MOHAN BABU UNIVERSITY

SreeSainath Nagar, Tirupati – 517 102

MBU
MOHAN BABU
UNIVERSITY
DREAM. BELIEVE. ACHIEVE

SCHOOL OF ENGINEERING

M. Tech - ELECTRICAL POWER SYSTEMS

CURRICULUM AND SYLLABUS
(From 2025-26 Admitted Students)

FULLY FLEXIBLE CHOICE BASED CREDIT SYSTEM (FFCBCS)

MOHAN BABU UNIVERSITY

Vision

To rise as one of the greatest hubs of innovation and entrepreneurship in the country, wherein students empower themselves with the best of knowledge, unleash their potential to the fullest, and soar high to attain a brighter future for themselves and the nation.

Mission

- To provide relevant knowledge founded on the spirit of curiosity, compassion, courage and commitment.
- To uphold novelle wings of leadership and excellence under expert mentors who guide students towards wisdom and knowledge.
- To create a dynamic learning environment that empowers learners with the right blend of passion and purpose to build a glorious tomorrow.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Vision

To become the Nation's premiere center of excellence in electrical engineering through teaching, training, research and innovation by creating competent engineering professionals with values and ethics.

Mission

- Providing state-of-art resources that foster academic excellence through teaching-learning, research, avenues for entrepreneurship, employability and other holistic developmental activities.
- Providing contemporary curriculum with academic flexibilities and learner centric higher order learning in the field of Electrical and Electronics Engineering or multi-disciplinary domains.
- Honing technical and soft skills to bridge the gap between the industry and academia through comprehensive modular training programs.
- Inspiring students for aptitude for research and innovation by exposing them to industry and societal needs to create solutions for contemporary problems.
- Inculcating values and ethics among students for a holistic engineering professional practice.

M.Tech. ELECTRICAL POWER SYSTEMS

PROGRAM EDUCATIONAL OBJECTIVES

- After few years of Post-graduation, the graduates of EPS will:

PEO1. Pursue higher academic programs in the disciplines of electrical engineering, multidisciplinary areas and in management.

PEO2. Become entrepreneurs or be employed as productive and valued engineers in reputed industries.

PEO3. Engage in lifelong learning, career enhancement and adopt to changing professional and foster the societal needs.

PROGRAM OUTCOMES

On successful completion of the Program, the graduates of M.Tech. (Electrical Power Systems) Program will be able to:

PO1. Demonstrate in-depth knowledge of power systems with an ability to practice, distinguish, evaluate and integrate the existing and advanced knowledge.

PO2. Investigate complex power system scenarios critically to design, evaluate and synthesize feasible, optimal solutions keeping in view of societal and environmental factors.

PO3. Select, learn and apply appropriate tools, techniques and resources to solve power system problems.

PO4. Work independently or in groups to solve problems in power systems

PO5. Communicate effectively on complex engineering activities with the engineering community and society at large through effective reports, documents and presentations adhering to appropriate standards.

PO6. Advance professionally through continuing education practicing professional ethics and values.

M.Tech. Electrical Power Systems

Sl. No.	Baskets	Credit Contribution
1	SCHOOL CORE	31-34
2	PROGRAM CORE	21-24
3	PROGRAM ELECTIVE	12-18
4	UNIVERSITY ELECTIVE	6
	TOTAL CREDITS	**Min. 70**

School Core (31 - 34 Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
25EE201001	Research Methodology	3	-	-	-	3	-
25EE201002	Innovation and Intellectual Property Rights	2	-	-	-	2	-
25EE211001	Internship	-	-	-	-	2	-
25EE209001	Project Work Phase -I	-	-	-	-	10	-
25EE210001	Project Work Phase -II	-	-	-	-	14	-
Mathematics Basket (Min. 03 Credits)							
25MM201402	Advanced Statistical Methods	3	-	-	-	3	-
Mandatory Non-Credit Courses (Min. 4 Credits) Earned Credits will not be considered for CGPA							
25CB207601	Essentials of Cyber Security *	2	-	-	-	2	-
25AI207601	Statistics with R	2	-	-	-	2	-
25LG207601	Technical Report Writing	2	-	-	-	2	-
25MG207601	Project Management	2	-	-	-	2	-
25MG207602	Essentials of Business Etiquettes	2	-	-	-	2	-

*Compulsory Course

Program Core (21-24 Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
25EE201003	Advanced Power System Protection	3	-	-	-	3	-
25EE201004	EHVAC Transmission systems	3	-	-	-	3	-
25EE205005	Electrical Power Systems Simulation Lab	-	-	3	-	1.5	-
25EE201006	Electrical Transients in Power System	3	-	-	-	3	-
25EE202007	High Voltage Engineering	3	-	3	-	4.5	-
25EE202008	Power quality Monitoring, Analysis and Control	3	-	3	-	4.5	-
25EE201009	Power System Modelling and Control	3	-	-	-	3	-
25EE201010	Power System Security and State Estimation	3	-	-	-	3	-

Program Elective (12 -18 Credits)

Course Code	Course Name	Lecture	Tutorial	Practical	Project based Learning	Credits	Prerequisite
		L	T	P	S	C	
25EE201011	Controllers for Power Applications	3	-	-	-	3	-
25EE201012	Digital Control of Power Electronics and Drives	3	-	-	-	3	-
25EE201013	Electromagnetic Field Computation and Modelling	3	-	-	-	3	-
25EE201014	FACTS Devices and Power Transmission	3	-	-	-	3	-
25EE201015	Machine Learning for Electrical Engineering	3	-	-	-	3	-
25EE201016	Power Sector Economics Restructuring and Regulation	3	-	-	-	3	-
25EE201017	Power System Planning and Reliability	3	-	-	-	3	-
25EE201018	Reactive Power Compensation and Management	3	-	-	-	3	-
25EE201019	SCADA Systems and Applications	3	-	-	-	3	-
25EE201020	Soft computing techniques	3	-	-	-	3	-
25EE201021	AI Applications to Power Systems	3	-	-	-	3	-
25EE201022	Power Electronics Applications To Power Systems	3	-	-	-	3	-
25EE201023	Control and Integration of Renewable Energy Sources	3	-	-	-	3	-

University Elective

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits
		L	T	P	S	C
25AI201701	Business Analytics	3	-	-	-	3
25AI201702	Ethics for AI	3	-	-	-	3
25CM201701	Cost Management of Engineering Projects	3	-	-	-	3
25CE201701	Disaster Management	3	-	-	-	3
25SS201701	Value Education	3	-	-	-	3
25SS201702	Pedagogy Studies	3	-	-	-	3
25LG201701	Personality Development through Essential Life Skills	3	-	-	-	3
25ME201701	Entrepreneurship and Innovation Management	3	-	-	-	3

Note:

1. If any student has chosen a course or equivalent course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s under University Elective.
2. The student can choose courses from other disciplines offered across the schools of MBU satisfying the pre-requisite other than the above list.

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25EE201001	**RESEARCH METHODOLOGY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: The course is developed for the students to understand the underlying concepts of research methodology and a systematic approach for carrying out research in the domain of interest. The course is emphasized on developing skills to recognize and reflect the strength and limitations of different types of research; formulation of the research hypothesis and its systematic testing methods. The course also emphasizes on interpreting the findings and research articulating skills along with the ethics of research.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understands the underlying concepts of research methodology, types of research and the systematic research process.

CO2. Understand the philosophy of research design, types of research design and develop skills for a good research design.

CO3. Understand the philosophy of formulation of research problem, methods of data collection, review of literature and formulation of working hypothesis.

CO4. Understand various data analysing techniques and parametric tests for testing the hypothesis.

CO5. Develop skills to interpret the findings and research articulating skills along with the ethics of research.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	-	-	-	3
CO2	3	3	1	-	-	3
CO3	3	-	2	-	-	3
CO4	3	3	3	-	-	3
CO5	3	-	-	3	3	3
Course Correlation Level	3	3	2	3	3	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO RESEARCH METHODOLOGY (08 Periods)

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research.

Module 2: RESEARCH DESIGN (08 Periods)

Research design—Basic Principles, Need of research design, Features of good design, Important concepts relating to research design, Different research designs, Basic principles of experimental designs, Developing a research plan.

Module 3: RESEARCH FORMULATION (08 Periods)

Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Data collection – Primary and secondary sources; Critical literature review – Identifying gap areas from literature review; Hypothesis— Types of hypothesis, Development of working hypothesis.

Module 4: ANALYSIS OF DATA AND HYPOTHESIS TESTING (14 Periods)

Quantitative Tools: Testing and Significance of Measures of Central Tendency, Dispersion; correlation, Principles of least squares—Regression; Errors-Mean Square error, Mean absolute error, Mena absolute percentage errors.

Testing of Hypothesis: Hypothesis Testing Procedure, Types of errors, Parametric testing (t, z and F), Chi-Square Test as a Test of Goodness of Fit; Normal Distribution- Properties of Normal Distribution; Analysis of Variance.

Module 5: INTERPRETATION AND REPORT WRITING (07 Periods)

Interpretation: Meaning of interpretation; Techniques of interpretation; Precautions in Interpretation.

Report Writing –Significance, Different Steps, Layout, Types of reports, Mechanics of Writing a Research Report, Precautions in Writing Reports; Research ethics—Plagiarism, Citation and acknowledgement.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING:

1. Should conduct a survey based on a hypothesis, analyze the data collected and draw the inferences from the data.
2. Should review the literature on the given topic and should identify the scope/gaps in the literature and develop a research hypothesis.
3. Should study a case, formulate the hypothesis and identify an appropriate testing technique for the hypothesis.
4. Study an article and submit a report on the inferences and should interpret the findings of the article.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. C.R. Kothari, Research Methodology: Methods and Techniques, New Age International Publishers, 2nd revised edition, New Delhi, 2004.
2. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.

REFERENCE BOOKS:

1. R. Panneerselvam, Research Methodology, PHI learning Pvt. Ltd., 2009.
2. Singh, Yogesh Kumar. Fundamental of research methodology and statistics. New Age International, 2006.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/121106007
2. https://onlinecourses.nptel.ac.in/noc22_ge08/preview
3. https://www.youtube.com/watch?v=VK-rnA3-41c

WEB RESOURCES:

1. https://www.scribbr.com/category/methodology/
2. https://leverageedu.com/blog/research-design/
3. https://prothesiswriter.com/blog/how-to-formulate-research-problem
4. https://www.formpl.us/blog/hypothesis-testing
5. https://www.datapine.com/blog/data-interpretation-methods-benefits-problems/
6. https://leverageedu.com/blog/report-writing/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25EE201002	**INNOVATION AND INTELLECTUAL PROPERTY RIGHTS**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: The course is designed to provide comprehensive knowledge to the students regarding the general principles of innovation and intellectual property rights, significance of innovation and steps for innovation, Concept and Theories, Criticisms of Intellectual Property Rights, International Regime Relating to IPR. The course provides an awareness on how to protect ones unique creation, claim ownership, knowledge of what falls under the purview of someone's rights and what doesn't, and safeguard their creations and gain a competitive edge over the peers.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the significance of innovation and steps for innovative thinking, and the concepts of intellectual property right and avenues for filling intellectual property rights.

CO2. Understand the legislative practices and protocols for acquisition of trademark and the judicial consequences for violating laws of trademark protection.

CO3. Understand the legislative practices and protocols for acquisition of copyrights and the judicial consequences for violating laws of copyrights protection.

CO4. Understand the fundamentals of patent laws, legislative practices and protocols for acquisition of trade secrets and the judicial consequences for violating laws of trade secrets protection.

CO5. Understand the latest developments and amendments in protection and filling of intellectual rights at international level.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	-	-	2	3
CO2	3	-	2	-	2	3
CO3	3	-	2	-	2	2
CO4	3	-	2	-	2	2
CO5	3	-	2	-	2	2
Course Correlation Level	3	-	2	3	3	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO INNOVATION AND IPR (06 Periods)

Innovation: Difference between Creativity and Innovation – Examples of innovation; Being innovative; Identify Blocks for creativity and innovation – overcoming obstacles; Steps for Innovation

Intellectual property rights: Need for intellectual property rights (IPR); types of intellectual property- Design, Geographical Indication; International organizations, agencies and treaties.

Module 2: TRADEMARKS (06 Periods)

Introduction to trademark, Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

Module 3: LAW OF COPYRIGHTS (06 Periods)

Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.

Module 4: TRADESECRETS (06 Periods)

Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, and protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

Module 5: NEW DEVELOPMENT OF INTELLECTUAL PROPERTY (06 Periods)

New developments in: trade mark law, copy right law, patent law, intellectual property audits. International overview on intellectual property; international - trade mark law, copy right law, international patent law, international development in trade secrets law.

Total Periods: 30

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING:

1. Should conduct a survey based on the real scenario, where IPR is misused or unethically used and present an article.
2. Prepare an article on the registration processes of IPR practically (copy right/trade mark/ patents).
3. Should study a case of conflict on trademarks/patents and should produce an article mentioning the circumstances and remedial measures.
4. Prepare an article on the latest development in the international intellectual property rights.
5. Refining the project, based on the review report and uploading the text.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. Deborah, E. Bouchoux, Intellectual property: The law of Trademarks, Copyright, Patents, and Trade Secrets, Cengage learning, 4th Edition, 2013.
2. PrabuddhaGanguli, Intellectual property right - Unleashing the knowledge economy, Tata McGraw Hill Publishing Company Ltd.
3. Tom Kelley & Jonathan Littman: The Art of Innovation, Profile Books Ltd, UK, 2008

REFERENCE BOOKS:

1. NeerajP.,&Khusdeep D. Intellectual Property Rights. India, IN: PHI learning Private Limited. 1st Edition 2019.
2. Nithyananda, K V. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited. 2019
3. Edward debone; How to have Creative Ideas, Vermilon publication, UK, 2007.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/110105139
2. https://www.youtube.com/watch?v=bEusrD8g-dM
3. https://www.youtube.com/watch?v=LS7TTb23nzU

WEB RESOURCES:

1. Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf
3. Cell for IPR Promotion and Management (http://cipam.gov.in/)
4. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
5. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25EE211001	**INTERNSHIP**	**-**	**-**	**-**	**-**	**2**

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: Expose students to the industrial environment; Create competent professionals for the industry; sharpen the real time technical / managerial skills required at the job; Gain professional experience and understand engineer's responsibilities and ethics; Familiarize with latest equipment, materials and technologies; Gain exposure to technical report writing; Gain exposure to corporate working culture.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze latest equipment, materials and technologies that are used in industry to solve complex engineering problems following relevant standards, codes, policies and regulations.

CO2. Analyze safety, health, societal, environmental, sustainability, economical and managerial factors considered in industry in solving complex engineering problems.

CO3. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on practicing engineering.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	2	3
CO2	3	2	2	2	2	3
CO3	3	2	2	2	2	2
Course Correlation Level	3	2	2	2	2	3

Correlation Levels: 3: High; 2: Medium;1: Low

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25EE209001	**PROJECT WORK PHASE -I**	**-**	**-**	**-**	**-**	**10**

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Identification of topic for the project work; Literature survey; Collection of preliminary data; Identification of implementation tools and methodologies; Performing critical study and analysis of the topic identified; Time and cost analysis; Implementation of the project work; Preparation of thesis and presentation.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Create/design electrical engineering systems or processes to solve complex electrical engineering and allied problems using appropriate tools and techniques following relevant standards, codes, policies, regulations and latest developments.

CO2. Consider society, health, safety, environment, sustainability, economics and project management in solving complex Electrical Power System and allied problems.

CO3. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on Electrical and Electronic engineering systems or processes.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	2	3
CO2	3	2	2	2	2	3
CO3	3	2	2	2	2	2
Course Correlation Level	3	2	2	2	2	3

Correlation Levels: 3: High; 2: Medium; 1: Low

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25EE210001	**PROJECT WORK PHASE -II**	**-**	**-**	**-**	**-**	**14**

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Identification of tools and methodologies for the implementation of the proposed problem; Performing critical study and analysis of the topic identified; Time and cost analysis; Implementation of the project work; Articulating of thesis/publications and presentation.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Utilize appropriate modern tools and techniques to solve complex engineering problems/design optimal solutions following relevant standards, codes, policies and regulations.

CO2. Analyze and interpret the results for validation, safety, health, societal, environmental, sustainability, economical and managerial factors considered in industry in solving complex engineering problems.

CO3. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on practicing engineering.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	2	3
CO2	3	2	2	2	2	3
CO3	3	2	2	2	2	2
Course Correlation Level	3	2	2	2	2	3

Correlation Levels: 3: High; 2: Medium; 1: Low

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25MM201402	**ADVANCED STATISTICAL METHODS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course describes the fundamental concepts of statistics, probability, random variables, sampling techniques, Testing the hypothesis and queuing techniques.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the concepts of statistics.

CO2. Apply the concepts of probability and random variable to solve a stochastic problems.

CO3. Test the hypothesis of the problem.

CO4. Apply queuing techniques to solve the problem

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	-	-	-	2
CO2	-	-	-	-	-	2
CO3	-	-	-	-	-	2
CO4	-	-	-	-	-	2
Course Correlation Level	-	-	-	-	-	2

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: STATISTICS FUNDAMENTALS **(09 Periods)**

Measures of Central Tendency - Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean. Measures of Dispersion- Range, Quartile Deviation, Mean Deviation, Standard Deviation and Root Mean Square Deviation, Coefficient of Dispersion, Moments, Skewness, Kurtosis.

Module 2: PROBABILITY AND RANDOM VARIABLES **(09 Periods)**

Introduction to probability –Bayes theorem-Random variables-discrete random variable (Binomial, Poisson, Geometric), Continues random variable (Uniform, Exponential and Normal distribution). Moment generating function

Module 3: TWO DIMENSIONAL RANDOM VARIABLES **(09 Periods)**

Joint distribution –Marginal and conditional distribution, covariance –correlation and regression (linear and Multiple). Central limit theorem, Chebyshev's inequality.

Module 4: SAMPLING **(11 Periods)**

Sampling-Introduction, Types or Sampling, Parameter and Statistic, Tests of Significance, Null Hypothesis, Errors in Sampling, Critical Region and Level of Significance, Sampling of Attributes, Sampling of Variable, Unbiased Estimate for population Mean and Variance, Standard Error of Sample Mean, Test of Significance for Single Mean, Difference of Means and Difference of Standard Deviations; Chi-Square Variate, Derivation of the Chi-square Distribution, Applications or Chi-square Distribution.

Module 5: QUEUING THEORY **(07 Periods)**

Pure Birth and Death process, M/M/1 & M/M/C models (related problems only).

Total Periods: 45

Topics for self-study are provided in the lesson plan.

Experiential Learning

1. What is the importance of probability distribution in computer science engineering?
2. If you draw from a normal distribution with known values of parameters, how do you generate draws in a uniform distribution?

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

3. S.P. Gupta, Statistical Methods, Sultan Chand & Sons Publication, 44th Edition, 2017
4. S.C. Gupta and V.K. Kapoor, Fundamentals of mathematical statistics; Sultan Chand & Sons.
5. T.Veerarajan , "Probability, Statistics and Random Processes" Tata McGraw-Hill,Education 2008
6. Introduction to Management Science "Operation Research" by Manmohan. P, P.K. Gupta, Kantiswarup, Sultan Chand & Sons Publishing house.

