JERUSALEM COLLEGE OF ENGINEERING

(An Autonomous Institution)

Approved by AICTE & Affiliated to Anna University

Accredited by NAAC with 'A' Grade

Chennai – 600 100

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM

REGULATION 2023

CHOICE BASED CREDIT SYSTEM

JERUSALEM COLLEGE OF ENGINEERING (AN AUTONOMOUS INSTITUTION, AFFILIATED TO ANNA UNIVERSITY, CHENNAI)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATION 2023

CHOICE BASED CREDIT SYSTEM

I TO VIII SEMESTERS CURRICULUM

S.No.	CATEGORY	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1	HS	4	4	-	-	1	-	2		11
2	BS	10	9	3	3	-	-	-	-	25
3	ES	8	3	-	-	-	-	-	-	11
4	PC	-	5	17	13	16	12	-	10	73
5	PE	-	-	-	3	3	6	6	-	18
6	OE	-	-	-	3	3	3	3	-	12
7	EEC	-	2	-	3	2	3	6	-	16
TOTAL		22	23	20	25	25	24	17	10	166

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM 2023

SEMESTER - 1

S. No	Course Code	Course Title	T/P/I	Category	Contact Periods	L	T	P	C
1	JHS2121	English for Communicative Competence	I	HS	4	2	0	2	3
2	JGE2102	Heritage of Tamils	T	HS	1	1	0	0	1
3	JMA2101	Matrices and Calculus	T	BS	4	2	2	0	3
4	JPH2101	Engineering Physics I	T	BS	3	3	0	0	3
5	JCY2101	Engineering Chemistry	T	BS	3	3	0	0	3
6	JGE2101	Basic Engineering	T	ES	3	3	0	0	3
7	JCS2121	Programming in C	I	ES	5	3	0	2	4
8	JPC2111	Engineering Physics and Chemistry Laboratory	P	BS	2	0	0	2	1
9	JGE2111	Basic Engineering Laboratory	P	ES	2	0	0	2	1
TOTAL					27	17	2	8	22

SEMESTER - 2

S. No	Course Code	Course Title	T/P/I	Category	Contact Periods	L	T	P	C
1	JHS2221	English for Science and Technology	I	HS	4	2	0	2	3
2	JGE2202	Tamils and Technology	T	HS	1	1	0	0	1
3	JMA2201	Statistics for Engineers	T	BS	4	2	2	0	3
4	JPH2201	Engineering Physics II	T	BS	3	3	0	0	3
5	JCY2201	Environmental Science and Sustainability	T	BS	2	2	0	0	2
6	JGE2221	Engineering Graphics	I	ES	4	2	0	2	3
7	JEE2201	Circuit Theory	T	PC	4	2	2	0	3
8	JPC2211	Engineering Physics and Environmental Science Laboratory	P	BS	2	0	0	2	1
9	JEE2211	Electric Circuits Laboratory	P	PC	4	0	0	4	2
10	JGE2241	Gaming and Crafts Studio	P	EEC	4	0	0	4	2
TOTAL					32	14	4	14	23

SEMESTER - 3

S. No	Course Code	Course Title	T/P/I	Category	Contact Periods	L	T	P	C
1	JMA2301	Transforms and Partial Differential Equations	T	BS	4	2	2	0	3
2	JEE2301	Electronic Devices and Circuits	T	PC	3	3	0	0	3
3	JEE2302	Electromagnetic Theory	T	PC	4	2	2	0	3
4	JEE2303	Electrical Machines	T	PC	3	3	0	0	3
5	JEE2321	Digital Logic Circuits	I	PC	5	3	0	2	4
6	JNC2361	Non-Credit Mandatory Course 1	T	NCM	3	3	0	0	-
7	JEE2311	Electronic Devices and Circuits Laboratory	P	PC	4	0	0	4	2
8	JEE2313	Electrical Machines Laboratory	P	PC	4	0	0	4	2
9	JPT2041	Soft Skills and Aptitude	P	EEC	2	0	0	2	*
TOTAL					32	16	4	12	20

* Only Internal Assessments will be conducted in the 3rd semester while the end semester examination will be conducted in the 4th semester.

SEMESTER - 4

S. No	Course Code	Course Title	T/P/I	Category	Contact Periods	L	T	P	C
1	JMA2401	Applied Numerical Methods	T	BS	4	2	2	0	3
2	JEE2421	Object Oriented Programming in Machine Design	I	PC	5	3	0	2	4
3	JEE2422	Linear Integrated Circuits and Applications	I	PC	5	3	0	2	4
4	JEE2401	Control and Instrumentation	T	PC	3	3	0	0	3
5	-	Professional Elective 1	T	PE	3	3	0	0	3
6	-	Open Elective 1	T	OE	3	3	0	0	3
7	JEE2411	Control and Instrumentation Laboratory	P	PC	4	0	0	4	2
8	JPT2041	Soft Skills and Aptitude	P	EEC	2	0	0	2	1
9	JGE2441	e-Protoshop	P	EEC	4	0	0	4	2
TOTAL					33	17	2	14	25

SEMESTER - 5

S. No	Course Code	Course Title	T/P/I	Category	Contact Periods	L	T	P	C
1	JEE2521	Introduction to Microprocessors and Microcontroller	I	PC	5	3	0	2	4
2	JEE2502	Transmission, Distribution and Protection	T	PC	3	3	0	0	3
3	JEE2501	Power Electronics and Drives	T	PC	3	3	0	0	3
4	JEE2522	Internet of Things in Electrical Engineering	I	PC	5	3	0	2	4
5	-	Professional Elective 2	T	PE	3	3	0	0	3
6	-	Open Elective 2	T	OE	3	3	0	0	3
7	JHS2541	Professional Communication	P	HS	2	0	0	2	1
8	JEE2511	Power Electronics and Drives laboratory	P	PC	4	0	0	4	2
9	JPT2042	Technical Skills and Aptitude	P	EEC	2	0	0	2	*
10	JGE2541	Industry 4.0 Laboratory	P	EEC	4	0	0	4	2
TOTAL					34	18	0	16	25

* Only Internal Assessments will be conducted in the 5th semester while the end semester examination will be conducted in the 6th semester.

SEMESTER – 6

S. No	Course Code	Course Title	T/P/I	Category	Contact Periods	L	T	P	C
1	JEE2621	Power Electronics for Renewable Energy Systems	I	PC	5	3	0	2	4
2	JEE2601	Power System Analysis, Operation and Control	T	PC	4	2	2	0	3
3	JEE2602	Artificial Intelligence in Electrical Engineering	T	PC	3	3	0	0	3
4	-	Professional Elective 3	T	PE	3	3	0	0	3
5	-	Professional Elective 4	T	PE	3	3	0	0	3
6	-	Open Elective 3	T	OE	3	3	0	0	3
7	JEE2611	Power System Simulation Laboratory	P	PC	4	0	0	4	2
8	JPT2042	Technical Skills and Aptitude	P	EEC	2	0	0	2	1
9	JGE2641	Product Development Laboratory	P	EEC	4	0	0	4	2
TOTAL					31	17	2	12	24

SEMESTER – 7

S. No	Course Code	Course Title	T/P/I	Category	Contact Periods	L	T	P	C
1	-	Professional Elective 5	T	PE	3	3	0	0	3
2	-	Professional Elective 6	T	PE	3	3	0	0	3
3	-	Open Elective 4	T	OE	3	3	0	0	3
4	JNC2761	Non-Credit Mandatory Course 2	T	NCM	3	3	0	0	-
5	JHS2741	Universal Human Values	I	HS	3	1	0	2	2
6	JGE2751	Entrepreneurship Development	I	EEC	4	2	0	2	3
7	JEE2741	Comprehension and Technical Seminar	P	EEC	2	0	0	2	1
8	JEE2742	Internship	P	EEC	-	-	-	4**	2
TOTAL					21	15	0	6	17

** Internship of one month must be undertaken in industry through semester 4,5 and 6 leading to 2 credit in semester 7

SEMESTER – 8

S. No	Course Code	Course Title	T/P/I	Category	Contact Periods	L	T	P	C
1	JEE2831	Project Work	P	PC	20	0	0	20	10
TOTAL					20	0	0	20	10

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

R2023

PROFESSIONAL ELECTIVE COURSES : VERTICALS

Vertical I **Renewable Energy Systems**	Vertical II **Embedded Systems**	Vertical III **Control Engineering**	Vertical IV **Instrumentation and Industrial Automation**	Vertical V **Power Systems**	Vertical VI **Electric Vehicle Technology**
JEE2001 - Power Semiconductor Devices	JEE2009 - Embedded System Framework	JEE2017 - Signals and Systems	JEE2025 - Sensors and Transducers	JEE2033 - High Voltage Direct Current Transmission	JEE2041- Electric Vehicle Architecture
JEE2002 -Forms of Energy and Energy Crisis	JEE2010- ARM Processors	JEE2018 - Advanced Control Systems	JEE2026 - Analytical Instruments	JEE2034 - Electric Energy Generation, Utilization and Conservation	JEE2042- Energy Storage System for E-Mobility
JEE2003- Solar and Energy Storage Systems	JEE2011 - Software for Embedded Systems	JEE2019 - Digital Signal Processing System Design	JEE2027- PLC Programming	JEE2035 - Power System Transients	JEE2043 - Power Converter for Electric Vehicle Drive Systems
JEE2004 - Solar Power Plant Designing	JEE2012- Real Time Operating Systems	JEE2020 - Model Based Control	JEE2028 - Advanced Integrated Automation	JEE2036 - Power Quality	JEE2044 - Vehicle Dynamics
JEE2005 - Software Tools for Energy Analysis	JEE2013 - Embedded System Networking	JEE2021- System Identification	JEE2029 - Intelligent Automation	JEE2037- Flexible AC Transmission Systems	JEE2045- Electric Vehicle Charging Systems
JEE2006- Wind Energy Conversion Systems	JEE2014 - Embedded System Security	JEE2022 - Adaptive Control	JEE2030 - Robotics	JEE2038 - Under Ground Cable Engineering	JEE2046 - Grid Integration of Electric Vehicles
JEE2007 - Energy Conversion Techniques	JEE2015- Smart System Design	JEE2023 - Machine Monitoring System	JEE2031 - Artificial Intelligence for Robotics	JEE2039 - Distributed Generation and Microgrids	JEE2047 - Battery Management Systems
JEE2008 - Energy Economics	JEE2016 - Embedded System for Automotive Applications	JEE2024 - Computer Control of Processes	JEE2032 - Industry 4.0	JEE2040 - Smart Grid	JEE2048- Testing of Electric Vehicles

OPEN ELECTIVES OFFERED BY EEE DEPARTMENT

SEMESTER – IV

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	JEE9201	Electrical Safety Engineering	OE	3	3	0	0	3
2.	JEE9202	Green Energy	OE	3	3	0	0	3
SEMESTER - V								
3.	JEE9203	Industrial Electronics	OE	3	3	0	0	3
4.	JEE9204	Measurement and Instrumentation	OE	3	3	0	0	3
SEMESTER - VI								
5.	JEE9205	Renewable Energy Systems	OE	3	3	0	0	3
6.	JEE9206	Intelligent Controllers	OE	3	3	0	0	3
SEMESTER - VII								
7.	JEE9207	Introduction to E- Vehicles	OE	3	3	0	0	3
8.	JEE9208	Energy Management and SCADA	OE	3	3	0	0	3

SEMESTER 1

JHS2121	ENGLISH FOR COMMUNICATIVE COMPETENCE	L T P C 2 0 2 3

COURSE OBJECTIVES:

- To enable the students of Engineering to develop their reading and other language skills
- To facilitate the learners to reflect and share their ideas effortlessly
- To develop their skills to communicate thoughts effectively in social contexts
- To expose them to different genres to develop their understanding and expression
- To train the students to improve their writing skills for efficient communication

UNIT I ANALYTICAL GRAMMAR AND INFORMATION SHARING 12

Parts of speech – Functional units – Tenses – Affixes; Reading comprehension: short general passages for skimming and scanning

Language Practice
Reading: Biographical essays, short stories; **Speaking:** Self-introduction, peer introduction; **Listening:** Inspiring speeches, newscasts; **Writing:** Journal writing

UNIT II FOUNDATIONAL GRAMMAR AND EXPRESSING THOUGHTS 12
Framing questions – Prepositions – Compound nouns – Contextual meaning; Letter writing (informal letters)

Language Practice
Reading: Travelogues; Speaking: Small talks, Just A Minute (JAM); Listening: Anecdotes, stories, podcasts; Writing: Fill in the blanks in short dialogues

UNIT III FUNCTIONAL GRAMMAR AND SOCIAL COMMUNICATION 12

Articles – Subject-verb agreement – Synonyms and antonyms – Email etiquette; Dialogue writing

Language Practice
Reading: Adverts; **Speaking:** Role play, storytelling / completion; **Listening:** Messages from social network; **Writing:** Writing messages for social network / emails

UNIT IV STRUCTURAL GRAMMAR AND VISUAL COMMUNICATION 12

Modal verbs – Simple, complex and compound sentences – Discourse markers – Correction of errors; Interpretation of posters on social issues

Language Practice
Reading: Excerpts from literature; **Speaking:** Asking for / giving directions - Picture description; **Listening:** Talks on English and language skills; **Writing:** Reporting on events / incidents

UNIT V TRANSFORMATIONAL GRAMMAR AND WRITTEN COMMUNICATION 12

Degrees of comparison – Reported speech – Connotations – One-word substitutes (general); Essay writing: narrative / descriptive / expository / argumentative

Language Practice
Reading: Newspaper articles, social media messages (educational contexts); **Speaking:** Group discussions (general topics); **Listening:** Formal and informal talks, Ted talks; **Writing:** Writing short stories / poems (guided)

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- To comprehend reading passages and express themselves
- To communicate their thoughts confidently and skillfully
- To participate in activities of daily life using appropriate communicative strategies
- To be creative and critical in expressing themselves
- To write effectively and persuasively and produce different types of writing

TEXT BOOKS:

1. Department of English, Anna University, English for Engineers & Technologists, Volume 2, Orient BlackSwan Private Limited, Chennai, 2022.
2. Dhanavel, SP. English and Communication Skills for Students of Science and Engineering. Orient BlackSwan Private Limited, Chennai, 2011.
3. Interact English: Lab Manual for Undergraduate Students. Orient BlackSwan Private Limited, Chennai, 2017.

REFERENCE BOOKS:

1. Chellammal, V. Learning to Communicate. Allied Publishing House, New Delhi, 2004.
2. Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practices. Oxford University Press, New Delhi. 2015.
3. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2008.
4. Rizvi M, Ashraf. Effective Technical Communication, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017.

WEB LINKS:

- www.esl-lab.com
- www.englishgrammar.org
- www.englishclub.com
- www.usingenglish.com
- www.esl.about.com
- www.bbc.co.uk/learningenglish/
- https://esl-bits.net/
- https://elt.oup.com/
- https://learnenglish.britishcouncil.org
- https://quizizz.com/

Mapping of CO with PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	1	-	1	1	1	3	-	1
CO2	-	-	-	1	-	1	1	1	3	-	1
CO3	-	-	-	1	-	1	1	1	3	-	1
CO4	-	-	-	1	-	1	1	1	3	-	1
CO5	-	-	-	1	-	1	1	1	3	-	1
AVG	-	-	-	1	-	1	1	1	3	-	1

JGE2102	HERITAGE OF TAMILS	L T P C 1 0 0 1

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages — Tamil as aClassical Language - Classical Literature in Tamil — Secular Nature of Sangam Literature — Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE-ROCK ART PAINTINGS TO MODERN ART-SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India — Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine — Inscriptions & Manuscripts — Print History of Tamil Books.

TOTAL: 15 PERIODS

TEXT BOOKS:

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL — (in print)

2. Social Life of the Tamils - The Classical Period (Dr.S.SingaraveIu) (Published by: International Institute of Tamil Studies.

3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Publish by: International Institute of Tamil Studies).

4. The Contributions of the Tamils to Indian Culture (Dr.M.VaIarmathi) (Published by:International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.BaIakrishnan) (Published by: RMRL) — Reference Book.

	Program Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	2				3	3	2	2		2
CO2	2	2				3	3	2	2		2
CO3	2	2				3	3	3	2		2
CO4	2	2				3	3	3	3		2
CO5	2	2				3	3	3	3		3
AVG	2	2				3	3	2.6	2.4		2.2

JMA2101	MATRICES AND CALCULUS	L T P C 2 2 0 3

COURSE OBJECTIVES:

- To equip students with the knowledge of matrices required for applications in engineering.
- To enable students understand the concepts of multivariable calculus.
- To introduce concepts of integral calculus as tools required for applications in engineering.
- To familiarize students in the concepts of vector calculus and its applications.
- To help students understand theory of analytic functions and provide knowledge of Cauchy Residue theorem and its applications.

UNIT I MATRICES 9+3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Reduction of a quadratic form to canonical form – Nature of quadratic forms

UNIT II FUNCTIONS OF SEVERAL VARIABLES 9+3

Jacobians – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers

UNIT III APPLICATIONS OF INTEGRAL CALCULUS 9+3

Double integrals in Cartesian coordinates – Change of order of integration – Area enclosed by plane curves – Triple integrals – Volume of solids

UNIT IV VECTOR CALCULUS 9+3

Gradient and directional derivative – Divergence and curl – Irrotational and Solenoidal vector fields.

Green's theorem, Gauss' divergence theorem, Stoke's theorem – Verification and evaluation in simple problems

UNIT V COMPLEX ANALYSIS 9+3

Analytic functions – Cauchy-Riemann equations – Milne-Thomson rule (given real or imaginary part) – Bilinear transformation.

Residues – Application of Cauchy's Residue theorem for evaluation of real integrals (Circular contour and semi-circular contour only)

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- To apply matrix method in reducing quadratic form to canonical form.
- To solve simple optimization problems through differential calculus.
- To evaluate multiple integrals required for solving area and volume problems.
- To apply vector calculus for verifying Green's, Gauss' and Stoke's theorems.
- To solve problems arising in analytic functions and solve real integrals through Cauchy Residue theorem.

TEXT BOOKS:

1. Grewal B S, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, New Delhi, 10th Edition, 2016.
3. Anuradha P and Sudhakar V, "Matrices and Calculus", Scitech Publications, 1st Edition, Chennai, 2019.

REFERENCES:

1. Anton H, Bivens I and Davis S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R K and Iyengar S R K, "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 8th Edition, 2022.
3. Srimantha Pal and Bhunia S C, "Engineering Mathematics" Oxford University Press, 1st Edition, 2015.
4. Weir, M D and Joel Hass, "Thomas Calculus", 15th Edition, Pearson India, 2022.

WEB REFERENCES:

- https://nptel.ac.in/courses/111107112
- https://nptel.ac.in/courses/111108157
- https://nptel.ac.in/courses/111107108
- https://nptel.ac.in/courses/111106141
- https://nptel.ac.in/courses/111103070

Mapping of CO with PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	1	2	3	-	-	2	-	-	1
CO2	2	1	1	2	3	-	-	2	-	-	1
CO3	2	1	1	2	3	-	-	2	-	-	1
CO4	2	1	1	2	3	-	-	2	-	-	1
CO5	2	1	1	2	3	-	-	2	-	-	1
AVG	2	1	1	2	3	-	-	2	-	-	1

JPH2101	ENGINEERING PHYSICS I	L T P C 3 0 0 3

OBJECTIVES:

- To enable the students to understand the basics of Properties of Matter
- To expand their knowledge about thermal properties of materials
- To enhance their understanding of Photonics
- To familiarize the students with the principles of quantum mechanics
- To enrich their knowledge on Solid State of Materials

UNIT I PROPERTIES OF MATTER 9

Elasticity – Stress-strain diagram and its uses - factors affecting elastic moduli and tensile strength - Torsion pendulum: theory and experiment - Bending of beams - stress due to bending in beams - bending moment – Cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment.

UNIT II THERMAL PHYSICS 9

Fundamentals of thermal energy - expansion joints – Bimetallic strips - Thermal conductivity, conductions in solids, Differential equation of one dimensional heat flow – Forbes's and Lee's disc method - Conduction through compound media- Solar heater

UNIT III LASERS AND FIBER OPTICS 9

Spontaneous and stimulated emission-Population inversion -Einstein's A and B coefficients derivation – Laser Principle – Nd:YAG and Semiconductor lasers (homojunction & heterojunction) Principle and propagation of light in optical fiber, Derivation of Numerical aperture and Acceptance angle – Fiber optical communication (Block diagram) – Active and passive sensors – Medical endoscope.

UNIT IV BASIC QUANTUM PHYSICS 9

Black body radiation –Planck's theory (derivation) –Deduction of Wien's displacement law and Rayleigh –Jeans' Law from Planck's theory –Compton effect-theory –Properties of Matter waves - Schrödinger's wave equation –Time independent and time dependent equations –Physical significance of wave function –Particle in a one dimensional box –Scanning Transmission electron microscope

UNIT V SOLID STATE PHYSICS 9

Single crystal, Polycrystalline and Amorphous materials – Single Crystals: Unit cell, Crystal systems, Bravais lattices, Directions and Planes in a crystal, Miller indices – Inter planar distances – Co ordination number and Packing factor for SC, BCC, FCC, HCP and Diamond structures - Crystal imperfections: Point defects, Line defects – Burgers vector, Surface defects and Volume defects.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- To apply their knowledge in analyzing the elastic property of any materials
- To assess the thermal properties of materials
- To use modern optical fiber communication systems and tools in reallife situations
- To compute problems in Quantum Physics
- To comprehend the structure of solid materials

TEXT BOOKS:

1. Dr. Beula Shanthi John, Dr.P.Mani, “Engineering Physics-I”, DhanamPublications, First Edition,2019.
2. Bhattacharya, D.K. & Poonam, T. “Engineering Physics- I”. Oxford University Press, 2015.
3. Gaur, R.K. & Gupta, S.L. “Engineering Physics”. Dhanpat Rai Publishers, 2012.
4. S. O. Pillai, “Solid State Physics”, New Age International Publications, Revised Edition.
5. Pandey, B.K. & Chaturvedi, S. “Engineering Physics”. Cengage Learning India, 2012.
6. Kittel, C. ―Introduction to Solid State Physics‖. Wiley, 2005

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. “Principles of Physics”. Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning,2010.
3. Tipler, P.A. & Mosca, G. “Physics for Scientists and Engineers with Modern Physics’.
4. Rajendran V, "Engineering Physics", Tata McGraw Hill, 2009.
5. Arumugam M, "Materials Science", Anuradha Publications, 2015.
6. Willam F Smith, “Material Science and Engineering”, Tata McGraw - Hill Publications, 2008.
7. John D.Cutnell, “Cutnell and Johnson Physics”, Willey Publications, 201

WEBSITE REFERENCES:

- https:// archive.nptel.ac.in/courses/105/105/105105177/
- https:// archive.nptel.ac.in/courses/102/105/102105090/
- https:// archive.nptel.ac.in/courses/108/104/108104113/
- https:// archive.nptel.ac.in/courses/115/104/115104096/
- https:// archive.nptel.ac.in/courses/115/104/115104109/

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	1	-1	1	-	-	1
CO2	3	2	1	-	-	1	-	-	-	-	1
CO3	3	2	1	-	-	-	-	-	-	-	1
CO4	3	2	1	-	-	-	-	-	-	-	1
CO5	3	2	1	-	-	-	-	-	-	-	1
AVG	3	2	1	-	-	1	1	1	-	-	1

JCY2101	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To inculcate the significance of water quality parameters and water treatment techniques.
- To acquaint the properties and applications of industrial polymers.
- To acquire knowledge in corrosion of material and its prevention.
- To import knowledge over energy conversion methods and of energy storage devices.
- To acquire knowledge on the basics of nanomaterials and its preparatory methods.

UNIT 1 WATER AND ITS TREATMENT 9

Water quality parameters (pH, TDS, DO, BOD, COD) - Hardness - Types and estimation (EDTA method). Alkalinity – Types and estimation. Water softening methods- Lime-soda Process (Cold and Hot methods) - Zeolite Process - Ion exchange process. Desalination of brackish water –reverse osmosis. Municipal water treatment- Primary treatment and Disinfection (UV, Ozonation, Chlorination) - Break point chlorination.

UNIT 2 POLYMER AND COMPOSITES 9

Classification of polymers – Functionality – Types of polymerisation (addition & condensation) – Mechanism of addition polymerisation (free radical, cationic, anionic) - Degree of polymerization - Thermoplastic and Thermosetting. Bio degradable polymer- Polylacetic acid, Polyvinyl acetate- Preparation – Properties – applications. Conducting polymer – types – Mechanism – application - Polymer composites – types – properties and application.

UNIT 3 CORROSION AND ITSPREVENTION 9

Corrosion - chemical, electrochemical corrosion, galvanic corrosion and differential aeration corrosion. Factors influencing the rate of corrosion. Corrosion control - material selection, design aspects, cathodic protection, Corrosion inhibitors - Electroplating (copper) and electroless plating (nickel) – Organic coating (Paints – Constituents and function).

UNIT 4 ENERGY SOURCES AND STORAGE DEVICES 9

Nuclear energy- critical mass, light water nuclear power plant and Breeder reactor. Principle, working and applications of solar energy and wind energy. Primary battery (dry cell and alkaline battery). Secondary battery (lead acid, nickel-cadmium and lithium-ion-battery). H2-O2 fuel cell.

UNIT 5 NANOCHEMISTRY 9

Distinction between molecules, nanomaterials and bulk materials - Size-dependent properties - Types of nanomaterials - Nanoparticle, nanocluster, nanorod, nanowire and nanotube. Synthesis of nanomaterials – solvothermal, laser ablation, chemical vapour deposition and electrochemical deposition - General applications of nanomaterial.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Identify water quality and propose suitable methods to treat water.
- Analyze the compatibility of polymeric materials for biomedical and electronic applications.
- Recognize the nature of corrosive environment and implement preventive methods of corrosion.
- Design different forms of energy sources for suitable applications.
- Identify suitable synthetic method of nanomaterials for specific applications.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008. S.S. Dara, "A Text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.
3. A.Ravikrishnan, "Engineering Chemistry" Sri Krishna Hitech Publishing CompanyPvt.Ltd., 22ndedition, 2023.

REFERENCES:

1. ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.
2. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
3. S. Ananda Kumar (Editor)"Eco-friendly Nano-hybrid materials for Advanced Engineering Applications" CRC Press, USA. (2016)
4. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
5. B.R.Puri, L.R.Sharma, Madan S.Pathana, Principle of physical chemistry, 47th edition, Vishal publishing Co, 2017.
6. Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2013.

WEB REFERENCES:

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2. https://nptel.ac.in/courses/113/106/113106093/

Mapping of CO with PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	2	3	1	3	2	1	1	-	1
CO2	1	1	1	2	1	3	1	-	1	-	1
CO3	1	1	2	2	1	2	-	-	1	-	1
CO4	1	1	2	2	1	2	1	1	1	-	1
CO5	1	1	1	2	1	-	-		1	-	1
Avg	1	1	1.6	2.2	1	2.5	1.3	1	1	-	1

JGE2101	BASIC ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide students with illustrations about mechanical engineering to satisfy societal needs
- To provide them knowledge on refrigeration, air-conditioning and power plants
- To help students acquire knowledge in the basics of surveying and building materials
- To impart knowledge on the electric circuits and working principles of Electrical Machines.
- To provide the knowledge on the Principles and characteristics of various electronic devices and measuring instruments.

UNIT I BASICS OF MECHANICAL ENGINEERING 9

Introduction to the concepts of Mechanization and Automation, Robotics - Manufacturing methods - casting, machining, forming operations. Introduction to IC Engine - Working principles of four stroke petrol and diesel engines. Electric vehicle Technology- Layout, components and control.

UNIT II REFRIGERATION,AIR CONDITIONING SYSTEM & POWER PLANT 9

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner. Classification of power plant and working principle of Thermal and Hydel power plant.

UNIT III BASICS OF CIVIL ENGINEERING 9

Introduction to Civil Engineering, Types of buildings, Components of a residential building, Building Materials. Surveying: Objects – Classification – Principles – Measurements of Distances and angles. Rain Water Harvesting, Solid Waste Management

UNIT IV ELECTRIC CIRCUITS AND ELECTRICAL MACHINES 9

Basic circuit components - Ohms Law - Kirchhoff's Law – Introduction to AC circuits - Power and power factor –Construction, Principle of operation and characteristics of DC machines ,Transformers and Induction machines.

UNIT V ELECTRONIC DEVICES & INSTRUMENTATION 9

Types of Materials - N type and P type materials - Principle of operation and Characteristics: PN Junction diode , Zener Diode, BJT, MOSFET. Elements of generalized measurement system -– Operating forces– Principle of operation of moving coil and moving iron instruments -Errors in measurement - Standards of Measurement.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able:

- To be acquainted with the concepts in mechanical engineering and vehicle concept.
- To understand the fundamentals of refrigeration, air-conditioning and power plant.
- To summarise the surveying, planning of building, infrastructure and building materials.
- Apply the basic concepts of electric circuits and working principles of electrical machines.
- Gain knowledge on the basics of electronics and choose appropriate instruments for electrical measurement for a specific application.

