net/123ps/managerial-economics-ppt>
<https://www.slideshare.net/rossanz/production-and-cost-45827016>
<https://www.slideshare.net/darkyla/business-organizations-19917607>
<https://www.slideshare.net/balarajbl/market-and-classification-of-market>
<https://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396>
<https://www.slideshare.net/ashu1983/financial-accounting>.

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES: TIRUPATI
(AUTONOMOUS)
AK20 Regulations**

II B.Tech

Branch Common to all

COURSE CODE	COURSE TITLE	L	T	P	CREDITS
20AHA9905	Universal Human Values	3	0	0	3

Course Objectives

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

UNIT – 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration
- Continuous Happiness and Prosperity- A look at basic Human Aspirations
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
- Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT II: Understanding Harmony in the Human Being - Harmony in Myself!

- Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’
- Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility
- Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of ‘I’ and harmony in ‘I’
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

UNIT III: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship.

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
- Understanding the meaning of Trust; Difference between intention and competence
- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
- Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

UNIT IV: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

- Understanding the harmony in the Nature
- Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature
- Understanding Existence as Co-existence of mutually interacting units in all- pervasive space
- Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT- V: Implications of the above Holistic Understanding of Harmony on Professional Ethics.

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
b. At the level of society: as mutually enriching institutions and organizations
- Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Course Outcomes:

On completion of this course, the students will be able to

1. Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. They would have better critical ability.
4. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

TEXT BOOKS

1. R R Gaur, R Asthana, G P Bagaria, “A Foundation Course in Human Values and Professional Ethics”, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. R R Gaur, R Asthana, G P Bagaria, “Teachers’ Manual for A Foundation Course in Human Values and Professional Ethics”, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

REFERENCE BOOKS

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantik, 1999.
2. A. N. Tripathi, “Human Values”, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi “The Story of My Experiments with Truth”
5. E. F. Schumacher. “Small is Beautiful”
6. Slow is Beautiful –Cecile Andrews
7. J C Kumarappa “Economy of Permanence”
8. Pandit Sunderlal “Bharat Mein Angreji Raj”
9. Dharampal, “Rediscovering India”
10. Mohandas K. Gandhi, “Hind Swaraj or Indian Home Rule”
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland(English)
13. Gandhi - Romain Rolland (English)

List of COs	PO no. and keyword	Competency Indicator	Performance Indicator
CO 1	PO 7: Environment and sustainability : Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development	7.1	7.1.2
CO 2	PO 7: Environment and sustainability : Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development	7.1	7.1.2
CO 3	PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	8.1 8.2	8.1.1 8.2.2
CO 4	PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	8.1 8.2	8.1.1 8.2.2
CO5	PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	8.1 8.2	8.1.1 8.2.2

Course Code	Basics of Python Programming Lab		L	T	P	C
20AES0510			0	0	3	1.5
Pre-requisite	Nil	Semester	I-II and II-I			
Course Objectives:						
<ul style="list-style-type: none"> • To train the students in solving computational problems • To elucidate solving mathematical problems using Python programming language • To understand the fundamentals of Python programming concepts and its applications. • To understand the object-oriented concepts using Python in problem solving. 						
Course Outcomes (CO):						
<ul style="list-style-type: none"> • Write, Test and Debug Python Programs • Implement Conditionals and Loops for Python Programs • Use functions and represent Compound data using Lists, Tuples and Dictionaries • Read and write data from & to files in Python and develop Application using Pygame 						
List of Experiments:						
<p>1. Install Python Interpreter and use it to perform different Mathematical Computations. Try to do all the operations present in a Scientific Calculator</p> <p>2. Write a function that draws a grid like the following:</p> <pre> + - - - - + - - - - + + - - - - + - - - - + + - - - - + - - - - + </pre> <p>3. Write a function that draws a Pyramid with # symbols</p> <pre> # # # # # # # # # # # # # </pre> <p>Up to 15 hashes at the bottom</p> <p>4. Using turtles concept draw a wheel of your choice</p> <p>5. Write a program that draws Archimedean Spiral</p> <p>6. The letters of the alphabet can be constructed from a moderate number of basic elements, like vertical and horizontal lines and a few curves. Design an alphabet that can be drawn with a minimal number of basic elements and then write functions that draw the letters. The alphabet can belong to any Natural language excluding English. You should consider at least Ten letters of the alphabet.</p> <p>7. The time module provides a function, also named time that returns the current Greenwich Mean Time in “the epoch”, which is an arbitrary time used as a reference point. On UNIX systems, the</p>						

epoch is 1 January 1970.

```
>>> import time
>>> time.time()
1437746094.5735958
```

Write a script that reads the current time and converts it to a time of day in hours, minutes, and seconds, plus the number of days since the epoch.