REFERENCE BOOKS:

3. T.K.V. Iyengar, B.Krishna Gandhi, S.Ranganatham and M.V.S.S.N.Prasad, Probability & Statistics by S. Chand publications.
4. K.S.Trivedi. John, Probability and statistics with reliability, Queuing and computer Science Application, Second edition, Wiley&Son, 2016.
5. Jay L.Devore, Probability and Statistics for Engineering and Sciences, Cengage Learning, 2015.
6. RonalsE.Walpole, Raymond H.Mayers, Sharon L.Myers, Keying E.Ye, Probability and Statistics for Engineers and Scientists, Pearson Publication, Ninth Edition, 2014.
7. Shankar Rao, Probability and Statistics for Science and Engineering, University Press, 2015.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=ly_FS3LZXEY
2. https://www.youtube.com/watch?v=0_ZcCqqpS2o
3. https://www.youtube.com/watch?v=Tye3dcBOqtY
4. https://www.youtube.com/watch?v=tsvIvQJiTL4

WEB RESOURCES:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4851520/
2. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Analytical_Sciences_Digital_Library/Active_Learning/Shorter_Activities/Electrochemical_Sensor_Project/01_Introduction_To_Electrochemical_Sensors
3. https://www.arsdcollege.ac.in/wp-content/uploads/2020/04/Document-2.pdf
4. https://www.salon.com/2015/10/14/4_outlandish_things_our_ancestors_used_as_lube_partner/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25CB207601	**ESSENTIALS OF CYBER SECURITY**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Cyber Security Fundamentals, Cyber Security Fundamentals, Attacker techniques and motivations, Fraud techniques, Threat infrastructure, Exploitation, Malicious code, Defense and analysis techniques, Intrusion detection techniques

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understanding the fundamental concepts of cyber security concepts

CO2. Identify the pattern of launching attacker and fraud techniques to reduce risk and impact of cyber-attacks.

CO3. Identify the vulnerabilities using the SQL injection and web exploitation techniques in a system for securing data.

CO4. Apply code obfuscation techniques to prevent any unauthorized party from accessing logic of an application

CO5. Apply honey pots and malicious code-naming techniques to defend against attacks in memory.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	-	-	-	2
CO2	-	-	-	-	-	2
CO3	-	-	-	-	-	2
CO4	-	-	-	-	-	2
CO5	-	-	-	-	-	2
Course Correlation Level	-	-	-	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CYBER SECURITY FUNDAMENTALS **(05 Periods)**

Network Security Concepts: Information assurance fundamentals, Basic cryptography, Symmetric encryption, Public key encryption, The Domain Name System (DNS), Firewalls, Virtualization, Radio-Frequency Identification.

Module 2: ATTACKER TECHNIQUES **(07 Periods)**

Attacker techniques and motivations: Anti forensics, proxy usage, Tunneling techniques: HTTP, DNS, ICMP, Intermediaries, Steganography and other concepts, Detection and prevention.

Fraud techniques: Phishing, smishing, vishing and mobile malicious code, rogue antivirus, click fraud.

Threat infrastructure: Botnets, Fast Flux, Advanced Fast Flux.

Module 3: EXPLOITATION **(06 Periods)**

Shellcode, Integer overflow vulnerabilities, Stack based buffer overflows, Format string vulnerabilities, SQL injection, Malicious PDF files, Race conditions, Web exploit tools, DoS conditions, Brute force and dictionary attacks.

Module 4: MALICOUS CODE **(06 Periods)**

Worms, viruses, Evading detection and elevating privileges: obfuscation, Virtual Machine obfuscation Persistent software techniques, Token kidnapping, Virtual machine Detection, Rootkits, Spyware, Attacks against privileged user accounts and escalation of privileges, Stealing information and Exploitation.

Module 5: DEFENSE AND ANALYSIS TECHNIQUES **(06 Periods)**

Importance of memory forensics, Capabilities of memory forensics, Memory analysis frameworks, Dumping physical memory, Installing and using volatility, Finding hidden processes, Volatality analyst pack.

Honeypots, Malicious code naming, Automated malicious code analysis systems, Intrusion detection techniques

Total Periods:30

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Observe the firewall settings on your personal computer or smartphone.
    - What configurations are enabled?
    - How does this firewall protect your device from threats?
2. Compare phishing, smishing, and vishing using real-life examples. Which of these do you think people are most vulnerable to, and why?

3. Research a recent DoS attack in the news.

    - What services were affected?
    - What preventive measures could have reduced the impact?

4. Explore your antivirus software logs.

    - What types of threats were blocked recently?
    - Were any of them worms, viruses, or spyware?

5. Reflect on the importance of intrusion detection systems (IDS).

    - How does an IDS differ from a firewall?
    - Why are both needed in an organisation's security framework?

RESOURCES

TEXT BOOKS:

1. James Graham, Richard Howard, Ryan Olson, "Cyber Security Essentials", CRC Press, 2011.
2. Chwan-Hwa (john) Wu,J. David Irwin, "Introduction to Cyber Security", CRC Press T&F Group.

REFERENCE BOOKS:

1. Nina Godbole and SunitBelpure, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley publications.
2. B.B.Gupta, D.P.Agrawal, HaoxiangWang, "Computer and Cyber Security: Principle s, Algorithm, Applications, and Perspectives", CRC Press, ISBN 9780815371335, 2018.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106106129
2. https://www.coursera.org/professional-certificates/ibm-cybersecurity-analyst

WEB RESOURCES:

1. https://www.interpol.int/en/Crimes/Cybercrime
2. https://www.geeksforgeeks.org/ethical-hacking/cyber-security-tutorial/
3. https://owasp.org/www-project-top-ten/
4. https://www.netacad.com/courses/cybersecurity-essentials?courseLang=en-US

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25AI207601	**STATISTICS WITH R**	2	-	-	-	2

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course introduces the basic concepts of statistics using R language. The course also deals with various types of sampling methods and its impact in the scope of inference through the computation of confidence intervals. The topics covered in the course also includes descriptive statistics, marginal and conditional distribution, statistical transformations, chi-squared test and ANOVA.

COURSEOUTCOMES: After successful completion of the course, students will be ablet o:

CO1. Import, manage, manipulate, structure data files and visualize data using R programming.

CO2. Identify trends and patterns in data using Marginal, Conditional distributions and Statistical transformations.

CO3. Analyse data using sampling and probability distribution methods and compute confidence intervals for statistical inference.

CO4. Apply chi- squared goodness-of-fittest, Pearson's□2-statistic and ANOVA to investigate the distribution of data.

CO-PO Mapping Table:

Course Out comes	ProgramOutcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	-	-	-	2
CO2	-	-	-	-	-	2
CO3	-	-	-	-	-	2
CO4	-	-	-	-	-	2
Course Correlation Mapping	-	-	-	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION (05 Periods)

Data,R's command line, Variables, Functions, The workspace, External packages, Datasets, Data vectors, Functions, Numeric summaries, Categoricaldata.

Module 2: BIVARIATE AND MULTIVARIATEDATA (07 Periods)

Lists, Data frames, Paired data, Correlation, Trends, Transformations, Bivariate categorical data, Measures of association, Two- waytables, Marginal distributions, Conditional distributions, Graphical summaries, Multivariate data-Data frames, Applying a function overall collection, Using external data, Lattice graphics, Grouping, Statistical trans formations.

Module 3: POPULATIONS (06 Periods)

Populations, Discrete random variables, Random values generation, Sampling, Families of distributions, Central limit theorem, Statistical Inference - Significance tests, Estimation, Confidence intervals, Bayesian analysis.

Module 4: CONFIDENCE INTERVALS (06 Periods)

Confidence intervals for a population proportion, p - population mean, other confidence intervals, Confidence intervals for differences, Confidence intervals for the median, Significance test - Significance test for a population proportion, Significance test for the mean(t-tests),Significance tests and confidence intervals, Significance tests for the median.

Module 5: GOODNESS OFF IT (06 Periods)

The chi-squared goodness-of-fit test, The multinomial distribution, Pearson's □2-statistic, chi-squared test of independence and homogeneity, Goodness-of-fit tests for continuous distributions, ANOVA-One-way ANOVA, Using lmfor ANOVA.

Total Periods:30

Topics for self-study are provided in the lesson plan.

EXPERIENTIALLEARNING

1. The data set baby boom (Using R) contains data on the births of 44 children in a one-day period at a Brisbane, Australia, hospital. Compute the skew of the wt variable, which records birth weight. Is this variable reasonably symmetric or skewed? The variable running. Time records the time after midnight of each birth. The command diff (running. time) records the differences or inter-arrival times. Is this variable skewed?
2. An elevator can safely hold 3, 500 pounds. A sign in the elevator limits the passengercountto15.Iftheadultpopulationhasameanweightof180poundswitha25-poundstandard deviation, how unusual would it be, if the central limit theorem applied, that an elevatorholding15peoplewouldbecarrying more than 3, 500 pounds?
3. The data set MLB Attend (Using R) contains attendance data for Major League Baseball between the years 1969 and 2000. Use lm to perform a t-test on attendance for thetwolevelsofleague.Isthedifferenceinmeanattendancesignificant?Compareyour Results to those provided by t-test.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXTBOOKS:

1. JohnVerzani, Using R for Introductory Statistics, CRC Press, 2nd Edition, 2014.
2. SudhaGPurohit, Sharad D Gore, ShailajaRDeshmukh, Statistics Using R, Narosa Publishing house,2nd Edition,2021.

REFERENCEBOOKS:

1. Francisco Juretig, R Statistics Cookbook, Packt Publishing, 1st Edition, 2019.
2. PrabhanjanN. Tattar, SureshRamaiah, B.G.Manjunath, A Coursein Statistics with R, Wiley, 2018.

VIDEOLECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_ma76/preview
2. https://onlinecourses.nptel.ac.in/noc19_ma33/preview
3. https://youtu.be/WbKiJe5OkUU?list=PLFW6lRTa1g83jjpIOte7RuEYCwOJa-6Gz
4. https://youtu.be/svDAkvh6utM?list=PLFW6lRTa1g83jjpIOte7RuEYCwOJa-6Gz
5. https://nptel.ac.in/courses/111104120

WEBRESOURCES:

1. https://www.geeksforgeeks.org/r-statistics/
2. https://www.geeksforgeeks.org/r-programming-exercises-practice-questions-and-solutions/
3. https://www.w3schools.com/r/r_stat_intro.asp
4. https://www.w3schools.com/r/r_stat_intro.asp
5. https://statsandr.com/blog/descriptive-statistics-in-r/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25LG207601	**TECHNICAL REPORT WRITING**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course deals with preparing effective technical documents for both written and digital media, with particular emphasis on technical memos, problem-solving and decision-making reports, and organizational, product-support, and technical-information webs.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge of Technical Report Writingand structures with a scientific attitude.

CO2. Analyze the process of writing in preparing effective reports.

CO3. Demonstrate styles of writing for Publication in a Scientific Journal.

CO4. Apply the process of referencing and editing techniques for effective communication in written documents.

CO5. Analyze the strategies in the technical report presentation.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	-	-	-	3	3
CO2	2	3	2	-	2	2
CO3	3	-	-	-	3	3
CO4	2	-	-	-	2	2
CO5	3	-	-	-	3	3
Course Correlation Mapping	2	3	2	-	2	2

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO TECHNICAL REPORT WRITING (06 Periods)

Concepts of Technical Report, Types of Reports, Planning Technical Report Writing, Components of a Technical Report,Report Writing in Science and Technology, Selecting and Preparing a Title, Language Use

Module 2: PROCESSOF WRITING (06 Periods)

Writing the 'Introduction', Writing the 'Materials and Methods, Writing the Findings/Results, Writing the 'Discussion', Preparing and using "Tables'.

Module 3: STYLE OF WRITING (06 Periods)

Preparing and using Effective 'Graphs', Citing and Arranging References, Writing for Publication in a Scientific Journal.

Module 4: REFERENCING (06 Periods)

Literature citations,, Bibliographical data according to ISO standards, Citations in the text, Copyright, andcopyright laws,the text of the Technical Report, Using a word processing and desktoppublishing (DTP) systems, Document or page layout, hints on editing Typographic details, Cross-references.

Module 5: PRESENTATION (06 Periods)

Presentation with appropriate pointing, Dealing with intermediate questions, Review and analysis of the presentation, Rhetoric tips from A to Z.

Total Periods: 30

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Prepare a report on technologies of modern times that enriched the originality of research works and their impacts on society concerning plagiarism.
2. Make PowerPoint presentations on the various style of writing academic reports.
3. Error-free Reports are so important for successful communication and sharing of information. Prepare a detailed chart on proofreading techniques to make a report effective and error-free.
4. Design a logo for a company and write down the copy-right laws for that.
5. Read research articles from any international journal of science and technology and differentiate research writing from other academic and non-academic writings.
6. Write an organizational memo Include a heading, introduction, and summary at the beginning of your memo, and present the details of your discussion in a logical order. Use headings and topic or main-idea sentences to clarify the organization.
7. Prepare an appraisal report on the staff performance of your company.
8. Prepare a PowerPoint presentation on the annual performance report of a company.
9. Critically review and write a report on any one of the recently released products.
10. Read the newspaper and write a detailed report about the content coverage and analyse the factors for the popularity of the newspaper.

RESOURCES

TEXTBOOK

1. RC Sharma Krishna Mohan, "Business Correspondence and Report" McGraw-Hill Publishing. Writing," Tata Company Limited, New Delhi", 3rd Edition, 2005 (reprint).

2. Patrick Forsyth, "How to Write Reports and Proposals", THE SUNDAY TIMES (Kogan Page), New Delhi, Revised 2ndEdition, 2010.

REFERENCE BOOKS:

1. John Seely, "The Oxford Writing & Speaking", Oxford University Press, Indian Edition

2. Anne Eisenberg, "A Beginner's Guide to Technical Communication", McGraw-Hill Education (India) Private Limited, New Delhi, 2013.

VIDEO LECTURES:

1. https://vimeo.com/143714818

2. https://digitalmedia.sheffield.ac.uk/media/002.+The+Anatomy+of+a+Technical+Report/1_u8wntcge

WEB RESOURCES:

1. http://www.resumania.com/arcindex.html

2. http://www.aresearchguide.com/writing-a-technical-report.htm

3. http://www.sussex.ac.uk/ei/internal/forstudents/engineeringdesign/studyguides/tec

   report writing

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25MG207601	**PROJECT MANAGEMENT**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: To understand the importance of decision-making while implementing any project and interpret and discuss the results of qualitative and quantitative analysis

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basic introduction to project management

CO2. Apply the methods of project identification and selection.

CO3. Understand project allocation methods and evaluation.

CO4. Analyse the techniques for project time, review, and cost

CO5. Understand the factors of risk and quality of a project.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	-	-	-	3
CO2	3	3	1	-	-	3
CO3	3	-	2	-	-	3
CO4	3	3	3	-	-	3
CO5	3	-	-	3	3	3
Course Correlation Level	3	3	2	3	3	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION (05 Periods)

Concept of project management, project definition and key features of projects, project life cycle phases, typical project management issues, basic project activities

Module 2: PROJECT IDENTIFICATION AND SELECTION (06 Periods)

Identification and screening (brainstorming, strength and weakness in the system, environmental opportunities and threats), Project evaluation methods- Payback period, Net present value, Internal rate of return and project evaluation under uncertainty.

Module 3: PROJECT RESOURCE MANAGEMENT (07 Periods)

Scheduling resources, resource allocation methods, project crashing and resource leveling, working of systems, design of systems, project work system design, project execution plan, project procedure manual project control system, planning scheduling and monitoring

Module 4: TIME AND COST MANAGEMENT (05 Periods)

Time Management-Network diagram, forward and backward pass, critical path, PERT and CPM, AOA and AON methods, tools for project network, Cost management-earned value method

Module 5: RISK AND QUALITY MANAGEMENT (07 Periods)

Risk identification, types of risk, risk checklist, risk management tactics, risk mitigation and contingency planning, risk register, communication management, Quality assurance and quality control, quality audit, methods of enhancing quality

Total Periods: 30

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Refer to any video lecture on project evaluation methods and give a brief seminar using PPT
2. Select any company wherein you will get the details of activities and time and draw the project network diagram and submit a report.

3.

Activity	Predecessor Activity	Normal Time (Weeks)	Crash Time (Weeks)	Normal Cost (Rs.)	Crash Cost (Rs.)
A	-	4	3	8,000	9,000
B	A	5	3	16,000	20,000
C	A	4	3	12,000	13,000
D	B	6	5	34,000	35,000
E	C	6	4	42,000	44,000
F	D	5	4	16,000	16,500
G	E	7	4	66,000	72,000
H	G	4	3	2,000	5,000

Determine a crashing scheme for the above project so that the total project time is reduced by 3 weeks

4. Collect any case study that discusses the process of probability calculation of success of the project and submit a report

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. R.Panneerselvam and P.Senthil Kumar (2013), Project Management, PHI Learning Private Limited.
2. Prasanna Chandra (2014), Projects: Planning, Analysis, Selection, Financing, implementation, and Review.

REFERENCE BOOKS:

1. A Guide to the Project Management Body of Knowledge: (PMBOK Guide) by Project Management Institute, 2013.
2. Gopala Krishnan & Rama Murthy, A Text book of Project Management, McMillan India.
3. S. Choudhary (2004), Project Management, Tata McGraw Hill Publication.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc19_mg30/preview
2. https://archive.nptel.ac.in/courses/110/104/110104073/

WEB RESOURCES:

1. https://www.pmi.org/about/learn-about-pmi/what-is-project-management
2. https://www.manage.gov.in/studymaterial/PM.pdf

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25MG207602	**ESSENTIALS OF BUSINESS ETIQUETTES**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is designed for learners who desire to improve their Business etiquette and professionlaism.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. learn the principles of business etiquettes and professional behavior

CO2. understand the etiquettes for making business correspondence effective

CO3. Develop awareness of dining and multicultural etiquettes

CO4. Demonstrate an understanding of professionalism in terms of workplace behaviors and workplace relationships.

CO5. Understand attitudes and behaviors consistent with standard workplace expectations.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	-	-	-	1
CO2	1	-	-	-	-	1
CO3	2	-	-	-	-	2
CO4	1	-	-	-	-	1
CO5	1	-	-	-	-	1
Course Correlation Level	2	-	-	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: BUSINESS ETIQUETTES- AN OVERVIEW (06 Periods)

Significance of Business Etiquettes in 21st Century- Professional Advantage; Need and Importance of Professionalism; Workplace Etiquette: Etiquette for Personal Contact-Personal Appearance, Gestures, Postures, Facial Expressions, Eye-contact, Space distancing

Module 2: COMMUNICATION SKILLS (06 Periods)

Understanding Human Communication, Constitutive Processes of Communication, Language as a tool of communication, Barriers to Effective communication, and Strategies to Overcome the Barriers.

Module 3: TEAMWORK AND LEADERSHIP SKILLS (06 Periods)

Concept of Teams; Building effective teams; Concept of Leadership and honing Leadership skills. Personality: Meaning & Definition, Determinants of Personality, Personality Traits, Personality and OrganisationalBehaviour Motivation: Nature & Importance, Herzberg's Two Factor theory, Maslow's Need Hierarchy theory, Alderfer's ERG theory

Module 4: INTERVIEW SKILLS (06 Periods)

Interview Skills: in-depth perspectives, Interviewer and Interviewee, Before, During and After the Interview, Tips for Success. Meeting Etiquette: Managing a Meeting-Meeting agenda, Minute taking,; Duties of the chairperson and secretary; Effective Meeting Strategies - Preparing for the meeting, Conducting the meeting, Evaluating the meeting

Module 5: DECISION-MAKING AND PROBLEM-SOLVING SKILLS (06 Periods)

Decision-Making and Problem-Solving Skills: Meaning, Types and Models, Group and Ethical Decision-Making, Problems and Dilemmas in application of these skills. Conflict Management: Conflict - Definition, Nature, Types and Causes; Methods of Conflict Resolution.

Total Periods:30

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Collect the case studies related to successful leaders and their traits.

2. Conduct a mock interview showcasing interview skills.

3. The case studies will be collected as Assignments and the same will be evaluated.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. Barbara Pachter, Marjorie Brody. Complete Business Etiquette Handbook. Prentice Hall, 2015.
2. Mahanand, Anand. English for Academic and Professional Skills. Delhi: McGraw, 2013. Print.