TEXT BOOKS:

1. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018.
2. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2018.
3. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, Mc Graw Hill, 2015.
4. 4. D P Kothari and I.J Nagarath, , “ Electrical Machines - Basic Electrical and Electronics Engineering” , Third Reprint , Mc Graw Hill Education (India) Private Limited, , 2016.
5. A.K.Sawhney, “ A Course in Electrical & Electronic Measurements & Instrumentation” , Dhanpat Rai and Co, 2010.
6. S Salivahanan , N Suresh Kumar, "Electronic Devices And Circuits ", fifth Edition, Mc Graw Hill, 2022.

REFERENCE BOOKS:

1. Ramamrutham S., “Basic Civil Engineering”, Dhanpat Rai Publishing Co.(P) Ltd, 2013.
2. Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press, First edition 2017.
3. Thereja. B.L., “ Fundament also f Electrical Engineering and Electronics” , S. Chand &Co.Ltd., 2008.
4. H.S.Kalsi, “Electronic Instrumentation “ , Tata Mc Graw-Hill, 2

WEB SITE REFERENCE:

1. **https://archive.nptel.ac.in/courses/112/103/112103262/**
2. **https://archive.nptel.ac.in/courses/112/105/112105129/**
3. **https://archive.nptel.ac.in/courses/105/106/105106201/**
4. **https://archive.nptel.ac.in/courses/105/106/105106201/**
5. **https://youtu.be/LPcQYXjPdIQ?list=PLp6ek2hDcoNCANsWM2mw3qi0387BhfLyV**
6. **https://www.youtube.com/playlist?list=PLMYtBmvT7X7QaLu0b0Jn1QQD4EOuT CA**
7. **https://youtu.be/5ZNeDxfgYAEhttps://youtu.be/36j6hCtL0E**

Mapping of CO with PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	1	1	1	-	-	-	-	-	-
CO2	1	1	1	1	1	-	-	-	-	-	-
CO3	1	1	1	1	1	-	-	-	-	-	-
CO4	1	1	1	1	1	-	-	-	-	-	-
CO5	1	1	1	1	1	-	-	-	-	-	-
AVG	1	1	1	1	1	-	-	-	-	-	-

JCS2121	PROGRAMMING IN C	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

- To understand the concepts of C Language.
- To implement programs using basic constructs of C
- To develop C programs using Arrays and Strings
- To develop modular applications in C using functions and Pointers.
- To be able to use File operations and Structures in C.

UNIT I INTRODUCTION TO C PROGRAMMING 9

Introduction to programming paradigms - Simple model of Computer - Algorithms and Flowcharts - Structure of C program - Applications of C Language - Data Types – Constants - Enumeration - Keywords – Number System.

UNIT II OPERATOR AND EXPRESSIONS 9

Data Input and Output statements – Operators: Arithmetic Operators, Relational Operators, Logical Operators, Increment and Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation – Decision Making and Branching – Looping statements.

UNIT III ARRAYS AND STRINGS 9

Arrays – Initialization – Declaration – One dimensional array – Two dimensional arrays - String - String operations: length, compare, concatenate, copy – Arrays of strings - Simple programs: Sorting, Searching and Matrix operations.

UNIT IV FUNCTIONS AND POINTERS 9

Function – Definition of function – Function Prototypes - Pass by value - Pass by reference - Recursion. Pointers: Definition- Initialization -Pointer Arithmetic- Pointers and Arrays.

UNIT V STRUCTURES, UNION AND FILES 9

Structure - Structure Definition - Structure Declaration - Nested structures - Array of structures - Union - Storage Classes - Files - Types of file processing: Sequential access, Random access - Sequential access file - Random access file - Command line arguments.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Usage of Basic Linux commands.
2. C Programming using Simple I/O Statements, operators and expressions.
3. C Programming using decision making and looping.
4. Simple programming for one dimensional and two dimensional arrays.
5. Solving problems using Strings.
6. C Programming using user defined functions (Pass by value and Pass by reference).
7. C Programming using Recursion.
8. C Programming using Pointers and Array of Pointers.
9. C Programming using structures and union.

10. C Programming using storage classes.
11. C Programming using Files.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able:

- Develop efficient algorithms for solving a problem.
- Develop simple applications using various operators in C.
- Design and Implement applications using Array and Strings.
- Develop applications using Functions and Pointers.
- Design and Develop applications using Structures and Files.

TEXT BOOKS

1. Paul J. Deitel, Harvey M. Deitel, "C: How to Program", 9th Edition, Prentice Hall.
2. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
3. E. Balaguruswamy, "Programming in ANSI C", 8th Edition, 2019, McGraw Hill Education.
4. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 16th edition 2017.

REFERENCE BOOKS

1. Pradip Dey, Manas Ghosh, "Programming in C", 2nd Edition, 2018, Oxford University Press, ISBN: 978-01-9949-147-6.
2. Kernighan B.W and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, 2015, Pearson Education India, ISBN: 978-93-3254-944-9.
3. Jacqueline A Jones and Keith Harrow, "Problem Solving with C", Pearson Education. ISBN: 978-93-325-3800-9.
4. PradipDey, ManasGhosh, "Programming in C - As per the latest AICTE syllabus", First Edition, Oxford University Press, 2018.
5. Byron S Gottfried, "Programming with C", Schaum's Outlines, Third Edition, McGraw- Hill, 2010.

WEBSITE REFERENCES

1. http://elearning.vtu.ac.in/econtent/courses/video/BS/14CPL16.html
2. https://nptel.ac.in/courses/106/105/106105171/
3. https://www.w3resource.com/c-programming-exercises/
4. https://www.programiz.com/c-programming/c-structures-pointers
5. https://www.sitesbay.com/cprogramming/c-applications

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11
CO1	2	2	2	2	-	-	3	2	2	-	2
CO2	3	3	3	3	-	-	3	3	3	-	3
CO3	3	3	3	3	-	-	3	3	3	-	3
CO4	3	3	3	3	-	-	3	3	3	-	3
CO5	3	3	3	3	-	-	3	3	3	-	3
Avg	2.8	2.8	2.8	2.8	-	-	3	2.8	2.8	-	2.8

JPC2111	ENGINEERING PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

To provide students the first-hand experience of verifying various concepts learntin theory courses.

LIST OF EXPERIMENTS

1. Determination of Young's Modulus for the given Uniform bar by Uniform Bending method
2. Determination of Moment of Inertia of the given Circular disc andRigidity Modulus of thin metal wire using Torsional Pendulum
3. Determination of Planck' constant using different color filters
4. Determine the Wavelength of Mercury Spectrum using Spectrometer.
5. Determine the Thermal conductivity of a Bad conductor using Lee's Disc
6. Determination of Wavelength of the Diode Laser and hencedetermine the Size of the coated powder particle
7. Estimation of Alkalinity of Water Sample.
8. Estimation of Total, Temporary and Permanent Hardness of Water by EDTAmethod.
9. Determination of Molecular Weight of a Polymer by Viscosity Average method
10. Estimation of Amount of an Acid by Conductometric Titration
11. Estimation of Ferrous ions by Potentiometric Titration
12. Estimation of Amount of Hydrochloric Acid using pH Meter.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

1. Evaluate elasticity of a linear body.
2. Discriminate different wavelengths of optical spectrum and the behavior of particles and waves at the atomic scale.
3. Identify the materials which are utilized for thermal insulation.
4. Estimate and analyze the amount of hardness and alkalinity in water for domestic consumption.
5. Apply the principles of conductivity and viscosity of substances in aqueous solutions for quantitative analysis using analytical instruments.

REFERENCES:

1. D. Bailey and E. Wright, Practical Fiber Optics, 2003.
2. Jerrad H.G. and Mc Neil D.B. -Theoretical and Experimental Physics.
3. Fretter W.B. -Introduction to Experimental Physics.
4. J. Mendham, RC Denney, JD Barnes, MJK Thomas, Text book ofquantitative chemical analysis, Vogel's, 2008.

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1. https://www.jhotpotinfo.com/2020/02/determination-of-youngs-modulus-of- bar.html
2. https://vlab.amrita.edu/index.php?sub=1&brch=280&sim=1518&cnt=1
3. https://vlab.amrita.edu/?sub=1&brch=281&sim=851&cnt=2
4. http://sites.iiserpune.ac.in/~bhasbapat/phy221_files/Lee%27s%20Method.pdf
5. https://edisciplinas.usp.br/pluginfile.php/4212400/mod_resource/content/0/Dunniv ant%2021.pdf
6. https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_A_Molecular_Approach_(Tro)/17%3A_Aqueous_Ionic_Equilibrium/17.04%3A_Titrations_and_pH

Mapping of CO with PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	1	2	1	1	-	2	1	-	1
CO2	1	1	1	2	1	1	-	2	1	-	1
CO3	1	1	1	2	1	1	-	2	1	-	1
CO4	1	1	1	2	1	1	-	2	1	-	1
CO5	1	1	1	2	1	1	-	2	1	-	1
Avg	1	1	1	2	1	1	-	2	1	-	1

JGE2111	BASIC ENGINEERING LABORATORY	L T P C 0 0 2 1

COURSE OBJECTIVES

- To provide an exposure to students with hands-on experience on various basic engineering practices in Civil, Mechanical Engineering
- To impart knowledge on creativity, ideation and realize the importance of team working
- To gain knowledge through experience in handling of engineering aggregates.
- To appreciate the use of various mechanisms involved in engineering products like vehicles.
- To provide exposure to the students with hands-on experience on various basic engineering practices in Electrical and Electronics Engineering
- To kindle your own creativity, ideation and realize the importance of team working.
- To gain knowledge through experience in handling of engineering aggregates.
-

GROUP A

I CIVIL ENGINEERING PRACTICE

BUILDINGS:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

PLUMBINGWORKS:

a) Study of pipe line joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
b) Hands-on-exercise: Basic pipe connections - Mixed pipe material connection Pipe connections with different joining components.

II MECHANICAL ENGINEERING PRACTICE

WELDING AND DRILLING

(a) Preparation of but joints, lap joints and T-joints by Shielded metal arc welding.
(b) Drilling Practice

TWO WHEELER DISMANTLING AND DIAGNOSIS

a. Brake Adjustment and Replacing
b. Chain Adjustment and lubrication
c. Air Filter and Spark plug Cleaning
d. Engine oil Replacement and Carburetor Tuning

STUDY AND DEMONSTRATION ON:

(a) Study of Lathe Machine, tools and components, Safety aspects

(b) Study of Sheet Metal work, tools and components, Safety aspects

GROUP B (ELECTRICAL & ELECTRONICS)

I ELECTRICAL ENGINEERING PRACTICE **8**

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Staircase wiring
4. Measurement of electrical quantities -voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of electrical equipment.

II ELECTRONICS ENGINEERING PRACTICE **7**

1. Study of Electronic components and equipment's - Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

COURSE OUTCOMES:

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

- To fabricate carpentry components and pipe connections including plumbing works.
- To weld various joints in steel plates using arc welding work.
- To understood various mechanism involved in automobiles.
- To illustrate on lathe machine and sheet metal work.
- Carry out basic home electrical works and appliances.
- Measure the electrical quantities.
- Elaborate on the components, gates, soldering practices.

WEBSITE REFERERENCE:

- https://nptel.ac.in/courses/107106088
- www.vikaspublishing.com/engineering-practices-lab
- https://archieve.org/mechanicalengineeeringworkshoplaboratory
- https://nptel.ac.in/courses/107106088
- www.vikaspublishing.com/engineering-practices-lab
- https://archieve.org/mechanicalengineeeringworkshoplaboratory

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	-	-	-	-	-	1	-	-	-
CO2	1	1	1	1	1	-	-	-	-	-	2	-	-	-
CO3	1	1	1	1	1	-	-	-	-	-	1	-	-	-
CO4	1	1	1	1	1	-	-	-	-	-	1	3	2	2
CO5	1	1	1	1	1	-	-	-	-	-	-	3	3	2
AVG	1	1	1	1	1	-	-	-	-	-	1.25	3	2.5	2

SEMESTER 2

JHS2221	ENGLISH FOR SCIENCE AND TECHNOLOGY (COMMON TO ALL BRANCHES)	L T P C 2 0 2 3

COURSE OBJECTIVES:

- To enable the students of Engineering to comprehend technical texts
- To improve their technical writing skill for better transmission of messages
- To help them acquire language skills required in academic and workplace contexts
- To facilitate them to hone their skills to prepare effective reports
- To equip them with effective communicative skills to meet their future needs

UNIT I COMMUNICATING TECHNICAL INFORMATION 12

Definitions – Conditional clauses – Technical vocabulary; Comprehension of short technical passage and note-making

Language Practice
Reading: Short technical texts / excerpts; **Speaking:** Interviewing on social or global issues; **Listening:** Talks on science, engineering, medicine / interviews of achievers; **Writing:** Sentence Completion, gap filling, verbal aptitude: sentence correction

UNIT II GRAPHICAL ANALYSIS AND INTERPRETATION 12

Purpose statements – Numerical adjectives – Collocation; Process Description - Interpretation of Graphs and Charts

Language Practice
Reading: Emails, invitations; **Speaking:** Describing charts and tables; **Listening:** Process descriptions; **Writing:** Paraphrasing – Developing outlines

UNIT II PERSUASIVE WRITING & INFORMATION DISSEMINATION 12

Cause and effect – Voice (active, personal and impersonal passive) – Words used as nouns and verbs; Instructions – Recommendations

Language Practice
Reading: User manuals, gadget reviews; **Speaking**: Presentation on social / technical topics; **Listening:** Announcements, instructions; **Writing:** Instructions – Recommendations

UNIT IV REPORT WRITING AND GROUP INTERACTION 12

Determiners – Editing - Initialisms and acronyms; Report writing: survey, accident – Minutes of meeting

Language Practice
Reading: Notices, reviews; **Speaking:** Group discussions (technical topics) and debates; **Listening:** IELTS and TOEFL; **Writing:** Writing profiles of personalities and industries

UNIT V CAREER AND BUSINESS COMMUNICATION 12

Adverbials – Misspelt words – Formal and informal English; Letter writing – Job application and resume by mail and email – Inviting and sending quotations and placing orders

Language Practice
Reading: Email invitations to job interviews; **Speaking:** About future / career; **Listening:** Talks by entrepreneurs; **Writing:** Career objective, short-term and long-term goals, tagline

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- To read and understand different types of technical texts
- To write procedural texts logically and sequentially in English
- To communicate effectively in academic and professional contexts
- To prepare effective reports and participate in group activities
- To use language precisely and accurately in business relations

TEXT BOOKS:

1. Department of English, Anna University, English for Engineers & Technologists, Volume 2, Orient BlackSwan Private Limited, Chennai, 2022.
2. Dhanavel, SP. English and Communication Skills for Students of Science and Engineering. Orient BlackSwan Private Limited, Chennai, 2011.
3. Interact English: Lab Manual for Undergraduate Students. Orient BlackSwan Private Limited, Chennai, 2017.

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1. Chellammal, V. Learning to Communicate. Allied Publishing House, New Delhi, 2004.
2. Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practices. Oxford University Press, New Delhi. 2015.
3. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2008.
4. Rizvi M, Ashraf. Effective Technical Communication, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017.

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- https://elt.oup.com/
- https://learnenglish.britishcouncil.org
- https://quizizz.com/

Mapping of CO with PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	1	-	1	1	1	3	-	1
CO2	-	-	-	1	-	1	1	1	3	-	1
CO3	-	-	-	1	-	1	1	1	3	-	1
CO4	-	-	-	1	-	1	1	1	3	-	1
CO5	-	-	-	1	-	1	1	1	3	-	1
AVG	-	-	-	1	-	1	1	1	3	-	1

JGE2202	TAMILS AND TECHNOLOGY	L T P C 1 0 0 1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age - Ceramic technology - Black and Red Ware Potteries (BRW) - Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age - Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, lndo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting.steel -Copper and gold- Coins as source of history - Minting of Coins - Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl-Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing - Digitalization of Tamil Books - Development of Tamil Software - Tamil Virtual Academy- Tamil Digital Library- Online Tamil Dictionaries - Sorkuvai Project.

TOTAL: 15 PERIODS

TEXT BOOKS:

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL — (in print)

2. Social Life of the Tamils - The Classical Period (Dr.S.SingaraveIu) (Published by: International Institute of Tamil Studies.

3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Publish by: International Institute of Tamil Studies).

4. The Contributions of the Tamils to Indian Culture (Dr.M.VaIarmathi) (Published by:International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.BaIakrishnan) (Published by: RMRL) — Reference Book.

Mapping of CO with PO

	Program Outcomes										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**2**	**2**			**2**	3	3	2	**2**		**2**
CO2	**2**	**2**			**2**	3	3	3	**2**		**2**
CO3	**2**	**2**			**2**	3	3	3	**2**		**2**
CO4	**2**	**2**			**2**	3	3	3	**2**		**2**
CO5	**2**	**2**			3	3	3	3	3		3
AVG	**2**	**2**	**0**	**0**	**2.2**	**3**	**3**	**2.8**	**2.2**	**0**	**2.2**

JMA2201	STATISTICS FOR ENGINEERS	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To provide basic concepts of discrete, continuous random variables and moments.
- To acquaint students in the concepts and problems of standard distributions.
- To familiarize students in problems of correlation and regression.
- To provide students knowledge of testing of hypothesis and its applications.
- To introduce Design of Experiments for practical problem solving.

UNIT I RANDOM VARIABLES 9+3

Discrete and continuous random variables – Moments – Moment generating functions

UNIT II STANDARD DISTRIBUTIONS 9+3

Discrete distributions: Binomial distribution – Poisson distribution – Geometric distribution Continuous distributions: Uniform distribution – Exponential distribution – Normal distribution

UNIT III STATISTICAL CORRELATION AND REGRESSION 9+3

Correlation coefficient – Rank correlation – Correlation for bivariate data – Regression coefficients – Lines of regression

UNIT IV TESTING OF HYPOTHESIS 9+3

Normal tests for mean and difference of means – t tests for mean and difference of means – Chi-square test for goodness of fit – Chi-square test for independence of attributes

UNIT V DESIGN OF EXPERIMENTS 9+3

ANOVA classification – Completely Randomized Design – Randomized Block Design – Latin Square Design

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- To solve problems of discrete and continuous type random variables for finding mean and variance.
- To apply standard probability distributions in solving real time problems.
- To solve correlation problems and to use regression analysis for predicting values of variables.
- To apply hypothesis testing for making statistical inferences in large and small sample real life problems.
- To compare and contrast various design of experiments methods and use them in problems.

TEXT BOOKS:

1. Gupta S C and Kapoor V K, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 12th Edition, 2020.
2. Ibe O C, "Fundamentals of Applied Probability and Random Processes", Elsevier, 2nd Edition, 2014.
3. Johnson R A, "Miller & Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2018.

REFERENCES:

1. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 3rd Edition 2014.
2. Trivedi K S, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2nd Edition, 2016.

WEB REFERENCES:

- https://nptel.ac.in/courses/117105085
- https://nptel.ac.in/courses/111105041
- https://nptel.ac.in/courses/102101056
- https://nptel.ac.in/courses/102106051

Mapping of CO with PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	1	2	3	-	-	2	1	-	1
CO2	2	1	1	2	3	-	-	2	1	-	1
CO3	2	1	1	2	3	-	-	2	1	-	1
CO4	2	1	1	2	3	-	-	2	1	-	1
CO5	2	1	1	2	3	-	-	2	1	-	1
AVG	2	1	1	2	3	-	-	2	1	-	1

JPH2201	ENGINEERING PHYSICS II	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To enlighten the students on the principles of semiconductor materials and Electron transport properties
- To acquaint them with the applications of magnetic materials
- To impart knowledge on superconducting materials
- To help them acquire a basic understanding of dielectric materials
- To introduce the basic principles in nano electronic devices

UNIT I SEMICONDUCTING MATERIALS 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors -Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Hall Effect- Hall Coefficient in N-type and P-type semiconductors.

UNIT II MAGNETIC MATERIALS 9

Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism Domain theory – Hysteresis – Soft and Hard magnetic materials– Ferrites and its applications – Memory devices-ROMs and RAMs(R/W)

UNIT III SUPERCONDUCTING MATERIALS 9

Properties of Superconductors – Josephson junction - Type I and Type II superconductors – BCS theory of superconductivity(Qualitative) – High Tc superconductors - Applications – SQUIDS. Cryotron and Maglev train.

UNIT IV DIELECTRIC MATERIALS 9

Polarization mechanisms in dielectrics– dielectric loss – internal field – Clausius-Mosotti relation- dielectric loss and dielectric breakdown – high-k dielectrics – Types of dielectrics – Applications in transformers and capacitors.

UNIT V NANOELECTRONIC MATERIALS 9

Size dependence of Fermi energy– quantum confinement – quantum structures - Density of states in quantum well, quantum wire and quantum dot structures - Single electron phenomena and Single Electron Transistor.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- To be familiar with the functioning of semiconductors
- To assess the magnetic properties of materials
- To make use of superconductors in real life situations
- To understand the nuances of advanced solid state physics
- To recognize the uses of Nano electronic materials

TEXT BOOKS:

1. Dr.P.Mani, "Engineering Physics – II", DhanamPublications, First Edition,2019.
2. Dr.G.Senthil Kumar "Engineering Physics – II", VRB Publications, Revised Edition 2018.
3. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
4. S.O.Pillai, "Solid State Physics", New Age International Publications, Revised Edition.
5. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press,2015.
6. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India,2012.

REFERENCES:

1. R. Murugeshan, "Modern Physics", Sultan chand & sons, 2021. 2.Halliday,
2. D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2020.
3. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning,2017.
4. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with ModernPhysics'.
5. Willam F Smith, "Material Science and Engineering", Tata McGraw - HillPublications, 4th Edition.

WEBSITE REFERENCES:

- https://archive.nptel.ac.in/courses/108/108/108108122/
- https://archive.nptel.ac.in/courses/115/103/115103038/
- https://archive.nptel.ac.in/courses/115/103/115103108/
- https://www.brainkart.com/article/Dielectric-Materials_6827/
- https://archive.nptel.ac.in/courses/117/108/117108047/

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	1	-	1	-	-	1
CO2	3	2	1	-	-	1	-	-	-	-	1
CO3	3	2	1	-	-	-	-	-	-	-	1
CO4	3	2	1	-	-	-	-	-	-	-	1
CO5	3	2	1	-	-	1	-	-	-	-	1
AVG	3	2	1	-	-	1	-	1	-	-	1

JCY2201	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To study the inter-relationship between living organisms and environment.
- To learn causes, effects and preventive methods of environmental pollution.
- To import knowledge on the needs of renewable and new energy sources.
- To acquire broad knowledge on sustainable development and its values on society.
- To expertise sustainability practices of sustainable habitat, sustainable energy and Green engineering.

UNIT 1 ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Biodiversity – Types and values. India as a mega-diversity nation – hot-spots of biodiversity - endangered and endemic species of India - threats to biodiversity – conservation of biodiversity - In-situ and ex-situ - Field visit

UNIT 2 ENVIRONMENTAL POLLUTION 6

Causes, Effects and preventive measures of water, air, soil and thermal pollution. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection acts - Field visit

UNIT 3 RENEWABLE SOURCES OFENERGY 6

Energy management and conservation – Need of new energy sources - Applications of-Hydrogen energy - Ocean energy resources - Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT 4 SUSTAINABLE DEVELOPMENT 6

Sustainability- concept, needs and challenges- economic and social aspects of sustainability - millennium development goals and protocols- Sustainable Development Goals - targets, indicators and intervention areas. Climate change - Global, Regional and local environmental issues and possible solutions - case studies. Concept of carbon credit and carbon footprint.

UNIT 5 SUSTAINABILITY PRACTICES 6

Zero waste and 3R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency and sustainable transports. Sustainable energy: Energy Cycles - carbon cycle, emission and sequestration. Green Engineering: Sustainable urbanization - Socio- economic and technological change.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Recognize the function of ecosystem and contribute to conservation of biodiversity.
- Identify the causes and effects of environmental pollution and practice the preventive measures.
- Recognize various types of new renewable sources of energy and their potential applications.
- Apply the sustainable development goals for technological advancement and societal development.
- Adopt sustainability practices for energy efficiency and sustainable urbanization.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition,New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi,2016.
3. Sanjay K Sharma, Green Corrosion Chemistry and Engineering: Opportunities and challenges, Wiley-VCH Verlag GmbH & Co. KGaA, Germany (2011)
4. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition,Pearson Education, 2004.

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . Edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

Related Links

1. https://www.hzu.edu.in/bed/E%20V%20S.pdf
2. https://catalogimages.wiley.com/images/db/pdf/9781119582052.excerpt.pdf
3. https://ncert.nic.in/textbook/pdf/keec109.pdf

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	2	-	-	2.5	2	-	1	-	1
CO2	1	1	1	-	-	2.5	3	-	1	-	1
CO3	1	1	2	-	-	2.5	2	-	1	-	1
CO4	1	1	2	-	-	2.5	3	-	1	-	1
CO5	1	1	1	-	-	2.5	3	-	1	-	1
Avg	1	1	1.6			2.5	2.6	-	1	-	1

JGE2221	ENGINEERING GRAPHICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To acquaint students with the importance of graphics in engineering
- To develop their skills in the preparation of basic drawing
- To improve their technical communication skill in the form of communicative drawing
- To impart knowledge about standard principle of orthographic projection of objects
- To improve their visualization skills for developing new products

UNIT I CONIC SECTIONS AND SPECIAL CURVES 12

Conics - Construction of ellipse, Parabola and hyperbola by eccentricity method, Rectangle method- Drawing of tangents and normal to the above curves.
Special curves: Cycloid-Involute-Drawing of tangents and normal to the curves.

UNIT II PROJECTION PLANE SURFACES & ORTHOGRAPHIC PROJECTIONS 12

Introduction to Points, Lines (Only theory not for Exam Practice) – Projection of Plane Surfaces- Projection of polygonal surface and circular lamina inclined to both reference planes.
Representation of Three Dimensional objects - General principles of orthographic projection – Need for importance of multiple views and their placement - First angle projection - layout views - Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT III- PROJECTION OF SOLIDS 12

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

UNIT IV DEVELOPMENT OF SURFACES 12

Introduction to Section of Solids (Only theory not for Exam Practice)
Development of lateral surfaces of simple and truncated solids - Prisms, pyramids, cylinders and cones

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 12

Principles of isometric projection – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones. Conversion of orthographic views into Isometric Drawing (Simple Objects) - Perspective projection of prisms and pyramids by visual ray method.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able

- To be familiar with the fundamental and standards of engineering graphics.
- To perform free hand sketching of basic geometrical constructions and multiple views of object.
- To project orthographic projections of lines and plane surfaces.
- To draw projection of solids and development of surfaces.
- To interpret isometric and perspective view of objects.

TEXT BOOKS:

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
2. Venugopal K and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited,2016.

REFERENCES:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I & II combined), Subhas Stores, Bangalore,2017..
3. Shah M.B and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.
4. Publication of Bureau of Indian Standards(BIS):
    i. IS 10711 - 2001: Technical products Documentation - Size and lay out of drawing sheets.
    ii. IS 9609 (Parts 0 & 1) - 2001: Technical products Documentation - Lettering.
    iii. IS 10714 (Part 20) - 2001 & SP 46 - 2003: Lines for technical drawings.
    iv. IS 11669 - 1986 & SP 46 - 2003: Dimensioning of Technical Drawings.
    v. IS 15021 (Parts 1 to 4) - 2001: Technical drawings - Projection Method

Website References:

1. www.pdfdrive.com/engineering drawing-books.html
2. https://freevideolectures.com
3. https://nptel.ac.in/courses

CO-PO MAPPINGS:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	1	1	-	-	-	-	-	-	-
CO2	1	1	1	1	-	-	-	-	-	-	-
CO3	1	1	1	1	-	-	-	-	-	-	-
CO4	1	1	1	1	-	-	-	-	-	-	-
CO5	1	1	1	1	-	-	-	-	-	-	-
AVG	1	1	1	1	-	-	-	-	-	-	-

JEE2201	CIRCUIT THEORY	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES

- To develop a strong foundation in fundamental circuit laws and network reduction techniques for electrical circuit analysis.
- To enable students to apply network theorems for solving and simplifying electrical circuits.
- To impart knowledge of resonance and coupled circuits with respect to frequency response and performance characteristics.
- To familiarize students with the behavior of three-phase circuits and interpretation of phasor diagrams for different load conditions.
- To develop the ability to perform transient analysis of RL, RC, and RLC circuits under DC and AC sinusoidal excitations.

UNIT 1 BASIC CIRCUIT ANALYSIS **12**

Kirchhoff's laws – Mesh current and node voltage - methods of analysis- Network reduction: voltage and current division, source transformation–star delta conversion.

UNIT 2 NETWORK THEOREMS **12**

Thevenin's and Norton's Theorems – Super position Theorem –Reciprocity Theorem- Maximum power transfer theorem.

UNIT 3 RESONANCE AND COUPLED CIRCUITS **12**

Series and parallel resonance – frequency response – Quality factor and Band width – Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits

UNIT 4 THREE PHASE CIRCUITS **12**

A.C. circuits – Phasor Diagram – Power, Power Factor and Energy.- Analysis of three phase 3- wire and 4-wire circuits with star and delta connected loads, balanced & unbalanced – phasor diagram of voltages and currents – power measurement in three phase circuits.

UNIT 5 TRANSIENT RESPONSE ANALYSIS **12**

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.