8. Given $n+r+1 \leq 2r$. n is the input and r is to be determined. Write a program which computes minimum value of r that satisfies the above.

9. Write a program that evaluates Ackermann function

10. The mathematician Srinivasa Ramanujan found an infinite series that can be used to generate a numerical approximation of $1/\pi$: Write a function called `estimate_pi` that uses this formula to compute and return an estimate of π .

$$\frac{1}{\pi} = \frac{2\sqrt{2}}{9801} \sum_{k=0}^{\infty} \frac{(4k)!(1103 + 26390k)}{(k!)^4 396^{4k}}$$

It should use a while loop to compute terms of the summation until the last term is smaller than $1e^{-15}$ (which is Python notation for 10^{-15}). You can check the result by comparing it to `math.pi`.

11. Choose any five built-in string functions of C language. Implement them on your own in Python. You should not use string related Python built-in functions.

12. Given a text of characters, Write a program which counts number of vowels, consonants and special characters.

13. Given a word which is a string of characters. Given an integer say 'n', Rotate each character by 'n' positions and print it. Note that 'n' can be positive or negative.

14. Given rows of text, write it in the form of columns.

15. Given a page of text. Count the number of occurrences of each letter (Assume case insensitivity and don't consider special characters). Draw a histogram to represent the same

16. Write program which performs the following operations on list's. Don't use built-in functions

- a) Updating elements of a list
- b) Concatenation of list's
- c) Check for member in the list
- d) Insert into the list
- e) Sum the elements of the list
- f) Push and pop element of list
- g) Sorting of list
- h) Finding biggest and smallest elements in the list
- i) Finding common elements in the list

17. Write a program to count the number of vowels in a word.

18. Write a program that reads a file, breaks each line into words, strips whitespace and punctuation from the words, and converts them to lowercase.

19. Go to Project Gutenberg (<http://gutenberg.org>) and download your favorite out-of-copyright book in plain text format. Read the book you downloaded, skip over the header information at the beginning of the file, and process the rest of the words as before. Then modify the program to count the total number of

words in the book, and the number of times each word is used. Print the number of different words used in the book. Compare different books by different authors, written in different eras.

20. Go to Project Gutenberg (<http://gutenberg.org>) and download your favorite out-of-copyright book in plain text format. Write a program that allows you to replace words, insert words and delete words from the file.

21. Consider all the files on your PC. Write a program which checks for duplicate files in your PC and displays their location. Hint: If two files have the same checksum, they probably have the same contents.

22. Consider turtle object. Write functions to draw triangle, rectangle, polygon, circle and sphere. Use object oriented approach.

23. Write a program illustrating the object oriented features supported by Python.

24. Design a Python script using the Turtle graphics library to construct a turtle bar chart representing the grades obtained by N students read from a file categorizing them into distinction, first class, second class, third class and failed.

25. Design a Python script to determine the difference in date for given two dates in YYYY:MM:DD format($0 \leq \text{YYYY} \leq 9999$, $1 \leq \text{MM} \leq 12$, $1 \leq \text{DD} \leq 31$) following the leap year rules.

26. Design a Python Script to determine the time difference between two given times in HH:MM:SS format. ($0 \leq \text{HH} \leq 23$, $0 \leq \text{MM} \leq 59$, $0 \leq \text{SS} \leq 59$)

References:

- Allen B. Downey , “ Think Python: How to Think Like a Computer Scientist”, Second Edition, Updated for Python 3, Shroff/O’Reilly Publishers, 2016.
- Shroff “Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
- David M.Baezly “Python Essential Reference”. Addison-Wesley Professional; Fourth edition, 2009.
- David M. Baezly “Python Cookbook” O’Reilly Media; Third edition (June 1, 2013).