REFERENCE BOOKS:

1. Pease, Allan and Barbara Pease. The Definitive Book of Body Language. New Delhi: Manjul Publishing House, 2005.
2. Rani, D Sudha, TVS Reddy, D Ravi, and AS Jyotsna. A Workbook on English Grammar and Composition. Delhi: McGraw, 2016.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=NqlfZOPMqjA
2. http://www.nitttrc.edu.in/nptel/courses/video/109104107/L24.html

WEB RESOURCES:

1. http://elibrary.gci.edu.np/bitstream/123456789/685/1/BM-783%20The%20Essential%20Guide%20to%20Business%20Etiquette%20by%20Lillian%20H.%20Chaney%2C%20Jeanette%20S.%20Martin.pdf
2. The Essentials of Business Etiquette: How to Greet, Eat, and Tweet Your Way to Success by Barbara Pachter (Ebook) - Read free for 30 days (everand.com)

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25EE201003	**ADVANCED POWER SYSTEM PROTECTION**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is an core course in the field of power systems. The course is emphasised on Introduction to Static and Digital Relay, Comparators; Static Over Current and Differential Relays; Static DistanceRelays. The course also emphasis on Microprocessor Based Protective Relays.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze and design static, digital, and AI-integrated relays for various protection schemes.

CO2. Develop and test comparator circuits and identify features for AI-driven protection logic.

CO3. Apply static protection techniques enhanced with data analytics for different power system components.

CO4. Evaluate the performance of distance relays under system disturbances using adaptive and ML-based models.

CO5. Apply the knowledge of numerical relays to design and analyze microprocessor based relay for power system protection.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	-	-	-
CO2	2	2	3	-	-	-
CO3	2	2	3	-	-	-
CO4	3	2	3	-	-	-
CO5	3	2	3	-	-	-
Course Correlation Level	3	2	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO STATIC AND DIGITAL RELAYS (08 Periods)

Static Relays: Basic construction and advantages. Level detectors, Replica impedance, Mixing circuits, Phase and Amplitude Comparators –General equation for two input phase and amplitude comparators, Duality between Phase and Amplitude Comparators.

Numerical Relays: Block diagram of typical Numerical Relay – Advantages and Disadvantages. **Introduction to intelligent relays and AI-enhanced diagnostic capabilities.**

Module 2: COMPARATORS (08 Periods)

Amplitude comparators: Circulating current type, opposed voltage typerectifier bridge comparators – Direct and Instantaneous comparators.

Phase comparators: Coincidence circuit type-block spike phasecomparator, techniques to measure the period of coincidence–Integratingtype–Rectifier and vector product type phase comparators.

Multi–Input comparators: Conic section characteristics–Three input amplitude comparator–Hybrid comparator. **Feature selection for AI models in protection schemes.**

Module 3: STATIC OVER CURRENT AND DIFFERENTIAL RELAYS (10 Periods)

Static over current relays: Introduction, Instantaneous over current relay – Time over current relays. Basic principles – Definite time, Inverse Definite time and Directional over current relays. **Static Differential Relays:** Analysis of Static differential relays – static relay schemes – Duo bias transformer differential protection – Harmonic restraint relay. **Pattern recognition-based fault classification using ML algorithms.**

Module 4: STATIC DISTANCE RELAYS (10 Periods)

Static impedance, Reactance, MHO and angle impedance relays – sampling comparator – realization of reactance and MHO relays using a sampling comparator.

Power Swings: Effect of power swings on the performance of distance relays, Power swing analysis, Principle of out-of-step tripping and blocking relays, effect of line length and source impedance on distance relays**. Data-driven models for fault prediction and adaptive zone settings**

Module 5: MICROPROCESSOR BASED PROTECTIVE RELAYS (09 Periods)

Microprocessor based over current relays, Impedance relay, Directional relay, Reactance relay, and flowcharts. Generalized mathematical expression for distance relays, measurement of resistance and reactance, MHO and offset-MHO relays –Realization of MHO characteristics, realization of offset MHO characteristics and flow charts – Microprocessor Implementation of Digital distance relaying algorithms – Mann-Morrison technique, Differential equation technique.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Visit a substation/ generating station to review the working of Numerical relays and prepare a technical report regarding its advantages and disadvantages.
2. Prepare a technical report by Visiting a substation/ generating station to review the types of relays used for different types faults.
3. Conduct an experiment to analyse the different characteristics of over current relay.
4. Conduct an experiment on directional relay and analyse the direction of power flow during the disturbance condition.
5. Develop a Prototype model to validate the operation of Microprocessor relay.
6. Study the application of multifunction digital relays to protect power transformers.
7. Develop a simulation model of relays using MATLAB

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. T.S. Madhava Rao, Power system Protection - Static relays with Microprocessor Applications, Tata McGraw Hill PublishingCompany limited, 2nd edition, 2008.
2. Badri Ram and D. N. Vishwakarma, Power system Protection and Switchgear, Tata McGraw Hill Publication Company limited, 2nd edition 2013.

REFERENCE BOOKS:

1. Bhuvanesh A Oza, Nirmal Kumar C Nair, Rashesh P Mehta, Vijay H Makwana, Power system protection and switchgear, Tata McGraw HillEducation Private Limited, 2010.
2. M. A. Abido, A. M. Eltamaly; Artificial Intelligence Applications in Electrical Power Systems; CRC Press; **ISBN:** 9780367771164

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=RnYzgEyHxVE
2. https://www.youtube.com/watch?v=9tJXhCJlYbo
3. https://www.youtube.com/watch?v=Kd_73FnTueI&t=109s
4. https://www.youtube.com/watch?v=1j3t6pNQ4ik

WEB RESOURCES:

1. https://cusp.umn.edu/advanced-power-systems-videos
2. https://archive.nptel.ac.in/courses/108/105/108105167/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25EE201004	**EHVAC POWER TRANSMISSION**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course has been specially designed to train the students to cater to the design and R&D requirements for the new UHV AC (765 kV /1200 kV) and DC(800 kV) power lines is setting up in India. The course emphasizes the Concept of EHVAC transmission; analysis and design of EHVAC lines; effects of EHVAC; Corona Effects; voltage control and compensation.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyse and evaluate the various configurations of EHVAC transmission lines parameters and line losses.

CO2. Access the knowledge in computing the voltage gradient of conductors and electric fields.

CO3. Demonstrate knowledge in computing the corona effects, power losses and analyse the audible & radio interference in EHVAC transmission lines.

CO4. Evaluate the parameters in electrostatic fields and safety measures for human, animals, and plants

CO5. Analyse and evaluate the various voltage control techniques and compensation techniques in EHVAC transmission lines

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	-	-	-
CO2	3	2	-	-	-	-
CO3	3	2	2	-	-	-
CO4	3	2	3	-	-	-
CO5	3	2	3	-	-	-
Course Correlation Level	3	2	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: TRANSMISSION LINE TRENDS AND PRELIMINARIES (12 Periods)

Role of EHV AC transmission. Power handling capacity and line loss, costsof transmission lines and equipment. Mechanical considerations in lineperformance - numerical problems.
Line and Ground parameters: Calculation of resistance of conductors. Properties of bundled conductors - bundle spacing, bundle radius and geometric mean radius of bundle. Inductance of EHV line configurations - Inductance of two conductors, multi-conductor lines (Maxwell's co-efficient) and bundled conductor lines. Line Capacitance calculation - sequence inductances and capacitances - line parameters for modes of propagation, ground return – numerical problems.

Module 2: VOLTAGE GRADIENTS OF CONDUCTORS (07 Periods)

Electrostatics, field of sphere gap, field of line changes and their properties, charge - potential relations for multi-conductors. Surface voltage gradienton conductors - distribution of voltage gradient on sub conductors of bundle- numerical problems.

Module 3: CORONA EFFECTS (10 Periods)

Power loss: corona loss formulae, charge-voltage (Q-V) diagram.
Audible noise (AN): generation, characteristics, limits and measurementsof AN, relation between 1-phase and 3-phase AN levels – numericalproblems.
Radio interference (RI): Corona pulses - generation, properties andfrequency spectrum. Limits for radio interference fields. Lateral profiles ofRI and modes of propagation, excitation function, measurement of RI,RIV and excitation functions - numerical problems.

Module 4: ELECTROSTATIC FIELDS (08 Periods)

Electrostatic field: calculation of electrostatic field of EHV lines, effecton humans, animals and plants - electrostatic induction in un-energizedcircuit of double-circuit line - electromagnetic interference – numericalproblems.

Module 5: POWER-FREQUENCY VOLTAGE CONTROL AND OVER VOLTAGES (08 Periods)

No-load voltage conditions and charging currents, voltage control -synchronous condenser, shunt and series compensation. StaticVARcompensation - numerical problems.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Develop a Mathematical/simulation model/Program/Prototype to determine the cost of the transmission line established for power transmission.
2. Prepare an article on the impact of Radio Interference and audible noise on transmission line.
3. Visit an industry/organization to review the Protection scheme on EHVAC transmission line and prepare a technical report on the same.
4. Develop a Mathematical/simulation model/Program/Prototype to determine the electromagnetic interference on double circuit transmission line.

5. Estimate the corona loss for a three-phase, 110 kV, 50 Hz, 150 km long transmission line consisting of three conductors each of 10 mm diameter and spaced 2·5 m apart in an equilateral triangle formation. The temperature of air is 30ºC and the atmospheric pressure is 750 mm of mercury. Take irregularity factor as 0·85. Ionization of air may be assumed to take place at a maximum voltage gradient of 30 kV/cm.
6. Develop a Mathematical/simulation model/Program/Prototype to compensate the voltage level by incorporating SVC and other FACTS device in respective buses.
7. Prepare a technical report on the various voltage control equipment based on location considering voltage drop in power transmission and distribution network.
8. Participate in the technical talk on electrostatic induction in un-energized circuit of double-circuit line.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. Rakosh Das Begamudre, Extra High Voltage AC Transmission Engineering, New Age International Pvt. Ltd, 3rd edition, 2006.

REFERENCE BOOKS:

1. S. Rao, EHVAC, HVDC Transmission and Distribution Engineering, Khanna Publications, 2001.
2. Edison Electric Institution (GEC), EHV Transmission line reference Book, Edison House, 1968.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=kCn4Spy0cdc&list=PLNK1c1aGI7KV1fcqna8yBjxAlThlGjnW9
2. https://www.youtube.com/watch?v=F5A5P01rSRE
3. https://www.youtube.com/watch?v=NqONLaRIPpo&list=PLYkE215HOwIY0tsAEzsNt0KfGhVcOgJMm

WEB RESOURCES:

1. a) https://www.brainkart.com/article/Mechanical-Design-of-Transmission-Line_12390/
   b)https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_EHVAC_LECTURE_NOTES.pdf
   c) https://www.siechem.com/tech-support/conductor-resistance-2/
2. a) https://accelconf.web.cern.ch/IPAC10/papers/wepd064.pdf
   b) https://studyelectrical.com/2019/01/bundled-conductors.html
3. a)https://www.electricportal.info/2020/10/corona-power-loss-calculation-formula.html
   b)https://www.cisa.gov/sites/default/files/publications/safecom-ncswic_rf_interference_best_practices_guidebook_2.7.20_-_final_508c.pdf
   c)http://vikramuniv.ac.in/files/wp-content/uploads/BE_EE_8_Sem-_Corona_Effects-_Neha_Singh.pdf
4. a) https://biet.ac.in/pdfs/IV-II%20EHVAC-converted.pdf
   b) https://www.electrical4u.com/electromagnetic-interference/
5. https://www.rgpv.ac.in/campus/EX/Reactive%20power%20and%20voltage%20control.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25EE205005	**ELECTRICAL POWER SYSTEMS SIMULATION LAB**	-	-	3	-	1.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Investigations on various operational aspects of power system; power flow studies; faults and stability analysis; Power quality issues and its control aspects using simulation tools; FACTS controllers and grid connected PV system. This course also provides analytical skills for the quantitative estimation of electrical systems through volumetric and instrumental methods of analysis and addresses the societal and safety issues in power grids.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Develop an appropriate simulation program/model to estimate the load profile, schedule the generators and analyze the dynamics of automatic generation control for various operating scenarios.

CO2. Develop an appropriate simulation program/model, to model the transmission network and investigate the power flow, fault levels and stability limits for various operating scenarios.

CO3. Develop an appropriate simulation/model to simulate various power quality issues and design appropriate filters to mitigate the harmonics.

CO4. Develop an appropriate simulation/model to analyze operational aspects of the FACTS controllers for reactive power support and grid connected PV system.

CO5. Develop independent working ability, through problem solving and effective communication.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	3	-
CO2	3	2	3	3	3	-
CO3	3	2	3	3	3	-
CO4	3	2	3	3	3	-
CO5	3	2	3	3	3	-
Course Correlation Level	3	2	3	3	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: (Minimum **10** exercises shall be conducted)

1. Electricity Price/Load forecasting using statistical methods.
2. Solving economic load dispatch problem with and without transmission lossesusing MATLAB programming.
3. Simulation of AVR and load frequency control with and without integral controller.
4. Analyze Load flows for a given transmission network.
5. Symmetrical fault analysis using bus impedance matrix.
6. Analysis of rotor dynamics using swing equation.
7. Simulation of power quality problems (Sag/Swell, interruption, transients, harmonics, flickers).
8. Harmonic analysis and Single tuned filter design to mitigate harmonics.
9. Simulation of single phase grid connected PV system.
10. Design a DVR to mitigate voltage sag/swell.
11. Measurement Harmonics in industrial drive using PQ analyzer.
12. Measurement of various power quality issues in a power system network using PQ analyzer.

RESOURCES

SOFTWARES/Tools used: MATLAB/SIMULINK

TEXT BOOKS:

1. Haadi A. Sadat, Power System Analysis, 2nd Edition, McGraw Hill Co. Ltd., India, 2004.
2. Dr. Shailendra Jain, Modeling and simulation using MATLAB/SIMULINK, 2nd Edition Wiley, 2017.
3. Randall Shaffer, Fundamentals of Power Electronics with Matlab,1st Edition, Da Vinci Engineering Series, 2007
4. D P Kothari, I J Nagrath,R K Saket, Modern Power System Analysis**,** 5th Edition, McGraw Hill, India,2022.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=ddAg1eTUJts
2. https://www.youtube.com/watch?v=etV7yLsX_mA
3. https://www.youtube.com/watch?v=vVs4uWKLRFg
4. https://www.youtube.com/watch?v=6XMGzJa6HWc
5. https://www.youtube.com/watch?v=vtacEGLJrWg
6. https://www.youtube.com/watch?v=QirsYZq-phY

WEB RESOURCES:

1 https://in.mathworks.com/help/documentation.

2 https://in.mathworks.com/solutions/utilities-energy/power-system-analysis-design.html

3 https://www.studocu.com/row/document/comsats-university-islamabad/power-transmission/simulink-lab-model-lab-manual/8911926

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25EE201006	**ELECTRICAL TRANSIENTS IN POWER SYSTEM**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is designed to provide an overview on Transients in power systems due to various sources and their effects on power systems. The course emphasis on Lightning transients, Switching transients, Traveling Waves on Transmission Line and Computation of Transients in power systems.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Realize the various types of transients in power systems and their effects on power systems.

CO2. Realize the transients due to switching operations in power systems and various methods to suppress the effect of transients.

CO3. Realize the transients due to lightning in power systems and various methods to mitigate the transients.

CO4. Realize the phenomenon of traveling waves on transmission lines and computational aspects of transients.

CO5. Realize various types of protection devices and systems for mitigate transients and the applications of EMTP for transient computation.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	-	-	-
CO2	3	2	-	-	-	-
CO3	3	2	2	-	-	-
CO4	3	2	3	-	-	-
CO5	3	2	3	-	-	-
Course Correlation Level	3	2	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO TRANSIENTS (09 Periods)

Review and importance of the study of transients - causes for transients; RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients; Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

Module 2: SWITCHING TRANSIENTS (09 Periods)

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients - Ferro resonance.

Module 3: LIGHTNING TRANSIENTS (09 Periods)

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

Module 4: TRAVELING WAVES ON TRANSMISSION LINE (09 Periods)

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely's lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves.

Module 5: PROTECTIVE DEVICES AND SYSTEMS (09 Periods)

Basic ides about protection-Surge diverters'-Surge absorbers-Ground fault neutralizers; Protection of lines and stations by shielding-Ground wires-Counter poises-Driven rods; Qualitative application of EMTP for transient computation: features and capabilities of EMTP; steady state and time step solution modules: basic solution methods.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING: The following activities are indicative only; the detailed experiential learning activities will be provided in the course handout.

1. Analyze a typical switching transient and apply EMTP for transient computation.
2. Analyze a typical lightning transient and apply EMTP for transient computation.
3. Participate in the technical talk on the topic given.
4. Review an article given, and prepare a report on the inferences of the article.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2ndEdition, 1991.
2. PritindraChowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., Second Edition, 2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010.

REFERENCE BOOKS:

1. Akihiro ametani," Power System Transient theory and applications", CRC press, 2013.
2. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.
3. Hermann W. Dommel, EMTP Theory Book, second Edition, Microtran Power System Analysis Corporation, Vancouver, British Columbia, Canada, May 1992, Last Update: April 1999.
4. EMTP Literature from www.microtran.com.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=6g7Quvq9dlI
2. https://www.youtube.com/watch?v=1jIH5_RT1Cw

WEB RESOURCES:

1. https://www.allumiax.com/blog/electrical-transients-in-power-systems
2. https://www.cedengineering.com/userfiles/Introduction%20to%20Switching%20Transients%20Analysis%20Fundamentals-R1.pdf
3. https://s3energy.com/learn/causes-and-effects-of-transient-voltages/
4. https://electricenergyonline.com/energy/magazine/948/article/Power-System-Transient-Studies-using-EMTP-RV.htm

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25EE202007	**HIGH VOLTAGE ENGINEERING**	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is designed to provide an overview on High Voltage Engineering. The course emphasizes on the fundamental physics of insulating materials and their behavior in the electric fields, the concepts of generation, and measurements of high voltages and currents. The course also emphasizes the non-destructive testing methods of high-voltage apparatus.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the behaviour of dielectrics in the presence of high voltages using the principles of electric fields.

CO2. Realize the philosophy of the breakdown of various dielectric materials in the presence of high voltages.

CO3. Analyze the generating circuits for the generation of high voltages and currents.

CO4. Analyze the measuring circuits and techniques for the measurement of high Voltages and currents.

CO5. Realize the philosophy of sustainable testing procedures for testing of various high-voltage equipment by adhering to relevant standards.

CO6. Work independently or in teams to solve problems with effective communication.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	-	-	-
CO2	3	2	-	-	-	-
CO3	3	2	2	-	-	-
CO4	3	2	3	-	-	-
CO5	3	2	3	-	-	-
CO6	-	-	-	3	3	-
Course Correlation Level	3	2	3	3	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: ELECTROSTATIC FIELDS AND CONTROL (06 Periods)

Introduction to High voltage Engineering-Electrical field distribution and breakdown strength of insulating materials; Field distortions by conducting particles; Fields in multi-dielectric materials; Control of electric field intensity; Optimization of electrode configuration.

Module 2: BREAKDOWN PHENOMENA (11 Periods)

Breakdown in gases — Townsend's theory, Streamer's theory, breakdown in electro negative gases, Paschen's law, time lags of breakdown; insulation co-ordination.

Breakdown in solid dielectrics — Thermal breakdown and electro mechanical breakdown, treeing and tracking, Internal discharges.

Breakdown in liquid dielectrics — Suspended particle theory and stressed oil volume theory.

Module 3: GENERATION OF HIGH VOLTAGE AC, DC AND GENERATION OF IMPULSE VOLTAGE AND CURRENT (12 Periods)

Generation of HVAC and HVDC — cascade connection of transformers; series resonant circuit; tesla coil; voltage doubler circuit; Cock Croft Walton circuit — calculation of regulation, ripple and optimum number of stages for minimum voltage drop.

Generation of impulse voltage and current — introduction to standard lightning and switching impulse voltages; analysis of single stage impulse generator — expression for output impulse voltage; multi stage impulse generator — working principle, rating and components of impulse generator; triggering of impulse generator; generation of high impulse current.

Module 4: MEASUREMENT OF HIGH VOLTAGE AND CURRENT (08 Periods)

HVAC measurement — Chubb and Fortescue method; HVDC measurements — generating voltmeter principle, construction; potential dividers — resistance dividers, capacitance dividers, mixed RC potential dividers; Standard sphere gap measurements of HVAC, HVDC and impulse voltages; factors affecting the measurements; Measurement of high impulse currents — Rogowsky coil and magnetic links.