TOTAL: 60 PERIODS

COURSE OUTCOMES

At the end of the course, the student will have

- Analyze electrical circuits using fundamental circuit laws and network reduction techniques.
- Apply network theorems to solve circuit equations and simplify electrical circuits.
- Demonstrate the frequency response and performance characteristics of resonance and coupled circuits.
- Analyze three-phase circuits and phasor waveforms for different loads
- Investigate the transient behavior of RL, RC, and RLC circuits for DC and AC sinusoidal excitations.

TEXTBOOKS

1. William H.HaytJr, Jack E.Kemmerly and Steven M.Durbin, "Engineering Circuits Analysis", Mc Graw Hill publishers, NewDelhi, 2013.
2. Charles K.Alexander, Mathew N.O.Sadiku, "Fundamentals of Electric Circuits" Second Edition, Mc Graw Hill, 2013.
3. Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

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1. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, Mc Graw - Hill, New Delhi, 2010.
3. VanValkenburg. M.E,"Network Analysis", Prentice - Hall of India Pvt Ltd, New Delhi, 2015.
4. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", Mc Graw Hill, 2015.

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- https://youtu.be/YLGrugmDvc0
- https://youtu.be/sdKJYVtOaQc
- https://youtu.be/KylJ2v1_c-o

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
CO1	2	3	2	3	2	1	1	1	1	-	1	2	2	2
CO2	1	2	1	2	1	1	1	1	1	-	1	1	1	1
CO3	1	2	1	2	1	1	1	1	1	-	1	1	1	1
CO4	2	3	2	3	2	1	1	1	1	-	1	2	2	2
CO5	2	3	2	3	2	1	1	1	1	-	1	2	2	2
AVG	**1.6**	**2.6**	**1.6**	**2.6**	**1.6**	**1**	**1**	**1**	**1**	**-**	**1**	**1.6**	**1.6**	**1.6**

JPC2211	ENGINEERING PHYSICS AND ENVIRONMENTAL SCIENCE LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To provide students the first hand experience of verifying various concepts learnt intheory courses.

LIST OF EXPERIMENTS:

1. Determination of Numerical Aperture of the giver Fiber and Estimate the Linearityof the Laser Source.
2. Determine the Dispersive power of a given Prism using Spectrometer
3. Determination of Thickness of the given thin Wire by forming Interference fringesusing air-wedge setup
4. Analysis of I-V Characterization of Solar cell
5. Determination of Energy gap of the given Semiconductor Diode by plotting thegraph between current and temperature.
6. Determination of Young's Modulus for the given bar by Nonuniform Bending method.
7. Determination of Dissolved oxygen by Winkler's method
8. Estimation of amount of chloride in water.
9. Estimation of the amount of mixture of acids in water
10. Estimation of Iron content in water by Spectrophotometeric method
11. Estimation of acetic acid adsorbed on charcoal.
12. Determination of per capita energy consumption and carbon footprint.

TOTAL: 30 PERIODS

COURSE OUTCOMES

At the end of the course, the students will able

1. To lucid the effective communication system and to scrutiny the required wavelength.
2. To quantify micro sized linear objects and to ascertain band gap of semiconducting materials.
3. To configure solar power system as close as possible to its maximum peak power point.
4. To quantify the degree of pollution of water samples by measuring water qualityparameters.
5. To carry out energy audit and practice energy conservation methods.

REFERENCES

1. D. Bailey and E. Wright, Practical Fiber Optics, Newnes publications, 2003.
2. Fretter W.B. -Introduction to Experimental Physics UCL Press, 2005
3. Gurdeep R.Chatwal, Sham K. Anand, Instrumental methods of chemicalanalysis, Himalaya Publishing House, 2007.

WEBSITE REFERENCES:

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2. https://anilpangantiwar.tripod.com/expt10.htm
3. https://praxilabs.com/en/3d-simulations/i-v-characteristics-of-solar-cell-I-physics-simulation
4. https://vlab.amrita.edu/?sub=2&brch=193&sim=575&cnt=1
5. https://jigyasa-csir.in/neeri/n32-t1-a2/

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	2	2	1	1	-	2	1	-	1
CO2	1	1	2	2	1	1	-	2	1	-	1
CO3	1	1	2	2	1	1	-	2	1	-	1
CO4	1	1	2	2	1	2	-	2	1	-	1
CO5	1	1	2	2	1	2	-	2	1	-	1
Avg	1	1	2	2	1	1.4	-	2	1	-	1

JEE2211	ELECTRIC CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To develop the ability to apply fundamental circuit laws and network theorems for analyzing electrical circuits through simulation and experimentation.
- To enable students to verify and interpret electrical circuit performance using both simulation and experimental methods for various network configurations.
- To familiarize students with the operation and application of analog and digital oscilloscopes for measuring electrical parameters.
- To build skills in analyzing transient, resonance, and frequency response characteristics of electrical circuits.
- To develop competence in designing, simulating, and evaluating single-phase and three-phase electrical circuits under balanced and unbalanced conditions.

LIST OF EXPERIMENTS

1. Simulation and experimental solving of electrical circuit problems using Kirchhoff's voltage and current laws.
2. Simulation and experimental solving of electrical circuit problems using Thevenin's theorem.
3. Simulation and experimental solving of electrical circuit problems using Norton's theorem.
4. Simulation and experimental solving of electrical circuit problems using Super position theorem.
5. Simulation and experimental verification of Maximum Power transfer Theorem.
6. Study of Analog and digital oscilloscopes and measurement of sinusoidal voltage, frequency and power factor.
7. Simulation and Experimental validation of R-C electric circuit transients.
8. Simulation and Experimental validation of frequency response of RLC electric circuit.
9. Design and Simulation of series resonance circuit.
10. Design and Simulation of parallel resonant circuits.
11. Simulation of three phase balanced and unbalanced star delta networks circuits.

Total: 60 Periods

COURSE OUTCOMES:

At the end of the course, the student will have:

- Apply fundamental circuit laws and network theorems to analyze and verify electrical circuit behavior through simulation and experimentation.
- Verify and interpret electrical circuit performance using experimental and simulation-based approaches for different network configurations.
- Demonstrate the operation and use of measuring instruments such as analog and digital oscilloscopes for electrical parameter measurement.
- Analyze and validate electrical circuit responses using transient, resonance, and frequency response techniques.
- Design, simulate, and evaluate single-phase and three-phase electrical circuits under balanced and unbalanced conditions.

REFERENCES:

1. Chakrabarti A, “Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, Mc Graw Hill, 2015.

WEB SITE REFERENCE:

- https://youtu.be/2Zu3ppq3n8I
- https://youtu.be/zTDgziJC-q8
- https://youtu.be/YLGrugmDvc0
- https://youtu.be/sdKJYVtOaQc
- https://youtu.be/KylJ2v1_c-o

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	1	2	3	2	1	2	2	2	2
CO2	2	3	2	3	2	1	2	3	2	1	2	2	2	2
CO3	1	2	1	2	1	1	2	3	2	1	2	1	1	1
CO4	2	3	2	3	2	1	2	3	2	1	2	2	2	2
CO5	3	3	3	3	3	1	2	3	2	1	2	3	3	3
AVG	**2**	**2.8**	**2**	**2.8**	**2**	**1**	**2**	**3**	**2**	**1**	**2**	**2**	**2**	**2**

JGE2241 Gaming and Crafts Studio

Objectives:

- Understand the fundamental principles of game development and the Unity interface.
- Analyse various game design principles to enhance gameplay experience.
- Evaluate and integrate audio and visual assets to create immersive game environments.
- Create a complete game project that incorporates learned techniques and personalized creative elements.
- Reflect on the game development process and critique peer projects to foster a collaborative learning environment.

Module 1: The World of Game Development and Gaming Fundamentals

- Introduction to Game Development & Unity
- Understanding the core elements of gameplay, such as mechanics, dynamics, and aesthetics.
- Interactive tutorial on Unity, exploring the interface and project setup.
- Navigate Unity and set up a basic project.

Module 2: Game Design Principles, Visual and Audio Design

- Game Design Principles & Basic Scripting - implementing basic game mechanics.
- implement simple player controls and game mechanics using C#.
- create responsive player controls using various input methods.
- Player Control and Game Technologies - Hands-on scripting for player controls.

Module 3: Game Mechanics, Technology, and Development

- Creating Game Assets- modelling and texturing basic game assets.
- Physics and Interactions - Practical exercises adding physics and collisions to objects.
- UI & Menus - UI development sessions for creating intuitive game menus.
- Audio and Visual Effects - Implementing background music and particle effects.

Module 4: Critical Analysis, Feedback, and Ethical Considerations

- Coding challenges to implement state machines and level progression.
- Testing and Debugging
- Debugging tools and techniques,
- Refine gameplay and fix issues, Optimisation

Module 5: Game Project & Presentation

- Students will work in groups of 4-5 to design and develop a functional video game prototype.
- The game should incorporate concepts and mechanics from at least two different genres.
- A GDD (Game Design Document) will be required as part of this project.
- Students will present their game prototype and GDD to the class and receive feedback from peers and instructors.

Course Outcome:

Upon successful completion of the course, students will be able to:

- navigate Unity and set up a basic project, implement simple player controls and game mechanics using C#.
- create responsive player controls using various input methods and import custom assets into Unity.
- Integrate Unity's Physics engine into their game projects and develop functional game menus and UI elements.
- enhance their games with audio cues and visual effects.
- use advanced scripting to manage game states and progression and perform debugging to refine gameplay and fix issues.

Resources:

https://www.youtube.com/watch?v=XtQMytORBmM

https://www.youtube.com/watch?v=AmGSEH7QcDg

https://www.youtube.com/watch?v=AmGSEH7QcDg

https://www.youtube.com/watch?v=HAvfA1F3qTo

https://www.youtube.com/playlist?list=PLfhbBaEcybmg-WnFoWDxgSIatmrzBRWSQ

https://www.youtube.com/watch?v=ldP0c2o1FJI

https://www.youtube.com/watch?v=ldP0c2o1FJI

Mapping of CO with PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	1	3	1	1	2	2	1	2
CO2	3	2	3	2	3	1	1	2	2	1	2
CO3	3	2	3	2	3	2	1	2	2	1	2
CO4	3	2	3	2	3	2	1	2	2	1	2
CO5	3	3	3	3	3	1	1	2	2	1	3
AVG	3	2.2	3	2	3	1.4	1	2	2	1	2.2

JMA2301	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS (FOR BME & EEE)	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To explain various methods of solving partial differential equations.
- To enable students understand Fourier series expansions and Harmonic analysis.
- To demonstrate use of Fourier series in solving standard partial differential equations occurring in boundary value problems.
- To conceptualize Fourier transforms and its properties.
- To outline the applications of Z-transform in solving difference equations.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations (PDEs) – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types

UNIT II FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic analysis

UNIT III FOURIER SERIES SOLUTION OF PDEs 9+3

Classification of PDEs – Fourier series solutions – one-dimensional wave equation and heat conduction equation – Steady state two-dimensional equation of heat conduction

UNIT IV FOURIER TRANSFORMS 9+3

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity

UNIT V Z-TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z-transforms – Elementary properties – Initial and final value theorems – Convolution theorem – Inverse Z-transform (using partial fraction and convolution theorem) – Formation of difference equations – Solution of difference equations using Z-transform

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Evaluate singular and general solution of standard partial differential equations.
- Deduce Fourier series expansions analytically and numerically.
- Apply Fourier series in solving partial differential equations occurring in boundary value problems.
- Find Fourier transforms by efficient use of properties.
- Apply Z-transforms in solving difference equations.

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition, 2021.
2. Kreyszig Erwin., "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCES:

1. Bali. N.P and Manish Goyal., "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2016.
2. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.

WEB REFERENCES:

- https://nptel.ac.in/courses/111106046/
- https://nptel.ac.in/courses/111102129/
- https://nptel.ac.in/courses/111101153/
- https://nptel.ac.in/courses/111105093/

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	3	-	-	2	-	-	1	-	-	-
CO2	3	2	1	2	3	-	-	2	-	-	1	-	-	-
CO3	3	2	1	2	3	-	-	2	-	-	1	-	-	-
CO4	3	2	1	2	3	-	-	2	-	-	1	-	-	-
CO5	3	2	1	2	3	-	-	2	-	-	1	-	-	-
AVG	3	2	1	2	3	-	-	2	-	-	1	-	-	-

JEE2301	ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the structure, operation and characteristics of various semiconductor diodes
- To impart knowledge on the types of rectifiers and power supply circuits.
- To provide knowledge for analyzing amplifier frequency response and performance.
- To develop the ability to analyze the frequency response characteristics and performance of amplifier circuits.
- To familiarize the operation and performance analysis of feedback amplifiers and oscillators.

PREREQUISITE:

- Engineering Physics
- Basic Engineering

UNIT I SEMICONDUCTOR DIODES 9

Structure, operation and characteristics of PN junction diode–Zener diode–Introduction to special diodes: Schottky diode –LED – Laser diode – Photodiode – Photo voltaic cell-Applications of Diodes.

UNIT II RECTIFIERS AND POWER SUPPLIES 9

Single phase half-wave and full-wave rectifiers – Ripple factor, rectification efficiency, Transformer utilization factor and PIV–Performance of rectifiers with filters–Regulated Power Supply– Switched Mode Power Supplies.

UNIT III TRANSISTORS AND THYRISTORS 9

Structure, operation, characteristics and biasing of BJT, JFET, MOSFET – Use of heatsink– Structure and characteristics of IGBT, UJT, Photo Transistor, SCR, Recent display devices.

UNIT IV AMPLIFIERS 9

Small signal model of BJT–Analysis of CE,CB, CC amplifiers–Small signal model of MOSFET– Analysis of CS Amplifier and Source follower – Cascade amplifier – single tuned amplifier– Gain and frequency response.

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Apply the knowledge of semiconductor device fundamentals to understand the operation of various diodes**.**
- Demonstrate rectifier and power supply circuits by selecting appropriate electronic components.
- Analyze the operating principles and characteristics of various transistors and thyristors.
- Analyze the frequency response characteristics of amplifiers circuits.
- Examine the operation of various feedback amplifiers and oscillators.

TEXT BOOKS:

1. David A. Bell, "Electronic Devices and Circuits", Fifth Edition, Oxford Higher Education press, 2010.
2. Jacob Millman, Christos C. Halkias, Satyabrata Jit, “Electronic Devices and Circuits”, Third Edition, McGraw-Hill, 2011.

REFERENCES:

1. Sedra, Smith, “Micro electronic Circuits: Theory and Application” Seventh Edition Oxford University Press, 2017
2. Muhammad H. Rashid, “Electronic Devices and Circuits”, Second Edition, Cengage Learning, 2014.
3. Salivahanan,“Electronic devices and Circuits”, Second edition, Tata McGraw Hill International, 2011.

4. Thomas L.Floyd, “Electronic devices” Conventional current version, Tenth Edition Pears on prentice hall, 2017.

5. Balbir Kumar, Shail. B. Jain, “Electronic devices and circuits” Second Edition ,PHI learning private limited, 2014.

WEB REFERENCES:

- https://nptel.ac.in/
- https://www.allaboutcircuits.com
- https://youtu.be/Rx431-QpeWQ
- https://youtu.be/5ZNeDxfgYAE
- https://youtu.be/36j6hCtL0E4

Mapping of CO with PO/PSO

	Program Outcomes											**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	2	2	1	1	1	1	-	1	2	1	1
CO2	2	2	3	2	2	1	1	1	1	-	1	2	1	2
CO3	1	2	2	3	2	2	1	1	1	-	1	2	1	2
CO4	1	2	2	3	2	2	1	1	1	-	1	2	1	1
CO5	1	2	2	3	2	2	1	1	1	-	1	2	1	1
AVG	1.4	2.0	2.4	2.8	2	1.6	1	1	1	-	1	2	1	1.4

JEE2302	ELECTROMAGNETIC THEORY	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To describe the basic mathematical concepts related to electromagnetic vector fields.
- To impart knowledge of electrostatics, electrical potential, energy density and their applications.
- To provide knowledge of magnetostatics, magnetic flux density, scalar and vector potentials, and their practical engineering applications.
- To familiarize with Faraday's laws of electromagnetic induction, induced emf, and their applications in electrical systems and devices.
- To develop the ability to analyse electromagnetic wave propagation, energy transfer, and the significance of the Poynting vector in electromagnetic systems.

PREREQUISITE:

- **Basic Engineering**
- **Circuit Theory**

UNIT I INTRODUCTION **12**
Sources and effects of electromagnetic fields–Vector fields–Different coordinate systems–vector calculus–Gradient, Divergence and Curl –Divergence theorem –Stoke's theorem, Applications.
UNIT II ELECTROSTATICS **12**
Coulomb's Law–Electric field intensity–Field due to point and continuous charges–Gauss's law and application – Electric potential – Electric field and equipotential plots – Electric field in free space, conductors, dielectric-Di electric strength–Electric field in multiple dielectrics–Boundary conditions, Poisson's and Laplace's equations–Capacitance- Energy density, Applications.
UNIT III MAGNETOSTATICS **12**
Lorentz Law of force, magnetic field intensity–Biot–savart Law-Ampere's Law–Magnetic field due to straight conductors, circular loop, infinite sheet of current–Magnetic flux density (B) – B in free space, conductor, magnetic materials–Magnetization–Magnetic field in multiple media–Boundary conditions–Scalar and vector potential–Magnetic force–Torque–Inductance–Energy density–Applications.
UNIT IV ELECTRODYNAMIC FIELDS **12**

Magnetic circuits, Faraday's laws, induced emf – Transformer and motional EMF – Forces and Energy in quasi-stationary Electromagnetic Fields - Maxwell's equations (differential and integral forms) –Displacement current–Relation between field theory and circuit theory, Applications.

UNIT V ELECTROMAGNETIC WAVES 12

Generation–Electro Magnetic Wave equations–Wave parameters; velocity, intrinsic impedance, propagation constant–Waves in free space, lossy and lossless dielectrics, conductors-skin depth, Poynting vector – Plane wave reflection and refraction – Applications.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Apply the basic mathematical concepts related to electromagnetic vector fields
- Investigate the basic concepts of electrostatics, electrical potential, energy density and their applications
- Investigate the basic concepts of magnetostatics, magnetic flux density, scalar and Vector potential and its applications
- Apply the basic Faraday's laws, induced emf and analyse their applications
- Analyse the concepts of electromagnetic waves and Poynting vector

TEXT BOOKS:

1. Mathew N. O. Sadiku, 'Elements of Electromagnetics', Oxford University press Inc.First India edition, 2007.
2. Ashutosh Pramanik, 'Electromagnetism – Theory and Applications', Prentice-Hall of India Private Limited, New Delhi, 2006.

REFERENCES:

1. Joseph. A.Edminister, 'Theory and Problems of Electromagnetics', Second edition, SchaumSeries, Tata McGraw Hill, 1993.
2. William .H.Hayt, 'Engineering Electromagnetics', Tata McGraw Hill, 6thedition, 2001.
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions,Fifth Edition, 1999.
4. S.Ramareddy, 'Electromagnetic Fields', Second Edition, Scitech Publication, 2016.

WEB REFERENCES:

- What is an Electromagnetic Field? - YouTube
- 1. Electrostatics (youtube.com)
- 3.1 The Steady Magnetic Field: BIOT - SAVART LAW for I.E.S/G.A.T.E. - YouTube
- Electrodynamics Session 1 (Scalar and Vector Fields) noise reduced (youtube.com)
- Electromagnetic Waves | Physics (youtube.com)

Mapping of CO with PO/PSO

	Program Outcomes											PSO		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	1	2	1	1	1	1	1	-	1	1	1	1
CO2	2	3	2	3	2	1	1	1	1	-	1	2	2	2
CO3	2	3	2	3	2	1	1	1	1	-	1	2	2	2
CO4	2	3	2	3	2	1	1	1	1	-	1	2	2	2
CO5	2	3	2	3	2	1	1	1	1	-	1	2	2	2
AVG	1.8	2.8	1.8	2.8	1.8	1	1	1	1	-	1	1.8	1.8	1.8

JEE2303	ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the construction, operating principles, EMF equation, characteristics, and speed control of DC generators and DC motors.
- To explain the operating principles, construction, equivalent circuits, phasor diagrams, regulation, and efficiency of single-phase and three-phase transformers.
- To illustrate the construction, operating principles, torque-slip characteristics, starting methods, and speed control of induction machines.
- To develop the ability to analyze the operating characteristics, torque equations, excitation methods, V-curves, and starting techniques of synchronous machines.
- To evaluate the construction, operating principles, performance characteristics, and applications of special electrical machines, including Universal Motor, BLDC Motor, PMSM, Stepper Motor, SRM, and Linear Induction Motor.

PREREQUISITE:

- Basic Engineering

UNIT I	**DC MACHINES** **9**
DC Generator - Principle of operation - construction – EMF equation – Characteristics of different types of DC Generators, DC Motor – Principle of operation - construction –torque equation – starting and speed control characteristics of DC motors.	
UNIT II	**TRANSFORMERS** **9**
Principle of operation – Types and constructional features of single-phase and three-phase transformers –EMF equation- Phasor diagrams – Equivalent circuit – Regulation and efficiency – Autotransformers.	
UNIT III	**INDUCTION MACHINES** **9**
Principle of operation - constructional features of single-phase Induction motors and types. Constructional features of three-phase induction motors –Four-quadrant operation – Torque-slip characteristics – starting, and speed control methods.	
UNIT IV	**SYNCHRONOUS MACHINES** **9**
Synchronous Generator -Principle of operation – Synchronous Motor - Torque equation –V and Inverted V curves – Power input and power developed equations – Starting methods –constant excitation and constant power developed -Hunting.	
UNIT V	**SPECIAL MACHINES** **9**
Construction and Principle of operation of Universal motor – BLDC motor –PMSM – Stepper motor –Switched reluctance motor- Linear Induction motor.	

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Explain the construction, operating principles, characteristics, EMF equation, torque equation, starting methods, and speed control of DC generators and DC motors.
- Apply transformer EMF equations, phasor diagrams, equivalent circuits, regulation, and efficiency calculations for the analysis of single-phase and three-phase transformers.
- Analyze the operating principles, torque-slip characteristics, four-quadrant operation, starting methods, and speed control techniques of induction machines.
- Analyze the performance of synchronous generators and motors using torque equations, V-curves, inverted V-curves, excitation control, starting methods, and hunting characteristics.
- Assess the performance and suitability of Universal Motor, BLDC Motor, PMSM, Stepper Motor, Switched Reluctance Motor, and Linear Induction Motor for various engineering applications.

TEXT BOOKS:

1. Stephen J. Chapman, 'Electric Machinery Fundamentals', Fourth edition, McGraw-Hill Education, 2017.
2. Nagrath, I.J. and Kothari, D.P., Electric Machines, Fifth Edition, McGraw-Hill Education, 2017.
3. P.S.Bhimbhra, 'Electrical Machinery', Fully Revised First Edition, Khanna Publishing, 2021.

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1. M.N.Bandyopadhyay, Electrical Machines Theory and Practice, Prentice Hall India Learning Private Limited, New Delhi,2009.
2. A.E.Fitzgerald, Charles Kingsley, Stephen. D.Umans, 'Electric Machinery', Seventh Edition, McGraw-Hill Education,2013.
3. B.R.Gupta, ' Fundamentals of Electric Machines, Third Edition, Reprint, 'New Age International Publishers, 2015.
4. Murugesh Kumar, 'Electric Machines- Volume I & II', Vikas Publishing House Pvt. Ltd, 2002.

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- https://www.youtube.com/playlist?list=PLPpCFgQP7QKHUOFYvZhQ6ra5XrU3dN2dD
- https://youtu.be/LPcQYXjPdIQ?list=PLp6ek2hDcoNCANsWM2mw3qi0387BhfLyV
- https://youtu.be/TENIqjTT5TA
- https://youtu.be/IcoLbF5-4ws
- https://youtu.be/aoSRYJCykhg

Mapping of CO with PO/PSO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	1	1	1	1	-	1	1	1	1
CO2	3	3	2	3	2	1	1	1	1	-	1	2	2	2
CO3	3	3	2	3	2	1	1	1	1	-	1	2	2	2
CO4	3	3	2	3	2	1	1	1	1	-	1	2	2	2
CO5	3	3	2	3	2	1	1	1	1	-	1	2	3	3
AVG	**2.8**	**2.8**	**1.8**	**2.8**	**1.8**	**1.0**	**1.0**	**1.0**	**1.0**	-	**1.0**	**1.8**	**2.0**	**2.0**

JEE2321	DIGITAL LOGIC CIRCUITS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To familiarize with the various number systems and simplify the logical expressions using Boolean functions.
- To impart the fundamental concepts involved in solving combinational circuits..
- To infer the the principles of synchronous sequential circuits to analyze their behavior and functionality.
- To study the implementation of various asynchronous sequential circuits.
- To introduce digital simulation techniques for development of application oriented logic circuit

PREREQUISITE:

- Basic Engineering
- Circuit Theory

UNIT I NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES 9

Review of number systems, binary, Octal and Hexadecimal codes, error detection and correction codes (Parity and Hamming code) – Introduction to Digital Logic Families-RTL, DTL, TTL, ECL.

UNIT II COMBINATIONAL CIRCUITS 9

Combinational logic- representation of logic functions- SOP and POS forms, K-map minimization- Implementation of combinational logic–multiplexers and demultiplexers–code converters, adders, subtractors, Encoders and Decoders.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Sequential circuits–Flip flops: Triggering, types, excitation tables–Analysis and design procedures–Finite State Machine-State reduction and state assignment–Shift registers–Counters.

UNIT IV SYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABLE LOGIC DEVICES 9

Analysis and design of a synchronous sequential circuits–Reduction of state and flow tables – Race condition – Hazards- Introduction to Programmable Logic
Devices: PROM–PLA–PAL.

UNIT V VHDL **9**

RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages–Sub programs–Test bench.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Verification of Logic gates
2. Implementation of Boolean Functions.
3. Verification of Adder and Subtractor circuits.
4. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa.
5. Parity generator and parity checker.
6. Encoders and Decoders.
7. Design and implementation of 3-bit modulo counters.
8. Verification of multiplexer and demultiplexer.
9. Simulation of combinational circuits using HDL
10. Simulation of sequential circuits using HDL.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Relate with the various number systems and simplify the logical expressions using Boolean functions.
- Verify combinational logic circuits through Boolean simplification and logic gate implementation.
- Analyze the behavior of synchronous sequential circuits using timing diagrams, state tables, and state transition diagrams.
- Evaluate the implementation of asynchronous sequential circuits by examining hazards and their influence on circuit operation.
- Examine the design and functionality of digital circuits through simulation tools.

TEXT BOOKS:

1. James W.Bignel, Digital Electronics, , Fifth Edition,Cengage learning, 2017.
2. M.Morris Mano, 'Digital Design with an introduction to the VHDL',Sixth Edition, Pearson Education, 2013.
3. A.P.Godse ,Dr.D.A.Godse, " Digital Logic Circuits",Fifth Edition, Technical Publications,2021.

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1. Digital Circuits and Design S. Salivahanan S. Arivazhagan, Third Edition, Oxford University Press, 2016.
2. Mandal,"Digital Electronics Principles & Application, First Edition,, Mc Graw Hill Edu,2013.
3. William Keitz, Digital Electronics-A Practical Approach with VHDL,Ninth Edition, Pearson Education, 2013.
4. Thomas L.Floyd, 'Digital Fundamentals', Eleventh Edition,Pearson Education, 2015.
5. Charles H. Roth, Jr.LizyLizy Kurian John, 'Digital System Design using VHDL", Second Edition Cengage learning, 2013.
6. D.P.Kothari, J.S.Dhillon, 'Digital circuits and Design', First Edition,Pearson Education, 2016.

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- https://youtu.be/RO5alU6PpSU
- https://youtu.be/n8Xs_70d850
- https://youtu.be/kQ9WICIFWnU
- https://youtu.be/BDq8-QDXmek

MAPPING OF CO WITH PO/PSO:

CO\PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	-	-	2	-	-	1	2	2	1
CO2	2	3	2	3	2	-	-	2	-	-	-	2	2	1
CO3	2	3	2	3	2	-	-	2	-	-	-	2	2	1
CO4	2	3	2	3	2	-	-	2	-	-	-	2	2	1
CO5	2	2	2	2	3	-	-	2	-	-	1	2	2	1
AVG	2	2.8	2	2.8	2.2	-	-	2	-	-	1	2	2	1

JNC2361	DISASTER RISK REDUCTION AND MANAGEMENT	L T P C
		3 0 0 0

COURSE OBJECTIVE

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To acquaint with the skills for planning and organizing disaster response

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, --, Inter relations between Disasters and Sustainable development Goals

UNIT II DISASTER RISK REDUCTION (DRR) 9

Sendai Framework for Disaster Risk Reduction**,** Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT 9

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 9

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management

UNIT V DISASTER MANAGEMENT: CASE STUDIES 9

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and

field works related to disaster management.- Field work-Mock drill -

TOTAL : 45 PERIODS

TEXT BOOKS:

1 Taimpo (2016), Disaster Management and Preparedness, CRC Publications

2 Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications

3 Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423

4 Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]

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1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.
3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

COURSE OUTCOME:

- To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)
- To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction
- To develop disaster response skills by adopting relevant tools and technology
- Enhance awareness of institutional processes for Disaster response in the country and
- Develop rudimentary ability to respond to their surroundings with potential Disaster responsein areas where they live, with due sensitivity.