Online Learning Resources/Virtual Labs:

<http://www.edx.org>

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

Year: II

Semester: IV

Branch of Study: EEE

COURSE CODE	COURSE TITLE	L	T	P	CREDITS
20APC0209	ELECTRICAL CIRCUITS-II LAB	0	0	3	1.5

COURSE OUTCOMES:

6. Able to understand simulation programs for DC circuit analysis using PSPICE.
7. Understand and compare basic electric circuit theorems with actual working circuits.
8. Design and understand RLC series and parallel circuits and its resonance condition.
9. Able to measure power in three phase circuits in day to day life.
10. Characterize and model the network in terms of all network parameters.

List of Experiments

13. Simulation of DC Circuits
14. DC Transient Response
15. Mesh Analysis in p-spice
16. Nodal Analysis in p-spice
17. Measure and calculate RC time constant for a given RC circuit.
18. Measure and calculate RL time constant for a given RL circuit.
19. Frequency response of RLC Series Circuits
20. Analysis of RL and RC Series circuits for DC Excitation
21. Analysis of RL and RC Series circuits for AC Excitation
22. Verification of the maximum power dissipation (plot the power dissipated versus the load).
23. Measure and calculate Z, Y parameters of two-port network.
24. Measure and calculate ABCD & h parameters of two-port network.

REFERENCES:

1. Simulation of Power Electronics Circuit, M B Patil, V Ramanarayan and V T Ranganat, Alpha Science International Ltd., 2009.
2. Public Domain Simulator: [http:// www.ee.iitb.ac.in/~sequel](http://www.ee.iitb.ac.in/~sequel)
3. PSPICE A/D user's manual – Microsim, USA.
4. PSPICE reference guide – Microsim, USA.

CO No.	PO No. and keyword	Competency Indicator	Performance Indicator
CO1	PO1: Engineering knowledge	1.3	1.3.1
CO2	PO1: Engineering knowledge	1.3	1.3.1
CO3	PO2: Problem analysis	2.4	2.4.1
	PO4: Conduct investigations of complex problems	4.3	4.3.1
CO4	PO1: Engineering knowledge	1.3	1.3.1
		1.4	1.4.1
CO5	PO4: Conduct investigations of complex problems	4.3	4.3.1

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES::TIRUPATI
(AUTONOMOUS)**

Year: II

Semester: IV

Branch: EEE

Course Code	Course Title	L	T	P	Credits
20APC0210	Electrical Machines-II Lab	0	0	3	1.5

Course Outcomes:

1. Analyze and apply load test, no-load and blocked-rotor tests for construction of circle diagram and equivalent circuit determination in a single-phase induction motor.
2. Predetermine regulation of a three-phase alternator by synchronous impedance & m.m.f methods.
3. Predetermine the regulation of Alternator by Zero Power Factor method X_d and X_q determination of salient pole synchronous machine.
4. Evaluate and analyze V and inverted V curves of 3 phase synchronous motor.

List of Experiments:

All the following ten experiments are required to be conducted:

1. No-load & Blocked-rotor tests on 3- ϕ Induction motor.
2. Brake Test on Three Phase Induction Motor.
3. Speed control of three phase induction motor.
4. Separation of no-load losses of three phase induction motor.
5. Determination of Equivalent circuit of a single phase induction motor.
6. Load test on single phase induction motor.
7. Predetermination of Regulation of a three phase alternator by synchronous impedance & m.m.f methods.
8. Predetermination of Regulation of three-phase alternator by Z.P.F. method.
9. Determination of X_d and X_q of a salient pole synchronous machine by slip test.
10. V and inverted V curves of a 3-phase synchronous motor.

References:

1. D. P.Kothari and B. S. Umre, "Laboratory Manual for Electrical Machines" I.K International Publishing House Pvt. Ltd, 2017.
2. D.R. Kohli and S.K. Jain, "A Laboratory Course in Electrical Machines" NEM Chand & Bros.

Online Learning Resources/Virtual Labs:

<http://vem-iitg.vlabs.ac.in/>

[http://em-coep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical Engineering](http://em-coep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical%20Engineering)

http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/experimentlist.html.

CO No.	PO No. and keyword	Competency Indicator	Performance Indicator
CO1	PO1: Engineering knowledge	1.3	1.3.1
CO2	PO1: Engineering knowledge	1.3	1.3.1
CO3	PO2: Problem analysis	2.4	2.4.1
	PO4: Conduct investigations of complex problems	4.3	4.3.1
CO4	PO4: Conduct investigations of complex problems	4.3	4.3.1