Module 5: TESTING OF HIGH VOLTAGE APPARATUS (08 Periods)

Non-destructive testing — measurement of DC resistivity — Galvanometer method, loss of charge method; Dielectric loss and loss angle measurements using Schering bridge; Partial discharge measurements – straight discharge detection circuit.

Testing of high voltage apparatus — testing of insulators, bushings, power transformers, cables, surge arresters and circuit breaker.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Electric field and stress analysis by using 2-D Ansoft software.
2. Generation of HVDC and lightning Impulse voltages.
3. Dielectric characteristics of gaseous dielectrics under uniform and non-uniform electric fields.
4. Dielectric characteristics of liquid dielectrics under uniform and non-uniform electric fields.
5. Dielectric characteristics of solid dielectrics under uniform and non-uniform electric fields.

6. Verification of Paschen's law.
7. Measurement of Earth resistance.
8. Measurement of HVAC and HVDC and impulse voltages using sphere gap.
9. Determination of string efficiency of suspension type insulator.
10. Determination of 50% critical Impulse flash-over voltages on the 11 kV Insulator with Positive Impulse and Negative Impulse.
11. Power frequency withstands test on ceramic and composite insulators.
12. Treeing and tracking phenomenon.

RESOURCES

TEXT BOOKS:

1. E. Kuffel, W.S. Zaengl and J. Kuffel, High Voltage Engineering: Fundamentals, Elsevier Press, 2nd edition,, 2000.
2. M. S. Naidu and V. Kamaraju, High Voltage Engineering, Tata McGraw-Hill Publishing Company Ltd., 4th edition, New Delhi, 2008.

REFERENCE BOOKS:

1. C.L. Wadhwa, High Voltage Engineering, New Age Science, 3rd revised edition, 2010.
2. Mazen Abdel-Salam, Hussein Anis, Ahdab El-Morshedy, RoshdyRadwan, High Voltage Engineering Theory and Practice, Revised & Expanded, Marcel-Dekker Publishers, 2nd edition, 2000.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/108104048
2. https://nptel.ac.in/courses/108104049
3. https://nptel.ac.in/courses/108104050
4. https://nptel.ac.in/courses/108104051

WEB RESOURCES:

1. http://vlabs.iitkgp.ac.in/vhv/#
2. https://bharatsrajpurohit.weebly.com/high-voltage-engineering-course.html
3. https://www.btechguru.com/courses-nptel-high-voltage-engineering-ee-lecture-ee10014w.html
4. https://www.iare.ac.in/sites/default/files/IARE_HVE_LECTURE
5. https://electrical-engineering-portal.com/download-center/books-and-guides/electricity-generation-t-d/lecture-notes-hv-engineering

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25EE202008	**POWER QUALITY MONITORING, ANALYSIS AND CONTROL**	3	-	3	-	4.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Power Quality monitoring; power quality Analysis; power quality Control.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply the conceptual knowledge of power quality and its standards to analyze, monitor and mitigate various power quality issues.

CO2. Apply the knowledge of power quality problem and issues due to industrial and commercial loads to monitor and mitigate the power quality issues.

CO3. Apply the conceptual knowledge on various power quality instruments to select and use an appropriate equipment for monitoring and measurement of power quality.

CO4. Demonstrate the conceptual knowledge of distributed generation to analyze the power quality issues in power systems.

CO5. Apply the conceptual knowledge of various custom power devices to enhance power quality for specific applications.

CO6. Work independently or in teams to solve problems with effective communication.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	-	-	-
CO2	3	2	-	-	-	-
CO3	3	2	2	-	-	-
CO4	3	2	3	-	-	-
CO5	3	2	3	-	-	-
CO6	-	-	-	3	3	-
Course Correlation Level	3	2	3	3	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: POWER QUALITY - AN OVERVIEW (10 Periods)

Power Quality definition, PQ characterization: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation-Power acceptability curves: CBEMA, ITIC - Sources for Electric Power Quality problem in power system: poor load power factor, Non-linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage - Power quality standards and Guidelines

Module 2: VOLTAGE VARIATIONS (10 Periods)

Voltage Sags - Magnitude & duration-Types- Sources of sags - Estimation of Voltage sag performance: Transmission system and Utility distribution system, Effect of sag on AC Motor Drives, Single-Phase Domestic and Office Loads, Monitoring and mitigation of voltage sag. Origin of Long & Short interruption -influence on various equipment's.

Module 3: POWER QUALITY MONITORING (08 Periods)

Monitoring considerations: Power line disturbance analyser, power quality measurement equipment, harmonic / spectrum analyser, flicker meters, disturbance analyser. Analysis of power outages, Analysis of unbalance: Symmetrical components of phasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers, Analysis of distortion: On-line extraction of fundamental sequence components from measured samples

Module 4: POWER QUALITY ANALYSIS (09 Periods)

Measurements of Voltage, Current, Power, Energy, power factor- Time domain methods and Frequency domain methods: Laplace's, Fourier and Hartley transform - The Walsh Transform - Wavelet Transform. Harmonic Distortion, Voltage versus Current Distortion, Harmonics versus Transients, Harmonic Indexes, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads.

Module 5: POWER QUALITY ENHANCEMENT (08 Periods)

Harmonic filters: passive, Active and hybrid filters - Custom power devices: Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC -control strategies: P-Q theory, Synchronous detection method - Custom power park.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: (Minimum 10 exercises shall be conducted)

1. Analyze voltage variation due to motor starting.
2. Analyze harmonics in inrush currents drawn by the transformer.
3. Simulation of capacitor switching transients.
4. Analyze power quality due to interruptions and flickering.
5. Analyze harmonics in various inverter configurations.
6. Analyze power quality due to voltage and sag.
7. Analyze power quality dueto voltage and swell.
8. Determination of Power quality issues while grid integration.

9. Analyze the effect of harmonics due to Commercial and industrial Loads.
10. Measurement of various power quality issues in a power system network using PQ analyzer.
11. Design a DVR to mitigate voltage sag.
12. Design a DSTATCOM to mitigate the PQ problem.

RESOURCES

TEXT BOOKS:

1. Roger C. Dugan, Mark E. Mc. Granaghan, Surya Santosoh and H. Wayne Beaty, Electrical Power Systems Quality, 2nd edition, TATA McGraw Hill, 2010.
2. ArindamGhosh, Gerard Ledwich, Power Quality Enhancement Using Custom Power Devices, Springer, 2002.

REFERENCE BOOKS:

1. Math H J Bollen, Understanding Power Quality Problems, IEEE Press, 1998.
2. C. Sankaran, Power quality, CRC Press, 2002.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=19eIVIVBrfE&list=PLp6ek2hDcoNBczPs_OoWYh4Siixdm20wQ
2. https://www.youtube.com/watch?v=z_E8uvhTrwY&list=PLLy_2iUCG87BPAd2561uroIhkb1zoywH6
3. https://www.youtube.com/watch?v=DiHIREIkwqs&list=PLy0RL0cwiTufq1TbbQe333f_faQeL24Bk
4. https://www.youtube.com/watch?v=z_E8uvhTrwY

WEB RESOURCES:

1 https://nptel.ac.in/courses/108106025
2 https://nptel.ac.in/courses/108106025
3 https://nptel.ac.in/courses/108102179/
4 https://nptel.ac.in/courses/108107157

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25EE201009	**POWER SYSTEM MODELLING AND CONTROL**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Introduction to the synchronous machine classical model; state space models of synchronous machine; Methods of Excitation systems and modelling; Effect of excitation on stability; Analysis of Voltage stability.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate in depth knowledge in analysing and evaluating the performance of regulated and unregulated single machine connected to infinite bus system with one time lag.

CO2. Use appropriate transformation techniques to model synchronous machine.

CO3. Represent the excitation systems, apply and analyze various control schemes to them.

CO4. Apply various control strategies to analyze the performance ofexcitation system stability.

CO5. Demonstrate knowledge on voltage and rotor angle stability, use various advance control techniques for analysing the single machineconnected to infinite bus system.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	-	-	-
CO2	3	2	-	-	-	-
CO3	3	2	2	-	-	-
CO4	3	2	3	-	-	-
CO5	3	2	3	-	-	-
Course Correlation Level	3	2	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CLASSICAL MODEL OF SYNCHRONOUS MACHINE (10 Periods)

A Classical model of one machine connected to infinite bus – Problems. System Response to small Disturbances: Types of problems studied, Block diagram of unregulated and regulated synchronous Machine, methods of studies – Effect of small changes of speed. Regulated synchronous machine – voltage regulator with one time lag – Governor with one time lag Classical model of multi-machine system – Modes of oscillation of unregulated Multi machine system

Module 2: THE SYNCHRONOUS MACHINE MODEL (10 Periods)

Introduction – Clarkes's and Park's Transformation – flux linkage equations, self and mutual inductances of stator and rotor, transformation of inductances, voltage equations. Formulations of state space model of one machine system connected to infinite bus, voltage, current equations.

Module 3: EXCITATION SYSTEMS (08 Periods)

Simplified view of excitation control, control configuration. Excitation system response: Non-continuously regulated systems, and continuously regulated systems. Excitation system compensation- state space description of the excitation system - simplified linear model only. Types of Excitation systems: Type -1 system: Continuously actingregulator, Type - 2 system: rotating rectifier system, Type - 3 system: Static with terminal potential and current supplies, Type-4system: non–continuous acting - Block diagram representation – state space representation.

Module 4: EFFECT OF EXCITATION ON STABILITY (08 Periods)

Introduction – effect of excitation on generator power limits – effect of the excitation system on transient stability, effect of excitation on dynamic stability – examination of dynamic stability by routh's criterion. Block diagram of the linear generator with exciter, supplementary stabilizing signals, approximate model of the complete exciter-generator system, Lead compensation.

Module 5: VOLTAGE STABILITY ANALYSIS (11 Periods)

Voltage stability – Factors affecting voltage instability and collapse –Comparison of Angle and voltage stability – Analysis of voltage in stability collapse – Control of voltage instability. Review of Lyapunov's stability theorems of non-liner systems using energy concept – Method based on first concept – Method based on first integrals –Quadratic forms – Variable gradient method – Zubov's method – Popov's method, Lyapunov function for single machine connected to infinite bus.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: (Minimum 10 exercises shall be conducted)

1. Model a typical excitation system using a simulation tool and analyze the effect of excitation on stability of the system.
2. Analyze the voltage stability of a system by developing a simulation model.
3. Participate in the technical talk on the topic given.
4. Review an article given, and prepare a report on the inferences of the article.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. P.M.Anderson, A.A.Fouad, Power System Control and Stability, IEEE Press, 2nd edition, 2003.
2. K.R.Padiyar, Power System Dynamics (Stability & Control), B.S.Publications, 2nd edition, India, 2008.

REFERENCE BOOKS:

1. PrabhaKundur, Neal J. Balu, Mark G. Lauby, Power System Stability and Control, McGraw-Hill, 2nd edition, 1994.
2. M.A.Pai, Power System Stability – Analysis by the direct method of Lyapunov, North Holland Publishing Company, Newyork, 1981.
3. VenkataramanaAjjarapu, Computational Techniques for Voltage Stability Assessment and Control, Springer US, 2007

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=O8SBXQbicro
2. https://www.youtube.com/watch?v=pWZPtZQZjKk

WEB RESOURCES:

1 https://www.osti.gov/servlets/purl/1083672

2 https://digital-library.theiet.org/content/books/po/pbpo086e

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25EE201010	**POWER SYSTEM SECURITY AND STATE ESTIMATION**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides information on Power system network matrices; Balanced and unbalanced short circuit analysis; AC and DC Load flow studies; Power system security; Power system state estimation.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Develop mathematical models of the power system for various power system studies.

CO2. Apply knowledge of power system network matrices to solve various fault sin power system.

CO3. Analyze the power system network to investigate the power flow in various lines of a power system network using numerical methods and factors influencing power system security.

CO4. Apply the conceptual knowledge of power flow methods and power system network matrices to evaluate Contingency selection of the power system.

CO5. Investigate the state of a power system network under various operating conditions using conventional and numerical methods.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	-	3	1
CO2	3	3	-	-	-	2
CO3	3	2	-	-	-	2
CO4	3	3	-	-	3	2
CO5	3	2	-	-	3	2
Course Correlation Level	3	3	-	-	3	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: POWER SYSTEM NETWORK MATRICES (10 Periods)

Formation of bus admittance matrices by direct inspection method and singular transformation method – Algorithm for formation of Bus impedance matrix: addition of a branch and addition of a link, removal of element in Bus impedance matrix – Sparsity programming and Optimal Ordering – Graph theory application in network modeling – Numerical problems – ∏-representation of off-nominal tap transformers – Applications of network matrices in simulation tools and smart grid systems.

Module 2: FAULT ANALYSIS (09 Periods)

Short circuit studies – Introduction, short circuit calculations using Zbus, Zfabc, Yfabc, Zf012 and Yf012 matrices for various faults – Analysis of balanced and unbalanced three-phase faults – Sequence networks and fault connections – Use of symmetrical components in modern protection – **Overview of fault analysis using real-time PMU (Phasor Measurement Unit) data**

Module 3: POWER SYSTEM SECURITY-I (08 Periods)

Review of power flow methods (qualitative treatment only) – DC power flow method – Fast decoupled power flow: Conceptual overview – Voltage stability indices – Power transfer capability – Impact of RES (Renewable Energy Sources) integration on power flow – Introduction to power system security and factors influencing it.

Module 4: POWER SYSTEM SECURITY-II (08 Periods)

Introduction to contingency analysis – Detection of network problems – Linear sensitivity factors – AC power flow methods – Contingency ranking and selection – Impact of FACTS devices on security assessment – Real-time data integration and visualization – **Use of contingency analysis tools in EMS – Simple problems.**

Module 5: STATE ESTIMATION IN POWER SYSTEM (10 Periods)

Power system state estimation – SCADA and EMS center architecture – Methods of state estimation: method of least squares, orthogonal matrix properties, Givens rotation, orthogonal decomposition – Bad data detection and identification techniques – PMU-based state estimation – **Applications of power system state estimation in real-time monitoring and grid resilience**

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: (Minimum 10 exercises shall be conducted)

1. Analyze the power system network matrices.
2. Develop the program for formation of bus impedance matrices.
3. Develop the algorithm for short circuit calculations using Zbus
4. Analyze balanced and unbalanced faults that occur in power system.
5. Discuss the importance of AC and DC power flow methods.
6. Seminar on power system security.
7. Develop the contingency analysis for any 5 bus system.
8. Case study on various load flow techniques.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. Allen J. Wood and Wollenberg B.F., Power Generation Operation and control, 2nd edition, John Wiley & Sons, 2006.
2. P. Venkatesh, B.V. Manikandan, S. Charles Raja and A.Srinivasan, Electrical power systems analysis, security, and deregulation, PHI learning private limited, Delhi, 2014.

REFERENCE BOOKS:

1. Nagrath I.J. and Kothari D.P., Modern Power System Analysis, TMH, New Delhi, 2004.
2. John J. Grainger and William D. Stevenson, Power System Analysis, Tata McGraw-Hill,

VIDEO LECTURE:

1. https://www.youtube.com/watch?v=QrHUni0NJws
2. https://www.youtube.com/watch?v=5Do9k9oI658
3. https://www.youtube.com/watch?v=X8Shu0Cplz0
4. https://www.youtube.com/watch?v=nIQhKykwXr4

WEB RESOURCE:

1 https://archive.nptel.ac.in/courses/108/105/108105067/

2 https://nptel.ac.in/courses/108106026

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE201011	**CONTROLLERS FOR POWER APPLICATIONS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is designed to provide an overview design aspects of the classical controllers and other advanced control techniques used in modern control systems. The course emphasises on the design and analysis aspects of classical PID controllers, Sliding mode controllers, Variable structure controllers, hysteresis current control and h-infinity robust controllers**.**

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Design a classical PID controller for controlling a system dynamics by applying the principles of classical control theory.

CO2. Analyze dynamics of a system and design an appropriate sliding mode controller by applying the principles of sliding mode control.

CO3. Analyze dynamics of a system and develop an appropriate Variable Structure controller by applying the principles of variable structure controller.

CO4. Design an appropriate Hysteresis current control and Predictive current controller for a given system.

CO5. Design an appropriate H-infinity and robust controller for a given system.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	-	-	2
CO2	3	3	2	-	-	2
CO3	3	3	2	-	-	2
CO4	3	3	2	-	-	2
CO5	3	3	2	-	-	2
Course Correlation Level	3	3	2	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CLASSICAL CONTROLLER DESIGN (08 Periods)

Introduction to classical Controller—Proportional (P), Integral (I), Derivative (D), PI-PD, PID Controllers; Characteristics, Design Controller; Tuning— Ziegler-Nichol's method and Cohencoon method, Damped oscillation method.

Module 2: SLIDING MODE CONTROL (09 Periods)

Dynamics in the sliding mode – linear system, non-linear system, chattering phenomenon; sliding mode control design – reachability condition, robustness properties application; Sliding Surfaces, Continuous approximations of Switching Control laws, Modelling/Performance.

Module 3: VARIABLE STRUCTURE CONTROLLER (10 Periods)

Variable Structure Systems (VSS)-Introduction- Synthesis of stable systems from unstable structures- VSS for improving speed of response,-VSS for stability Basic Concepts, Theory, and Methods.

Module 4: HYSTERESIS CURRENT CONTROL (08 Periods)

Hysteresis current control (HCC) – Design of HCC with PWM schemes Predictive current controller (PCC) –Model predictive control (MPC)-PWM predictive control (PPC).

Module 5: H-INFINITY AND ROBUST CONTROL THEORY (10 Periods)

Design Objectives – Shaping the Loop Gain –Signal Spaces – Computation of H-norm- All Pass Systems-- Linear-quadratic-Gaussian control (LQG); Robust Control Theory- Robust Controller Design- Robust decision methods- Analytic tools for robust decision making.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING: The following activities are indicative only; the detailed experiential learning activities will be provided in the course handout.

1. Design a classical PID controller for controlling the dynamics of the given system.
2. Design a sliding mode controller to meet the design specifications.
3. Design a variable structure controller to meet the design specifications.
4. Design a hysteresis current control to generate the pulses for a converter and to meet the design specifications.
5. Review an article given, and prepare a report on the inferences of the article.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. Jean Pierre Barbot," Sliding Mode Control in Engineering" Marcel Bekker, 2002.
2. Zinober, Alan S.I., ed.1994 "Variable Structure and Lyapunov Control", London: Springer-Verlag.

REFERENCE BOOKS:

1. Chandrasekharan P.C., "Robust Control of Linear Dynamical Systems", Academic Press Limited, San Diego.1996.
2. Somanath Majhi., "Advanced Control Theory A relay Feedback Approach", CengageLearning, 2009.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=4xdd-xRp8KE
2. https://www.youtube.com/watch?v=R0WbAWuPnG4
3. https://www.youtube.com/watch?v=CkjKl876J-w

WEB RESOURCES:

1. https://users.ece.cmu.edu/~koopman/des_s99/control_theory/
2. https://www.hindawi.com/journals/ape/2011/397872/
3. https://ieeexplore.ieee.org/document/8707755
4. https://core.ac.uk/download/pdf/20524199.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE201012	**DIGITAL CONTROL OF POWER ELECTRONICS AND DRIVES**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on peripherals of DSP, memory addressing modes of DSP; DSP based control of DC-DC converter, DSP based control of matrix converter, DSP based control of PMBLDC and SRM drives.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Comprehend various addressing modes of LF2407 processor and its instruction sets.

CO2. Develop simple and complex programs to control power electronic circuits using LF2407 processor.

CO3. Apply the Pulse width modulation techniques to control inverter fed AC drives and to implement them using LF2407 processor.

CO4. Design controller for DC-DC and Matrix Converters using LF2407 processor.

CO5. Design controller for PMBLDC and SRM drives using LF2407 processor.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	-	1	1
CO2	3	2	3	-	1	1
CO3	3	2	2	-	1	1
CO4	3	2	3	-	1	1
CO5	3	2	3	-	1	1
Course Correlation Level	3	2	3	-	1	1

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: MOTOR CONTROL SIGNAL PROCESSORS (09 Periods)

Introduction - Brief Introduction to Peripherals - Types of Physical Memory - The Components of the C2xx DSP Core - System configuration registers-Memory Addressing modes - Instruction set – Programming techniques – simple programs.