Mapping of CO with PO/PSO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
CO1	3	2	-	-	-	2	2	1	-	2	1	1	2	1
CO2	2	3	1	-	-	3	3	2	1	2	1	1	2	1
CO3	2	2	-	-	-	3	3	2	1	3	2	2	2	2
CO4	2	2	2	3	2	2	2	-	-	2	2	1	1	1
CO5	2	3	2	2	-	3	3	2	-	2	1	1	2	1
AVG	2.2	2.4	1.66	2.5	2	2.6	2.6	1.75	1	2.2	1.4	1.2	1.8	1.2

JEE2311	ELECTRONIC DEVICES AND CIRCUITS LABORATORY	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES :

- To simulate and analyze analog electronic circuits using software tools.
- To explain the structure, operation, and characteristics of semiconductor diodes.
- To infer knowledge on the various types and performance of rectifier circuits.
- To investigate the characteristics, configurations, and biasing techniques of transistors and thyristors.
- To explain the principles and operation of feedback amplifiers and oscillators.

LIST OF EXPERIMENTS :

S.No.	NAME OF EXPERIMENT
1	Simulation and Experimental Characterization of Semiconductor diode and Zener diode.
2	Simulation and Experimental Characterization of a NPN Transistor under common emitter and common base configurations.
3	Simulation and Experimental Characterization of JFET.
4	Simulation and Experimental Characterization of UJT and generation of saw tooth wave forms.
5	Design and Frequency response characteristics of a Common Emitter amplifier.
6	Experimental Characteristics of photo diode and photo transistor.
7	Design and testing of RC oscillators.
8	Design and testing of LC oscillators.
9	Simulation and Experimental Characterization of Single Phase half-wave rectifiers with filters.
10	Simulation and Experimental Characterization of Single Phase full wave rectifiers with filters.
11	Study of DSO.

TOTAL: 30 PERIODS

COURSE OUTCOMES :

At the end of the course, the student will be able

- Analyze analog electronic circuits using simulation software and interpret the obtained results.
- Investigate the characteristics of semiconductor devices and analyze their behavior from experimental data.
- Determine suitable circuit components and analyze the performance of rectifier circuits.
- Differentiate the operation of various transistors and thyristors and analyze their applications.
- Assess the operation and performance of feedback amplifiers and oscillators through comparative analysis.

TEXT BOOKS:

1. David A. Bell, "Electronic Devices and Circuits", Fifth Edition, Oxford Higher Education press, 2010.
2. Jacob Millman, Christos C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", Third Edition, McGraw-Hill, 2011.

REFERENCE BOOKS :

1. Sedra, Smith, "Micro electronic Circuits: Theory and Application" Seventh Edition Oxford University Press, 2017.
2. Muhammad H. Rashid, "Electronic Devices and Circuits", Second Edition ,Cengage Learning, 2014.
3. Salivahanan,"Electronic devices and Circuits", Second edition, Tata McGraw Hill International, 2011.
4. Thomas L.Floyd, "Electronic devices" Conventional current version, Tenth Edition Pears on prentice hall , 2017.
5. Balbir Kumar, Shail. B. Jain, "Electronic devices and circuits" Second Edition, PHI learning private limited, 2014.

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- ★ https://be-iitkgp.vlabs.ac.in/exp/characteristicsdiode
- ★ https https://be-iitkgp.vlabs.ac.in/exp/half-wave-rectification
- ★ https://be-iitkgp.vlabs.ac.in/exp/frequency-response
- ★ https://be-iitkgp.vlabs.ac.in/exp/common-emitter-characteristics

CO–PO &-PSO MAPPING :

CO\PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	-	-	2	2	-	1	1	1	2
CO2	2	3	2	3	2	-	-	2	2	-	1	1	1	2
CO3	2	3	2	3	2	-	-	2	2	-	1	1	1	2
CO4	2	3	2	3	2	-	-	2	2	-	1	1	1	2
CO5	2	3	2	3	2	-	-	2	2	-	1	1	1	2
AVG	2	3	2	3	2	-	-	2	2	-	1	1	1	2

JEE2313	ELECTRICAL MACHINES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To demonstrate the operating characteristics of DC machines through load and speed control experiments.
- To illustrate performance characteristics of single-phase and three-phase transformers through standard testing methods.
- To examine the performance behavior of induction machines under load conditions and determine associated losses.
- To simulate and analyze dynamic operation of AC and DC machines under different operating conditions using software tools.
- To explain the working principles and performance characteristics of synchronous, BLDC, and stepper motors.

PREREQUISITE:

- Basic Engineering
- Basic Engineering Laboratory

LIST OF EXPERIMENTS:

1. Open circuit and load characteristics of DC shunt generator.
2. Load test on DC series motor.
3. Speed control of DC shunt motor.
4. Simulation of Load test on separately excited DC motor.
5. Open circuit and short circuit test on single -phase transformer.
6. Load test on single-phase transformers and three-phase transformers.
7. Separation of No-load losses of three-phase induction motor.
8. Load test on single-phase induction motor.
9. Simulation of four quadrant operation of 3 phase induction motor.
10. V and Inverted V curves of Three Phase Synchronous Motor
11. Load test on BLDC Motor
12. Experiment to rotate the stepper motor in both directions.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Determine the performance characteristics of DC Generators and DC Motor under no load and load condition.
- Analyze the performance of single-phase and three-phase transformers using open circuit and short circuit tests.
- Evaluate the performance characteristics of single-phase and three-phase induction motors under loaded and no-load conditions.
- Apply simulation techniques to analyze dynamic behavior of electrical machines under different operating conditions.

- Examine the operating characteristics of synchronous motor, BLDC motor, and stepper motor through experimental studies.

REFERENCES:

1. Nagrath, I.J. and Kothari. D.P., Electric Machines', Fifth Edition, McGraw-Hill Education, 2017.
2. M.N. Bandyopadhyay, Electrical Machines Theory and Practice, Prentice Hall India Learning Private Limited, New Delhi ,2009.

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- https://youtu.be/LPcQYXjPdIQ?list=PLp6ek2hDcoNCANsWM2mw3qi0387BhfLyV
- https://youtu.be/TENIqjTT5TA
- https://youtu.be/IcoLbF5-4ws
- https://youtu.be/aoSRYJCykhg

Mapping of CO with PO/PSO

	Program Outcomes											PSO		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	2	-	-	2	2	1	-	2	1	1	-
CO2	3	3	1	3	-	-	2	2	1	-	2	1	1	-
CO3	3	3	2	3	-	-	2	2	1	-	2	1	1	-
CO4	3	3	1	2	2	-	2	2	1	-	2	1	1	2
CO5	3	3	1	3	1	-	2	2	1	-	2	1	1	1
AVG	3	2.8	1.2	2.6	1.5	-	2	2	1	-	2	1	1	1.5

JPT2041	SOFT SKILLS AND APTITUDE	L	T	P	C
		0	0	2	0

COURSE OBJECTIVES:

- To make students analyze and solve problems in technical as well as aptitude. Enhance the technical skills and basics of programming language
- To make the students understand how to apply the practical knowledge with real time applications.
- To make the students think and draw a conclusion from different scenarios.
- To help the students understand C programming concepts

UNIT-I SOFT SKILLS AND APTITUDE - I **6**

Synonyms - Antonyms - Odd Words - Idioms and Phrases - Error Spotting - Interpersonal Communication- Sentence Correction - Resume Writing Skills - Interview Skills.

UNIT-II SOFT SKILLS AND APTITUDE-II **6**

Reading Comprehension - Sentence Improvement - Jumbled Sentences - Parts of speech - Fact, Inference, Judgements - . Paragraph formation -Fill in the Blanks - Group Discussion - Mock Interview Sessions.

UNIT III QUANTITATIVE APTITUDE **6**

Number Theory - Divisibility rule - LCM and HCF - Simplification - Surds and Indices - Average - Percentage

UNIT IV LOGICAL REASONING **6**

Number and letter Series - Coding and Decoding - Ranking and Ordering - Odd man out - Image Based Relationships

UNIT V TECHNICAL APTITUDE IN C-I **6**

Pointers - Pointer dereferencing - Functions - Call by value, Call by reference - Structures - Structure Pointers - Arrays - One Dimensional, Two Dimensional, Multi Dimensional - Sorting - Time Complexity -Strings-String Method

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Develop different types of content using the skills learnt
- Manage time and stress competently
- Find answers to real time application problems
- Use Logical reasoning skills to solve problems differently
- Apply C programming concepts for coding

TEXT BOOKS:

1. Dr.RS Aggarwal, "Quantitative Aptitude", S Chand Publishing, 2020
2. Dr.R.S Aggarwal. "A Modern Approach To Verbal Reasoning",S. Chand Publishing, 2017
3. Dr. R. S. Aggarwal, "A Modern Approach to Non-Verbal Reasoning". S. Chand Publishing, 2017
4. Pradip Dey, ManasGhosh, "Fundamentals of Computing and Programming in C. First Edition

REFERENCES:

1. Data Communications and Networks- 2nd edition -Achyut S Godbole- and Atul Kahate Tata McGraw-Hill, 2017.
2. Computer Networking - James F. Kurose & Keith W. Ross- Pearson, 6th Edition, 2017.
3. Computer Communications and Networking Technologies - Michael A. Gallo & William M. Hancock- BROOKS&COLE, 2001.

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
CO1	2	2	2	-	-	-	-	3	3	3	3	-	-	2
CO2	2	2	2	-	-	-	-	3	3	3	3	-	-	2
CO3	2	3	2	2	2	-	-	3	3	3	3	-	-	3
CO4	2	3	2	2	2	-	-	3	3	3	3	-	-	3
CO5	3	3	2	2	3	-	-	3	3	3	3	-	-	3
AVG	2.2	2.6	2	2	2.2	-	-	3	3	3	3	-	-	2.6

JMA2401	APPLIED NUMERICAL METHODS (For BME & EEE)	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To introduce numerical techniques for solving algebraic, transcendental equations and system of equations.
- To acquaint students with interpolation for various intervals in real-time problems.
- To outline numerical methods for differentiation and integration.
- To explain concepts of numerical methods involved in solving ordinary differential equations.
- To familiarize students in solving partial differential equations numerically.

UNIT I SOLUTION OF EQUATIONS 9+3

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations – Direct methods of Gauss elimination and Gauss-Jordan – Iterative methods of Gauss-Jacobi and Gauss-Seidel

UNIT II INTERPOLATION AND APPROXIMATION 9+3

Interpolation with equal intervals – Newton's forward and backward difference formulae – Interpolation with unequal intervals – Lagrange's interpolation – Newton's divided difference interpolation – Spline Interpolation

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3

Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 and 3/8 rule – Romberg's Method – Evaluation of double integrals by Trapezoidal and Simpson's rules

UNIT IV INITIAL VALUE PROBLEMS 9+3

Single step methods – Taylor's series method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations – Multi step methods – Milne's and

Adam-Bashforth's predictor corrector methods for solving first order equations
UNIT V BOUNDARY VALUE PROBLEMS 9+3 One dimensional heat flow equation by explicit and implicit methods – One dimensional wave equation by explicit method – Finite difference method for Laplace equation on rectangular domain

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Solve algebraic, transcendental equations and system of equations numerically.
- Interpolate and extrapolate data numerically.
- Apply numerical methods for differentiation and integration.
- Demonstrate efficient use of numerical techniques in solving first order ordinary differential equations.
- Solve standard partial differential equations through numerical methods.

TEXT BOOKS:

1. Burden R.L. and Faires J.D., "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

REFERENCES:

1. Brian Bradie., "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi, 2006.

WEB REFERENCES:

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- https://nptel.ac.in/courses/111101003/
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- https://nptel.ac.in/courses/105105043/

Mapping of CO with PO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	3	-	-	2	-	-	1	-	-	-
CO2	3	2	1	2	3	-	-	2	-	-	1	-	-	-
CO3	3	2	1	2	3	-	-	2	-	-	1	-	-	-
CO4	3	2	1	2	3	-	-	2	-	-	1	-	-	-
CO5	3	2	1	2	3	-	-	2	-	-	1	-	-	-
AVG	3	2	1	2	3	-	-	2	-	-	1	-	-	-

JEE2421	OBJECT ORIENTED PROGRAMING IN MACHINE DESIGN	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To summarize an introduction to Python Programming Language and understand the decision-making and looping concepts.
- To demonstrate functions, lists and dictionaries in Python.
- To synthesize Object Oriented Programming principles and apply the same to model basic electrical machines
- To relate Python libraries and develop programs for basic electrical calculations
- To explain the simulation of Electrical machines and basic design

PREREQUISITE:

- Programming in C
- Basic Engineering

UNIT I INTRODUCTION TO PYTHON 9 Basic Python syntax – Identifiers, Reserved Words, Indentation, Comments, Variables, Input and output – data types operators – decision making and control structures.
UNIT II FUNCTIONS, LISTS AND DICTIONARY 9 Functions: Pre-defined Functions – User-defined Functions – Lists: Operations – pre-defined functions – Dictionary: Dictionary Operations and methods.
UNIT III INTRODUCTION TO OBJECT ORIENTED PROGRAMMING AND MODELLING ELECTRICAL MACHINES 9 Overview of Object-Oriented Programming (OOP) principles – Classes and objects in Python – Implementing inheritance in Python – Implementing simple classes to model basic electrical machines – Implementing inheritance to model different types of electrical machines – their properties and methods.
UNIT IV PYTHON LIBRARIES AND BASIC ELECTRICAL ENGINEERING APPLICATIONS 9 Introduction to Python libraries – Overview of NumPy for numerical computations – Utilizing Matplotlib for data visualization – Programs for basic electrical computations – Magnetic parameter calculations – Program development for Transformer Equivalent circuit and Induction motor Equivalent circuit.
UNIT V SIMULATION AND DESIGN OF ELECTRICAL MACHINES 9

Introduction to simulation techniques for electrical machines – Developing simulation models for electrical machines –Torque and speed calculations – Induction motor Load characteristics visualization using Matplotlib – Electrical machine design using look-up tables and computations based on design parameters such as rating, speed etc.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Find the maximum of a list of numbers
4. Insert a card in a list of sorted cards.
5. Find the most frequent words in a text read from a file
6. Magnetic circuit calculations
7. Model Induction motor using Inheritance
8. Transformer Equivalent circuit Parameter Calculation
9. DC Motor characteristics using Matplotlib
10. Induction motor characteristics using Matplotlib

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- apply basic Python programs and structure simple Python programs for solving programs.
- develop larger programs into functions and understand compound structures like lists and dictionaries.
- design electrical machines based on OOP principles
- develop programs for electrical engineering calculations
- build machines and develop basic machine design programs

TEXT BOOKS:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', Second edition, Shroff O'Reilly Publishers, 2016
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. M.G Say, "The Performance And Design Of Alternating Current Machines", Third edition, CBS Publishers & Distributors, 2015

REFERENCES:

1. John V Guttag, “Introduction to Computation and Programming Using Python’’, Revised and Expanded Edition, MIT Press, 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Interdisciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Doug Helaman, “Python Standard Library by Example, The (Developer's Library)”, Second Edition, Pearson Education India, 2017
4. A.Shanmuga Sundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint, 2007.
5. R.K.Agarwal “ Principles of Electrical Machine Design” Esskay Publications, Delhi, 2002.

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1. https://www.w3schools.com/python/python_reference.asp
2. https://www.pythonforbeginners.com/basics/python-websites-tutorials
3. https://www.datacamp.com/tutorial/python-oop-tutorial
4. https://matplotlib.org/
5. https://archive.nptel.ac.in/courses/108/106/108106023/

Mapping of CO with PO/PSO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	2	1	-	-	-	-	-	1	2	2	2
CO2	3	-	-	2	1	-	-	-	-	-	1	2	1	1
CO3	3	-	-	2	1	-	-	-	-	-	1	2	1	1
CO4	3	-	-	2	1	-	-	-	-	-	1	2	1	1
CO5	3	-	-	2	1	-	-	-	-	-	1	2	1	1
AVG	3	-	-	2	1	-	-	-	-	-	1	2	1.2	1.2

JEE2422	LINEAR INTEGRATED CIRCUITS AND APPLICATIONS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To describe about the various steps involved in IC fabrication technology.
- To study the Op-amp characteristics and its basic applications in electronic systems.
- To impart the knowledge on the development of analog circuits using Op-Amp
- To familiarize with the basic concepts of analog circuits using 555 Timer IC.
- To illustrate the characteristics of various analog circuits using application ICs.

PREREQUISITE:

- Electronic Devices and Circuits.
- Digital Logic Circuits

UNIT I IC FABRICATION	**9**
IC classification, fundamental of monolithic IC technology, Basic Planar process: epitaxial growth, masking and etching, diffusion of impurities. Realization of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance, FETs.	
UNIT II CHARACTERISTICS OF OPAMP	**9**
Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier, Basic applications of op-amp – Inverting and Non-inverting Amplifiers, summer, differentiator and integrator.	
UNIT III APPLICATIONS OF OPAMP	**9**
Instrumentation amplifier , filters, Comparators, Waveform generators, Peak detector, Sample/Hold circuit, clipper, clamper, D/A Converter, A/D converters using op-amps.	
UNIT IV SPECIAL ICs	**9**
Functional block, characteristics of IC 555 Timer and its PWM application – IC566 voltage controlled oscillator, IC565-phase locked loop,PLL and VCO applications.	
UNIT V APPLICATION ICs	**9**
IC voltage regulators–LM78XX, LM79XX; Fixed voltage regulators –LM317, 723 Variable voltage regulators, switching regulator,ICL8038 function generator IC.	

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Experiment using Basic op-amp circuits-Inverting and Non-Inverting Amplifier
2. Experiment of Op-Amp using Voltage summer circuit
3. Design of Integrator using Op-Amp.
4. Design of Differentiator using Op-Amp.
5. Simulation and experimental verification of Comparators using IC741.
6. Simulation and experimental verification of Astable and Monostable multivibrator in IC555 timer.
7. Study of VCO and PLL ICs
8. Voltage to frequency characteristics of NE/SE 566IC.
9. Frequency Multiplication using NE/SE 565 PLLIC.
10. Design of Voltage Regulator using IC 723

TOTAL: 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Apply the sequence of processes involved in IC fabrication technology for semiconductor device manufacturing.
- Analyze the characteristics and operational behavior of Op-Amp circuits in various analog applications.
- Design and develop analog circuits using Op-Amp for specified engineering requirements.
- Validate the performance of analog circuits implemented using 555 Timer applications.
- Evaluate the characteristics and performance of various analog circuits using application-specific ICs.

TEXT BOOKS:

1. D.Roy Chaudhary, Sheila B.Jani, 'Linear Integrated Circuits', Sixth Edition, New Age
   International Pvt Ltd Publishers, 2022.
2. Ramakant A.Gayakward,'Op-amps and Linear Integrated Circuits',Fourth Edition, Pearson Education Limited , 2021.
3. Uday A. Bakshi , Atul P. Godse , " Linear Integrated Circuits" , First Edition, Technical Publications, 2023.

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- https://www.youtube.com/watch?v=kiiA6WTCQn0
- https://www.youtube.com/watch?v=nqk714QpRos
- https://www.youtube.com/watch?v=WkI7uYLRbwQ
- https://www.youtube.com/watch?v=VfxKL4376_8

MAPPING OF CO WITH PO/PSO:

	Program Outcomes											**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	2	3	2	1	-	1	-		1	2	2	2
CO2	2	3	2	3	2	1	-	1	-		1	2	2	2
CO3	2	3	2	3	2	1	-	1	-		1	2	2	2
CO4	2	3	2	3	2	1	-	1	-		1	2	2	2
CO5	2	2	2	2	2	1	-	1	-		1	2	1	1
AVG	2	2.8	2	2.8	2	1	-	1	-		1	2	1.8	1.8

JEE2401	CONTROL AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop a mathematical model for physical systems, and uses block diagram reduction and signal flow methods for obtaining transfer function
- To explain the time response analysis of the systems.
- To describe the frequency responses of systems.
- To outline the basic functions of Sensors and Transducers.
- To summarize the applications of special meters.

PREREQUISITE:

- Basic Engineering
- Circuit Theory

UNIT I SYSTEMS AND REPRESENTATION	**9**
Basic elements in control systems–Open and closed loop systems–Electrical analogy of mechanical and thermal systems – Transfer function – AC and DC servomotors – Block diagram reduction techniques– Signal flow graphs.	
UNIT II TIME RESPONSE	**9**
Time response: – Time domain specifications – Types of test input – I and II order system response–Error coefficients–Steady state error–Root locus construction– Effects of P, PI, PID modes of feedback control.	
UNIT III FREQUENCY RESPONSE AND STABILITY	**9**
Frequency response: – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications. Characteristics equation–Routh Hurwitz criterion.	

UNIT IV SENSORS AND TRANSDUCERS	**9**
Motion sensors – Optical sensors – Inductive sensors – Capacitive sensor – LVDT – Accelerometer – Strain gauge sensors – Proximity sensors. Classification of transducers – Piezoelectric – Hall effect – optical and digital transducers.	
UNIT V SPECIAL METERS	**9**
Functional elements of an instrument – Principle and types of digital voltmeters, ammeters and digital multimeters — PQ meters – IOT enabled meters.	

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- State the system representation and calculate the transfer function of the systems
- Analyze the time domain response of the system
- Analyze the frequency response of the system
- Label the basic functions of sensors and transducer.
- Discuss the application of special meters.

TEXT BOOKS:

1. Nagrath, I.J. and Gopal. M. "Control Systems Engineering", Seventh Edition, New Age International (P) LTD 2022.
2. Gopal. M, "Control System: Principle and design", Fourth Edition, McGraw Hill Education, 2012.
3. Sawhney A. K., "A Course in Electronic Measurements & Instrumentation", Seventh Edition, Dhanpat Rai and Co.,2015.
4. Gupta J.B, "A Course in Electronic and Electrical Measurements", Fourteenth Edition, S.K. Kataria & Sons, Delhi, 2014.

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1. Katsuhiko Ogata, "Modern Control Engineering", Fifth Edition, Pearson Education, 2015.
2. Richard C. Dorf and Bishop R.H., "Modern Control Systems", Thirteenth Edition, Pearson Education, 2016.

3. Kalsi. H.S., “Electronic Instrumentation and Measurements”, Fourth Edition, Mc Graw Hill, 2019.
4. Murthy D.V.S. ‘Transducers and Instrumentation’, Second Edition, Prentice Hall of India Pvt Ltd, 2015.
5. David Bell, “Electronic Instrumentation & Measurements”, Third Edition, Oxford University Press, 2013.

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- https://youtu.be/HGOnH2tQIxI?si=9HZ3MZ2ygwq8hRLC
- https://youtu.be/kUfJl0VDelk?si=rKBdd9o_M9vZ3i12
- https://youtu.be/6TswCR6pmr8?si=mSmPQNWMJSXdDqGX

Mapping of CO with PO/PSO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	3	2	1	1	1	0	1	3	1	1
CO2	3	3	2	3	3	2	1	1	1	0	1	3	2	2
CO3	3	3	2	3	3	2	1	1	1	0	1	3	2	2
CO4	2	2	1	2	2	1	1	1	1	0	1	2	1	1
CO5	2	2	1	2	2	1	1	1	1	0	1	2	1	1
AVG	**2.6**	**2.4**	**1.4**	**2.4**	**2.6**	**1.6**	**1**	**1**	**1**	**0**	**1**	**2.6**	**1.4**	**1.4**

JEE2411	CONTROL AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To provide knowledge of the analysis and design principles of control systems.
- To develop an understanding of bridge circuits and their applications in measurement systems.
- To impart practical knowledge of industrial instruments and their operation in engineering applications.
- To introduce the fundamentals of signal conditioning circuits and power measurement techniques.
- To acquire skills in circuit simulation and validation using simulation software.

LIST OF EXPERIMENTS

S.No.	NAME OF THE EXPERIMENT
CONTROL SYSTEMS:	
1	P, PI and PID controllers
2	Stability Analysis
3	Design of Lag, Lead and Lag-Lead Compensators
4	Position Control Systems
5	Synchro-Transmitter- Receiver and Characteristics
6	Simulation of Control Systems by Mathematical development tools.
INSTRUMENTATION:	
7	Study and Measurement Using DC Bridges
8	Study and Measurement Using AC Bridges
9	Experimental Investigation of Dynamic Characteristics of Temperature, Pressure, and Flow Transducers
10	Experimental Investigation of Dynamic Characteristics of Displacement, Optical, and Strain Transducers
11	Signal Conditioning using Instrumentation Amplifier
12	Analog – Digital and Digital –Analog converters (ADC and DACs)

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Examine controller parameters and compensators designs to determine their effects on control system performance.
- Differentiate basic bridge networks based on their characteristics and measurement applications.
- Analyze the operating principles and performance characteristics of various transducers.
- Investigate the functions of signal conditioning circuits and power measurement circuits in instrumentation systems.
- Interpret simulation results of basic electrical and electronic circuits using appropriate software tools to validate theoretical concepts.

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1. JohnJ.D.,Azzo Constantine and Houpis Sttuart, "Linear Control System Analysis and Design with MATLAB", Sixth Edition, CRC Press ,Taylor & Francis Group, 2021.
2. Ramesh C .Panda and Thyagarajan T. "An Introduction to Process Modelling Identificationand Control of Engineers", First Edition, Narosa Publishing House, 2017.
3. Kalsi H.S.,"Electronic Instrumentation", Third Edition, McGraw Hill, 2017.
4. Murthy D.V.S. 'Transducers and Instrumentation', Second Edition, Prentice Hall of IndiaPvt Ltd, 2015.

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- http://sl-coep.vlabs.ac.in/StrainGuage/strainguage.htm
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- http://vlabs.iitkgp.ernet.in/asnm/exp11/index.html
- http://vlabs.iitkgp.ernet.in/asnm/exp21/index.html
- http://vlabs.iitkgp.ernet.in/asnm/exp7/js-simulator/power_web.html

http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/electronerds/experiments/instrumentation- amplifier-pvg/simulation.HTML

MAPPING OF CO WITH PO/PSO:

CO/PO /PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	1	-	1	-	-	2	2	2	2
CO2	2	3	2	3	2	1	-	1	-	-	2	2	2	2
CO3	2	3	2	3	2	1	-	1	-	-	2	2	2	2
CO4	2	3	2	3	2	1	-	1	-	-	2	2	2	2
CO5	2	3	2	3	2	1	-	1	-	-	2	2	2	2
AVG	2	3	2	3	2	1	-	1	-	-	2	2	2	2

JPT2041	SOFTSKILLS AND APTITUDE	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To help students learn various forms of writing and develop content
- To help students acquire time and stress management skills
- To facilitate students to gain required knowledge to understand practical concepts in aptitude
- To develop the thinking and analytical skills of students
- To gain knowledge in concepts of C programming language

UNIT - I SOFT SKILLS AND APTITUDE-III 5

Communication – on Specific topics – both oral and written – Content development – various forms of writing and specific writing – Brainstorming – Individual – Concept focusing – Public Speaking – Analytical writing.

UNIT - II SOFT SKILLS AND APTITUDE-IV 5

Importance of Time – Time Management techniques – The art of prioritizing and scheduling – Stress – Positive and Negative Stress - Stress Management techniques – SWOT Analysis

UNIT III QUANTITATIVE APTITUDE 6

Profit and Loss and Discount – Simple and compound Interest - Ratio and Proportions – Allegations and Mixtures – Problem on Ages

UNIT IV LOGICAL REASONING 6

Directions – Blood Relation – Linear and Circular Arrangement – Cross variables - Set theory

UNIT V TECHNICAL APTITUDE IN C-II 8

Strings - Storage Classes – Pointers – Preprocessor directives - Structures – Union. Type def – Input/Output – File I/O - Header Files – Type casting – Error handling – Command Line Arguments – Variable Arguments – Memory Management - Bitwise operators

COURSE OUTCOMES

At the end of the course, the student will be able to

- To enhance their knowledge in JAVA concepts.
- To Enhance knowledge in JAVA programming.
- To gain knowledge in Coding the concepts of JAVA programming.
- To solve the complex Arithmetic problems practically with real time application problems.
- To think logically in solving problems enhance their decision making for difficult situations.
- To enhance their employability skills and well prepared to face the MNCs Campus Interviews.

TEXT BOOKS:

1. Herbert Schildt, "Java The complete reference", 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9th Edition, Prentice Hall, 2013.
3. Dr. R.S Agrawal, "Quantitative Aptitude" and Non Verbal Reasoning published in 2000.
4. S.Chand – A Modern Approach to Logical Reasoning Published in 2000.