Module 2: PERIPHERALS OF SIGNAL PROCESSORS (09 Periods)

General purpose Input/output (GPIO) Functionality- Interrupts - A/D converter-Event Managers (EVA, EVB) - PWM signal generation.

Module 3: DSP-BASED CONTROL OF DC-DC CONVERTERS (09 Periods)

Introduction- Converter Structure-Continuous Conduction Mode, Discontinuous Conduction Mode- Connecting the DSP to the Buck-Boost Converter- Controlling the Buck-Boost Converter-Main Assembly Section Code Description Interrupt Service Routine. The regulation Code Sequences.

Module 4: DSP-BASED CONTROL OF MATRIX CONVERTERS (09 Periods)

Pulse Width Modulation- Principle of Constant V/Hz Control for Induction Motors- SVPWM Technique- DSP Implementation- Introduction to matrix converter-Topology and Characteristics- Control Algorithms- Bidirectional Switch-Current Commutation - Overall Structure of Three-Phase Matrix Converter-Implementation of the Venturini Algorithm using the LF2407.

Module 5: DSP-BASED CONTROL OF PMBLDC AND SRM DRIVES (09 Periods)

Control of PMBLDC motor drives: Introduction-Principles of the BLDC Motor- Torque Generation -BLDC Motor Control System Implementation of the BLDC Motor Control System Using LF2407.Control of SRM drives: Introduction-Fundamentals of Operation-Fundamentals of Control in SRM Drives- Open Loop Control Strategy for Torque- Closed Loop Torque Control of the SRM Drive.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING:

1. Simulation of various power electronics converters.
2. Presentation of different PWM techniques.
3. Case study of different control strategies of DC-DC and matrix converters.
4. Seminar on real time applications of various electric drives.
5. Technical talk on various control methods BLDC and SRM drives.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. Hamid A.Toliyat, Steven Campbell, DSP based electromechanical motion control, CRC Press, Special Indian Edition.

REFERENCE BOOKS:

1. R.Krishnan, Electric Motor Drives – Modeling, Analysis and Control, Prentice-Hall of India Pvt. Ltd., New Delhi, 2010
2. T.Kenjo and S.Nagamori, Permanent magnet and Brushless DC motors, Clarendon press, London, 1988.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/108/104/108104140/
2. https://elearn.nptel.ac.in/shop/iit-workshops/ongoing/digital-controller-for-power-applications/
3. https://archive.nptel.ac.in/courses/108/105/108105186/

WEB RESOURCES:

1. https://link.springer.com/book/10.1007/978-0-387-48598-0
2. https://www.academia.edu/31224499/Digital_Control_in_Power_Electronics_i
3. https://www.scribd.com/document/543030813/Digital-Control-in-Power-Electronics-2nd-Edition
4. https://www.researchgate.net/publication/225183513_Digital_Control_in_Power_Electronics

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE201013	**ELECTROMAGNETIC FIELD COMPUTATION AND MODELLING**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: The course deals with various fundamentals and advanced design concepts of electromagnetic field computations using various analytical, numerical, and by using finite element analysis methods. The course also emphasizes the design of electrical components based in the field stress and optimizing the field stress on the electrical components.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the fundamentals of Electromagnetic Field Theory.

CO2. Develop and compute electromagnetic field stress using analytical methods.

CO3. Develop and compute electromagnetic field stress using numerical methods.

CO4. Develop and compute electromagnetic field stress using Finite Element Analysis.

CO5. Design of electrical components and optimize the design features.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	-	-	1
CO2	3	2	2	-	-	2
CO3	3	2	2	-	-	2
CO4	3	2	3	-	-	2
CO5	3	2	3	-	-	2
Course Correlation Level	3	2	3	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION (10 Periods)

Review of basic field theory – Maxwell's equations – Constitutive relationships and Continuity equations – Laplace, Poisson and Helmholtz equation – principle of energy conversion – force/torque calculation.

Module 2: BASIC SOLUTION METHODS FOR FIELD EQUATIONS (09 Periods)

Limitations of the conventional design procedure need for the field analysis based design, problem definition, boundary conditions, and solution by analytical methods - direct integration method – variable separable method – method of images.

Module 3: SOLUTION BY NUMERICAL METHODS (10 Periods)

Finite Difference Method - Finite Element method – Boundary Elimination method - Variational Formulation – Energy minimization – Discretisation – Shape functions –Stiffness matrix –1D and 2D planar and axial symmetry problems

Module 4: COMPUTATION OF BASIC QUANTITIES USING FEM PACKAGES (08 Periods)

Basic quantities – Energy stored in Electric Field – Capacitance – Magnetic Field – Linked Flux – Inductance – Force – Torque – Skin effect – Resistance

Module 5: DESIGN APPLICATIONS (08 Periods)

Design of Insulators –Magnetic actuators – Transformers – Rotating machines.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING: The following activities are indicative only; the detailed experiential learning activities will be provided in the course handout.

1. Investigate the impact of various parameters (e.g., geometry, material properties, and boundary conditions) on the electromagnetic field distribution.
2. Explore electromagnetic interference (EMI) and electromagnetic susceptibility (EMS) analysis.
3. Explore optimization techniques like parameter sweeps, design of experiments (DOE), or genetic algorithms to find the optimal design parameters.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. Matthew. N.O. Sadiku, "Elements of Electromagnetics", Seventh Edition, Oxford University Press, First Indian Edition 2018.
2. K.J.Binns, P.J.Lawrenson, C.W Trowbridge, "The analytical and numerical solution of Electric and magnetic fields", John Wiley & Sons, 1995.
3. Nicola Biyanchi, "Electrical Machine analysis using Finite Elements", Taylor and Francis Group, CRC Publishers, 2005.

REFERENCE BOOKS:

1. Nathan Ida, Joao P.A.Bastos, "Electromagnetics and calculation of fields", Springer-Verlage, 1997.
2. S.J Salon, "Finite Element Analysis of Electrical Machines" Kluwer Academic Publishers, London, Second Edition, 2011, distributed by TBH Publishers & Distributors, Chennai, India.
3. Silvester and Ferrari, "Finite Elements for Electrical Engineers" Cambridge University press, Third Edition 1996.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=3PijHOd5jUs
2. https://www.youtube.com/watch?v=ZRvXEAzfP0A&list=PLL6Ah8JHS-GBwCJeiqZ2n4YqZUq7MNL1y
3. https://www.youtube.com/watch?v=4sHmSF2tJKg
4. https://www.youtube.com/watch?v=CX7X6YrVUdk
5. https://www.youtube.com/watch?v=mEeX7iwLzQQ
6. https://www.youtube.com/watch?v=9GuXWtvHuGA
7. https://www.youtube.com/watch?v=LUK8su4LINk

WEB RESOURCES:

1 https://cds.cern.ch/record/1400571/files/p15.pdf

2 https://www.damtp.cam.ac.uk/user/reh10/lectures/nst-mmii-chapter2.pdf

3 https://engineering.purdue.edu/wcchew/ece604f20/Lecture%20Notes/Lect36.pdf

4 http://nicadd.niu.edu/~syphers/phys790D/2019f/lec/FEMMintro_a.pdf

5 https://engineering.purdue.edu/wcchew/ece604f19/Lecture%20Notes/Lect36.pdf

6 http://home.cc.umanitoba.ca/~lovetrij/cECE4390/Notes/Sadiku.ch6.pdf

7 https://ocw.mit.edu/courses/6-007-electromagnetic-energy-from-motors-to-lasers-spring-2011/55c2a25e1012ed8a76ba82a024bb441f_MIT6_007S11_actuators.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE201014	**FACTS DEVICES AND POWER TRANSMISSION**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is an core course in the field of power systems. The course is emphasised on Introduction to Need for flexible AC transmission systems; objectives of shunt and series compensations, phase angle regulators; FACTS controllers: shunt, series and combined; coordination of various FACTS controllers.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the issues in power transmission and the role of FACTS devices in controlling the power in transmission system.

CO2. Understand the importance of compensation and realize various methods of static shunt compensation and devices for compensation.

CO3. Realize various methods of static series compensation and devices for compensation.

CO4. Understand the power flow control bystatic phase angle regulators and combined compensators

CO5. Understand the Coordination of multiple controllers and realize their performance and cost comparisons.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	-	-	-
CO2	2	2	3	-	-	-
CO3	2	2	3	-	-	-
CO4	3	2	3	-	-	-
CO5	3	2	3	-	-	-
Course Correlation Level	3	2	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO AC TRANSMISSION SYSTEMS (07 Periods)

Overview of interconnected power system. Power flow in AC systems – Expression for real and reactive power flow between two nodes of a power system, controllable parameters. Power flow in parallel and meshed system. Overview of compensated transmission lines – shunt and series compensation. Conventional controllers for real and reactive power flows – merits and demerits. FACTS –benefits, types of FACTS controllers.

Module 2: STATIC SHUNT COMPENSATION (10 Periods)

Expression for real and reactive power flow with mid-point voltage regulation. Variable impedance type static VAR generators - V-I characteristics and control schemes of TCR, TSR, TSC. QD-QO characteristic and control scheme of TSC-TCR. Switching converter type VAR generators – V-I characteristics and control schemes of STATCOM. Hybrid VAR generators – V-I characteristics of SVC and STATCOM, regulation of V-I slope. Applications of static shunt compensators – Voltage regulation, improvement in transient stability, prevention of voltage instability, power oscillation damping. Comparison of static shunt compensators.

Module 3: STATIC SERIES COMPENSATION (10 Periods)

Expression for real and reactive power flow with series line compensation. Variable impedance type series compensators: V-I characteristics and control schemes of GCSC, TSSC, TCSC- modes of operation. Subsynchronous resonance. Switching converter type series compensator – V-I characteristics, internal and external control schemes of SSSC. Applications of static series compensators – improvement in transient stability, power oscillation damping. Comparison of static series compensators.

Module 4: STATIC PHASE ANGLE REGULATORS AND COMBINEDCOMPENSATORS (10 Periods)

Power flow control by phase angle regulators - Concept of voltage and phase angle regulation. Operation and control of TCVR and TCPAR. Switching converter type phase angle regulators. Objectives of TCPAR -improvement of transient stability, power oscillation damping. UPFC – Principle, expression for real and reactive power between two nodes of UPFC, independent real and reactive power flow control using UPFC, control schemes of UPFC - operating principle and characteristics of IPFC.

Module 5: CO-ORDINATION OF FACTS CONTROLLERS (08 Periods)

FACTS controller interactions – interaction between multiple SVC's – interaction between multiple TCSC's – SVC-TCSC interaction – Coordination of multiple controllers using linear control techniques. Comparative evaluation of different FACTS controllers: performance comparison and cost comparison.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Develop a model for static shunt compensating FACT device and simulate its operational aspects and performance under various scenarios.
2. Develop a model for static series compensating FACT device and simulate its operational aspects and performance under various scenarios.
3. Simulate the power flow using a UPFC and its performance for various operating conditions.
4. Review a professional article on the FACTS controllers and prepare a technical report on the article.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. Narain G. Hingorani, LasziGyugyi, and Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, Wiley-IEEE Press, 1999.
2. R. Mohan Mathur and Rajiv k. Varma, Thyristor based FACTS Controllers for Electrical Transmission Systems, Wiley-IEEE Press, 2002.

REFERENCE BOOKS:

1. Xiao-Ping Zhang, ChristianRehtanz, BikashPal, Flexible AC Transmission Systems: Modeling and Control, Springer Power Systems Series, 2006.
2. T.J.E. Miller, Reactive Power Control in Electric Systems, Wiley, 1982.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/108/107/108107114/

WEB RESOURCES:

1. https://www.iitk.ac.in/npsc/Papers/NPSC2002/26.pdf
2. https://powerquality.blog/2021/11/17/power-quality-benefits-of-utilizing-facts-devices-in-electrical-power-systems/
3. https://www.electrical4u.com/facts-on-facts-theory-and-applications/#google_vignette

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE201015	**MACHINE LEARNING FOR ELECTRICAL ENGINEERING**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Types of machine learning, data pre-processing, model selection, Supervised learning, classification algorithms, Neural network-activation functions, architectures, Backpropagation, Regression algorithms, Clustering techniques, Recurrent neural network- Long Short-Term Memory(LSTM), Gated Recurrent Unit(GRU), Restricted Boltzmann Machine, applications.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the underlying mathematical models within machine learning algorithms and learning tasks.

CO2. Analyze the concept learning algorithms to automatically infer a general description for a given learning problem

CO3. Evaluate and apply suitable machine learning algorithms for various types of learning tasks.

CO4. Select and apply machine learning algorithms to solve problems such as optimal allocation of Distributed Generation(DG)

CO5. Design efficient recurrent Neural Network architectures to model patterns for a given learning problem.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	-	-	1
CO2	3	2	-	-	-	2
CO3	3	2	2	-	-	2
CO4	3	2	3	-	-	1
CO5	3	2	3	-	-	2
Course Correlation Level	3	2	3	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FUNDAMENTALS OF MACHINE LEARNING (09 Periods)

Introduction to machine learning – Importance in real-time engineering systems – Types of machine learning: Supervised, Unsupervised, Reinforcement – Comparison and applications – Real-time case studies (e.g., fault classification, predictive maintenance) – Data pre-processing techniques: normalization, encoding, handling missing data – Workflow of an ML model: selection, training, evaluation – Model representation and interpretability.

Module 2: SUPERVISED LEARNING:CLASSIFICATION AND BASICS OF NEURAL NETWORK (10 Periods)

Introduction to supervised learning – Classification models and learning steps – Algorithms: Naïve Bayes classifier – Concept learning and Bayes theorem – k-Nearest Neighbour, Decision Tree, Support Vector Machine – Introduction to neural networks – Biological vs artificial neurons – Activation functions – McCulloch-Pitts model – Multi-layer Perceptron (MLP) – Backpropagation algorithm – Applications: speed control of motor using neural networks, fault classification in transmission lines.

Module 3: SUPERVISED LEARNING: REGRESSION (08 Periods)

Introduction to regression and its applications – Simple and multiple linear regression – Assumptions and techniques to improve accuracy – Polynomial regression – Logistic regression – Maximum Likelihood Estimation – Model evaluation metrics – Applications: machine learning algorithms for motor speed control and load forecasting.

Module 4: UNSUPERVISED LEARNING (09 Periods)

Introduction to unsupervised learning, unsupervised vs supervised learning, applications of unsupervised learning, clustering-clustering as a machine learning task, different types of clustering techniques, partitioning methods, k-means-a centroid-based technique, Elbow method, K-Medoids: a representative object based technique, hierarchical clustering, density based methods, association rule, pattern finding using association rule, algorithm for association rule, build the appropriate principle rules, study of machine learning algorithm for optimal allocation of Distributed Generation(DG).

Module 5: DEEP LEARNING (08 Periods)

Introduction to deep learning – Recurrent Neural Networks (RNN): architecture, training, vanishing gradient problem – Variants: Bidirectional and Stateful RNNs – Long Short-Term Memory (LSTM) networks – Gated Recurrent Unit (GRU) – Deep Recurrent Neural Networks – Restricted Boltzmann Machines: energy-based model –Applications: short-term load forecasting, power system stability prediction.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING: The following activities areindicative only; the detailed experiential learning activities will be provided in the course handout.

1. Develop a mathematical model of a motor and develop a controller to control the speed using a Neural network
2. Develop a mathematical model for optimal allocation of Distributed Generation(DG)and develop a controller to control the speed using a Neural network
3. Develop a neural network model to forecast the electricity demand or price of the electricity for a real time application.
4. Review an IEEE article relevant to neural networks and prepare a technical report on latest developments in the domain.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. SaikatDutt, Subramanian Chandramouli and Amit Kumar Das, "Machine Learning", Pearson Publications, 5th Edition, 2020.
2. Dr.S.Lovelyn Rose, Dr.L.Ashok Kumar and Dr.D.KarthikaRenuka, "Deep Learning using PYTHON", Wiley Publications, 1st Edition, 2019.

REFERENCE BOOKS:

1. CharuC.Aggarwal "Neural Networks and Deep learning" Springer International Publishing, 2018.
2. EthemAlpaydin, Introduction to Machine Learning, MIT Press, 4thEdition, 2020.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=ukzFI9rgwfU
2. https://www.youtube.com/watch?v=vT1JzLTH4G4
3. https://www.youtube.com/watch?v=4dwsSz_fNSQ
4. https://www.youtube.com/watch?v=5tvmMX8r_OM

WEB RESOURCES:

1 https://www.digimat.in/nptel/courses/video/106105152/L01.html

2 https://onlinecourses.nptel.ac.in/noc23_cs18/preview

3 https://nptel.ac.in/courses/106106184

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE201016	**POWER SECTOR ECONOMICS RESTRUCTURING AND REGULATION**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion onfeatures of restructured power systems, market models, information and transmission services, electricity pricing and bidding strategies in the new environment.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the conceptual knowledge of deregulation for various market models, electricity pricing, and forecasting methods in a competitive market.

CO2. Apply the conceptual knowledge of deregulation for various market models, electricity pricing, and forecasting methods in restricted power systems.

CO3. Analyze transmission Congestion and its management strategies in new restructured power systems.

CO4. Realize Pricing of transmission network usage and loss allocation in the new restructured power systems.

CO5. Realize various financial markets associated with electricity for various bidding strategies by GENCOs.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	-	-	-
CO2	3	2	-	-	-	-
CO3	3	2	2	-	-	-
CO4	3	2	3	-	-	-
CO5	3	2	3	-	-	-
Course Correlation Level	3	2	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY (08 Periods)

Introduction, Reasons for restructuring / deregulation of power industry, Understanding the restructuring process, Introduction to issues involved in deregulation, Reasons and objectives of deregulation of various power systems across the world.

Module 2: PHILOSOPHY OF MARKET MODELS (10 Periods)

Introduction, Market models based on contractual arrangements, Comparison of various market models, Electricity vis-à-vis other commodities, Market architecture

Module 3: TRANSMISSION CONGESTION MANAGEMENT (08 Periods)

Introduction, Classification of congestion management methods, Calculation of ATC, Non-market methods, Market based methods, Nodal pricing, Inter-zonal Intra-zonal congestion management, Price area congestion management, Capacity alleviation method

Module 4: PRICING OF TRANSMISSION NETWORK USAGE AND LOSS ALLOCATION (10 Periods)

Introduction to transmission pricing, Principles of transmission pricing, Classification of transmission pricing methods, Rolled-in transmission pricing methods, Marginal transmission pricing paradigm, , Composite pricing paradigm, Merits and de-merits of different paradigms, Debated issues in transmission pricing, Introduction to loss allocation, Classification of loss allocation methods, Comparison between various methods

Module 5: MARKET POWER AND GENERATORS BIDDING (09 Periods)

Attributes of a perfectly competitive market, The firm's supply decision under perfect competition, Imperfect competition, Market power, Financial markets associated with electricity markets, Introduction to optimal bidding by a generator company, Optimal bidding methods

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING:

1. Develop a market model for a deregulated power system and analyze the operational aspects and economical aspects.
2. Review a professional article on the deregulated power system models and prepare a technical report on the article.

(Note: It’s an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. Kirschen and Goran Strbac, John Daniel, Fundamentals of Power System economics, Wiley & Sons Ltd, 2004.
2. Mohammad Shahidehpour, MuwaffaqAlomoush, "Restructured Electric Power Systems: Operation, Trading and Volatility", Marcel Dekker, Inc., 2001.

REFERENCE BOOKS:

1. Sally Hunt, John, Making competition work in electricity, Wiley & Sons, Inc., 2002.
2. Jaap E. Daadler, Math H.J Bollen, Kluwer, Kankar Bhattacharya, Operation of restructured power systems, Academic Pub., 2001.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=aM9CrGHFlg4
2. https://www.youtube.com/watch?v=OxWXRGs_Gec
3. https://www.youtube.com/watch?v=l9I2jWEnyEA

WEB RESOURCES:

1 https://nptel.ac.in/courses/108101005/2

2 https://posoco.in/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE201017	**POWER SYSTEM PLANNING AND RELIABILITY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Load forecasting; Fundamentals of Reliability Engineering; Evaluation of Power system operating capacity reserve; Evaluation of Frequency and Duration Techniques; Reliability Analysis of Interconnected Systems; Power Distribution System Reliability Analysis.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the conceptual knowledge of forecasting and apply load-forecasting techniques to predict load demand under normal and adverse weather conditions.

CO2. Use conceptual knowledge of probability techniques in analysing, designing and evaluating the various network configurations.

CO3. Apply conceptual knowledge of probability techniques for solving power system reliability indices.

CO4. Apply conceptual knowledge of capacity outage probability table for solving interconnected power system reliability problems.

CO5. Apply conceptual knowledge of reliability networks in solving power distribution system reliability problems.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	-	-	-
CO2	3	2	2	-	-	-
CO3	3	2	2	-	-	-
CO4	3	2	2	-	-	-
CO5	3	2	2	-	-	-
Course Correlation Level	3	2	2	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: POWER SYSTEM PLANNING (06 Periods)

Objectives of system Planning - Long term, medium term and short term planning - stages in planning and design, Transition from planning to operation. Overview of transmission and distribution planning.

Module 2: LOAD FORECASTING (08 Periods)

Objectives of forecasting, Factors affecting Load Forecasting – Load Forecasting Methods – Extrapolation, Co-Relation Techniques, Peak Load Forecasting, Weather sensitive load forecasting, Non - Weather sensitive load forecasting, Determination of annual forecasting, Reactive Load Forecasting.

Module 3: FUNDAMENTALS OF RELIABILITY ENGINEERING (09 Periods)

Introduction to Probability Concept, Random variables, Probability Density and Distribution functions – Probability Distributions: time dependent an independent. Network and Markov Modeling: redundant and non redundant configuration – complex systems – conditional probability approach, Decomposition Method, cut-set, tie-set approaches – Markov chain – Markov Process, STPM, LSP – one, two model.

Module 4: EVALUATION OF GENERATING CAPACITY RESERVE, FREQUENCY AND DURATION TECHNIQUES (12 Periods)

Introduction – Generation system model – determination of capacity outage probability table – Identical Unit s – Non-Identical Unit s – Determination of transitional rates – deterministic and probabilistic criteria – Sequential addition method – Recursive relation for Unit addition, Unit removal - LOLP, LOLE, EIR. Frequency and Duration Techniques: Frequency and duration concepts – Two components repairable model (with & without identical components) – Evaluation of cumulative probability and cumulative frequency by using recursive relation

Module 5: RELIABILITY ANALYSIS OF INTERCONNECTED SYSTEMS AND DISTRIBUTION SYSTEMS (10 Periods)

Introduction–probability array method in two interconnected systems– evaluation technique – equivalent assisting approach – factors affecting interconnections, effect of tie capacities, tie lines.

Distribution system reliability system analysis – Basic indices – Customer oriented indices – Load and energy indices – Active and Passive failures –Problems on above indices.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING:

1. Develop a reliability model to assess the reliability of the power system nerwork.
2. Review a professional article on the power system planning and reliability models and prepare a technical report on the article.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. Roy Billinton and Ronald N Allen, Reliability Evaluation of Power Systems, Springer, 2nd edition, New York, 1996.
2. R.L. Sullivan, Power System Planning, Tata McGraw Hill Publishing Company Ltd, 1977.

REFERENCE BOOKS:

1. Roy Billinton and Ronald N Allen, Reliability Evaluation of Engineering Systems, Springer, 2nd Edition, NewYork, 2013.
2. X. Wang & J.R. McDonald, Modern Power System Planning – McGrawHill Book Company, 1994

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=gqgKNVXLf7g
2. https://archive.nptel.ac.in/courses/117/103/117103149/

WEB RESOURCES:

1 https://ekeeda.com/degree-courses/electrical-engineering/power-system-planning-and-reliability

2 https://zoetalentsolutions.com/course/electric-power-system-planning-and-reliability-calculation/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE201018	**REACTIVE POWER COMPENSATION AND MANAGEMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is designed to provide an overview on the fundamentals and concept of Reactive Power compensation and management in domestic and industrial sectors; the various compensation techniques and power quality issues. The course alsohighlights the need for compensators to deal with reactive power problems reactive power compensation management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply the conceptual knowledge on reactive power compensation techniques and techniques to mitigate the issues related to deficit of reactive power.

CO2. Analyze the need of reactive power compensation in transmission networks and apply appropriate compensation technique to improve steady state and transient behaviour of the transmission system.

CO3. Understands the aspects of reactive power coordination, analyze the power quality issues due to quality of power supply and realize the economic benefits by capacitor bank placement.

CO4. Understand the reactive power requirements in industrial and domestic appliances and realize the demand side management for minimization of losses in the system.

CO5. Understand the reactive power management in industrial sectors and realize remedial measures to manage reactive power requirements in the sector.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	-	-	2
CO2	3	2	-	-	-	2
CO3	3	2	2	-	-	2
CO4	3	2	3	-	-	2
CO5	3	2	3	-	-	-
Course Correlation Level	3	2	3	-	-	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: REACTIVE POWER COMPENSATION (09 Periods)

Need for Reactive Power compensation – reactive power characteristics. Ideal compensator, practical compensation – power factor correction and voltage regulation. Load compensator as a voltage regulator, phase balancing and power factor correction of unsymmetrical loads – examples.

Module 2: REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEM (09 Periods)

Steady state Reactive power compensation – Uncompensated line, Types of compensation, Passive shunt, seriesand dynamic shunt compensation – examples. **Transient state Reactive power compensation** – Characteristic time periods. Passive shunt compensation. Static compensations–series capacitor compensation, compensation using synchronous condensers - examples

Module 3: REACTIVE POWER COORDINATION AND PLANNING (09 Periods)

Reactive power coordination: Objectives, Mathematical modelling, Operation planning, transmission benefits. Basic concepts of quality of power supply: Disturbances, steady – state variations, effects of under voltages, frequency, Harmonics, radio frequency and electromagnetic interferences. Reactive power planning: Objectives, Economics Planning capacitor placement and retrofitting of capacitor banks.

Module 4: REACTIVE POWER MANAGEMENT (09 Periods)

KVAR requirements for domestic appliances: Purpose of using capacitors, selection of capacitors, deciding factors. Types of available capacitors – characteristics and limitations, Control of capacitors.

Demand side management: Load patterns, basic methods load shaping, power tariffs, KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels - System losses, loss reduction methods - examples.

Module 5: REACTIVE POWER MANAGEMENT IN INDUSTRIAL SECTORS (09 Periods)

Typical layout of traction systems–reactive power control requirements. Electric arc furnaces, textile and plastic industries, furnace transformer, filter requirements, remedial measures, and power factor of an arc furnace, minimum capacitance required for excitation.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Analyze the reactive power requirements for domestic and industrial appliances for voltage control and develop suitable strategies for management of reactive power.
2. Participate in the technical talk on the topic given.
3. Participate in a technical quiz/competitive exam.
4. Review an article given, and prepare a report on the inferences of the article.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. T.J.E. Miller, Reactive power control in Electric power systems, A Wiley–Inter science publications, New York, 1982.
2. D.M. Tagare, Reactive power Management, Tata McGraw-hill publishing company Ltd., New Delhi, 2004.

REFERENCE BOOKS:

1. Wolfgang Hofmann, JurgenSchlabbach, Wolfgang Just, Reactive power compensation: A Practical Guide, Willey, April, 2012.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/117103149
2. https://nptel.ac.in/courses/108106025
3. https://nptel.ac.in/courses/108107157
4. https://nptel.ac.in/courses/108107114

WEB RESOURCES:

1. https://www.electrical4u.com/capacitor-bank-reactive-power-compensation/
2. https://www.electrical4u.com/three-phase-shunt-reactor/
3. https://uem.edu.in/uem-jaipur-blog/470-2/
4. https://ieeexplore.ieee.org/document/4349142
5. https://ieeexplore.ieee.org/document/9447586

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE201019	**SCADA SYSTEMS AND APPLICATIONS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: The course deals with the evolution of SCADA, functional architecture, communication protocols, and applications of SCADA in controlling the operation and control of interconnected power systems.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the fundamentals of SCADA and PLC systems, including their architecture, programming, and relevance to intelligent automation.

CO2. Identify and describe key SCADA components such as RTUs, IEDs, and communication networks used in real-time industrial systems.

CO3. Analyze various SCADA architectures and assess their suitability for smart grid and power system applications.

CO4. Evaluate communication protocols and media in SCADA systems and understand the role of intelligent data exchange and synchronization.

CO5. Apply SCADA and AI techniques for effective monitoring, control, and decision-making in interconnected power systems and industrial processes.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	-	-	-
CO2	3	2	-	-	-	-
CO3	3	2	2	-	-	-
CO4	3	2	3	-	-	-
CO5	3	2	3	-	-	-
Course Correlation Level	3	2	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO SCADA, PLC AND AI-AWARE AUTOMATION (10 Periods)

Data acquisition systems – Evolution of SCADA – Overview of monitoring and supervisory functions – Communication technologies in SCADA – **Introduction to AI in automation**: role of AI in SCADA systems (anomaly detection, predictive maintenance) –PLC: Block diagram – Programming languages (Ladder diagram, Functional Block diagram) – Applications –Interfacing of PLC with SCADA – Basics of integrating intelligent decision-making into PLC routines.

Module 2: SCADA SYSTEM COMPONENTS AND INTELLIGENT FIELD DEVICES (07 Periods)

SCADA system schemes – Remote Terminal Unit (RTU), Intelligent Electronic Devices (IEDs) – Communication Networks – SCADA Server – **Smart sensors and AI-enabled IEDs** – Basics of edge AI in field devices for faster decision-making and fault detection.

Module 3: SCADA ARCHITECTURE AND SMART GRID INTEGRATION (08 Periods)

Various SCADA Architectures – Centralized, Distributed, and Networked – Pros and cons of each system –IEC 61850 standard architecture – SCADA/HMI systems – **Integration of AI in modern SCADA architectures** for smart grid applications – Substation automation using AI models.

Module 4: SCADA COMMUNICATION AND INTELLIGENT PROTOCOLS (10 Periods)

SCADA communication requirements – Protocol evolution: past, present, and future – Structure and comparison of communication protocols (DNP3, Modbus, IEC 61850) – Fiber optics, PLCC, wireless technologies – Interface provisions – Synchronization with NCC and DCC

AI-driven communication optimization – Traffic prediction, anomaly detection in SCADA network data – Role of machine learning in fault-tolerant communication.

Module 5: OPERATION, CONTROL AND AI APPLICATIONS IN INTERCONNECTED POWER SYSTEMS (10 Periods)

Automatic substation control – SCADA configuration – Energy Management System (EMS) – System operating states, system security – State estimation – SCADA applications in transmission and distribution operations – **AI in power systems**: predictive fault analysis, load forecasting using neural networks, demand response management using AI

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Learn about alarm prioritization, acknowledgment, and escalation procedures within a SCADA system.
2. Explore different security mechanisms such as authentication, authorization, encryption, and network segmentation within a SCADA environment.
3. Learn about SCADA system security vulnerabilities and the importance of cybersecurity measures.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. **Stuart A. Boyer**, SCADA: Supervisory Control and Data Acquisition, Instrument Society of America Publications, USA, 2004.
2. Gordon Clarke, Deon Reynders, Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK, 2004.
3. William T. Shaw, Cyber security for SCADA systems, PennWell Books, 2006.
4. Michael Wiebe, A guide to utility automation: AMR, SCADA, and IT systems for electric Power, PennWell 1999.

REFERENCE BOOKS:

1. Dieter K. Hammer, Lonnie R. Welch, Dieter K. Hammer, "Engineering of Distributed Control Systems", Nova Science Publishers, USA, 1st Edition, 2001
2. **John W. Webb and Ronald A. Reis**, Programmable Logic Controllers: Principles and Applications, 5th Edition, Prentice Hall of India, New Delhi, 2002.
3. David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2003.
4. Sunil S. Rao, Switchgear and Protections, Khanna Publication, ISBN: 9789387394728, 2019.

VIDEO LECTURES:

1. http://www.digimat.in/nptel/courses/video/108108099/L30.html
2. https://www.youtube.com/watch?v=EzR-mRhFrtw

WEB RESOURCES:

1. https://jcboseust.ac.in/electrical/images/subject_notes/scada.pdf
2. https://www.electrical4u.com/scada-system/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE201020	**SOFT COMPUTING TECHNIQUES**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Fundamentals of Artificial Neural Networks, back propogation Neural Networks, Deep Neural Networks, Fuzzy Logic Systems, Adaptive Neuro Fuzzy Inference Systems, evolutionary and swarm algorithms.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Develop architecture of a neural network, its training/learning algorithms and apply them to solve various real world problems.

CO2. Apply the conceptual knowledge of deep learning and neural networks to solve the real time problems.

CO3. Develop a rule base fuzzy system and apply the control strategy to control various real world appliances.

CO4. Develop an algorithm based on evolutionary principles and model an objective function to optimize the given problem.

CO5. Develop an algorithm, mimicking the swarm behaviour of a school and model the objective function to optimize the given problem.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	-	-	1
CO2	3	2	2	-	-	2
CO3	3	2	2	-	-	2
CO4	3	2	3	-	-	1
CO5	3	2	3	-	-	2
Course Correlation Level	3	2	3	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: ARTIFICIAL NEURAL NETWORKS (10 Periods)

Biological neural network, architectures of artificial neural networks; activation functions, learning strategies- supervised, un supervised, reinforced; learning rules; single layer perceptron network, linear separability with AND & XOR examples; Back propagation neural network- architecture, training algorithm; Kohonen self-organizing maps- competitive process, training algorithm.

Module 2: DEEP NEURAL NETWORKS (08 Periods)

Introduction to deep learning, architecture of recurrent neural networks; Backpropagation through time; multilayer recurrent networks; long short-term memory; regression (load forecasting) and classification (object classification) usingneural network.

Module 3: FUZZY LOGIC SYSTEMS (09 Periods)

Fuzzy Logic Systems:Classical Vs fuzzy sets, fuzzy relations & operations; membership functions; fuzzification; rule base; inference mechanism; defuzzification; development of fuzzy control system; speed control of DC motors using fuzzy logic.

Module 4: EVOLUTIONARY ALGORITHMS (09 Periods)

Genetic Algorithms: Introduction to evolutionary computation, Genetic algorithms - (GA)biological background, traditional optimization and search techniques, basic terminologies, simple GA, flow chart;operators in GA -encoding, selection, crossover, mutation, constraints in GA, fitness function;advantages and limitations of GA.

Differential Evaluation: Overview, initialization, base vector selection, differential mutation, recombination, selection and termination criteria; Optimal allocation of DG.

Module 5: PARTICLE SWARM OPTIMIZATION (09 Periods)

Introduction to swarm intelligence, the basic PSO method, characteristic features of PSO, PSO algorithm, optimum parameter setting for the best performance of PSO, comparison with other Evolutionary computing techniques;MPPT for PV system.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: (Minimum 10 exercises shall be conducted)

1. Illustrate the application of Load forecasting problem using neural networks.
2. Develop the rule base for the speed control of DC motor.
3. Predict choosing of optimum values for parameters to get the best performance of PSO for different types of applications.
4. Illustrate the application of object classification problem using neural networks.
5. Develop algorithm for Optimal allocation of DG using differential evaluation.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. S.N. Sivanandam, S.N.Deepa, Principles of Soft computing, Wiley India private Ltd., 2nd edition, 2013.
2. Charu C. Aggarwal, Neural Networks and Deep Learning**,** Springer International Publishing AG, part of Springer Nature, 2018.

REFERENCE BOOKS:

1. Jacek M. Zurada, Introduction to Artificial Neural Networks, Jaico Publishing House.
2. Fakhreddine O. karray, Clarence De Silva, Soft computing and Intelligent systems Design, Theory, tools and applications, Pearson Education Limited, 2009.
3. Kenneth V. Price · Rainer M. StornJouni A. Lampinen, Differential Evolution, A Practical Approach to Global Optimization, Springer.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=9ZhwKv_bUx8
2. https://www.coursera.org/lecture/nlp-sequence-models/backpropagation-through-time-bc7ED
3. https://www.youtube.com/watch?v=ep3hLUDM7uA
4. https://www.youtube.com/watch?v=8dpYjgRskgQ

WEB RESOURCES:

1 https://www.aitude.com/supervised-vs-unsupervised-vs-reinforcement/

2 https://www.quora.com/How-is-RNN-related-to-deep-learning

3 https://intellipaat.com/blog/supervised-learning-vs-unsupervised-learning-vs-reinforcement-learning/

4 https://www.quora.com/Is-reinforcement-learning-the-combination-of-unsupervised-learning-and-supervised-learning

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE201021	**AI APPLICATIONS TO POWER SYSTEMS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course introduces the fundamentals of Artificial Intelligence (AI) with applications in power systems. It covers knowledge representation, statistical reasoning, pattern recognition, and neural networks. Emphasis is placed on using AI techniques for power system tasks such as load forecasting, economic dispatch, and system stability analysis. The course equips students with the skills to apply AI in smart grid and modern power system protection.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the fundamental components of Artificial Intelligence systems, different problem-solving approaches, and knowledge representation techniques applicable in engineering contexts.

CO2. Apply probabilistic and statistical reasoning methods like Bayes' theorem, certainty factors, and belief networks to model uncertainty in intelligent systems.

CO3. Design and evaluate pattern recognition systems using statistical classifiers and feature selection methods for classification and decision-making tasks.

CO4. Develop neural network-based models for engineering applications and analyze their behavior in supervised and unsupervised learning environments.

CO5. Apply AI techniques to solve practical power system problems such as load forecasting, economic dispatch, and dynamic stability analysis.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	-	-	-
CO2	3	2	3	-	-	-
CO3	3	2	2	-	-	-
CO4	3	2	3	-	-	-
CO5	3	2	3	-	-	-
Course Correlation Level	3	2	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO AI (09 Periods)

Definition, Applications, Components of an AI program; production system. Problem Characteristics. Overview of searching techniques. Knowledge representation: Knowledge representation issues; and overview. Representing knowledge using rules; procedural versus declarative knowledge. Logic programming, forward versus backward reasoning, matching. Control knowledge.

Module 2: STATISTICAL REASONING (09 Periods)

Probability and Daye's theorem. Certainty factor and rule based systems. Baysian Networks, Dampster Shafer theorem. Semantic nets and frames, Scripts. Examples of knowledge based systems.

Module 3: PATTERN RECOGNITION (09 Periods)

Introduction, automatic pattern recognition scheme. Design Concepts, Methodologies, Concepts of Classifier, concept of feature selection. Feature selection based on means and covariances. Statistical classifier design algorithms; increment-correction and LMSE algorithms. Applications.

Module 4: ARTIFICIAL NEURAL NETWORKS (09 Periods)

Biological Neuron, Neural Net, use of neural 'nets, applications, Perception, idea of single layer and multilayer neural nets, back propagation, Hopfield nets, supervised and unsupervised learning.

Module 5: APPLICATIONS OF AI TECHNIQUES (09 Periods)

Load forecasting – Load flow studies – Economic load dispatch – Load frequency control – Single area system and two area system – Small Signal Stability (Dynamic stability) Reactive power control

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Developing a Rule-Based Expert System for Fault Diagnosis in Power Systems– Use of production rules, forward/backward chaining.
2. Building a Pattern Recognition Model for Power System Disturbance Classification– Use of real or simulated fault data and classifier design (e.g., SVM or decision tree).
3. Load Forecasting Using Artificial Neural Networks (ANNs) Time-series forecasting using historical load data.
4. Implementing a Perceptron/Backpropagation Neural Network for Economic Load Dispatch– Optimization and allocation of generation resources.
5. Designing a Knowledge-Based System for Intelligent Relay Coordination– Applying logic and reasoning to set relay characteristics.