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https://m4maths.com/placement-puzzles.php

www.freshers world.com

www.careerride.com

www.youtube.com/watch/python

www.youtube.com/watch/concepts of python

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
CO1	2	2	2	-	-	-	-	3	3	3	3	-	-	2
CO2	2	2	2	-	-	-	-	3	3	3	3	-	-	2
CO3	2	3	2	2	2	-	-	3	3	3	3	-	-	3
CO4	2	3	2	2	2	-	-	3	3	3	3	-	-	3
CO5	3	3	2	2	3	-	-	3	3	3	3	-	-	3
AVG	2.2	2.6	2	2	2.2	-	-	3	3	3	3	-	-	2.6

JGE2441	e-PROTOSHOP	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To help students to Identify societal needs and problems and able to find solutions.
- To help students learn the fundamentals/essentials of the Design Thinking and Innovation process.
- To creates awareness in the students through design tools, observation, discovery, analysis, experience, collaboration, visualization and reflection.
- To nurture the student's curiosity and enhance their explorative abilities to foster creativity and innovation in students in any field.
- To enable the students to realize their ideas as prototypes and set a roadmap to commercialize the product developed.

1. **Design thinking** - Determine Innovative Idea – Need, understand the requirement, Define and redefine the problem, Brainstorm to generate ideas.

2. **Product design** – Conceptualization, Analysis, sketching a design that represents a product idea, Optimize a design through market experts.

3. **Virtual model Generation** – create realistic model of the proposed design using a 3D imaging software.

4. **Training on Skills and Tools** - Specific training on tools and machinery relevant to the prototype generation – Knowledge on specific tools, machinery, etc. (Hands-on workshops)

5. **Minimum Viable product** – POC contains hardware and software components, Hardware-software codesign, operatable like a finished product.

6. **Prototype creation** – Deployment, testing, redesign, user satisfaction and feedback, prototype upgradation.

7. **Roadmap to startup –** Analysis of target market, Marketing and sales plan, Business plan, Financial projections, Team building, Register your startup, licensing, permissions and certifications.

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Understand the problem identification and finding solutions using one or more domains of technology.
- Create virtual mode of design.
- Use the tools and techniques relevant to the prototype generation.
- Develop a prototype of product ad a minimum viable product.
- Initiate start up and commercialize the product developed.

REFERENCES:

1. Arun Jain, From Teenager to Achiever, School of Design thinking www.d-thinking.com
2. Chakku 7C's https://www.idc.iitb.ac.in/~chakku/chakku7Cs.pdf
3. Collaborative Model For Innovation https://www.idc.iitb.ac.in/~chakku/COLLABORATIVE_ MODEL_FOR_INNOVATION.pdf
4. Pitfalls in the Innovation process https://www.idc.iitb.ac.in/~chakku/Pitfalls_in_the_innovation_process.pdf
5. Innovation By Design – Collaboration is the key to cross the Pitfalls in the Innovation Process https://www.idc.iitb.ac.in/~chakku/Innovation_by_Design.pdf

CO-PO/PSO MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	3	2	3	2	2	3	3	3	3	3	2	2
CO2	2	2	3	2	3	2	2	3	3	3	3	2	1	3
CO3	2	2	3	3	3	2	2	3	3	3	3	2	1	3
CO4	2	2	3	3	3	2	2	3	3	3	3	3	2	2
CO5	2	2	3	3	3	3	3	3	3	3	3	2	2	1
AVG	2	2.2	3	2.6	3	2.2	2.2	3	3	3	3	1.4	1.6	2.2

JEE2521	INTRODUCTION TO MICROPROCESSORS AND MICROCONTROLLER	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To outline the internal architecture and operation of the 8085 microprocessor.
- To develop the assembly language programs for the 8085 microprocessor.
- To infer the knowledge about the interfacing techniques of 8085 with various peripheral devices.
- To familiarize with the architecture and functionality of the 8051 microcontroller.
- To develop programming skills using the 8051 microcontroller for real-world applications.

PREREQUISITE:

- Electronic Devices and Circuits.
- Digital Logic Circuits

UNIT I THE 8085 MICROPROCESSOR 9 Hardware Architecture – Functional Building Blocks of Processor – Memory organization –I/O ports and data transfer concepts–Timing Diagram–Interrupts.
UNIT II PROGRAMMING OF 8085 PROCESSOR 9 Instruction -format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions–Programming: Loop structure with counting & Indexing– Sub routine instructions.
UNIT III PERIPHERAL INTERFACING 9 Programmable Peripheral Interface (8255) -Keyboard/Display Controller (8279)- Programmable Timer/ Counter (8254) - Programmable Interrupt Controller (8259) – DMA Controller(8257)-Serial Communication Interface (8251)
UNIT IV 8051 MICRO CONTROLLERS 9 Architecture of 8051 – Special Function Registers (SFRs)- Interrupts –Timer and counter – Instruction set-Addressing modes-Simple assembly language programming.
UNIT V MICRO CONTROLLER PROGRAMMING AND APPLICATIONS 9 Simple programming exercises- key board and display interface –Control of servo motor-stepper motor control-Traffic Light control - ADC/DAC & Sensor Interfacing – Wave form generation.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

8085 PROGRAMS USING KITS

- Basic arithmetic and Logical operations
- Move a data block
- Programming with control instructions
  - Ascending/Descending order,
  - Maximum /Minimum of numbers.
  - Programs for code Conversion.
  - Sorting and searching

PERIPHERAL IINTERFACING USING 8085

- Traffic light control
- Key board and Display
- A/D and D/A interface and Waveform Generation

8051 EXPERIMENTS USING KITS

- Basic arithmetic and logical operations
- Conditional jumps & looping

PERIPHERAL INTERFACING USING 8051

- Stepper motor control

TOTAL: 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Analyze the architecture and functional organization of the 8085 microprocessor.
- Differentiate between addressing modes and instruction sets of the 8085 microprocessor and interpret assembly language programs for given problems.
- Investigate the features, functionalities, and interfacing requirements of peripheral devices used in microprocessor-based systems.
- Examine the architecture, instruction set, and programming concepts of the 8051 microcontroller.
- Evaluate the 8051 microcontroller-based system designs in the various application
- domains.

TEXT BOOKS:

1. Sunil Mathur & Jeebananda Panda, “Microprocessor and Micro controllers”, First edition, PHI Learning Pvt. Ltd, Reprint 2025.
2. R.S. Gaonkar, ‘Microprocessor Architecture Programming and Application’, with 8085, Fifth edition, Wiley Eastern Ltd., New Delhi, Reprint 2024.
3. KrishnaKant, “Microprocessor and Micro controllers, Architecture, Programming and System Design 8085, 8086, 8051”, Second Edition, PHI Learning Private Limited, 2014.
4. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin Mc Kinlay, “The 8051 Micro

controller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011.
5. Rajkamal, "Micro controllers - Architecture, Programming, Interfacing and System design, Second Edition, Pearson education, 2012.

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5. Soumitra Kumar Mandal, Microprocessor & Micro controller Architecture,

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MAPPING OF CO WITH PO/PSO:

	Program Outcomes											**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	2	3	2	1	-	1	-	-	2	2	2	2
CO2	2	3	2	3	2	1	-	1	-	-	2	2	2	2
CO3	2	3	2	3	2	1	-	1	-	-	2	2	2	2
CO4	2	3	2	3	2	1	-	1	-	-	2	2	2	2
CO5	2	2	2	2	2	1	-	1	-	-	2	2	2	2
AVG	2	2.8	2	2.8	2	1	-	1	-	-	2	2	2	2

JEE2501	POWER ELECTRONICS AND DRIVES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the fundamentals of electric drives, load dynamics, stability criteria, and motor selection.
- To explain the operation and performance characteristics of phase-controlled rectifiers and DC-DC converters used in electric drives.
- To illustrate the speed control, braking methods, and four-quadrant operation of DC drives.
- To develop an understanding of inverter-fed drives, PWM techniques, and AC voltage controllers.
- To evaluate the performance and control strategies of induction motor and synchronous motor drives.

UNIT I DRIVE CHARACTERISTICS 9 Electric drive–Equations governing motor load dynamics–steady state stability–multi-quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor-heating and cooling curves.
UNIT II PHASE-CONTROLLED RECTIFIERS & DC-DC CONVERTERS 9 2-pulse, 6-pulse converters–performance parameters–Effect of source and load Inductance – Time Ratio Control - Buck, Boost, Buck-Boost converters.
UNIT III DC DRIVES 9 Separately excited DC motor with single-phase and three-phase converters - Speed Torque Characteristics – Dynamic braking and Regenerative braking operations - Four-quadrant operation of chopper fed separately excited DC motor drive.
UNIT IV INVERTERS & AC VOLTAGE CONTROLLERS 9 Single-phase and three-phase voltage source inverters, Voltage and harmonic control – PWM techniques - Current Source Inverters - Single-phase and three-phase AC voltage controllers.
UNIT V AC DRIVES 9 Drive operating regions - Stator voltage control of induction motor – Variable Frequency operation – Constant v/f operation – Separate and Self control of synchronous motor drives – Comparison of VSI and CSI drives - closed loop control with current and Speed feedback.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Explain electric drive dynamics, steady-state stability, multi-quadrant operation, load torque characteristics, and motor selection criteria.
- Apply phase-controlled rectifiers and DC-DC converters for speed control and performance improvement of electric drives.
- Analyze the speed-torque characteristics, braking methods, and four-quadrant operation of DC motor drives.
- Analyze the operation of voltage source inverters, current source inverters, PWM techniques, and AC voltage controllers used in drive applications.
- Assess the performance of AC drives using variable frequency control, constant V/f control, synchronous motor drives, and closed-loop control techniques.

TEXT BOOKS:

1. Muhammad H. Rashid, "Power Electronics: Circuits, Devices and Applications", Fourth Edition, Pearson Education, New Delhi, 2023.
2. Bimbra P.S."Power Electronics", Second Edition, Khanna Publishers, Reprint 2022.
3. Gopal K. Dubey, "Fundamentals of Electrical Drives", Second Edition, Narosa Publishing House, Reprint 2022.

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1. Joseph Vithayathil, 'Power Electronics, Principles and Applications', Sixth Reprint, McGraw-Hill Series, 2013.
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4. Shaahin Felizadeh, "Electric Machines and Drives", First edition, CRC Press (Taylor and Francis Group), 2013.

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4. https://www.youtube.com/watch?v=7CReXeMAXHA
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CO - PO & PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	1	1	1	1	-	1	2	1	1
CO2	3	3	2	3	3	1	1	1	1	-	1	2	2	2
CO3	3	3	2	3	3	1	1	1	1	-	1	3	3	2
CO4	3	3	2	3	3	1	1	1	1	-	1	3	3	3
CO5	3	3	2	3	3	1	1	1	1	-	1	3	3	3
AVG	3.0	2.8	1.8	2.8	2.8	1.0	1.0	1.0	1.0	-	1.0	2.6	2.4	2.2

JEE2502	TRANSMISSION, DISTRIBUTION AND PROTECTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To emphasize analysis of power transmission system structure and transmission line parameters and performance.
- To explain mechanical design of overhead lines and characteristics of underground cable systems including sag, insulation, and grading.
- To impart knowledge on AC/DC distribution systems, substations, grounding methods, and modern transmission technologies.
- To familiarize with the operating principles of protective relays and circuit breakers used in power system protection.
- To discuss protection schemes for alternators, transformers, and transmission lines under fault condition.

PREREQUISITE:

- Circuit Theory
- Control and Instrumentation

UNIT I POWER TRANSMISSION 9

Transmission Line Parameters-Structure of Power System –Parameters of single and three phase transmission lines with single and double circuits-Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition. Performance of Transmission lines - short line, medium line and long line- phasor diagram.

UNIT II OVERHEAD TRANSMISSION AND UNDER GROUND TRANSMISSION 9

Mechanical design of OH lines–Line Supports–Stress and Sag Calculation-Effects of Wind and Ice loading. Insulators: Types, voltage distribution in insulator string, improvement of string efficiency. Underground cables - Insulation Resistance – Potential Gradient - Capacitance of Single core cables-Grading of cables

UNIT III DISTRIBUTION SYSTEMS 9

Distribution Systems–AC and DC distributions- Types of Substations –Importance of earthing in substation-Methods of Grounding–Trends in Transmission and Distribution: EHVAC, HVDC and FACTS.

UNIT IV NEED FOR POWER SYSTEM PROTECTION 9

Protective Relays- Electro mechanical Relays- Static Relays- Static over current, Differential Relay, Microprocessor Based Relay. Circuit breakers – principle of operation- formation of arc -arc quenching theory, Types of Circuit Breakers: Air blast CB– Oil CB– SF6 CB.

UNIT V PROTECTION OF EQUIPMENTS 9

Protection of alternator -Stator inter turn, Earth fault Protection, Protection of transformers - Percentage Differential Protection-Buchholz relay. Protection of transmission lines- carrier current protection.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Analyze transmission line parameters and performance of power transmission systems.
- Analyze the mechanical behavior of overhead lines and insulation performance and electric field distribution in underground cables.
- Differentiate AC/DC distribution systems, substation configurations, grounding methods, and modern transmission technologies.
- Interpret the operation, characteristics, and applications of protective relays and circuit breakers with emphasis on fault detection and arc extinction techniques.
- Examine various methods and techniques used for protection of power system equipment.

TEXT BOOKS:

1. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Third Edition, Tata McGraw-Hill Education, 2019.
2. Wadhwa. C.L., 'Electrical Power Systems', Seventh Edition, New Age International (P) Ltd.,2022.
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3. J. Brian Hardy and Colin R. Bayliss 'Transmission and Distribution in Electrical Engineering', Fifth Edition, Newnes, 2020.
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- https://youtu.be/zZ4li_nzyOk
- https://youtu.be/K1klGNZYLdc
- https://youtu.be/TsDHce-k8d4

Mapping of CO with PO/PSO

	Program Outcomes											PSO		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	1	3	1	-	1	1	-	-	1	3	-	1
CO2	3	3	1	3	1	-	1	1	-	-	1	3	-	1
CO3	3	3	2	3	1	-	1	1	-	-	1	3	-	1
CO4	3	3	1	2	1	-	1	1	-	-	1	3	-	1
CO5	3	3	1	3	1	-	1	1	-	-	1	3	-	1
AVG	3	3	1.2	2.8	1	-	1	1	-	-	1	3	-	1

JEE2522	INTERNET OF THINGS IN ELECTRICAL ENGINEERING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To explain the foundational concepts, architecture, and significance of IoT in Electrical Engineering systems.
- To demonstrate the integration of sensors, actuators, and power management techniques in IoT-based Electrical applications.
- To apply IoT hardware platforms and communication protocols for Electrical Engineering use cases.
- To analyze IoT applications in smart grids, energy monitoring, and automation of Electrical systems.
- To evaluate IoT security challenges, standards, and cloud integration strategies in Electrical Engineering

PREREQUISITE:

- Control and Instrumentation
- Embbeded System Framework

UNIT I IOT IN ELECTRICAL SYSTEMS 9

Overview of IoT-Importance of IoT in modern technology-IoT Architecture-Evolution of IoT in Electrical Domain.- IoT in Electrical Engineering: Role of IoT in electrical power systems, smart grids, automation, and energy management.

UNIT II SENSORS, ACTUATORS, AND POWER MANAGEMENT 9

Sensors in IoT:Types of electrical sensors and their interfacing with IoT systems-Actuators: Overview of actuators used in IoT applications-Power Management for IoT: Low-power IoT devices, power consumption optimization techniques, energy harvesting and battery management.

UNIT III IOT HARDWARE AND COMMUNICATION TECHNOLOGIES 9

Overview of IoT Hardware Platforms: Arduino, Raspberry Pi, ESP8266/ESP32, STM32- IoT Communication Technologies: LoRaWan, Low Power Wide Area Networks (LPWAN), Cellular technologies: LTE-M, NB-IoT, IoT Networking Protocols.

UNIT IV IOT FOR ELECTRICAL POWER SYSTEMS AND AUTOMATION 9

Smart Grids: Role of IoT in modernizing power grids, monitoring energy consumption, smart meters, and power quality analysis- Power System Automation: Automation of electrical systems (e.g., circuit breakers, protection relays) using IoT for fault detection and response.

UNIT V IOT SECURITY, STANDARDS AND CLOUD INTEGRATION 9

IoT Security: Electrical system vulnerabilities, securing IoT devices, encryption, and authentication mechanisms in IoT networks, IoT Standards and Regulations: Electrical IoT standards (IEEE, IEC) and regulatory frameworks governing electrical IoT devices-Cloud Integration in IoT.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Controlling the Light Emitting Diode (LED) with a push button,Potentiometer and interfacing.
2. Detection of the light using photo resistor and interfacing with Active Buzzer.
3. Interfacing of temperature sensor LM35 with Arduino.
4. Interfacing Servo Motor with the Arduino.
5. Interfacing of the Relay with Arduino.
6. Building Intrusion Detection System with Arduino and Ultrasonic Sensor.
7. Directional Control of the DC motor using Arduino.
8. Smart Energy Meter using IOT.
9. RFID based student attendance System.
10. Weather Station using Raspberry Pi.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Apply the basic concepts and architecture of IoT to Electrical engineering problems.
- Analyze the role of sensors, actuators, and power management strategies in IoT-enabled Electrical systems.

Examine and select appropriate IoT hardware platforms and communication protocols for specific Electrical engineering applications

- Develop and analyze IoT-based solutions for smart grid management, energy monitoring, and automation..
- Evaluate IoT security risks, encryption/authentication mechanisms, and compliance with standards, while integrating cloud platforms effectively.

TEXT BOOKS:

1. F. John Dian ”Fundamentals of Internet of Things: For Students and Professionals”, First Edition, Wiley-IEEE Press, ISBN: 978-1-119-84729-8,December 2022.
2. Maurizio L. Rocco, S. G. S. Raju, L. B. S. Ghosh “ IoT-Enabled Multidisciplinary Applications” First Edition, CRC Press, 2020.
3. Jamil Y. Khan, Mehmet R. Yuce, “Internet of Things (IoT) Systems and Applications”, First Edition, Jenny Stanford Publishing, September,2019.

4. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton " IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" First Edition, Cisco Press, 2017.

5. Raj Kamal, "Internet of Things " Second Edition, McGraw Hill publishers, June 2022.

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1. Jeeva Jose "Internet of Thgings", First Edition, Khanna Publishing House, 2023.

2. Rajeev Alur, Sandeep Bhatnagar " Internet of Things for Engineers", First Edition ,Wiley, 2021.

3. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", First Edition, New York, NY : Apress, 2016.

4. Arshdeep Bahga, Vijay Madisetti,"Industry 4.0: The Industrial Internet of Things." First Edition, Orient Blackswan Private Limited - New Delhi, January 2015.

5. Greengard, Samuel,"The internet of things",First Edition, Cambridge, Massachusetts : MIT Press, 2015.

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- **https://www.youtube.com/watch?v=IzKoaKD8ep4**
- **https://www.sciencedirect.com/journal/internet-of-things**
- **https://www.electricaltechnology.org/2016/07/internet-of-things-iot-and-its-applications**
- **www.nptel.ac.in**

MAPPING OF CO WITH PO/PSO:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	1	2	1	1	2	3	3	-	2	1	1	1
CO2	2	3	2	3	2	1	2	3	3	-	2	2	2	2
CO3	2	3	2	3	2	1	2	3	3	-	2	2	2	2
CO4	2	3	2	3	2	1	2	3	3	-	2	2	2	2
CO5	2	3	3	3	2	1	2	3	3	-	2	2	2	2
AVG	1.8	2.8	2	2.8	1.8	1	2	3	3	-	2	1.8	1.8	1.8

JHS2541	PROFESSIONAL COMMUNICATION	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To enhance reading comprehension and oral communication through self-reflection and peer feedback
- To improve listening and speaking skills through exposure to diverse accents and group discussions
- To develop professional writing and critical thinking through email composition and career-related tasks
- To refine presentation skills and job application writing for effective workplace communication
- To build interview confidence and problem-solving abilities through simulations and case analysis

LIST OF EXPERIMENTS AND ACTIVITIES:

1. Reading: 21st Century Skills

Activity: Read an article or infographic on 21st-century skills, summarize key skills and conduct a quiz.

2. Speaking: Self-introduction

Activity: Deliver a 2 to 3-minute self-introduction or elevator pitch and receive peer feedback on content and delivery.

3. Listening: Accents in English

Activity: Listen to English audio clips in British, American, and Indian accents and answer comprehension questions based on the content.

4. Speaking: Group Discussion Dynamics

Activity: Participate in a formal group discussion on a current or technical topic and observe turn-taking, assertiveness, and relevance.

5. Writing: Working in Virtual Teams

Activity: Conduct a virtual team-based design challenge, simulate and record a remote meeting, and complete a reflective report on communication effectiveness.

6. Reading: Career Planning and Research Proposals

Activity: Read and analyse a sample career plan or research proposal, extract key points and compare effectiveness.

7. Speaking: Presentation Skills

Activity: Prepare and deliver a 4 to 5-minute oral or PPT presentation on a technical or career-related topic and receive peer and instructor feedback.

8. Writing: Job Application and Resume Writing

Activity: Prepare a tailored cover letter and resume—both by mail and email—for a specific job description, emphasizing clarity, proper formatting, and relevance.

9. Speaking: Interview Skills

Activity: Participate in mock interviews in pairs or with instructors, practice behavioural questions and receive structured feedback.

10. Listening: Professional Challenges

Activity: Listen to workplace case studies based on real-life experiences shared by friends or relatives, identify challenges and discuss possible solutions and ethical considerations.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the students should be able:

- To demonstrate improved reading and speaking through summarization and structured self-introductions
- To apply listening and discussion strategies by interpreting diverse accents and engaging in collaborative dialogues
- To produce professional emails and analyse career-related documents with clarity
- To deliver concise presentations and craft effective job applications tailoring to contexts
- To show interview readiness and ethical awareness by engaging in mock interviews and analysing workplace challenges.

TEXT BOOKS:

1. Meenakshi Raman & Sangeeta Sharma, Technical Communication: Principles and Practice Oxford University Press, 2022.
2. Pushp Lata & Sanjay Kumar, Communication Skills, Oxford University Press, 2011

REFERENCES:

1. Alex, K, 2019, Soft Skills: Know Yourself and Know the World, New Delhi: S. Chand & Company Limited.
2. Butterfield, Jeff, 2015, Soft Skills for Everyone. New Delhi: Cengage Learning.
3. Dhawan, Erica. (2021). Digital Body Language: How to Build Trust and Connection, No Matter the Distance. New York: St. Martin's Press.
4. Gallo, Carmine. (2014). Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds. New York: St. Martin's Press.
5. Interact English Lab Manual for Undergraduate Students, 2016, Hyderabad: Orient BlackSwan.
6. Mitra, Barun K, 2016, Personality Development and Soft Skills, New Delhi: Oxford University Press.
7. Raman, Meenakshi and Sangeeta Sharma, 2022, Professional Communication, Oxford: Oxford University Press.
8. Rizvi, Ashraf, M, 2018, Effective Technical Communication, Chennai: McGraw-Hill Education.

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1. https://www.coursera.org/learn/english-for-career-development
2. https://owl.purdue.edu/
3. https://www.mindtools.com/
4. https://www.toastmasters.org/resources/public-speaking-tips
5. https://www.ted.com/topics/communication
6. https://learnenglish.britishcouncil.org/skills
7. https://www.indeed.com/career-advice/resumes-cover-letters
8. https://www.skillsyouneed.com/

CO - PO MAPPINGS:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	Pso1	PSO2	PSO3
CO1	-	-	-	-	-	2	-	2	3	-	1	-	-	-
CO2	-	-	-	-	-	2	-	2	3	-	1	-	-	-
CO3	-	-	-	-	-	2	-	2	3	-	1	-	-	-
CO4	-	-	-	-	-	2	-	2	3	-	1	-	-	-
CO5	-	-	-	-	-	2	-	2	3	-	1	-	-	-
AVG	-	-	-	-	-	2	-	2	3	-	1	-	-	-

JEE2511	POWER ELECTRONICS AND DRIVES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To describe the operating principles and characteristics of power semiconductor devices such as SCR, TRIAC, MOSFET, and IGBT.
- To demonstrate the operation of AC-DC converters, DC-DC choppers, and AC voltage controllers.
- To develop PWM-based inverter circuits for single-phase and three-phase applications.
- To compare and analyze the performance of power electronic converters used in electrical drive systems.
- To evaluate the speed control techniques of DC and induction motor drives using power electronic converters.

LIST OF EXPERIMENTS:

1. Gate Pulse Generation using R, RC, and UJT.
2. Characteristics of SCR and TRIAC.
3. Characteristics of MOSFET and IGBT.
4. AC to DC Half-Controlled Converter.
5. AC to DC Fully Controlled Converter.
6. MOSFET-based Step-Up Chopper.
7. MOSFET-based Step-down Chopper.
8. IGBT-based single-phase PWM inverter.
9. IGBT-based three-phase PWM inverter.
10. AC Voltage Controller.
11. Speed Control of DC Motor using Single-Phase Converter.
12. V/f Control of Induction Motor.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Demonstrate gate pulse generation circuits and obtain characteristics of SCR, TRIAC, MOSFET, and IGBT devices.
- Analyze the performance of AC-DC converters under different operating conditions.
- Experiment with MOSFET-based DC-DC choppers and evaluate their voltage conversion characteristics.
- Analyze the operation and output characteristics of PWM-based single-phase and three-phase inverters.
- Assess the performance of AC voltage controllers and power electronic drive systems.

REFERENCES:

1. Muhammad H. Rashid, “Power Electronics: Circuits, Devices and Applications”, Fourth Edition, Pearson Education, New Delhi, 2023.

2. Bimbra P.S.“Power Electronics”, Second Edition, Khanna Publishers, Reprint 2022.

3. Gopal K. Dubey, “Fundamentals of Electrical Drives”, Second Edition, Narosa Publishing House, Reprint 2022.

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2. https://www.youtube.com/watch?v=fOZ8bUrFJGk
3. https://www.youtube.com/watch?v=P0MK7sWfs9k
4. https://www.youtube.com/watch?v=7CReXeMAXHA
5. https://www.youtube.com/watch?v=tMFFmmw3LTg

CO-PO/PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	2	3	1	1	1	1	-	1	2	2	1
CO2	3	3	2	3	2	1	1	1	1	-	1	2	2	2
CO3	3	3	3	3	2	1	1	1	1	-	1	2	3	2
CO4	3	3	3	3	3	1	1	1	1	-	1	2	3	3
CO5	3	3	2	3	3	1	1	1	1	-	1	3	3	3
AVG	2.8	2.8	2.2	2.8	2.6	1.0	1.0	1.0	1.0	-	1.0	2.2	2.6	2.2

JPT2042	TECHNICAL SKILLS AND APTITUDE	L	T	P	C
		0	0	2	*

COURSE OBJECTIVES:

- To make students analyze and solve problem in technical as well as aptitude. Enhance the Technical skills and basics of programming language
- To make the students understand how to apply the practical knowledge with real time applications.
- To make the students think and draw a conclusion from different scenarios.
- To help the students understand OOPS and python programming concepts
- To help the students understand concepts and problems in OOPS and python.

UNIT I FUNDAMENTALS OF C++ 6

Introduction to C++ - Data Types and Operators - Control Structures - Functions in C++ - Arrays and Strings - Structures and Unions - File Handling

UNIT II OBJECT-ORIENTED PROGRAMMING (OOP) & ADVANCED C++ 6

Object-Oriented Programming (OOP) - Inheritance & Polymorphism - Operator Overloading - Templates and Exception Handling - Standard Template Library (STL) - Multi-threading & Advanced Topics

UNIT III PYTHON BASICS & FUNDAMENTALS 6

Introduction to Python **-** Data Types & Variables - Operators & Expressions - Control Flow Statements - Functions & Modules - File Handling - Exception Handling

UNIT IV QUANTITATIVE APTITUDE 6

Time and work – Pipes and Cistern – Time and Distance – Problems on Trains – Boats and streams – Arithmetic and Geometric progression

UNIT V LOGICAL REASONING 6

Syllogism: Statement and Conclusion – Clocks - Inequalities – Non Verbal Reasoning – Logical Sequence, Inferred Meaning

TOTAL: 30 PERIODS

COURSE OUTCOMES

At the end of the course, the student will be able to:

- enhance their knowledge in OOPS concepts
- enhance knowledge in PYTHON programming
- gain knowledge in Coding the concepts of python programming.
- solve the complex Arithmetic problems practically with real time application problems
- think logically in solving problems enhance their decision making for difficult situations.

TEXTBOOKS:

1. Dr.E. Balagurusamy,"Programming in C++" complete reference 8th Edition.
2. "THE COMPLETE REFERENCE PYTHON", Herbert schildt., McGraw Hill Education, 2011.
3. Python: The Complete Reference by Martin Brown and Martin C.Brown Published in 2014.
4. Python in a nutshell by Alex Martelli Revised in March 2013.
5. Dr. R.S Agrawal, "Quantitative Aptitude" and Non Verbal Reasoning published in 2000

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2. https://m4maths.com/placement-puzzles.php
3. www.freshers world.com
4. www.careerride.com
5. www.youtube.com/watch/python
6. www.youtube.com/watch/concepts of python
7. https://stackoverflow.com/
8. https://www.w3schools.com/
9. https://www.geeksforgeeks.org/

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	2	2	2	3	2	2	3
CO2	3	3	3	3	3	-	-	2	2	2	3	2	2	3
CO3	3	3	3	3	3	-	-	2	2	2	3	2	2	3
CO4	3	3	3	3	3	-	-	2	2	2	3	2	3	3
CO5	3	3	3	3	3	-	-	3	3	3	3	2	3	3
AVG	3	3	3	2.8	3	-	-	2.2	2.2	2.2	3	2	2.4	3

JGE2541	INDUSTRY 4.0 LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To provide a thorough understanding of Arduino and ESP32 platforms
- To equip learners with foundational and practical knowledge of the Raspberry Pi platform
- To develop a deep understanding of industrial sensor and actuator networks
- To provide a comprehensive introduction to build basic IoT sensing systems
- To introduce the foundational concepts of mobile robotics

MODULE I ARDUINO AND ITS APPLICATIONS

Arduino Fundamentals, Advanced Interfacing & ESP32 Concepts, Hands-on Lab -ESP32 GPIO & Advanced Applications, Project presentations.