(Note: It’s an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. S.Rajasekaran and G.A.V.Pai; Neural Networks, Fuzzy Logic & Genetic Algorithms, PHI, New Delhi, 2003

2. P.D.Wasserman, Van No strand Reinhold; Computing Theory & Practice, New York, 1989.

REFERENCE BOOKS:

1. M. A. Abido, A. M. Eltamaly; Artificial Intelligence Applications in Electrical Power Systems; CRC Press; **ISBN:** 9780367771164

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=L8CYBqgAPAc

2. https://www.youtube.com/watch?v=i23jr7pkjsM

WEB RESOURCES:

1. https://www.weforum.org/stories/2024/07/generative-ai-energy-emissions/?gad_source=1&gad_campaignid=22234048793&gbraid=0AAAAAoVy5F6M8y9ZDHMrm9GNu6XvevrFT&gclid=Cj0KCQjwjJrCBhCXARIsAI5x66WAde4e9okQ52wMgavvm2Qmmuc539T07nPzSwv1KR3PxRf0aiCnN1UaAus0EALw_wcB

2. https://www.jcboseust.ac.in/assets/electrical/images/notes/aitech_ug_ai_reactive_power_control.pdf

3. https://www.viva-technology.org/New/IJRI/2021/38.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE201022	**POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course focuses on the role of power electronic converters in power systems, covering DC–DC converters, grid-connected inverters, reactive power compensation, power quality improvement, and UPS applications with emphasis on control strategies and real-time implementation.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the role of power electronics in power systems.

CO2. Understand the grid connected inverters for dynamics and control in conventional and renewable energy applications

CO3. Understand the need for control of Real and Reactive power flows

CO4. Acquire knowledge on Custom Power devices.

CO5. Develop an algorithm, mimicking the swarm behaviour of a school and model the objective function to optimize the given problem.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	-	-	1
CO2	3	2	2	-	-	2
CO3	3	2	2	-	-	2
CO4	3	2	3	-	-	1
CO5	3	2	3	-	-	2
Course Correlation Level	3	2	3	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: POWER ELECTRONIC CONVERTERS (10 Periods)

Role of power electronics in power systems, Fundamentals of power converter, Voltage-Fed DC–DC Converters, Buck Boost, Buck-Boost converters, Peak Current Mode Control, Average Current-Mode Control. Control Design Issues in Voltage-Fed DC–DC Converters, Developing Switching and Average Models

Module 2: THREE-PHASE GRID-CONNECTED CONVERTERS (08 Periods)

High-Power Semiconductor Devices, High-Power Devices Operated as Simple Switches, PWM algorithms, Three phase voltage source inverter-Operation, Functions and Performance indices (Total Harmonic Distortion (THD), Harmonic Current Factor (HCF), Current Distortion Factor, DC Bus Capacitor within an AC /DC /AC Power Converter.

Module 3: LINE COMPENSATION (09 Periods)

Analysis of Uncompensated AC Line, Compensation by a Series Capacitor Connected at the Mid-point of the Line, Passive Compensation, Various FACTs devices; Power Quality Requirements, types of loads, harmonics, Active and Passive filters, Shunt, series and hybrid filters, Power Quality Conditioners,

Module 4: PRINCIPLES OF CONVENTIONAL REACTIVE-POWER COMPENSATORS (09 Periods)

Concepts of SVC Voltage Control, Static Var Compensator (SVC), SVC Controller, Voltage Regulator Design, Harmonics and Filtering, Protection Aspects. Static Synchronous Compensator (STATCOM), Static Synchronous Series Compensator.

Module 5: UNINTERRUPTIBLE POWER SUPPLIES (09 Periods)

Power electronics in domestic and industrial loads; Power conditioning units for renewable power generation and distributed generation systems. Power Quality and Introduction to Custom Power devices.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: (Minimum 10 exercises shall be conducted)

1. Develop MATLAB/Simulink models to analyze performance and ripple characteristics
2. Design and Implementation of Peak and Average Current Mode Control
3. Investigate sizing and dynamic behavior of capacitors through simulations.
4. Analyze uncompensated vs compensated line behavior using a simulation environment.
5. Simulate DVR (Dynamic Voltage Restorer) or UPQC (Unified Power Quality Conditioner) for voltage sag mitigation.

(Note: It's an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. Teuvo Suntio, Tuomas Messo, and Joonas Puukko , Power electronic converters: dynamics and control in conventional and renewable energy applictions , Wiley-VCH Verlag GmbH & Co. KGaA , Germany, 2018
2. A. Ghosh, G. Ledwich, Power Quality Enhancement Using Custom Power Devices, Springer, 2012

REFERENCE BOOKS:

1. Dorin O. Neacsu, powers witching converters: Medium and High Power, CRC Taylor & Francis Group, LLC 2006
2. Alok Jain, Power Electronics and Its Applications, Penram International Publishing (India) 2016 3/e

VIDEO LECTURES:

1. https://www.google.com/search?sca_esv=813765718ccf2407&q=Power+Electronics+Applications+to+Power+Systems&udm=7&fbs=AIIjpHxU7SXXniUZfeShr2fp4giZ1Y6MJ25_tmWITc7uy4KIeiAkWG4OlBE2zyCTMjPbGmMU8EWskMk2JSE__efdUJ3xRFvZ0M2vJLB0hUMk5HOE2OjlycQYRp9vQECfaBtuI766UjmxPoHIHzqoAp3yNuz3Fl-PVh4hb3ucKWH_IX4pHJi8M0lRnPFaqGQh6DpliW2CemDyaYW9_NLOX7W-LTlOq9fcYw&sa=X&ved=2ahUKEwiWloePw-aNAxXrxTgGHau7Dd8QtKgLegQIEhAB&biw=1522&bih=688&dpr=1.25#fpstate=ive&vld=cid:11f683fb,vid:rAKq3mwbsv4,st:0
2. http://digimat.in/nptel/courses/video/117103488/L26.html

WEB RESOURCES:

1. https://archive.nptel.ac.in/courses/108/102/108102145/
2. https://archive.nptel.ac.in/courses/108/105/108105104/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25EE201023	**CONTROL AND INTEGRATION OF RENEWABLE ENERGY SOURCES**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides an overview of dynamic and static energy conversion technologies, control strategies, and integration of renewable energy sources into the grid, focusing on stability, power quality, and hybrid system operations.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the structure and challenges of modern electric grids, including the impact of renewable energy integration and consumption patterns.

CO2. Explain the working principles and characteristics of various dynamic energy conversion technologies such as engines, turbines, hydro, and wind systems.

CO3. Analyze static energy conversion technologies including fuel cells, photovoltaic systems, and storage devices, along with MPPT and shading effects.

CO4. Apply appropriate control strategies for renewable energy systems, addressing load frequency, voltage control, and fault handling in hybrid systems.

CO5. Evaluate the integration requirements and operational aspects of hybrid and grid-connected renewable energy systems, including standards and protection.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	-	-	1
CO2	3	2	2	-	-	2
CO3	3	2	2	-	-	2
CO4	3	2	3	-	-	1
CO5	3	2	3	-	-	2
Course Correlation Level	3	2	3	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: POWER ELECTRONIC CONVERTERS (10 Periods)

Electric grid, Utility ideal features, Supply guarantee, power quality, Stability and cost; Importance & Effects of Renewable Energy penetration into the grid, Boundaries of the actual grid configuration, Consumption models and patterns.

Module 2: DYNAMIC ENERGY CONVERSION TECHNOLOGIES (08 Periods)

Introduction, types of conventional and nonconventional dynamic generation technologies, principle of operation and analysis of reciprocating engines, gas and micro turbines, hydro and wind based generation technologies.

Module 3: STATIC ENERGY CONVERSION TECHNOLOGIES (09 Periods)

introduction, types of conventional and nonconventional static generation technologies; Principle of operation and analysis of fuel cell, photovoltaic systems and wind generation technologies; MPPT techniques and its classifications, principle of operation and partial shading effects; Storage Technologies - batteries, fly wheels, super capacitors and ultra-capacitors.

Module 4: CONTROL ISSUES AND CHALLENGES (09 Periods)

Linear and nonlinear controllers, predictive controllers and adaptive controllers, Load frequency and Voltage Control, PLL, Modulation Techniques, Control of Diesel, PV, wind and fuel cell based generators, Dimensioning of filters, Fault-ride through Capabilities.

Module 5: INTEGRATION OF ENERGY CONVERSION TECHNOLOGIES (09 Periods)

Introduction & importance, sizing, Optimized integrated systems, Interfacing requirements, Distributed versus Centralized Control, Grid connected Photovoltaic systems – classifications, operation, merits & demerits; Islanding Operations, stability and protection issues, load sharing, operation & control of hybrid energy systems, Solar Photovoltaic applications. IEEE & IEC standards for renewable energy grid integrations.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Real-time or simulated implementation of Maximum Power Point Tracking techniques in PV systems.
2. Analyze the impact of renewable integration on grid stability, power quality, and supply reliability
3. Design and simulate linear, nonlinear, or predictive control for PV, wind, or diesel generators.
4. Analyze frequency and voltage variations in a multi-source system under different load conditions.
5. Develop an optimized hybrid system (e.g., solar-wind-diesel-storage) for a specific location or load profile.

(Note: It’s an indicative one. The course instructor may change the activities and shall be reflected in the course handout.)

RESOURCES

TEXT BOOKS:

1. G. Masters, Renewable and Efficient Electric Power Systems, IEEE-John Wiley and Sons Ltd. Publishers, 2013, 2nd Edition.
2. Felix A. Farret, M. Godoy Simoes, Integration of Renewable Sources of Energy, Wiley, 2017, 2nd Edition.

REFERENCE BOOKS:

1. A. Mahaboob Subahani, G. R. Kanagachidambaresan, M. Kathiresh, Integration of Renewable Energy Sources with Smart Grid, Willey 2021.
2. Chetan Singh Solanki, Fundamentals, Technologies & Applications, Solar Photovoltaic, PHI Publishers, 2019, 3rd Edition.

VIDEO LECTURES:

1. https://www.google.com/search?sca_esv=813765718ccf2407&q=Control+and+Integration+of+Renewable+Energy+Sources&udm=7&fbs=AIIjpHxU7SXXniUZfeShr2fp4giZ1Y6MJ25_tmWITc7uy4KIeoJTKjrFjVxydQWqI2NcOha3O1YqG67F0QIhAOFN_ob1yXos5K_Qo9Tq-0cVPzex8YVosMX4HbDUrR7LivhWnk0FuAZVXvp62Oi2LViZ2OMmfytS7nNJKwjX-dfWDM13u79Ad-ozOsBhPchmVRVEnbtWFJzd1HixniG-pG3cQciEsrkJqA&sa=X&ved=2ahUKEwjJhfDFyeaNAxXpR2wGHWfVDTwQtKgLegQIEhAB#fpstate=ive&vld=cid:a5e034f6,vid:-ksJJCkyXrU,st:0
2. https://www.google.com/search?sca_esv=813765718ccf2407&q=Control+and+Integration+of+Renewable+Energy+Sources&udm=7&fbs=AIIjpHxU7SXXniUZfeShr2fp4giZ1Y6MJ25_tmWITc7uy4KIeoJTKjrFjVxydQWqI2NcOha3O1YqG67F0QIhAOFN_ob1yXos5K_Qo9Tq-0cVPzex8YVosMX4HbDUrR7LivhWnk0FuAZVXvp62Oi2LViZ2OMmfytS7nNJKwjX-dfWDM13u79Ad-ozOsBhPchmVRVEnbtWFJzd1HixniG-pG3cQciEsrkJqA&sa=X&ved=2ahUKEwjJhfDFyeaNAxXpR2wGHWfVDTwQtKgLegQIEhAB#fpstate=ive&vld=cid:d4180e92,vid:sob03s6d5_s,st:0

WEB RESOURCES:

1. https://nptel.ac.in/courses/108/102/108102145/
2. https://nptel.ac.in/courses/103/103/103103206/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25AI201701	**BUSINESS ANALYTICS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course emphasizes on the basic concepts of Business Analytics. It covers the basic excel skills, Excel look up functions for database queries in business analytics. By the end of this course students will acquire basic knowledge to implement statistical methods for performing descriptive, predictive and prescriptive analytics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basic concepts and models of Business Analytics

CO2. Select Suitable basic excel function to perform analytics on spread sheets.

CO3. Apply different statistical techniques and distributions for modeling the data

CO4. Develop user-friendly Excel applications by using statistical models for effectiveness decision making.

CO5. Analyze the performance of different optimization models used in prescriptive analytics on Binary and Categorical data.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	-	-	-	-
CO2	2	3	-	-	-	-
CO3	2	2	-	-	3	-
CO4	1	1	-	-	-	-
CO5	-	-	-	-	-	-
Course Correlation Level	**2**	**2**	**-**	**-**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FOUNDATIONS OF BUSINESS ANALYTICS (09 Periods)

Introduction, What is Business Analytics, Evolution of Business Analytics, Scope of Business Analytics, Data for Business Analytics, Applications of Business Analytics, Models in Business Analytics, Problem Solving with Analytics.

Module 2: ANALYTICS ON SPREADSHEETS (09 Periods)

Basic Excel Skills, Excel Functions, Using Excel Lookup Functions for Database Queries, Spreadsheet Add-Ins for Business Analytics.

Visualizing and Exploring Data: Data Visualization, Creating Charts In Microsoft Excel, Other Excel Data Visualization, Statistical Methods For Summarizing Data, Exploring Data Using Pivottables.

Module 3: DATA MODELING (09 Periods)

Basic concepts of Probability, Random Variables and Probability Distributions, Continuous Probability Distributions.

Statistical Sampling, Estimation population parameters, Sampling Error, Sampling Distributions, Hypothesis Testing, ANOVA, Chi Square Test.

Module 4: PREDICTIVE ANALYTICS (09 Periods)

Trend lines And Regression Analysis,Modeling Relationships And Trends In Data,Simple Linear Regression,Multiple Linear Regression,Building Good Regression Models,

Strategies for predictive decision modeling,implementing models on spreadsheets,spreadsheet applications in business analytics,developing user-friendly excel applications, analysing uncertainty and model assumptions,model analysis using analytic solver platform

Module 5: PRESCRIPTIVE ANALYTICS (09 Periods)

Linear Models: Building Linear Models, Implementing Linear Optimization Models On Spreadsheets,Graphical Interpretation Of Linear Optimization, Linear Optimization Models for prediction and Insight.

Integer Models: Solving models with Integer Variables, Integer Optimization Models with Binary Numbers

Decision Analysis: Formulating Decision Problems, Decision Strategies Without Outcome Probabilities, Decision Trees With Outcome Probabilities, Decision Trees.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. **Diabetic Prediction:**

   The National Institute of Diabetes and Digestive and Kidney Diseases has a created a dataset. The objective of the dataset is to diagnostically predict whether or not a patient has diabetes, based on certain diagnostic measurements included in the dataset. Several constraints were placed on the selection of these instances from a larger database. In particular, all patients here are females at least 21 years old of Pima Indian heritage. The datasets consists of several medical predictor variables and one target variable, Outcome. Predictor variables includes the number of pregnancies the patient has had, their BMI, insulin level, age, and so on. Build a machine learning model to accurately predict whether or not the patients in the dataset have diabetes or not?

2. Solve the house price prediction problem using **Linear regression analysis** method. Optimize the parameters of the regression function using gradient descent method.

3. Visualize the decision tree built for solving Heart disease prediction problem and measure the impurity of nodes created via **Decision Tree Analysis**.

   Dataset:https://www.kaggle.com/arviinndn/heart-disease-prediction-uci dataset/data

4. The data set baby boom (Using R) contains data on the births of 44 children in a one-day period at a Brisbane, Australia, and hospital. Compute the skew of the wt variable, which records birth weight. Is this variable reasonably symmetric or skewed?

5. Visualize the **Distribution of data** with different feature scaling methods on online news popularity dataset for article word count.

   Dataset:https://www.kaggle.com/datasets/deepakshende/onlinenewspopularity

6. **Human Activity Recognition System:**

   The human activity recognition system is a classifier model that can identify human fitness activities. To develop this system, you have to use a smart phone dataset, which contains the fitness activity of 30 people which is captured through smart phones. This system will help you to understand the solving procedure of the Multi-classification problem.

RESOURCES

TEXT BOOKS:

1. James Evans, Business Analytics, Pearson Education, 2nd Edition, 2017.

REFERENCE BOOKS:

1. Marc J.Schniederjans, Business Analytics, Pearson Education,2015
2. Camm,Cochran,Essentials of Business Analytics,Cenage learning,2015

VIDEO LECTURES:

1. https://nptel.ac.in/courses/110105089
2. https://archive.nptel.ac.in/courses/110/107/110107092/
3. https://nptel.ac.in/courses/110106050

WEB RESOURCES:

1. https://www.proschoolonline.com/certification-business-analytics-course/what-is-ba
2. https://michael.hahsler.net/SMU/EMIS3309/slides/Evans_Analytics2e_ppt_01.pdf
3. https://www.guru99.com/business-analyst-tutorial-course.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25AI201702	**ETHICS FOR AI**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION:

Recognize the fundamental ideas and standards of AI ethics. Recognizing fairness and prejudice in artificial intelligence. Obstacles to obtaining explain ability and openness. Frameworks based on ethics and the law that designate accountability. Privacy and security concerns related to AI ethics. Ethics in AI in the future.

COURSE OUTCOMES: At the end of the course, student will be able to:

CO1. Understand the basic concepts of AI Ethics and ethical principles.

CO2. Understanding the concept of bias and fairness in AI.

CO3. Challenges in achieving the transparency and explainability.

CO4. Legal and ethical frameworks for assigning responsibility.

CO5. Security and privacy issues of AI Ethics. Future of AI ethics.

CO-PO Mapping Table

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	2	-	-	-
CO2	3	3	3	-	-	-
CO3	3	3	-	-	-	-
CO4	2	3	3	-	-	-
CO5	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**3**	**3**	-	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

MODULE 1: INTRODUCTION TO AI ETHICS (09 Periods)

Overview of ethical issues in AI. Historical context and key concepts. Importance of ethical considerations in AI development and deployment.

Ethical Principles and Frameworks:

Utilitarianism, deontology, virtue ethics, and other ethical theories. Ethical principles forAI, such as fairness, transparency, accountability, and privacy.

MODULE 2: BIAS AND FAIRNESS IN AI (09 Periods)

Understanding bias in AI systems. Types of bias (e.g., algorithmic bias, dataset bias). Approaches to detecting and mitigating bias. Fairness metrics and fairness-aware machine learning algorithms.

MODULE 3: TRANSPARENCY AND EXPLAINABILITY (09 Periods)

Importance of transparency and explainability in AI. Techniques for explaining AI decisions. Challenges and trade-offs in achieving transparency and explainability. Regulatory requirements and guidelines for transparent AI systems.

MODULE 4: ACCOUNTABILITY AND RESPONISIBILITY (09 Periods)

Holding AI developers, users, and organizations accountable for AI systems' actions. Legal and ethical frameworks for assigning responsibility. Challenges in attributing responsibilityin complex AI systems

MODULE 5: PRIVACY AND DATA PROTECTION (09 Periods)

Privacy issues in AI, including data collection, storage, and sharing. Privacy-preserving AI techniques. Regulatory frameworks (e.g., GDPR) and ethical guidelines for data protectionin AI. Ethical considerations in emerging AI technologies.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERENTIAL LEARNING

Case -1: Emergence of Bias and Fairness Interventions

For the problem of Loan Approval and Hiring by AI, specify the steps and practices to the entry of bias and fairness improvement interventions.

Case-2: AI governance with critical thinking, negotiation skills, and a multi-stakeholder perspective
Undertake the study from ethical perspective for the problem of Public response system, Policy making and Contract negotiation.

(Note: It’s an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Müller, Vincent C., Ethics of Artificial Intelligence and Robotics. The Stanford Encyclopedia of Philosophy, 2021.
2. Meredith Broussard, Artificial Unintelligence: How Computers Misunderstand the World, Cambridge, MA: MIT Press, 2018.

REFERENCE BOOKS:

1. Brett Frischmann and Evan Selinger, Re-Engineering Humanity, Cambridge University Press, Cambridge, 2018.
2. Cathy O'Neil, Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy, Crown Publishers, 2016.
3. Shoshana Zuboff, The Age of Surveillance Capitalism, Financial Times, 2020.