MODULE II RASPBERRY PI FOR EMBEDDED SYSTEMS AND IOT

Raspberry Pi fundamentals, setting up Raspberry Pi (OS installation, configurations), Hands-on Lab – GPIO, Serial port & Data collection, Hands – on Lab – Actuators & Complete Projects.

MODULE III INDUSTRIAL SENSOR NETWORKS AND AUTOMATION

Industrial sensor networks – Hands – on lab: Advanced actuators. Industry applications and case studies – Complete sensor – actuator system, Project presentations.

MODULE IV FUNDAMENTALS OF IoT SYSTEMS AND CLOUD INTEGRATION

IoT Fundamentals, Sensors in IoT applications, Hands – on lab: Basic IoT sensing, IoT Connectivity and Cloud Integration, Hands – on lab: Cloud integration, IoT project planning and deployment, Project presentations.

MODULE V INTRODUCTION TO ROBOTICS, SENSORS AND ACTUATORS

Introduction to robotics basics and key components, Introduction to sensors and actuators, Mobile robot fundamentals, Basic motion control principles, Introduction to sensor – based navigation, Project Integration, building a robot that can follow lines and avoid obstacles.

TOTAL: 60 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able to:

- program using Arduino and interfacing techniques
- design and implement end-to-end embedded and IoT solutions.
- apply knowledge in industrial automation and smart systems
- build basic IoT sensing systems
- develop a mobile robot capable of line follow and obstacle avoidance

CO-PO/PSO MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	2	2	-	3	3	1	2
CO2	3	3	3	3	3	-	-	2	2	-	3	3	1	2
CO3	3	3	3	3	3	2	-	3	2	2	3	3	2	2
CO4	3	3	3	3	3	2	-	3	2	2	3	2	1	2
CO5	3	3	3	3	3	2	2	3	3	3	3	3	1	3
AVG	3	3	3	3	3	2	2	2.6	2.2	2.3	3	2.8	1.2	2.2

JEE2621	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To explain the operating principles and characteristics of solar photovoltaic and wind energy conversion systems.
- To demonstrate the modelling and simulation of renewable energy systems using appropriate software tools.
- To develop MPPT-based control techniques for maximum power extraction from solar PV and wind energy systems.
- To conduct performance analysis of renewable energy systems under varying environmental and operating conditions.
- To construct grid-connected and hybrid renewable energy systems using suitable power electronic interfaces.

PREREQUISITE:

- Power Electronics and Drives

UNIT I INTRODUCTION TO RENEWABLE ENERGY SYSTEMS 9 Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems, and hybrid renewable energy systems.
UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9 Review of reference theory fundamentals, principle of operation, and analysis: IG, PMSG, SCIG, and DFIG.
UNIT III POWER CONVERTERS 9 Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three-phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters- matrix converters.
UNIT IV A N A L Y S I S OF WIND AND PV SYSTEM 9 Stand-alone operation of fixed and variable speed wind energy conversion systems and solar system- Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar PV system.
UNIT V HYBRID RENEWABLE ENERGY SYSTEMS 9 Energy Storage Systems - Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV -Maximum Power Point Tracking (MPPT).

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Simulation study of VI-Characteristics, Efficiency, at various insolation levels, and
2. Shadowing Effect with Diode-based Solution in a Solar PV System.
3. Modeling and Simulation of a Solar PV System.
4. Design and Simulation of Grid-Connected Solar PV System.
5. Performance Analysis of Induction Generator in Wind Energy Conversion Systems.
6. Performance Analysis of Permanent Magnet Synchronous Generator in Wind Energy Conversion Systems.
7. Design and Simulation of MPPT Controller for Maximum Power Extraction from Solar PV.
8. Design and Simulation of MPPT Controller for Wind Turbine Using PMSG.
9. Simulation study on Intelligent Controllers for solar PV Systems.
10. Simulation study on Hybrid (Solar-Wind) Power System.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Analyze the operating characteristics and performance of solar photovoltaic systems under varying irradiance and shading conditions.
- Distinguish the performance characteristics of different renewable energy conversion systems and their associated power electronic interfaces.
- Differentiate the operational features and performance of induction generator-based and PMSG-based wind energy conversion systems.
- Calculate the maximum power extraction capability and efficiency of renewable energy systems using MPPT techniques and suitable controllers.
- Develop grid-connected and hybrid renewable energy systems incorporating suitable power electronic converters and control techniques.

TEXT BOOKS:

1. Kothari, D.P., Singal, K.C., Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies, PHI learning 2022
2. Bhadra S. N., Kastha D., Banerjee S., "Wind Electrical Systems", Oxford University Press, 2005.
3. Khan, B.H. Non-conventional Energy sources, Tata McGraw-Hill Publishing Company, New Delhi,2017.

REFERENCES:

1. Rashid, M. H "Power Electronics Handbook", Fourth edition, Pearson, 2017.
2. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
3. Rai. G.D, "Non-conventional energy sources", Khanna, 1993.
4. Grey, L. Johnson, "Wind energy system", Prentice Hall, 1995.
5. Andrzej M. Trzynnadlowski, 'Introduction to Modern Power Electronics', Second edition, Wiley India Pvt. Ltd, 2014

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3. https://youtu.be/DNPu_JcGeTY
4. https://youtu.be/xKxrkht7CpY
5. https://youtu.be/Tjm-Oa4GKW0
6. https://youtu.be/JSTDFJXAdNM

Mapping of CO with PO/PSO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	2	2	3	3	2	2	3	3	2
CO2	2	3	2	3	2	2	2	3	3	2	2	3	3	2
CO3	2	3	2	3	2	2	2	3	3	2	2	3	3	2
CO4	2	3	2	3	2	2	2	3	3	2	2	3	3	2
CO5	2	3	2	3	2	2	2	3	3	2	2	3	3	2
Avg.	2	3	2	3	2	2	2	3	3	2	2	3	3	2

JEE2601	POWER SYSTEM ANALYSIS, OPERATION AND CONTROL	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To explain the fundamental concepts of power systems, per-unit representation, bus admittance matrix formation, and power flow analysis techniques.
- To illustrate the procedures involved in balanced and unbalanced fault analysis
- To explain the principles of power system stability and the methods used for stability assessment under steady-state and transient conditions.
- To discuss the modeling and control strategies of single-area and two-area Load Frequency Control systems.
- To introduce the principles and solution techniques of Economic Dispatch and Unit Commitment problems in power system operation.

PREREQUISITE:

- Transmission, Distribution and Protection

UNIT I POWER FLOW ANALYSIS 12

Need for system planning and operational studies–basic components of a power system–Single line diagram – per phase and per unit analysis – Generator – transformer – transmission line and load representation for different power system studies. Construction of Y-bus using inspection — Z-bus. classification of buses – iterative solution using Gauss-Seidel method and Newton-Raphson method.

UNIT II FAULT ANALYSIS 12

Importance of short circuit analysis -approximations in Short Circuit Analysis, Symmetrical Short Circuit Analysis-Symmetrical Component Transformation- Z bus in phase frame and sequence frame-Unsymmetrical Fault Analysis LG-LL-LLG faults (Qualitative Treatment Only) .

UNIT III STABILITY ANALYSIS 12

Power system stability - Steady state and transient stability concepts, synchronous machine modelling for stability studies - Swing equation- swing curve - equal area criterion- voltage and frequency stability - factors affecting stability.

UNIT IV LOAD FREQUENCY CONTROL 12

An overview of power system operation and control–system load variation–load curves and load duration curve - Importance of load forecasting. Basics of speed governing mechanism and modeling–speed-load characteristics. Load frequency control of a single-area system and two-area system.

UNIT V UNIT COMMITMENT AND ECONOMIC DISPATCH 12

Formulation of economic dispatch problem – I/O cost characterization – incremental cost curve –coordination equations without and with loss – solution by direct method and λ-iteration method – statement of unit commitment problem – priority-list method– forward dynamic programming.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Apply power flow analysis techniques to model power systems and determine bus voltages and power flows.
- Analyze symmetrical and unsymmetrical faults in power systems using impedance and sequence network methods.
- Analyze the stability of power systems under steady-state and transient operating conditions.
- Apply Load Frequency Control concepts to evaluate the performance of single-area and two-area power systems.
- Evaluate Economic Dispatch and Unit Commitment solutions for optimal operation of power systems.

TEXT BOOKS:

1. John J. Grainger, William D. Stevenson, ‘Power System Analysis’, McGraw Hill Education (India) Private Limited, New Delhi, 2017.
2. Soni. M.L, P.V. Gupta, U.S. Bhatnagar, A. Chakrabarti, ‘A Text Book on Power System Engineering’, Dhanpati Rai & Co.,2013.
3. Kothari D.P. and Nagrath I.J., ‘Power System Engineering’, Third Edition, Tata McGraw-Hill Education, 2019.
4. Allen. J. Wood and Bruce F. Wollenberg, ‘Power Generation, Operation and Control’, John Wiley & Sons, Inc., 2016.
5. Abhijit Chakrabarti and Sunita Halder, ‘Power System Analysis Operation and Control’, Fourth Edition, PHI learning Pvt. Ltd., New Delhi, 2022.

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1. Hadi Saadat, ‘Power System Analysis’, McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
2. Wadhwa. C.L., ‘Electrical Power Systems’, Seventh Edition, New Age International (P) Ltd.,2022.
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Mapping of CO with PO/PSO

	Program Outcomes											PSO		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	2	1	-	-	1	-	-	1	3	-	1
CO2	3	3	2	3	1	-	-	1	-	-	1	3	-	1
CO3	3	3	2	3	1	-	-	1	-	-	1	3	-	1
CO4	3	2	1	2	1	-	-	1	-	-	1	3	-	1
CO5	3	3	2	3	1	-	-	1	-	2	1	3	-	1
AVG	3	2.6	2	2.6	1	-	-	1	-	2	1	3	-	1

JEE2602	ARTIFICIAL INTELLIGENCE IN ELECTRICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on the fundamental concepts and various approaches used in Artificial Intelligence to solve complex real-world problems.
- To classify different types of Artificial Neural Networks along with their corresponding learning algorithms.
- To infer the principles of fuzzy set theory and analyse the structure of fuzzy rules.
- To familiarize with the genetic algorithm approach for solving optimization problems.
- To evaluate diverse real-world applications of Artificial Intelligence.

UNIT I INTRODUCTION TO ARTIFICAL INTELLIGENCE 9

Introduction - Difference between Soft Computing Techniques and Hard Computing Systems - Foundations of Artificial Intelligence - History of Artificial Intelligence - Risks and Benefits of AI - Approaches to Artificial Intelligence – Symbolic Reasoning System – Rule Based Systems – Knowledge Representation – Expert Systems.

UNIT II ARTIFICIAL NEURAL NETWORKS 9

Biological Neuron – Artificial Neuron – Neuron Model –Single Layer and Multi-Layer Feed Forward Network – Supervised And Unsupervised Learning Algorithm - Back Propagation Network. - Feedback Networks – Hopfield Networks.

UNIT III FUZZY SYSTEMS 9

Classical Sets – Fuzzy Sets – Basic Fuzzy Set Operations -Fuzzy Relations – Introduction to Fuzzy Logic Modeling and Control - Fuzzification – Inferencing - Defuzzification – Fuzzy Rules – Membership Function – Knowledge Base – Decision-Making Logic –- Adaptive Fuzzy Systems.

UNIT IV GENETIC ALGORITHM 9

Introduction to Evolutionary Programming – Basic Concepts of Genetic Algorithm - Genetic Operators – Reproduction, Cross Over, Mutation – Detailed Algorithmic Steps - Convergence Of Genetic Algorithm, Simple Optimization Problems Using GA -Tabu Search – Ant Colony Optimization.

UNIT V APPLICATIONS 9

AI in Renewable System Integration - Intelligent Controllers for Inverters and Converters – AI based Energy Management Systems - Artificial Neural Network in Process Identification – Neuro Controller for Inverted Pendulum - Fuzzy Systems For Motor Speed Control - Genetic Algorithms For Optimizing Economic Dispatch Problems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Demonstrate the fundamental concepts and techniques of Artificial Intelligence.
- Investigate the structural and functional differences between feedforward and feedback neural networks in the context of learning processes.
- Analyze the concepts of fuzzy set over classical set theory and the function of fuzzy logic controller.
- Examine the core concepts and operational mechanisms of genetic algorithms used for optimization in AI applications.
- Apply artificial neural network, fuzzy logic control and genetic algorithm to electrical engineering problems and design the control strategy.

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3. S.N.Sivanandam, S. Sumathi, S. N. Deepa, “Soft Computing Techniques”, Third edition, Wiley Publications, 2018.

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1. Goldberg, "Genetic Algorithm in Search, Optimization and Machine learning", First Edition, Addison Wesley Publishing Company Inc. 1989.
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Mapping of CO with PO/PSO

	Program Outcomes											PSO		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	1	2	1	1	1	1	1	-	1	1	1	1
CO2	2	3	2	3	2	1	1	1	1	-	1	2	2	2
CO3	2	3	2	3	2	1	1	1	1	-	1	2	2	2
CO4	2	3	2	3	2	1	1	1	1	-	1	2	2	2
CO5	3	3	3	3	3	1	1	1	1	-	1	3	3	3
AVG	2	2.8	2	2.8	2	2.8	1	1	1	-	1	2	2	2

JEE2611	POWER SYSTEM SIMULATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To determine transmission line parameters and formulate bus admittance and impedance matrices for power system network modeling using MATLAB software.
- To execute power flow analysis using Gauss–Seidel, Newton–Raphson, and DC load flow techniques through ETAP simulation.
- To examine symmetrical and unsymmetrical fault conditions in power systems and evaluate fault current variations under different operating scenarios using ETAP.
- To interpret economic dispatch and load–frequency control concepts for optimal and stable power system operation.
- To elucidate state estimation using Weighted Least Square methods and electromagnetic transient behavior during transmission line energization.

LIST OF EXPERIMENTS

1. Computation of Transmission Line Parameters
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks
3. Power Flow Analysis using Gauss-Seidel Method
4. Power Flow Analysis using Newton Raphson Method
5. DC Load Flow Analysis
6. Symmetric fault analysis
7. Unsymmetrical fault analysis
8. Economic Dispatch in Power Systems
9. Load–Frequency Dynamics of Single-Area and Two-Area Power Systems
10. State estimation: Weighted least square estimation
11. Electromagnetic Transients in Power Systems: Transmission Line Energization

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

- Calculate transmission line parameters and formulate Y_{bus} and Z_{bus} matrices for power system analysis using MATLAB software.
- Apply load flow methods to determine power system operating conditions using ETAP software.
- Analyze symmetrical and unsymmetrical faults and evaluate fault current variations under

different fault scenarios.

- Evaluate economic dispatch solutions and interpret load–frequency dynamics in single-area and two-area power systems.
- Explain weighted least square state estimation and electromagnetic transient behavior during transmission line energization in power systems.

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4. Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control', Fourth Edition, PHI learning Pvt. Ltd., New Delhi, 2022
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7. https://youtu.be/gcPtW9l_ebU?si=uNEGLrG-oYlxCOAE

Mapping of CO with PO/PSO

	Program Outcomes											PSO		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	2	2	-	2	2	1	-	2	3	-	2
CO2	3	2	-	2	3	-	2	2	1	-	2	3	-	3
CO3	3	3	1	3	3	-	2	2	1	-	2	2	1	3
CO4	3	3	2	3	2	2	2	2	1	2	2	2	1	2
CO5	2	1	-	-	1	-	2	2	1	-	2	2	-	1
AVG	2.8	2.2	1.5	2.5	2.2	2	2	2	1	2	2	2.4	1	2.2

JGE2641	PRODUCT DEVELOPMENT LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To provide overview of product development boards
- To familiarize students with embedded platforms, sensors, actuators, communication protocols, and cloud-based IoT integration.
- To enhance problem-solving skills in real-world applications across various domains
- To develop prototyping skills using modern tools and techniques
- To provide hands-on experience in designing and product development.

LIST OF EXPERIMENTS / MODULES

Module 1: Introduction to Product Development & Embedded Platforms

- Introduction to IoT and Embedded Systems in various domains.
- Overview of development boards (Arduino, ESP32, STM32, Raspberry Pi).
- Basics of sensors, actuators, and communication modules.
- Industry best practices and future scope in IoT and embedded systems.
- Hands-on: Blinking LED, sensor interfacing, GPIO control.

Module 2: Communication Protocols & IoT Integration

- Overview of wired and wireless communication protocols (UART, I2C, SPI, Bluetooth, Wi-Fi, MQTT, LoRa).
- Hands-on: Interfacing with an IoT cloud platform (Thingspeak, Firebase, AWS IoT, Google Firebase).
- Data acquisition and visualization using IoT dashboards.

Module 3: Embedded System Development & Real-Time Processing

- Introduction to RTOS for embedded applications.
- Hands-on: Task scheduling and real-time data processing using FreeRTOS on ESP32.
- Sensor fusion techniques for real-world applications.

Module 4: Domain-Specific Product Development

Students will choose a domain and develop a prototype based on real-world needs. Sample applications are listed but not limited to: Consumer electronics, wearable electronics, automotive Electronics, Agricultural, EV, BMS, Energy monitoring, smart metering, biomedical products such as IoT based patient monitoring, signal processing etc. home automation, product for automobile industries.

Module 5: Prototyping, Testing, Product deployment and Documentation

- Hardware design: PCB designing using KiCad / Eagle.
- Firmware development and debugging using Keil / MPLAB / Arduino IDE.
- Product reliability testing and performance analysis.
- Project presentations, demonstration of working prototypes.
- Writing technical documentation, reports, and product manuals.

TOTAL: 60 PERIODS

TOOLS & SOFTWARE REQUIRED:

- **Development Boards**: Arduino UNO, ESP32, STM32, Raspberry Pi
- **Sensors & Actuators**: Temperature, humidity, motion, pressure sensors, servo motors, relays
- **Communication Modules**: Bluetooth (HC-05), Wi-Fi (ESP8266/ESP32), LoRa modules
- **Embedded Development Environments**: Arduino IDE, STM32CubeIDE, Keil uVision, MPLAB X, PlatformIO
- **IoT Platforms**: Thingspeak, AWS IoT, Google Firebase, Blynk
- **PCB Design Tools**: KiCad, Eagle, Altium Designer
- **Simulation Tools**: Proteus, Tinkercad, MATLAB Simulink

COURSE OUTCOMES:

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

- Design and implement embedded systems for real-world applications.
- Develop IoT-based solutions using appropriate hardware and software tools.
- Interface sensors, actuators, and communication modules with microcontrollers.
- Analyze product requirements and create working prototypes.
- Document product development processes and present project outcomes.

TEXTBOOKS:

1. Raj Kamal, Internet of Things: Architecture and Design Principles, McGraw Hill.
2. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press.
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1. Pethuru Raj, Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press.
2. Jan Axelson, Embedded Ethernet and Internet Complete, Lakeview Research.
3. Jonathan W. Valvano, Embedded Systems: Introduction to ARM Cortex-M Microcontrollers, CreateSpace.
4. Adrian McEwen, Designing the Internet of Things, Wiley.

CO-PO/PSO MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	3	-	3	2	-	-	1	-	-	3	1	2
CO2	3	-	3	-	3	2	-	-	2	-	-	3	1	3
CO3	3	2	3	-	3	-	-	-	2	-	-	3	1	2
CO4	3	3	3	2	3	2	-	-	2	-	-	2	1	3
CO5	-	-	-	-	-	-	-	2	2	2	2	1	1	2
AVG	3	2.5	3	2	3	2	-	2	1.8	2	2	2.4	1	2.4

JPT2042	TECHNICAL SKILLS AND APTITUDE	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To make students analyze and solve problem in technical as well as aptitude. Enhance the technical skills and basics of programming language
- To make the students understand how to apply the practical knowledge with real time applications.
- To make the students think and draw a conclusion from different scenarios.
- To help the students understand JAVA programming concepts
- To help the students understand concepts and develop new Applications in JAVA.

UNIT1 OBJECT-ORIENTED & ADVANCED PYTHON 6

Object-Oriented Programming (OOP) - Advanced Data Structures & Algorithms - Decorators & Closures - Regular Expressions & String Manipulation - Multi-threading & Multiprocessing.

UNIT II JAVA FUNDAMENTALS 6

Introduction to Java - Data Types & Variables - Operators & Control Statements - Functions & Methods - Arrays & Strings.

UNIT III OBJECT-ORIENTED PROGRAMMING (OOP) & ADVANCED JAVA 6

Object-Oriented Programming (OOP) Basics - Exception Handling - Inheritance & Polymorphism - Collections Framework - File Handling & Serialization.

UNIT IV QUANTITATIVE APTITUDE 6

Permutation and combination: Letter, Number and circular permutation – Probability – Logarithm – Mensuration – Data sufficiency.

UNIT V LOGICAL REASONING 6

Calendar – Visual Reasoning – Mirror Image and Water Image – Picture analogy – Pattern completion – Data Interpretation – Selection decision table.

TOTAL: 30 PERIODS

COURSE OUTCOMES

At the end of the course, the student will be able to

- enhance the knowledge in JAVA concepts and programming
- gain knowledge in Coding the concepts of JAVA programming
- solve the complex Arithmetic problems practically with real time application problems
- think logically in solving problems enhance their decision making for difficult situations.
- enhance the employability skills and well prepared to face the MNCs Campus interviews.

TEXTBOOKS:

1. Herbert Schildt, "Java The complete reference", 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9th Edition, Prentice Hall, 2013.
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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	2	2	2	3	2	2	3
CO2	3	3	3	3	3	-	-	2	2	2	3	2	2	3
CO3	3	3	3	3	3	-	-	2	2	2	3	2	2	3
CO4	3	3	3	3	3	-	-	2	2	2	3	2	3	3
CO5	3	3	3	3	3	-	-	3	3	3	3	2	3	3
AVG	3	3	3	2.8	3	-	-	2.2	2.2	2.2	3	2	2.4	3

JNC2761	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES

- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.
- To have knowledge about Workplace Exposures and Hazards.
- To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I SAFETY TERMINOLOGIES 9

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS.

UNIT II STANDARDS AND REGULATIONS 9

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT III SAFETY ACTIVITIES 9

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT IV WORKPLACE HEALTH AND SAFETY 9

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES 9

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Course outcomes on completion of this course the student will be able to:

- Understand the basic concept of safety.
- Obtain knowledge of Statutory Regulations and standards.
- Know about the safety Activities of the Working Place.
- Analyze on the impact of Occupational Exposures and their Remedies

- Obtain knowledge of Risk Assessment Techniques.

TEXT BOOKS

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems Khanna Publisher.
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education.

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1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries. Butterworth-Heinemann publications, UK, 4th Edition.
2. John Ridley & John Channing , "Safety at Work: Routledge", Seventh Edition, 2008
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.
4. Alan Waring.(1996).Safety management system: Chapman &Hall,England
5. Society of Safety Engineers, USA

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CO's-PO's & PSO's MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
CO1	3	3	3	1	1	3	2	3	3	1	3	1	2	1
CO2	2	3	2	2	1	3	3	3	2	1	3	2	1	2
CO3	2	2	2	2	1	2	2	3	2	1	2	2	1	1
CO4	3	3	3	2	2	3	2	3	2	1	3	2	2	1
CO5	3	2	3	2	2	3	2	3	2	2	3	2	2	2
AVG	2.6	2.6	2.6	1.8	1.4	2.8	2.2	3	2.2	1.2	2.8	1.8	1.6	1.4

JHS2741	UNIVERSAL HUMAN VALUES	L	T	P	C
		1	0	2	2

COURSE OBJECTIVES:

The objective of the course is four-fold:

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

Module I: Introduction (3L, 6P)

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

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

Module II: Harmony in the Human Being (3L, 6P)

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

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

Module III: Harmony in the Family and Society (3L, 6P)

Understanding values in human-human relationship; meaning of Justice (nine universal values in

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

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

Module IV: Harmony in the Nature and Existence (3L, 6P)

Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all- pervasive space, Holistic perception of harmony at all levels of existence.

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

Module V: Implications of Harmony on Professional Ethics (3L, 6P)

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations, Sum up.

Practical Session: *Include Exercises and Case Studies will be taken up in Sessions E.g. To discuss the conduct as an engineer or scientist etc.*

TOTAL: 45 (15 Lectures + 30 Practicals) PERIODS

COURSE OUTCOMES:

By the end of the course, the students will be able to:

1. Become more aware of themselves, and their surroundings (family, society, nature);
2. Have more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. Have better critical ability.
4. Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

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

Web URLs:

1. Class preparations: https://fdp-si.aicte-india.org/UHV-II%20Class%20Note.php
2. Lecture presentations: https://fdp-si.aicte-india.org/UHV-II_Lectures_PPTs.php
3. Practice and Tutorial Sessions: https://fdp-si.aicte-india.org/UHV-II%20Practice%20Sessions.php

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
CO1	-	-	-	-	-	2	1	3	-	-	3	1	2	1
CO2	-	-	-	-	-	2	1	3	-	-	3	1	2	1
CO3	-	-	-	-	-	2	2	3	-	1	3	1	1	1
CO4	-	-	-	-	-	3	2	3	-	1	3	1	2	1
CO5	-	-	-	-	-	3	3	3	-	2	3	1	1	1
AVG	-	-	-	-	-	2.6	1.8	3	-	1.33	3	1	1.8	1

JGE2751	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn basic concepts in entrepreneurship, develop mind-set and skills necessary to explore entrepreneurship
- To apply process of problem - opportunity identification and validation through human centred approach to design thinking in building solutions as part of engineering projects
- To analyse market types, conduct market estimation, identify customers, create customer persona, develop the skills to create a compelling value proposition and build a Minimum Viable Product
- To explore business models, create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture ideas & solutions built with domain expertise
- To prepare and present an investible pitch deck of their practice venture to attract stakeholders

MODULE – I: ENTREPRENEURIAL MINDSET **4L, 8P**

Introduction to Entrepreneurship: Definition – Types of Entrepreneurs – Emerging Economics – Developing and Understanding an Entrepreneurial Mindset – Importance of Technology Entrepreneurship – Benefits to the Society.

Case Analysis: Study cases of successful & failed engineering entrepreneurs - Foster Creative Thinking: Engage in a series of Problem-Identification and Problem-Solving tasks

MODULE – II: OPPORTUNITIES **4L, 8P**

Problems and Opportunities – Ideas and Opportunities – Identifying problems in society –Creation of opportunities – Exploring Market Types – Estimating the Market Size, - Knowing the Customer and Consumer - Customer Segmentation - Identifying niche markets – Customer discovery and validation; Market research techniques, tools for validation of ideas and opportunities

Activity Session: Identify emerging sectors / potential opportunities in existing markets - Customer Interviews: Conduct preliminary interviews with potential customers for Opportunity Validation - Analyse feedback to refine the opportunity.

MODULE – III: PROTOTYPING & ITERATION **4L, 8P**

Prototyping – Importance in entrepreneurial process – Types of Prototypes - Different methods – Tools & Techniques.

Hands-on sessions on prototyping tools (3D printing, electronics, software), Develop a prototype based on identified opportunities; Receive feedback and iterate on the prototypes.

MODULE – IV: BUSINESS MODELS & PITCHING **4L, 8P**

Business Model and Types - Lean Approach - 9 block Lean Canvas Model - Riskiest assumptions to Business Models – Using Business Model Canvas as a Tool – Pitching Techniques: Importance of pitching - Types of pitches - crafting a compelling pitch – pitch presentation skills - using storytelling to gain investor/customer attention.

Activity Session: Develop a business model canvas for the prototype; present and receivefeedback from peers and mentors - Prepare and practice pitching the business ideas- Participate in a Pitching Competition and present to a panel of judges - receive & reflect feedback

MODULE – V: ENTREPRENEURIAL ECOSYSTEM **4L, 8P**

Understanding the Entrepreneurial Ecosystem – Components: Angels, Venture Capitalists, Maker Spaces, Incubators, Accelerators, Investors. Financing models – equity, debt, crowdfunding, etc, Support from the government and corporates. Navigating Ecosystem Support: Searching & Identifying the Right Ecosystem Partner – Leveraging the Ecosystem - Building the right stakeholder network

Activity Session: Arrangement of Guest Speaker Sessions by successful entrepreneurs and entrepreneurial ecosystem leaders (incubation managers; angels; etc), Visit one or two entrepreneurial ecosystem players (Travel and visit a research park or incubator or makerspace or interact with startup founders).

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

- Develop an Entrepreneurial Mind-set and Understand the EntrepreneurialEcosystem Components and Funding types
- Comprehend the process of opportunity identification through design thinking,identify market potential and customers
- Generate and develop creative ideas through ideation techniques
- Create prototypes to materialize design concepts and conduct testing to gatherfeedback and refine prototypes to build a validated MVP
- Analyse and refine business models to ensure sustainability and profitability Prepare and deliver an investible pitch deck of their practice venture to attract stakeholders

REFERENCES:

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha , Entrepreneurship, Eleventh edition , McGrawHill , 2020.
2. Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use ContinuousInnovation to Create Radically Successful Businesses. Crown Business
3. Blank, S. G., & Dorf, B. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch, (2012).

4. Roy, R. Indian Entrepreneurship: Theory and Practice. New Delhi: Oxford University Press, (2017).
5. Osterwalder, A., & Pigneur, Y. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons, (2010).

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2	PSO3
CO1	2	1	-	-	-	1	-	-	-	-	2	-	-	-
CO2	2	2	1	-	-	-	-	-	-	-	2	-	-	-
CO3	2	3	2	2	1	-	-	-	-	-	2	-	-	-
CO4	1	2	3	2	2	-	-	-	2	2	2	-	-	-
CO5	1	2	1	-	-	3	2	1	2	-	3	-	-	-
AVG	1.6	2	1.75	2	1.5	2	2	1	2	2	2.2	-	-	-

JEE2741	COMPREHENSION AND TECHNICAL SEMINAR	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To revamp the knowledge gained in the semester and prepare the students to face interview both at the academic and the Industrial Sector
- To encourage the students to study about the recent developments in the field
- To prepare and present technical reports
- To encourage the students to use various teaching aids such as power point presentation and demonstrative models

METHOD OF EVALUATION:

COMPREHENSION:

One period is allotted for comprehension. During this period, a test with objective type questions from competitive exams is conducted in identified technical courses. The evaluation is purely internal. Average of all the test marks shall be calculated, a weightage of 50 marks is awarded to the comprehension component.

TECHNICAL SEMINAR:

Three periods are allotted for the technical seminar. During the seminar session each student is expected to prepare and present a technical topic for duration of 10 minutes.
Each student is expected to make presentation at least twice during the semester and the student is evaluated based on various parameters such as topic chosen, content delivery, communication skills and presentation. A faculty guide is allotted who shall guide and monitor the progress and attendance of all the students. Equal weightage is considered for the two seminar sessions for a total weightage of 50 marks.

The total mark awarded for the course shall be the sum of marks scored out of 50 each for the two components. Evaluation is purely internal.

EVALUATION:

Technical Seminar (50)	Comprehension (50)	Total (100)	Internal Marks (50)	Internal Marks (100)

TOTAL : 30 PERIODS

COURSE OUTCOMES:

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

- Consolidate all the engineering concepts acquired in the course of study.
- Enrich their technical knowledge.
- Prepare and present technological developments.
- Communicate effectively the concepts related to the various topics.
- Face the interviews with confidence during the placement drives.

Mapping of CO with PO/PSO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	1	2	2	2	3	3	2	2
CO2	3	3	2	2	3	1	1	2	2	1	3	3	2	2
CO3	2	2	2	2	2	1	1	2	3	2	2	2	2	3
CO4	1	1	1	1	2	1	1	2	3	1	2	2	1	2
CO5	2	2	1	1	1	1	1	3	3	2	3	2	1	2
AVG	2.2	2.2	1.8	1.6	2	1.2	1	2.2	2.6	1.6	2.6	2.4	1.6	2.2

JEE2742	INTERNSHIP	L T P C 0 0 4 2

COURSE OBJECTIVES:

To enable the students to

- Get connected with reputed industry/ laboratory/academia / research institute
- Get practical knowledge on Product development / Software design and development / Testing / Analytics/ research/ startups/ professionalism / business processes and insights / domain knowledge/ Industry Practices/ and other related aspects and develop skills to solve related problems
- Develop technical, soft, team skills to cater to the needs of the industry / academia / businesses / research / organizations in the core aspects of Automation, Digitalization

The students may undergo Industrial training for a period as specified in the Curriculum during summer/winter vacation. In this case the training has to be undergone continuously for the entire period.

In lieu of Industrial training, students may undergo Internship at Industry / Research organizations / University (after due approval from Head of the Department) during the IV, V or VI semester breaks for a continuous period of 30 days to an Industry / Organization / University and two credit is allotted in the Seventh semester based on a viva voce examination. The Industrial / Practical Training, Summer Project, Internship, shall carry 100 marks and shall be evaluated through internal assessment only.

At the end of Industrial/Practical Training/Internship/ Summer Project, the student shall submit an attendance certificate from the organization where he / she has undergone training and a brief report. The evaluation will be made based on this report and a viva-voce Examination, conducted internally by a three member departmental committee constituted by the Head of the Institution consisting of the course coordinator and two experts from the Department. The certificates

(issued by the organization) submitted by the students shall be attached to the mark list sent by the Head of the Institution to the Controller of Examinations.

EVALUATION:

Internship Report (40)	Presentation (30)	Viva Voce (30)	Total Marks (100)

Number of days : 30

COURSE OUTCOMES:

On completion of the course, the student will know about

- Industry Practices, Processes, Techniques, technology, automation and other core aspects of software industry
- Analyze, Design solutions to complex business problems
- Build and deploy solutions for target platform
- Preparation of Technical reports and presentation.
- Ability to acknowledge the value of continuing education for oneself and to stay up with technology advancements.

Mapping of CO with PO/PSO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	1	3	1	1	1	2	2	2	2	1	3
CO2	3	3	3	2	3	1	1	1	1	2	2	2	1	2
CO3	2	2	3	2	3	2	1	1	1	2	2	2	1	3
CO4	1	1	1	1	2	-	-	2	3	2	2	1	-	1
CO5	1	1	1	1	2	1	1	1	2	1	3	1	1	2
AVG	1.8	1.8	2	1.4	2.6	1.25	1	1.2	1.8	1.8	2.2	1.6	1	2.2

JEE2831	PROJECT WORK	L	T	P	C
		0	0	20	10

COURSE OBJECTIVES:

- To develop the ability to solve a specific problem related to their subject expertise.
- To develop the methodology to solve the identified problem.
- To design, analyze and implement the chosen problem using the hardware components.
- To validate the simulation, hardware results with the theoretical results.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

METHOD OF EVALUATION:

The students in a group of 3 to 4 work on a topic approved by the Head of the Department under the guidance of a faculty member, prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee is constituted by the Head of the Department. The project work is evaluated based on oral presentation and the project report, jointly by external and internal examiners.

PROJECT EVALUATION

ZEROTH REVIEW

Novelty/Problem Identification & Objectives (20)	Literature survey (30)	Methodology (10)	Guide (20)	PowerPoint Presentation (20)			Total (100)
				BL (5)	CS (5)	CP (10)	

FIRST REVIEW

Implementation of Methodology (20)	Design/ Analysis/ Testing/ Algorithm/Model (30)	Inferences (10)	Guide (20)	Power Point Presentation (20)			Total (100)
				BL (5)	CS (5)	CP (10)	

SECOND REVIEW

Progress (20)	Results (30)	Preparation of Conference Paper (10)	Guide (20)	Power Point Presentation (20)			Total (100)
				BL (5)	CS (5)	CP (10)	

THIRD REVIEW

Results & Discussions (30)	Conclusions (20)	Publications (10)	Guide (20)	Power Point Presentation (20)			Total (100)
				BL (5)	CS (5)	CPS (10)	

BL - Body Language, CS-Communication Skills, CP-Content of Presentation

TOTAL: 300 PERIODS

END SEMESTER EXAM

Project report (External Only) (30)	Result/Demonstration (30)		Power Point Presentation (20)		Viva (External Only) (20)	Total (100)
	Internal	External	Internal	External		

COURSE OUTCOMES:

On Completion of the project work, the student will be able to

- Apply the technical knowledge acquired for solving real world problems.
- Develop skills such as self-learning, critical thinking, problem solving, project management and finance.
- Apply modern tools and techniques for implementing the project.
- Work with team mates and collectively work towards the success of the project.
- Communicate effectively to present the outcomes of the project both in written and oral forms.

Mapping of CO with PO/PSO

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	2	3	3	3	3	3	3	3
CO2	3	3	3	3	3	2	2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	2	2	3	3	3	3	3	3	3
CO4	3	3	3	3	3	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	3	3	3	3	3	3	3
AVG	3	3	3	3	3	2	2	3	3	3	3	3	3	3

Vertical I- Renewable Energy Systems

JEE2001	POWER SEMICONDUCTOR DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts related to power switches and their requirements.
- To know about the developments and characteristics of Silicon Carbide (SiC) and Gallium Nitride (GaN) devices.
- To understand the working, steady state, and switching characteristics of current-controlled and voltage-controlled silicon devices.
- To study the working of driving circuits, and protection circuits for power devices.
- To understand the thermal characteristics of power devices and the ability to design heat sinks for the power devices.

Pre-Requisites: Basic Engineering

UNIT I INTRODUCTION **9**

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Power diodes – Types, forward and reverse characteristics, switching characteristics – rating. Features and Brief History of Silicon Carbide- Promise and Demonstration of SiC Power Devices- Physical Properties of Silicon Carbide devices–Unipolar and Bipolar Diodes- GaN Technology Overview

UNIT II CURRENT CONTROLLED DEVICES **9**

BJT's Construction, static characteristics, switching characteristics; Negative temperature coefficient and second breakdown; - Thyristors – Construction, working, static and transient characteristics, types, series, and parallel operation; comparison of BJT and Thyristor – steady state and dynamic models of BJT & Thyristor- Basics of GTO, SiC-based Bipolar devices-Applications- Building a GaN Transistor –GaN Transistor Electrical Characteristics

UNIT III VOLTAGE CONTROLLED DEVICES **9**

Power MOSFETs and IGBTs – Principle of voltage-controlled devices, construction, types, static and switching characteristics, steady-state and dynamic models of MOSFET and IGBTs – and IGCT. New semiconductor materials for devices – Intelligent power modules- the study of modules like APTGT100TL170G, MSCSM70TAM05TPAG. Integrated gate commutated thyristor (IGCT) SiC-based unipolar devices-applications

UNIT IV DEVICE SELECTION, DRIVING AND PROTECTING CIRCUITS 9

Device selection strategy – On-state and switching losses – EMI due to switching . Necessity of isolation, pulse transformer, optocoupler – Gate drive integrated circuit: Study of Driver IC – IRS2110/2113. SCR, MOSFET, IGBTs, and base driving for power BJT. – Over voltage, overcurrent and gate protections; Design of snubbers

UNIT V THERMAL PROTECTION 9

Heat transfer – conduction, convection, and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for heat sink selection – Thermal resistance and impedance –Electrical analogy of thermal components, heat sink types, and design – Mounting types- switching loss calculation for power device

Total: 45 Periods

Course Outcomes: At the end of the course, the student will be able to

- Identification of a suitable device for the application.
- Know the advantages of Silicon Carbide devices and Gallium Nitride devices.
- Understand the principles and characteristics of Silicon devices, Silicon Carbide devices, and Gallium Nitride devices.
- Design proper driving circuits and protection circuits.
- Construct proper thermal protective devices for power semiconductor devices.

TEXT BOOKS:

1. Rashid M.H., “Power Electronics Circuits, Devices and Applications”,Fourth Edition, Pearson, 2021.

2. Tsunenobu Kimoto and James A. Cooper, “Fundamentals of Silicon Carbide Technology: Growth, Characterization, Devices, and Applications”, First Edition., 2014

3. Ned Mohan, T.M.Undel and, W.P.Robbins, “Power Electronics: Converters, applications, and design”, Third Edition (reprint), John Wiley and Sons, 2009

REFERENCE BOOKS:

1. Mohan, Undel and Robins, “Power Electronics: Converters Applications and Design”, Third Edition, Wiley Media Enhanced, 2007

2. Alex Lidow, Johan Strydom, Michael de Rooij, David Reusch, “GaN Transistors for efficient power conversion”, Second Edition, Wiley, 2015

3. Biswanath Paul, “Power Electronics”, Universities Press 2019

WEB SITE REFERENCES:

1. https://onlinecourses.nptel.ac.in/
2. https://youtu.be/djbJm-xWo2w?list=PLgwJf8NK-2e4B9bchhZBBvsoEEhCQfQ4k
3. https://youtu.be/KTzQgAFTbCY
4. https://youtu.be/WWjldCmRteg
5. https://youtu.be/pkIxCmaxWFg

CO-PO&PSO MAPPING:

CO\PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	-	-	-	-	-	-	-	3	3	3
AVG	3	3	3	3	-	-	-	-	-	-	-	3	3	3

JEE2002 FORMS OF ENERGY AND ENERGY CRISIS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the various forms of energy
- To get an idea about demand and energy consumption
- To understand various energy resources
- To get an insight into the energy crisis and energy conservation practice
- To get the knowledge of fundamental energy calculation.

UNIT I FORMS OF ENERGY 9

Introduction – various forms of energy – thermal, sound, light electrical, magnetic, chemical, nuclear, mechanical, Elastic, Gravitational energy, Types of energy sources – Renewable – Non – Renewable sources

UNIT II ENERGY CONSUMPTION AND DEMAND 9

Energy consumption – energy consumption (per capita) and economic growth Global energy consumption – Energy demand – primary energy demand and cumulative energy demand

UNIT III ENERGY RESOURCES 9

Energy routes for non-renewable energy resources – age of renewables and alternatives Energy developments – energy requirements and future prospects

UNIT IV ENERGY CRISIS ITS CAUSES AND SOLUTIONS 9

Introduction: Causes of energy crisis: Over consumption, over population, infrastructure Unexplored Renewable Energy Options – Commissioning of Power Plants Moving toward renewable energy sources – energy conservation practices Technology up gradation and strategies to meet energy requirements

UNIT V SITE ANALYSIS: FUNDAMENTAL ENERGY CALCULATIONS AND WORKPLACE SAFETY 9

Energy calculations: units and conversion dimensional equations – Joules, kWh/units Energy crisis: Global scenario – Energy crisis of developing countries – Report Energy storage various energy storage systems and Energy savings – Comparative study of power consumption in electrical appliances Basic First aid & Safety at workplace

Total: 45 Periods

Course Outcomes: At the end of the course, the student will be able to

- Pertain knowledge of the various forms of energy
- Insight into demand and energy consumption
- Acquire Knowledge of various energy resources
- Get an insight into the energy crisis and energy conservation practice
- Work with the fundamental energy calculation.

TEXT BOOKS:

1. Rao. S and Parulakar. B, “Energy Technology”, New Delhi: Khanna Publishers, 1997

2. Sastri .M, “Energy Sources, resources and options”**,** Mumbai: Himalaya Publishing House,1994

REFERENCE BOOKS:

1. Thipse. S.S. “Non- Conventional and Renewable energy sources” , New Delhi: Narosa Publishing.

WEB SITE REFERENCE:

1. https://onlinecourses.nptel.ac.in/

CO-PO&PSO MAPPING:

CO\PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	-	-	3	2	2
CO2	3	3	3	2	-	-	-	-	-	-	-	3	2	2
CO3	3	3	3	2	-	-	-	-	-	-	-	3	2	2
CO4	3	3	3	2	-	-	-	-	-	-	-	3	2	2
CO5	3	3	3	2	-	-	-	-	-	-	-	3	2	2
AVG	3	3	3	2	-	-	-	-	-	-	-	3	2	2

JEE2003 SOLAR AND ENERGY STORAGE SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To describe the characteristics of solar radiation, semiconductor materials, and photovoltaic cell operation.
- To explain the design principles and components of stand-alone photovoltaic systems.
- To illustrate the operation, performance, safety, and economic aspects of grid-connected photovoltaic systems.
- To develop an understanding of energy storage technologies used in photovoltaic applications.
- To evaluate photovoltaic system applications in domestic, industrial, transportation, and communication sectors.

Pre-Requisites: Basic Engineering, Power Semiconductor Devices

UNIT I INTRODUCTION TO PHOTOVOLTAIC SYSTEM 9

Characteristics of sunlight – semiconductors and P-N junctions – the behaviour of solar cells – cell properties – PV cell interconnection.

UNIT II STAND-ALONE PV SYSTEM 9

Solar modules – storage systems – power conditioning and regulation - MPPT- protection – stand-alone PV systems design – sizing.

UNIT III GRID-CONNECTED PV SYSTEMS 9

PV systems in buildings – design issues for central power stations – safety – Economic aspect –Efficiency and performance - International PV programs.

UNIT IV ENERGY STORAGE SYSTEMS 9

Impact of intermittent generation – Battery energy storage – solar thermal energy storage – pumped hydroelectric energy storage.

UNIT V APPLICATIONS 9

Water pumping – battery chargers – solar car – direct-drive applications – Space – Telecommunications.

Total: 45 Periods

COURSE OUTCOMES: At the end of the course, the student will be able to

- Explain the characteristics of sunlight, photovoltaic cell operation, semiconductor behavior, and PV cell interconnections.
- Apply design principles, sizing methods, MPPT techniques, and protection schemes for stand-alone photovoltaic systems.
- Analyze grid-connected photovoltaic systems with respect to performance, efficiency, safety requirements, and economic considerations.
- Analyze the role of battery, solar thermal, and pumped hydro storage systems in renewable energy integration.
- Assess the suitability of photovoltaic systems for water pumping, battery charging, solar vehicles, direct-drive systems, space, and telecommunication applications.

TEXT BOOKS:

1. Solanki C.S., “Solar Photovoltaics: Fundamentals, Technologies and Applications”, PHI Learning Pvt. Ltd., 2015.
2. Chetan Sigh Solanki, “Energy Swaraj My Experiment with Solar Truth”, Notion Press, 2019.
3. Eduardo Lorenzo G. Araujo, “Solar electricity engineering of photovoltaic systems”, Progensa, 1994.
4. Frank S. Barnes & Jonah G. Levine, “Large Energy Storage Systems Handbook”, CRC Press, 2011.

REFERENCE BOOKS:

1. McNeils, Frenkel, Desai, “Solar & Wind Energy Technologies”, Wiley Eastern, 1990
2. S.P. Sukhumi, “Solar Energy”, Tata McGraw Hill, 1987.

WEB SITE REFERENCES:

1. https://swayam.gov.in/
2. https://www.coursera.org/
3. https://youtu.be/so3XT69Q4eo
4. https://youtu.be/iZyzvDj6Y3c

CO-PO&PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	3	1	1	1	1	-	1	2	2	1
CO2	3	3	2	3	3	1	1	1	1	-	1	2	2	2
CO3	3	3	2	3	3	1	1	1	1	-	1	3	3	2
CO4	3	3	2	3	3	1	1	1	1	-	1	3	3	3
CO5	3	3	2	3	3	1	1	1	1	-	1	3	3	3
AVG	3.0	2.8	1.8	2.8	3.0	1.0	1.0	1.0	1.0	-	1.0	2.6	2.6	2.2

JEE2004 SOLAR POWER PLANT DESIGNING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To assess the solar power plant needs.
- To gain simulation experience in designing solar power plants.
- To gain Hands on Experience in designing solar power plants.
- To gain knowledge on safety measures for working in a Solar power plant.
- To gain the knowledge in design of foundation.

Pre-Requisites: Basic Engineering

UNIT I STRUCTURAL DESIGN OF SOLAR PV POWER PLANT 9

Basics of electricity and the structure of the electricity supply system Alternating currents - AC Generator - AC Power –Three-phase Ac generation and distribution Electrical power system components: Substations and transformers –Overhead lines and underground cables – Faults, circuit breakers, fuses and electrical protection Study of site survey and soil test reports Design and documentation: Plant Infrastructure - overall plant layout - solar module mounting and other components - switchyard and power transmission system

UNIT II ELECTRICAL DESIGN OF SOLAR PV POWER PLANT AND THE ENERGY SIMULATION 9

Design the capacity of solar power plant. Design and selection of solar modules Selection of other components: Inverters, Strings, Combiner boxes, switchgear, batteries, and Inverters

UNIT III ENERGY SIMULATION OF ROOFTOP OFF-GRID SOLAR PV POWER PLANT 9

Design of combiner boxes, switchgear, batteries, and Inverters Energy simulation report for the design of combiner boxes, and switchgear. Energy simulation report for the design of batteries and Inverters

UNIT IV PERSONAL HEALTH & SAFETY AT SOLAR PV PROJECT SITE 9

Establish and Follow safe work procedures - Use and maintain personal protective equipment Identify and mitigate safety hazards - Demonstrate safe and proper use of required tools and equipment Identify work safety procedures and instructions for working at height

UNIT V DESIGN OF FOUNDATION FOR OTHER COMPONENTS 9

Design plan for Earthing pits, lightning arrestor foundation, Design of Street light foundation, and switchyard - Design of power transmission system and structure of the transmission tower, Design of mounting structures for Rooftop

Total: 45 Periods

Course Outcomes: At the end of the course, the student will be able to

- Assess the solar power plant needs.
- Simulate the designing solar power plants.
- Experience in designing solar power plants.
- Ensure the safety measures for working in a solar power plant.
- Design of foundation.

TEXT BOOKS:

1. Solanki C.S, "Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers", Delhi, PHI Learning Private Limited, 2013
2. Michael Boxwell, "The Solar Electricity Handbook: A Simple, Practical Guide to Solar Energy: How to Design and Install Photovoltaic Solar Electric Systems", UK, Green Stream Publishing Limited, 2016

REFERENCE BOOKS:

1. Solanki C.S, "Solar Photovoltaics - Fundamentals, Technologies and Applications" , PHI Learning Private Limited, 2015
2. Kapur A S., "Practical Guide for Total Engineering of MW capacity Solar PV Power Project" White Falcon Publishing, 2016

WEB SITE REFERENCES:

1. https://swayam.gov.in/
2. https://www.coursera.org/

CO-PO&PSO MAPPING:

CO\PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	-	-	-	-	-	-	3	3	2
CO2	3	3	2	3	3	-	-	-	-	-	-	3	3	2
CO3	3	3	2	3	3	-	-	-	-	-	-	3	3	2
CO4	3	3	2	3	3	-	-	-	-	-	-	3	3	2
CO5	3	3	2	2	2	-	-	-	-	-	-	3	3	2
AVG	3	3	2	2.8	2.8	-	-	-	-	-	-	3	3	2

JEE2005 SOFTWARE TOOLS FOR ENERGY ANALYSIS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To inculcate knowledge of the overview solar software
- To illustrate the concepts of Solar PVsyst
- To learn about the PVsyst demonstration
- To impart knowledge on Solar RETSCREEN software.
- To impart knowledge in application of PVsyst.

Pre-Requisites: Basic Engineering, Power Semiconductor Devices

UNIT I OVERVIEW 9

Overview of effective tools for energy systems Analysis Of Software Parameters - PVSYST, RETScreen.

UNIT II PVSYST DEMONSTRATION 9

Demonstration of the software to study the sizing, simulation and data analysis of the PVsystems Preliminary design , Project Design and economic evaluation of the PV systems.

UNIT III PVSYST STAND ALONE SYSTEM 9

Arranging of PV panel on rooftop, Analysis of stand-alone system, shadow analysis.

UNIT IV RET SCREEN 9

Identification , assessment and optimization of the technical viability of potential clean energy projects. Measurement and verification of actual energy performance Evaluation of additional energy savings /production opportunities.

UNIT V APPLICATIONS 9

Analysis of solar array electrical behavior using software, Simulation of panel installation in building using software, Real-time analysis of power generation using software, Economic evaluation – 'Return on investment study

Total: 45 Periods

Course Outcomes: At the end of the course, the student will be able to

- Design flatness-based control for power converters. To inculcate knowledge of the overview solar software
- Incorporate the concepts of Solar in PVsyst software
- Work with the PVsyst demonstration software.
- Work with Solar RETSCREEN software.
- Expose knowledge in various PVsyst applications.

TEXT BOOKS:

1. "Step by Step Guide to Solar Simulation Software PVsyst: Practical Approach to Solar Simulation", 2021

2. Solanki C.S., "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Pvt. Ltd.,2015.

3. Chetan Sigh Solanki, "Energy Swaraj My Experiment with Solar Truth", Notion Press, 2019.

REFERENCE BOOKS:

1. Help in PVsyst software

WEB SITE REFERENCES:

1. https://youtube.com

CO-PO&PSO MAPPING:

CO\PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO3
CO1	2	2	2	2	-	-	-	-	-	-	-	2	2	2
CO2	2	3	3	3	-	-	-	-	-	-	-	2	2	2
CO3	2	3	3	2	-	-	-	-	-	-	-	2	2	2
CO4	2	3	3	3	-	-	-	-	-	-	-	2	2	2
CO5	2	3	3	3	-	-	-	-	-	-	-	2	2	2
AVG	2	2.8	2.8	2.6	-	-	-	-	-	-	-	2	2	2

JEE2006 WIND ENERGY CONVERSION SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn about the basic concepts of wind energy conversion system
- To learn the design and control principles of Wind turbines.
- To study the concepts of fixed-speed wind energy conversion systems.
- To study the concepts of variable speed wind energy conversion systems.
- To familiarize with various grid integration issues.

Pre-Requisites: Basic Engineering, Power Semiconductor Devices

UNIT I INTRODUCTION TO WIND ENERGY CONVERSION SYSTEMS 9

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory Power coefficient- Sabinin's Theory-Aerodynamics of Wind turbine.

UNIT II WIND TURBINES 9

HAWT - VAWT - Power Developed – Thrust – Efficiency -Rotor Selection-Rotor design considerations Tip speed ratio-Blade profile-Power Regulation-yaw control-Pitch angle control stall control-Schemes for maximum power extraction.

UNIT III FIXED SPEED SYSTEMS **9**

Generating Systems - Constant speed constant frequency systems - Choice of Generators Deciding Factors- Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed - Model wind turbine rotor - Drive Train model- Generator model for Steady-state and Transient stability analysis.

UNIT IV VARIABLE SPEED SYSTEMS **9**

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modeling - Variable speed variable frequency schemes.

UNIT V GRID CONNECTED SYSTEMS **9**

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices, and industry trends wind interconnection impact on the steady-state and dynamic performance of the power system including modeling issues.

Total: 45 Periods

Course Outcomes: At the end of the course, the student will be able to

- Acquire knowledge of the basic concepts of Wind energy conversion systems.
- Analyze the mathematical modeling and control of the Wind turbine.
- Design and develop fixed speed wind energy conversion systems.
- Design and develop Variable speed wind energy conversion systems.
- Analyze various Grid integration issues and current practices of wind interconnections with power systems.

TEXT BOOKS:

1. S.N.Bhadra, D.Kastha, S.Banerjee–"Wind Electrical Systems", Oxford University Press , 2013.
2. L.L.Freris "Wind Energy Conversion Systems", Prentice Hall, 1990.
3. Muhammed Kamran, Muhammed Rayyan Fazal, "Renewable Energy Conversion System", Elsevier Science, 2021.
4. Ion Boldea, "Variable speed generators", Taylor & Francis Group, 2006.

5. E.W. Golding "The generation of Electricity by wind power", Redwood burns Ltd.,Trowbridge,1976.

REFERENCE BOOKS:

1. N. Jenkins," Wind Energy Technology" John Wiley & Sons, 1997
2. S.Heir "Grid Integration of WECS", Wiley 1998.

WEB SITE REFERENCES:

1. https://swayam.gov.in/
2. https://www.coursera.org/

CO-PO&PSO MAPPING:

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CO3	3	-	2	-	-	-	-	-	-	-	-	3	3	3
CO4	3	-	3	-	-	-	-	-	-	-	-	3	3	3
CO5	3	3	2	-	-	-	-	-	-	-	-	3	3	3
AVG	3	3	2.2	-	-	-	-	-	-	-	-	3	3	3

JEE2007 ENERGY CONVERSION TECHNIQUES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To analyze the conventional energy conversion techniques.
- To develop an understanding of direct energy conversion systems.
- To familiarize the concepts of electrochemical and hydrogen generation systems.
- To infer the need and necessity of energy storage systems and their desirable.
- To gain knowledge in practical case studies in energy conversion systems.

Pre-Requisites: Basic Engineering

UNIT I INTRODUCTION 9

Introduction – energy conversion –conventional techniques. Reversible and irreversible cycles.

UNIT II DIRECT CONVERSION OF THERMAL TO ELECTRICAL ENERGY 9

Thermoelectric converters – thermoelectric refrigerator – thermoelectric generator– Thermionic converters – Ferro electric converter – Nernst effect generator – thermomagnetic converter.

UNIT III CHEMICAL, ELECTROCHEMICAL ENERGY AND HYDROGEN ENERGY GENERATION 9

Batteries – types – working – performance governing parameter– Dye sensitized solar cells - Quantum dots sensitized solar cells – Photo catalysis – Photo electro catalysis–Photo bio synthesis–Bio reactors- Water splitting–Hydrogen generation

UNIT IV ENERGY STORAGE SYSTEMS 9

Introduction – storage of mechanical energy, electrical energy, chemical energy thermal energy. Electro chemical energy storage – super capacitor- pseudo capacitor- ultra capacitor.

UNIT V CASE STUDY 9

Types of batteries- Chemical Energy to Electrical Energy - Conversion of Solar Energy to Heat Energy- Solar Water heater - Conversion of Solar Energy to Electrical Energy-Solar Water pump

Total: 45 Periods

Course Outcomes: At the end of the course, the student will be able to

- Analyze the conventional energy conversion techniques.
- Develop an understanding of direct energy conversion systems.
- Analyzing the concepts of electrochemical and hydrogen generation systems.
- Assess the need and necessity of energy storage systems
- Apply knowledge gained from case studies to evaluate the performance of energy conversion systems.