VIDEO LECTURES:

1. https://rainermuehlhoff.de/en/EoAI2025/
2. https://www.youtube.com/watch?v=qpp1G0iEL_c
3. https://rainermuehlhoff.de/en/EoAI2025/

WEB RESOURCES:

1. https://www.ibm.com/topics/ai-ethics
2. https://www.coursera.org/articles/ai-ethics
3. https://ai.google/responsibility/principles/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CM201701	**COST MANAGEMENT OF ENGINEERING PROJECTS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course will provide an understanding of the cost tools and techniques thatcan be used throughout a project's design and development. The students will be exposed to the methods, processes, and tools needed to conduct economic analysis, estimation of Project.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the costing concepts and their role in decision-making.

CO2. Understand the project management concepts and their various aspects in selection.

CO3. Interpret costing concepts with project execution.

CO4. Knowledge of costing techniques in the service sector and various budgetary control techniques.

CO5. Become familiar with quantitative techniques in cost management.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	-	-	-	-	2
CO2	-	-	-	-	-	2
CO3	-	-	-	-	-	2
CO4	-	-	-	-	-	2
CO5	-	-	-	-	-	2
Course Correlation Level	**-**	**-**	**-**	**-**	**-**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO COSTING CONCEPTS (05 Periods)

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost, and Opportunity cost; Creation of a Database for operational control.

Module 2: INTRODUCTION TO PROJECT MANAGEMENT (10 Periods)

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre-project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts

Module 3: PROJECT EXECUTION AND COSTING CONCEPTS (10 Periods)

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing

Module 4: COSTING OF SERVICE SECTOR AND BUDGETARY CONTROL (10 Periods)

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets

Module 5: QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT (10 Periods)

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1 Prepare a mini-project report regarding cost control techniques in manufacturing units.

2 Prepare a report on real-life engineering project case studies, especially those that faced cost overruns or successfully managed costs

3 Conduct hands-on budgeting exercises where participants are given a project scope, and they have to create detailed budgets.

RESOURCES

TEXT BOOKS:

1. John M. Nicholas, Herman Steyn, Project Management for Engineering, Business and Technology, Taylor & Francis, 2 August 2020, ISBN: 9781000092561
2. Albert Lester, Project Management, Planning and Control, Elsevier/Butterworth-Heinemann, 2007, ISBN: 9780750669566, 075066956X.

REFERENCE BOOKS:

1. Charles T. Horngren et al, Cost Accounting a Managerial Emphasis, Prentice Hall of India, New Delhi, 2011.
2. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting, A. H. Wheeler publisher, 1991.
3. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=rck3MnC7OXA
2. https://www.youtube.com/watch?v=QWD1LMzStI4

WEB RESOURCES:

1. https://www.superfastcpa.com/what-are-cost-concepts-in-decision-making
2. https://www.indeed.com/career-advice/career-development/project-cost-controls
3. https://www.geeksforgeeks.org/difference-between-pert-and-cpm/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE201701	**DISASTER MANAGEMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion ondisaster prone areas in India, repercussions of disasters and hazards, disaster preparedness and management, risk assessment and disaster management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the vulnerability of an area to natural and man-made disasters/hazards as per the guidelines to solve complex problems using appropriate techniques ensuring safety, environment and sustainability.

CO2. Analyze the causes and impacts of disasters using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Suggest the preparedness measures using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability.

CO4. Analyze the Risk Assessment using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability.

CO5. Design disaster management strategies to solve pre, during and post disaster problems using appropriate tools and techniques following the relevant guidelines and latest developments ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	-	-	-	-	2
CO2	-	-	-	-	-	2
CO3	-	-	-	-	-	2
CO4	-	-	-	-	-	2
CO5	-	-	-	-	-	2
Course Correlation Level	**-**	**-**	**-**	**-**	**-**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DISASTER PRONE AREAS IN INDIA **(09 Periods)**

Introduction: Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. **Disaster Prone Areas:** Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Module 2: REPERCUSSIONS OF DISASTERS AND HAZARDS **(09 Periods)**

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Module 3: DISASTER PREPAREDNESS AND MANAGEMENT **(11 Periods)**

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

Module 4: RISK ASSESSMENT **(08 Periods)**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Module 5: DISASTER MANAGEMENT **(08 Periods)**

Disaster management organization and methodology, Disaster management cycle, Disaster management in India – Typical cases and Cost–benefit analysis, Disaster management programs implemented by NGOs and Government of India, Usage of GIS and Remote sensing techniques in disaster management, Leadership and Coordination in Disaster management, Emerging trends in disaster management.

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Perform hazard assessment and vulnerability analysis for any nearby town/city and prepare a detailed report of possible impacts of various disasters on environment, infrastructure and development.
2. Prepare a detailed report on the causes and effects of Tsunami that was occurred in the year 2004. Also discuss various advancements in Tsunami warning systems.
3. Identify the major causes of urban floods in cities like Chennai, Hyderabad & Mumbai. Also list various mitigation strategies to reduce the impact of floods.
4. Prepare a detailed report on how various man-made activities are directly/indirectly related to the occurrence of landslides that occurred in recent days in India.
5. Visit AP State Disaster Response and Fire Services Department and record about various methods used by them in mitigating disasters and their management.

RESOURCES

TEXT BOOKS:

1. Sharma V. K., Disaster Management, Medtech Publishing, 2nd Edition, 2013.
2. Anand S. Arya, AnupKaranth, and Ankush Agarwal, Hazards, Disasters and Your Community: A Primer for Parliamentarians, GOI–UNDP Disaster Risk Management Programme, Government of India, National Disaster Management Division, Ministry of Home Affairs, New Delhi, Version 1.0, 2005

REFERENCE BOOKS:

1. Donald Hyndman and David Hyndman, Natural Hazardsand Disasters, Cengage Learning, USA, 5th Edition, 2015.
2. Disaster Management in India, A Status Report, Ministry of Home Affairs, Govt. of India, May 2011.
3. Rajendra Kumar Bhandari, Disaster Education and Management: A Joyride for Students, Teachers, and Disaster Managers, Springer India, 2014.
4. Singh R. B., Natural Hazards and Disaster Management, Rawat Publications, 2009.
5. R. Nishith, Singh AK, and Disaster Management in India: Perspectives, issues and strategies, New Royal book Company.
6. Sahni, PardeepEt.Al. (Eds.), Disaster Mitigation Experiences And Reflections, Prentice Hall of India, New Delhi.
7. Goel S. L. , Disaster Administration And Management Text And Case Studies, Deep &Deep Publication Pvt. Ltd., New Delhi

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105104183
2. https://www.digimat.in/nptel/courses/video/124107010/L01.html

WEB RESOURCES:

1. https://egyankosh.ac.in/handle/123456789/25093
2. https://www.egyankosh.ac.in/handle/123456789/25912
3. https://www.nios.ac.in/media/documents/333courseE/12.pdf
4. https://ndmindia.mha.gov.in/images/public-awareness/Primer%20for%20Parliamentarians.pdf

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25SS201701	**VALUE EDUCATION**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course deals with understanding the value of education and self-development, Imbibe good values in students, and making them know about the importance of character.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the knowledge of values and self-development

CO2. Analyze the importance of the cultivation of values.

CO3. Learn suitable aspects of personality and behavioral development

CO4. Function as a member and leader in multi-disciplinary teams by avoiding faulty thinking.

CO5. Develop character and competence for effective studies.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	-	-	-	-	-
CO2	2	3	-	-	2	-
CO3	2	-	-	-	2	-
CO4	2	-	-	-	-	-
CO5	2	2	-	-	-	-
Course Correlation Level	**2**	**3**	**-**	**-**	**2**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: VALUES AND SELF-DEVELOPMENT (09 Periods)

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements- Case studies

Module 2: IMPORTANCE OF CULTIVATION OF VALUES. (09 Periods)

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline- Case studies

Module 3: PERSONALITY AND BEHAVIOR DEVELOPMENT (09 Periods)

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity anddiscipline, Punctuality, Love and Kindness - Case studies

Module 4: AVOID FAULTY THINKING. (09 Periods)

Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature - Case studies

Module 5: CHARACTER AND COMPETENCE (09 Periods)

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation, Equality, Nonviolence, Humility, Role of Women. All religions and the same message. Mind your Mind, Self-control. Honesty, Studying effectively- Case studies

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Demonstrate orally using your experiences of what values are naturally acceptable in a relationship to nurture or exploit others.
2. Prepare a report by identifying and analyzing the importance of cultivation of values.
3. Present a poster on different attitudes and behaviours.
4. Students give a PowerPoint presentation ondoing best for nature.
5. Students are encouraged to bring a daily newspaper to class or to access any news related to the need for human values and note down the points.
6. Prepare a case study on how to maintain harmony with different religious people through character and competence.

(It’s an indicative one. The Course Instructor may change the activities and the same shall be reflected in the Course Handout)

RESOURCES

TEXTBOOKS:

1. R. Subramanaian, Professional Ethics, Oxford Higher Education, 2013.
2. Mike W. Martin and Roland Schinzinger, Ethics in Engineering, Tata McGraw-Hill, 3rd Edition, 2007.
3. Chakravarthy, S.K.: Values and ethics for Organizations: Theory and Practice, Oxford University Press, NewDelhi, 1999.

REFERENCE BOOKS:

1. M.G. Chitakra: Education and Human Values, A.P.H. Publishing Corporation, New Delhi, 2003
2. Awakening Indians to India, Chinmayananda Mission, 2003
3. Satchidananda, M.K.: Ethics, Education, Indian Unity and Culture, Ajantha Publications, Delhi, 1991

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=90VQPZURN5c
2. https://www.youtube.com/watch?v=6ofPcK0uDaA
3. https://www.youtube.com/watch?v=5_f-7zCi79A
4. https://www.youtube.com/watch?v=2ve49BWAJRE
5. https://www.youtube.com/watch?v=kCOIfnxxQ5U

WEB RESOURCES:

1. https://www.livingvalues.net/
2. https://livingvalues.net/materials-for-schools/
3. https://www.edb.gov.hk/en/curriculum-development/4-key-tasks/moral-civic/index.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25SS201702	**PEDAGOGY STUDIES**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course deals with understanding pedagogical practices that are being used by teachers in formal and informal classrooms, the effectiveness of pedagogical practices, teacher education (curriculum and practicum), and the school curriculum and guidance materials that can best support effective pedagogy.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge of pedagogical methodology

CO2. Analyze the functional knowledge in Pedagogical practices, Curriculum, and Teacher Education

CO3. Learn effective pedagogical practices and apply strategies.

CO4. Function effectively as an individual and as a member of the Professional development.

CO5. Understand research Gaps and provide future Directions.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	-	-	-	-
CO2	2	3	-	-	3	-
CO3	2	2	-	-	3	-
CO4	1	1	-	-	-	-
CO5	-	-	-	-	-	-
Course Correlation Level	**2**	**2**	**-**	**-**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION AND METHODOLOGY (09 Periods)

Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of Methodology and Searching- Case studies

Module 2: THEMATIC OVERVIEW (09 Periods)

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher Education- Case studies

Module 3: EFFECTIVENESS OF PEDAGOGICAL PRACTICES (09 Periods)

Evidence on the effectiveness of pedagogical practices, Methodology for the in-depth stage: quality assessment of included studies, teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy, Theory of change, Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' Attitudes and beliefs and Pedagogic strategies- Case studies

Module 4: PROFESSIONAL DEVELOPMENT (09 Periods)

Alignment with classroom practices and follow-up support, Peer support, and Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes- Case studies

Module 5 RESEARCH GAPS AND FUTURE DIRECTIONS (09 Periods)

Research design**,** Contexts**,** Pedagogy**,** Teacher Education**,** Curriculum and Assessment**,** Dissemination and research impact- Case studies

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. List out the self-improvement in you after going through pedagogical methodologies.
2. Discuss different practices that you would like to adopt in the curriculum.
3. Describe in your own words how can you bring effectiveness to the curriculum.
4. Imagine you are a head teacher and illustrate different barriers to learning.
5. Assume you are a teacher and Interpret different directions that you would bring for the assessment of the students.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in the Course Handout)

RESOURCES

TEXTBOOK:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Alexander RJ (2001), Culture and pedagogy: International comparisons in primary education.

REFERENCES:

1. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.Oxford and Boston: Blackwell.
3. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count, International Journal Educational Development, 33 (3): 272–282.
4. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=WL40UeySag4
2. https://www.youtube.com/watch?v=MMXaXDIHFJ8
3. https://www.youtube.com/watch?v=7uJL1R6M4Iw

WEB RESOURCES:

1. https://acrl.ala.org/IS/instruction-tools-resources-2/pedagogy/a-selected-list-of-journals-on-teaching-learning/
2. https://guides.douglascollege.ca/TLonline/resourcesforonlinepedagogy
3. https://www.refseek.com/directory/teacher_resources.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25LG201701	**PERSONALITY DEVELOPMENT THROUGH ESSENTIAL LIFE SKILLS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course gives awareness to students about the various dynamics of personality development.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge in Self-Management and Planning Career

CO2. Analyze the functional knowledge in attitudes and thinking strategies

CO3. Learn and apply soft skills for professional success.

CO4. Function effectively as an individual and as a member in diverse teams

CO5. Communicate effectively in public speaking in formal and informal situations.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	-	-	-	-
CO2	2	3	-	-	-	-
CO3	2	2	-	-	3	-
CO4	1	1	-	-	-	-
CO5	-	-	-	-	-	-
Course Correlation Level	**2**	**2**	**-**	**-**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: SELF-ESTEEM & SELF-IMPROVEMENT (09 Periods)

Concept of personality, significance of personality**-**Know Yourself – Accept Yourself; Self-Improvement: Plan to Improve - Actively Working to Improve Yourself- SWOT Analysis- Exercises- case studies

Module 2: DEVELOPING POSITIVE ATTITUDES (09 Periods)

How Attitudes Develop – Attitudes are Catching – Improve Your Attitudes – Exercises- case studies- Positive attitude and its advantages, negative attitude and its disadvantages-case studies

Module 3: SELF-MOTIVATION & SELF-MANAGEMENT (09 Periods)

Concept of motivation, significance, factors leading to de-motivation- Show Initiative – Be Responsible - Self-Management; Efficient Work Habits – Stress Management – Employers Want People Who can Think – Thinking Strategies- Exercises- case studies

Module 4: GETTING ALONG WITH THE SUPERVISOR (09 Periods)

Know your Supervisor – Communicating with your Supervisor – Special Communication with your Supervisor – What Should you Expect of Your Supervisor? – What your Supervisor expects

of you - Moving Ahead Getting Along with your Supervisor- Exercises- case studies

Module 5: WORKPLACE SUCCESS (09 Periods)

First Day on the Job – Keeping Your Job – Planning Your Career – Moving Ahead- Essential employability skills, professional attributes, and career development strategies -Exercises- Case studies.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. List out the self-improvements in you on the charts and explain in detail.
2. Discuss different famous personalities and their attitudes.
3. Describe different personalities concerning self-motivation and self-management.
4. Imagine you are a supervisor and illustrate different special communications.
5. Assume and Interpret different experiences on the first day of your job.

RESOURCES

TEXTBOOK:

1. Harold R. Wallace and L. Ann Masters, Personal Development for Life and Work, Cengage Learning, Delhi, 10th edition Indian Reprint, 2011. (6th Indian Reprint 2015)
2. Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.

REFERENCE BOOKS:

1. K. Alex, Soft Skills, S. Chand & Company Ltd, New Delhi, 2nd Revised Edition, 2011.
2. Stephen P. Robbins and Timothy A. Judge, Organizational Behaviour, Prentice Hall, Delhi, 16th edition, 2014

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=6Y5VWBLi1es
2. https://www.youtube.com/watch?v=H9qA3inVMrA

WEB RESOURCES:

1. https://www.universalclass.com/.../the-process-of-perso
2. https://www.ncbi.nlm.nih.gov/pubmed/25545842
3. https://www.youtube.com/watch?v=Tuw8hxrFBH8

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25ME201701	**ENTREPRENEURSHIP AND INNOVATION MANAGEMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course aims to provide students with a deep understanding of entrepreneurship and innovation. It explores entrepreneurial processes, opportunity identification, business planning, innovation management, intellectual property rights, and venture growth strategies. Students will develop entrepreneurial thinking, creativity, and problem-solving abilities to create and manage innovative ventures that contribute to economic and societal development.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Explain the fundamentals of entrepreneurship and its role in economic development.

CO2. Analyze opportunities and prepare business plans for entrepreneurial ventures.

CO3. Apply creativity and innovation techniques to business problems.

CO4. Demonstrate knowledge of technology management, IPR, and startup ecosystem.

CO5. Evaluate financing options, marketing strategies, and growth models for ventures.

CO-PO MappingTable:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	-	-
CO2	3	3	2	2	2	-
CO3	2	3	3	2	2	1
CO4	2	2	2	2	2	1
CO5	3	3	2	2	3	1
Course Correlation Mapping	**3**	**3**	**2**	**2**	**2**	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO ENTREPRENEURSHIP (09 Periods)

Concept, meaning and importance of entrepreneurship – Characteristics and skills of entrepreneurs – Types of entrepreneurs: social, women, corporate, rural, technology-based – Intrapreneurship vs. entrepreneurship – Entrepreneurial ecosystem and its components.

Module 2: ENTREPRENEURIAL PROCESS AND BUSINESS PLANNING (09 Periods)

Stages of entrepreneurial process: Idea, Feasibility, Startup, Growth – Opportunity identification and evaluation – Market research and environmental scanning – Structure and components of a business plan – Case studies of successful entrepreneurs.

Module 3: INNOVATION MANAGEMENT (09 Periods)

Meaning, scope and significance of innovation – Types of innovation: product, process, And business model, disruptive, frugal – Creativity techniques: brainstorming, lateral thinking, design thinking, TRIZ – Managing innovation in organizations – Innovation as a competitive advantage.

Module 4: TECHNOLOGY, IPR AND STARTUP ECOSYSTEM (09 Periods)

Technology management and commercialization – Intellectual Property Rights (IPR): patents, copyrights, trademarks, designs, trade secrets – Technology transfer and licensing – Startup India, Atal Innovation Mission, MSME policies – Role of incubators, accelerators and innovation hubs.

Module 5: FINANCING AND GROWTH OF VENTURES (09 Periods)

Sources of finance: bootstrapping, angel investors, venture capital, crowdfunding, government support – Entrepreneurial marketing strategies – Financial planning for startups – Scaling up ventures: challenges and strategies – Exit strategies: mergers, acquisitions, IPO.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Prepare a mini-business plan for a startup idea.
2. Visit a nearby incubation/innovation center and prepare a report.
3. Conduct a creativity workshop (brainstorming/design thinking session).
4. Prepare a case study presentation on a successful entrepreneur/startup.

RESOURCES

TEXT BOOKS:

1. Hisrich, R.D., Peters, M.P., & Shepherd, D.A. (2017), Entrepreneurship, McGraw-Hill Education.
2. Drucker, P. (2007), Innovation and Entrepreneurship, Harper Business.
3. Kuratko, D.F. (2020), Entrepreneurship: Theory, Process and Practice, Cengage Learning.

REFERENCE BOOKS:

1. Timmons, J.A., & Spinelli, S. (2019), New Venture Creation: Entrepreneurship for the 21st Century, McGraw-Hill Education.
2. Schilling, M.A. (2020), Strategic Management of Technological Innovation, McGraw-Hill Education.
3. Scarborough, N.M. (2018), Essentials of Entrepreneurship and Small Business Management, Pearson.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=rA4uKIy5gO0&list=PLsh2FvSr3n7fQlIDbfKutmSL26TsWitGQ
2. https://www.youtube.com/watch?v=itRVzjk9mkg

WEB RESOURCES:

1. https://nacosadsu.org.ng/main/docs/300L/ENT%20301.pdf?utm_source=chatgpt.com
2. https://www.measiim.edu.in/myweb/uploads/2022/05/PMFEA-IE-1.pdf?utm_source=chatgpt.com
3. https://ocw.mit.edu/courses/15-351-managing-innovation-and-entrepreneurship-spring-2008/pages/lecture-notes/?utm_source=chatgpt.com