TEXT BOOKS:

1. Archie.W.Culp. “Principles of Energy Conversion”, McGraw-Hill Inc., 1991,

2. Kordesch. K. and Simader.G. “Fuel Cell and Their Applications”, Germany: Wiley-Vch, 1996

REFERENCE BOOKS:

1. Kettari, M.A. “Direct Energy Conversion” , Addison-Wesley Pub. Co. 1997

2. Hart A.B and Womack. G.J. “Fuel Cells: Theory and Application”, London: Prentice Hall,

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1. https://swayam.gov.in/
2. https://www.coursera.org/

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CO3	3	3	2	3	1	1	1	1	-	1	3	3	2	3
CO4	3	3	3	3	1	1	1	1	-	1	3	3	3	3
CO5	3	3	2	3	1	1	1	1	-	1	3	3	3	3
AVG	3	3	2.2	2.8	1.0	1.0	1.0	1.0	-	1.0	2.6	2.6	2.2	2.8

JEE2008 ENERGY ECONOMICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To develop in the students an awareness of the basic issues and problems relating to Energy Economics.
- To develop knowledge of sustainable energy
- To help in critically analyzing the energy market in the Indian context
- To develop knowledge of energy policies.
- To develop knowledge of energy management systems.

UNIT I INTRODUCTION TO MICRO ECONOMICS CONCEPTS 9

Supply and Demand – Applying supply and demand - elasticity Consumer theory –Preference and utility- Budget Constraints- Deriving Demand C Curve C Producer Theory – Productivity and costs

UNIT II INTRODUCTION TO SUSTAINABLE ENERGY 9

Historical Context – post-industrialization- growth of the developed countries and growing energy needs of less developed countries Overview of energy use and related issues Global climate change issues and responses – Greenhouse gas emissions and potential effects – effect on ecology and biodiversity- Responses to CO build up– Mitigation – Policy – Carbon tax- Command and Control Sustainability, energy, and clean technologies – Sustainability attributes-population and consumption growth

UNIT III ENERGY DECISION, MARKETS 9

Natural Gas – Introduction to Natural gas markets- Future Electricity, Coal, Renewable Energy, Nuclear power – Prospects and Future

.

UNIT IV ENERGY POLICIES 9

Future of global energy, Climate Change - Understanding public complacency Energy supply and economics of deflectable resources, Energy Security – Clean Energy – Energy paradox Pollution Control Public Policies- Indian Environmental Policies – Social Movements – energy efficiency policies – renewable energy policies – Regulations- Emission trading

UNIT V ENERGY MANAGEMENT & CASE STUDY 9

Energy use by individuals and households – energy calculator – energy consumption , Industry Power management.

Total: 45 Periods

Course Outcomes: At the end of the course, the student will be able to

- Pertain the basic issues and problems relating to Energy Economics.
- Incorporate the concept of sustainable energy
- Analyzing the energy market in the Indian context
- Analyze the various energy policies.
- Working in any energy management systems.

TEXT BOOKS:

1. Banks F.E. “Energy Economics: A Modern Introduction ” , Kluwer Academic Publishers Dordrecht 2000.
2. Griffin J.M. and H.B. Steele. “ Energy Economics and Policy”, Academic, Orlando, 1986
3. Hussen. Ahmed.M. “Principles of Environmental Economics: Economics, Ecology and Public Sector”, London: Routledge.1999.

REFERENCE BOOKS:

1. Kolestad. Charles D. “Environmental Economics” , New York: Oxford University Press. 2000.
2. Singh, Katar. And Shishodia. Anil. “Environmental Economics: An Indian Perspectives”, New Delhi: Oxford University Press. 2007

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2. https://www.tutorialspoint.com
3. https://youtu.be/ZbvWe9xBu3Q?list=PLp6ek2hDcoND7i5-DAD9mPmYF1Wg6ROdO
4. https://youtu.be/EEETzABZ8Sc

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CO3	3	-	2	-	-	-	-	-	-	1	-	2	2	-
CO4	3	-	3	-	-	-	-	-	-	1	-	2	2	-
CO5	3	3	2	-	-	-	-	-	-	1	-	2	2	-
AVG	3	3	2.2	-	-	-	-	-	-	1	-	2	2	-

Vertical II - EMBEDDED SYSTEMS

JEE2009	EMBEDDED SYSTEM FRAMEWORK	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the architecture, components, memory organization, and basic concepts of embedded systems.
- To outline the various communication interfaces and networking protocols used in embedded systems.
- To explain firmware development methodologies, embedded product development life cycle, and modelling techniques.
- To illustrate the concepts of Real-Time Operating Systems (RTOS), task scheduling, and inter-process communication mechanisms.
- To develop embedded system solutions for real-time and industrial applications using appropriate hardware and software design approaches.

PRE REQUISITE:

- Digital Logic Circuits, Microprocessor and microcontroller

UNIT I BASICS OF EMBEDDED SYSTEMS **9** History of embedded systems, Classification of embedded systems based on generation and complexity – Structural Units in Embedded processor, Selection of processor & memory devices – DMA– Memory management methods – Timer and Counting devices, Watch dog Timer, Real Time Clock, Target Hardware Debugging.
UNIT II EMBEDDED NETWORKING **9** Embedded Networking: Introduction, I/O Device Ports & Buses – Serial Bus communication protocols RS232 standard–RS422–RS485-USB bus-CAN Bus-Serial Peripheral Interface (SPI)–Inter Integrated Circuits (I2C) – Blue tooth, Wi-Fi, ZigBee, GPRS, GSM.
UNIT III EMBEDDED FIRM WARE DEVELOPMENT ENVIRONMENT **9** Embedded firmware design approaches –super loop-based approach – Embedded Product Development Life Cycle-objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co- design, Data Flow Graph, State machine model, Sequential Program Model, Concurrent Model, Object oriented Model.

UNIT IV RTOS BASED EMBEDDED SYSTEM DESIGN 9
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multitasking and Multithreaded system, Preemptive and non –preemptive scheduling, Task communication: shared memory-message passing-Inter process Communication– synchronization between processes- Semaphores, Mailbox, Pipes, priority inversion, priority in heritance.
UNIT V EMBEDDED SYSTEM APPLICATION AND DEVELOPMENT 9
Case Study of Washing Machine – Automotive Application – Air pollution detector – Smart card System Application-Digital camera

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Explain the architecture, memory organization, and hardware components of embedded systems.
- Demonstrate the use of embedded communication interfaces and networking protocols for data communication.
- Analyze embedded firmware development methodologies, modelling techniques, and hardware-software co-design issues.
- Differentiate RTOS scheduling mechanisms, task communication methods, and synchronization techniques used in embedded systems.
- Design embedded system solutions for real-world applications such as automotive systems, smart cards, digital cameras, and home appliances.

TEXT BOOKS:

1. Iqbal Hussain, "Electric and Hybrid Vehicles-Design Fundamentals", Third Edition, CRC Press, 2021

2. Mehrdad Ehsani, Yimin Gao, and Ali Emadi, "Modern Electric, Hybrid and Fuel Cell Vehicles: Fundamentals, CRC Press,2019.

REFERENCES:

1. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2015.
2. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2012.
3. Chris Mi, MA Masrur, and D W Gao, "Hybrid Electric Vehicles- Principles and Applications with Practical Perspectives”, Wiley,2017.

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2. **https://youtu.be/v071sCp-xrs**
3. **https://youtu.be/47U1g4ChVkM**

4. **https://youtu.be/GFpEXekI-BM**
5. **https://youtu.be/Blo9vyV_QDE**
6. **https://youtu.be/LDRq-odYAbA**

Mapping of CO with PO/PSO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	2	2	1	1	2	2	0	1	2	2	0
CO2	1	1	1	2	2	1	1	3	3	0	1	3	3	1
CO3	2	2	2	3	2	2	1	3	3	0	1	3	3	1
CO4	2	2	2	3	2	2	1	3	3	0	1	3	3	2
CO5	2	2	2	3	3	2	1	3	3	0	1	3	3	2
Avg.	1.6	1.6	1.6	2.6	2.2	1.6	1	2.8	2.8	0	1	2.8	2.8	1.5

JEE2010	ARM PROCESSORS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the architecture of the ARM Cortex A35 processor.
- To discuss memory management and train students in ARM Cortex A35 programming.
- To learn about the ARM peripherals and their interfacing methods.
- To involve and familiarize the communication concepts.
- To impart the knowledge on Raspberry Pi.

PRE REQUISITE:

- Digital Logic Circuits, Microprocessor and microcontroller

UNIT I ARM Cortex-A35 PROCESSOR FUNDAMENTALS	**9**
Introduction to ARM -Key features- ARM Cortex-A35 processor-Architecture – instruction set, pipeline architecture, and memory system-Instruction Set Architecture (ISA)- Different Instruction formats and Addressing Modes	
UNIT II ARM Cortex-A35 PROGRAMMING	**9**
Memory System-memory hierarchy-different levels of cache- Memory management unit (MMU) and virtual memory support- Power Management-Basic programming.	
UNIT III ARM PERIPHERALS & INTERFACING	**9**
System integration features- – I/O Ports – Interrupt handling; standard and vector control - Timers – Serial Communication with PC – ADC/DAC Interfacing-Stepper motor interfacing	
UNIT IV ARM COMMUNICATION & SOFTWARE TOOLS	**9**
ARM communication protocols-Types-UART, USART, USB- I2C, SPI and CAN-Software development tools and environments- Keil MDK-Debug Probes and Adapters - C/C++ Compilers for Arm.	
UNIT V RASPBERRY PI	**9**
Introduction to Raspberry Pi- Different Models – SoC architecture- Pin Description-On-board components-Peripherals- Communication using RPi-Applications.	

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Interpret the basics and functionality of ARM Cortex A35 processor functional blocks.
- Observe the specialty of Memory management and programming.
- Incorporate the I/O hardware interface of processor with peripherals.
- Emphases the communication features of the processor.
- Enhance knowledge up gradation on the Raspberry Pi.

TEXT BOOKS:

1. Muhammad Tahir, Kasif Javed, "ARM Microprocessor Systems, Cortex- M Architecture, Programmingand Interfacing", 1st Edition, CRC Press,2017.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield's, "ARM System Developer's Guide Designing and Optimizing System Software"', Elsevier, 1st Edition, 2004.
3. Joseph Yiu ,"The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors" 3rd Edition, Newnes Publishers, October 2013.

REFERENCES:

4. Steve Furber, Addisonn, "ARM system on chip architecture", Wesley,2nd Edition,2015.
5. Larry D. Pyeatt, "modern assembly language programming with the arm processor", Newnes, 2016.
6. Andrew sloss, Chris Wright, Dominic Symes " ARM System Developer's Guide: Designingand Optimizing System Software", 1st Edition**,** Publisher: Morgan Kaufmann Publishers, 2011.
7. William Hohl, "ARM Assembly Language Fundamentals and Techniques", CRC Press, 2ndEdition 2014.

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2. https://onlinecourses.nptel.ac.in/noc20_cs15/preview
3.https://www.csie.ntu.edu.tw/~cyy/courses/assembly/12fall/lectures/handouts/lec0 8_ARMarch.pdf
4. https://maxembedded.com/2013/07/introduction-to-single-board-computing/
5. https://www.youtube.com/watch?v=J4fhE4Pp55E&list=PLGs0VKk2DiYypuwUUM2wxzc I9B

Mapping of CO with PO/PSO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	2	1	2	1	1	1	-	-	-	-	1	2	2	1
CO3	1	2	2	2	2	1	-	-	-	-	1	2	2	2
CO4	2	2	1	2	2	1	-	-	-	-	1	2	2	2
CO5	2	2	1	2	1	1	-	-	-	-	1	2	1	1
Avg.	1.6	1.8	1.4	1.8	1.6	1.2	-	-	-	-	1	2	1.8	1.6

JEE2011	SOFTWARE FOR EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals of embedded Programming
- To Introduce the GNU C Programming Tool Chain in Linux.
- To study the basic concepts of embedded C.
- To teach the basics of Java technology for embedded systems
- To involve Discussions/ Practice onto the concepts in Android framework

PRE REQUISITE:

- Digital Logic Circuits, Microprocessor and microcontroller

UNIT I BASICS OF EMBEDDED C	**9**
Typical C Program Development Environment - Introduction to C Programming - Structured Program Development in C - Data Types and Operators - C Program Control - C Functions - Introduction to Arrays.	
UNIT II PROGRAMMING IN EMBEDDED C	**9**
Adding Structure to 'C' Code: Object oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.	
UNIT III C PROGRAMMING TOOL-CHAIN IN LINUX	**9**
C preprocessor - Stages of Compilation - Introduction to GCC - Debugging with GDB - The Make utility - GNU Configure and Build System - GNU Binary utilities - Profiling - using gprof - Introduction to GNU C Library.	
UNIT IV JAVA TECHNOLOGY FOR EMBEDDED SYSTEMS	**9**
Basic concepts of Java - IO streaming – Object serialization – Networking – Threading – RMI – distributed databases — Advantages and limitations of Internet – Web architecture for embedded systems – security model for embedded systems.	
UNIT V ANDROID FRAMEWORK	**9**
Android SDK – Access to Hardware - Framework development - Peer-to-Peer communication Android security design and architecture – Case study.	

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Demonstrate C programming and its salient features for embedded systems
- Deliver insight into various programming languages/software compatible to embedded process development with improved design & programming skills.
- Develop knowledge on C programming in Linux environment.
- Possess ability to write Java programming for Embedded applications.
- Develop knowledge on android framework

TEXT BOOKS:

1. Noel Kalicharan, "Learn to Program with C", A press Inc., 2015.
2. Mattis Hayes and Isaiah Johansen, "Java Software and Embedded Systems", Computer Science, Technology and Applications, Nova, 2010
3. Adam Gerber, Clifton Craig, David Selvaraj, "Learn Android Studio Build Android Apps Quickly and Effectively", Apress, 2018.

REFERENCE BOOKS:

1. Noel Kalicharan, "Learn to Program with C", Apress Inc., 2015.
2. Martin Schoeberl , "JOP Reference Handbook: Building Embedded Systems with a Java Processor", Kindle, 2019
3. Michael Burton , "Android App Development For Dummies 3e", Wiley, March 201

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3. https://www.allaboutcircuits.com/technical-articles/introduction-to-the-c-programming language- for-embedded-applications/
4. https://onlinecourses.nptel.ac.in/noc19_cs42/preview
5. https://microcontrollerslab.com/8051-microcontroller-tutorials-c/
6. https://www.circuitstoday.com/getting-started-with-keil-uvision

Mapping of CO with PO/PSO

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CO1	2	2	1	2	2	2	-	-	-	-	2	2	2	2
CO2	2	1	2	1	1	2	-	-	-	-	2	1	2	1
CO3	2	2	2	1	2	2	-	-	-	-	1	2	2	2
CO4	2	2	1	1	2	1	-	-	-	-	2	1	2	2
CO5	2	2	1	1	1	2	-	-	-	-	2	2	2	1
Avg.	2	1.8	1.4	1.2	1.6	1.8	-	-	-	-	1.8	1.6	2	1.6

JEE2012	REAL TIME OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals of interaction of OS with a computer and User computation.
- To teach the fundamental concepts of how process are created and controlled with OS.
- To study on programming logic of modeling Process based on range of OS features
- To compare types and Functionalities in commercial OS, application development using RTOS
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the subject for improved employability skills

PRE REQUISITE:

- Digital Logic Circuits, Microprocessor and microcontroller

UNIT I REVIEW OF OPERATING SYSTEMS	**9**
Basic Principles - Operating System structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – Embedded operating systems	
UNIT II OVERVIEW OF RTOS	**9**
RTOS Task and Task state –Multithreaded Preemptive scheduler- Process Synchronization- Message queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronization problem – Deadlocks	
UNIT III REALTIME MODELS AND LANGUAGES	**9**
Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.	
UNIT IV REALTIME KERNEL	**9**
Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.	
UNIT V APPLICATION DEVELOPMENT	**9**
Discussions on Basics of Linux supportive RTOS – uCOS-C Executive for development of RTOS Application –Free RTOS -RTOS Firmware Design-Task-Queue-Interrupt Management.	

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Outline Operating System structures and types.
- Insight into scheduling, disciplining of various processes execution.
- llustrate knowledge on various RTOS support modelling.
- Demonstrate commercial RTOS Suite features to work on real time processes design.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in RTOS and embedded automation design.

TEXT BOOKS:

1. Silberschatz,Galvin,Gagne" Operating System Concepts,6th ed,John Wiley,2003
2. Charles Crowley, "Operating Systems-A Design Oriented approach" McGraw Hill,1997
3. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill,2006.

REFERENCE BOOKS:

1. Karim Yaghmour,Building Embedded Linux System",O'reilly Pub,2003
2. MukeshSighal and N G Shi "Advanced Concepts in Operating System", McGraw Hill,2000

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1. https://www.hackerrank.com/
2. https://www.cprogramming.com/
3. https://www.allaboutcircuits.com/technical-articles/introduction-to-the-c- programminglanguage- for-embedded-applications/
4. https://onlinecourses.nptel.ac.in/

Mapping of CO with PO/PSO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	2	-	-	-	-	2	2	2	2
CO2	2	2	2	2	1	2	-	-	-	-	2	2	2	1
CO3	1	1	2	2	1	2	-	-	-	-	1	1	2	2
CO4	2	2	2	2	2	2	-	-	-	-	2	2	1	2
CO5	2	2	1	1	2	2	-	-	-	-	2	2	2	1
Avg.	1.8	1.8	1.6	1.8	1.6	2	-	-	-	-	1.8	1.8	1.8	1.6

JEE2013	EMBEDDED SYSTEM NETWORKING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals of wired embedded networking techniques.
- To introduce the concepts of embedded Ethernet.
- To expose the students to the fundamentals of wireless embedded networking.
- To discuss the fundamental building blocks of digital instrumentation.
- To introduce design of Programmable measurement & control of electrical Device.

PRE REQUISITE:

- Digital Logic Circuits, Microprocessor and microcontroller

UNIT I EMBEDDED PROCESS COMMUNICATION WITH INSTRUMENT BUS 9
Embedded networking: Introduction – Cluster of instruments in System: Introduction to bus protocols – comparison of bus protocols –USB standards – embedded ethernet – MOD bus and LIN bus.
UNIT II EMBEDDED ETHERNET 9
Elements of a network – Inside Ethernet – Building a Network : Hardware options – Cables, Connections and network speed – Ethernet controllers – Inside the internet protocol – Exchanging messages using UDP and TCP – Email for Embedded systems using FTP – Keeping devices and network secure.
UNIT III WIRELESS EMBEDDED NETWORKING 9
Wireless sensor networks – Introduction – Node architecture – Network topology - Localization – Time synchronization – Energy efficient MAC protocols – SMAC – Energy efficient and robust routing – Data centric routing - WSN Applications - Home Control - Building Automation - Industrial Automation.
UNIT IV BUILDING SYSTEM AUTOMATION 9
Data acquisition system- Signal conditioning circuit design- microcontroller Based & PC based data acquisition – microcontroller for automation and protection of electrical appliances – processor based digital controllers for switching Actuators: Stepper motors, Relays .
UNIT-V COMMUNICATION FOR ELECTRICAL SYSTEM AUTOMATION 9
Data Acquisition, Monitoring, Communication, Event Processing, and Polling Principles, SCADA system principles – outage management– Decision support application - substation automation, extended control feeder automation, Performance measure and response time.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Analyze the different bus communication protocols used for embedded networking
- Explain the basic concepts of embedded networking
- Apply the embedded networking concepts in wireless networks
- Relate different data acquisition concepts
- Build a system automation for different applications

TEXT BOOKS:

1. Mohammad Ilyas And ImadMahgoub, "Handbook of sensor Networks: Compact wireless and wired sensing systems", CRC Press,2005
2. Peter W Gofton , “Understanding Serial Communication”, Sybes International, 2000

REFERENCE BOOKS:

1.Jan Axelson "Embedded Ethernet and Internet Complete", Penram publications, 2006
2. Krzysztof Iniewski,"Smart Grid ,Infrastructure& Networking”, The McGraw-Hill,2012
3. James Northcote-Green, Robert Wilson, "Control and automation of electrical power distribution systems", CRC, Taylor and Francis, 2006

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3. https://www.allaboutcircuits.com/technical-articles/introduction-to-the-c- programming language- for-embedded-applications/
4. https://onlinecourses.nptel.ac.in/noc19_cs42/preview

Mapping of CO with PO/PSO

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CO1	2	2	1	2	2	2	-	-	-	-	2	2	2	2
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CO3	-	2	2	1	2	1	-	-	-	-	1	2	2	2
CO4	1	2	1	1	2	1	-	-	-	-	2	1	1	2
CO5	1	2	1	1	1	2	-	-	-	-	1	2	2	1
Avg.	1.2	1.8	1.4	1.2	1.6	1.4	-	-	-	-	1.6	1.8	1.6	1.6

JEE2014	EMBEDDED SYSTEM SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamentals related to Cryptography and Data Security
- To teach the mathematical foundations for Cryptography.
- To impart knowledge about Embedded Cryptography and Data Protection Protocols
- To make them understand the practical aspects of Embedded System Security.
- To involve the students in Discussions/Tutorials/Programming to familiarize the concepts for improved employability skills.

PRE REQUISITE:

- Digital Logic Circuits, Microprocessor and microcontroller

UNIT I BACKGROUND AND INTRODUCTION 9
Computer and Network Security Concepts: Computer Security Concepts – The OSI Security Architecture – Security Attacks – Security Services – Security Mechanisms – Fundamentals of Security Design Principles – Attack Surfaces and Attack Trees – A Model for Network Security. Introduction to Number Theory: Divisibility and the Division Algorithm – The Euclidean Algorithm – Modular Arithmetic – Prime Numbers – Fermet's and Euler's Theorems – Testing for Primality – The Chinese Remainder Theorem – Discrete Logarithms.
UNIT II SYMMETRIC CIPHERS 9
Classical Encryption Techniques: Symmetric Cipher Model – Substitution Techniques – Transposition Techniques. Block Ciphers and the Data Encryption Standard (DES): Traditional Block Cipher Structure – The Data Encryption Standard – A DES Example – Strength of DES. Advanced Encryption Standard: Finite Field Arithmetic – AES Structure – AES Transformation Functions – AES Key Expansion – An AES Example – AES Implementation.
UNIT III EMBEDDED SYSTEMS SECURITY 9
Embedded Security Trends – Security Policies – Security Threats. System Software Considerations: The Role of Operating System – Microkernel versus Monolithic – Core Embedded OS Security Requirements – Access Control and Capabilities – Hypervisors and System Virtualization – I/O Virtualization – Remote Management – Assuring Integrity of the TCB
UNIT IV EMBEDDED CRYPTOGRAPHY AND DATA PROTECTION PROTOCOL 9
The One-time Pad – Cryptographic Modes – Block Ciphers – Authenticated Encryption – Public Key Cryptography – Key Agreement – Public Key Authentication – Elliptic Curve Cryptography – Cryptographic Hashes – Message Authentication Codes – Random Number Generation – Key Management for Embedded Systems – Cryptographic Certifications. Data Protection Protocols for Embedded Systems: Data-in-Motion Protocols – Data-at-Rest Protocols. Emerging Applications: Embedded Network Transactions – Automotive Security –Secured Android.

UNIT V PRACTICAL EMBEDDED SYSTEM SECURITY **9**

Network Communications Protocols and Built-in Security – Security Protocols and Algorithms – The Secured Socket Layer – Embedded Security – Wireless – Application- Layer and Client/Server Protocols – Choosing and Optimizing Cryptographic Algorithms for Resource-Constrained Systems – Hardware Based Security.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Explain the significance of Security.
- Understand the major concepts and techniques related to Cryptography.
- Demonstrate thorough knowledge about the aspects of Embedded System Security.
- Delivers insight onto role of Security Aspects during Data Transfer and Communication.
- Applying the Security Algorithms for Real-time Applications.

TEXT BOOKS:

1. William Stallings, “Cryptography and Network Security Principles and Practice”, 7th Edition – Global Edition, Pearson Education Limited, 2017.
2. David Kleidermacher and Mike Kleidermacher, “Embedded Systems Security - Practical Methods for Safe and Secure Software and Systems Development”, Newnes (an imprint of Elsevier), 2012.
3. Timothy Stapko, “Practical Embedded Security - Building Secure Resource-Constrained Systems”, Newnes (an imprint of Elsevier), 2008.

REFERENCE BOOKS:

1. Ashford Lee Edward, "Introduction To Embedded Systems", 2nd Edition, PHI publication, 2019.
2. James K. Peckol, "Embedded Systems: A Contemporary Design Tool" , wiley, January 2009.

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3. https://www.e3sconferences. org/articles/e3sconf/pdf/2019/13/e3sconf_SeFet2019_01004.pdf
4. https://www.electronics-tutorials.ws/blog/pulse-width-modulation.html
5. http://kaliasgoldmedal.yolasite.com/resources/SEM/SRM.pdf

Mapping of CO with PO/PSO

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CO1	2	2	1	2	2	2	-	-	-	-	2	2	2	2
CO2	1	1	2	1	1	1	-	-	-	-	2	2	2	1
CO3	2	2	2	1	2	1	-	-	-	-	2	2	2	2
CO4	1	2	2	2	2	2	-	-	-	-	2	1	1	2
CO5	2	2	1	1	1	2	-	-	-	-	2	2	2	1
Avg.	1.6	1.8	1.6	1.4	1.6	1.6	-	-	-	-	2	1.8	1.8	1.6

JEE2015	SMART SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn about the smart system technologies and its role in real time applications
- To expose students to different open-source platforms.
- To provide knowledge on Home automation systems.
- To familiarize the design of smart appliances and energy management techniques.
- To study about robots and controllers

PRE REQUISITE:

- Digital Logic Circuits, Microprocessor and microcontroller

UNIT 1 INTRODUCTION TO EMBEDDED SYSTEMS	**9**
Over view of smart system design and requirements-Hardware and software selection & co-design –Communications-smart sensors and actuators-Open-source resources for embedded system- Android 42 for embedded system-Embedded system for Ecommerce-Embedded system for Smart card design and development– Recent trend.	
UNIT 2 MOBILE EMBEDDED SYSTEM	**9**
Design requirements-Hardware platform-OS and Software development platform-Mobile Apps development – Applications: heart beat monitoring, blood pressure monitoring, mobile banking and appliances control.	
UNIT 3 HOME AUTOMATION	**9**
Home Automation System – Architecture-Essential Components-Linux and Raspberry Pi– design and real time implementation.	
UNIT 4 SMART APPLIANCES AND ENERGY MANAGEMENT	**9**
Overview-functional requirements-Embedded and Integrated Platforms for Energy Management- Energy Measurement Techniques for Smart Metering-Smart Embedded Appliances Networks– Security Considerations.	
UNIT 5 ROBOTS AND CONTROLLERS	**9**
Robots and Controllers –components-Aerial Robotics-Mobile Robot Design –Three-Servo Ant Robot-Autonomous Hexa copter System	

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Understand the concepts of smart System design and its present developments.
- Acquire knowledge on various embedded open-source platforms
- Analyze different effective techniques for developing solution for real time Applications
- Acquire knowledge on smart appliances and energy management techniques
- Understand about robots and controllers

TEXT BOOKS:

1. Thomas Bräunl, “Embedded Robotics”, Springer, 2003.
2. Grimm, Christoph, Neumann, Peter, Mahlknech and Stefan, “Embedded Systems for Smart Appliances and Energy Management” , Springer 2013.
3. RajKamal, “Embedded Systems-Architecture, Programming and Design”, McGraw-Hill, 2008
4. Nilanjan Dey, Amartya Mukherjee, “Embedded Systems and Robotics with Open Source Tools”, CRC press, 2016.
5. Karim Yaghmour, “Embedded Android”, O’Reilly, 2013

REFERENCE BOOKS:

1. Steven Good win, “Smart Home Automation with Linux and Raspberry Pi”, A press, 2013
2. TohC.K., “Adhoc mobile wireless networks”, Prentice Hall, Inc, 2002.
3. Kazem Sohraby, Daniel Minoli and Taieb Znati, “Wireless Sensor Networks Technology, Protocols, and Applications“, John Wiley & Sons, 2007.
4. Anna Hác, “Wireless Sensor Network Designs”, John Wiley & Sons Ltd, 2003.
5. Robert Faludi, ”Wireless Sensor Networks”, O’ Reilly, 2011.

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4. https://youtu.be/rlWVYBR-W54
5. https://youtu.be/Yjf77P062BU
6. https://youtu.be/JUwIC73uiIw

Mapping of CO with PO/PSO

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CO2	3	3	3	3	3	2	-	-	-	1	3	1	2	2
CO3	3	3	3	3	2	1	-	-	-	1	3	1	2	2
CO4	2	2	2	1	2	1	-	-	-	1	2	1	1	-
CO5	2	1	2	2	2	1	-	-	-	1	2	2	3	3
Avg.	2.6	2.4	2.6	2.4	2.4	1.2	-			1	2.6	1.4	1.8	2

JEE2016	EMBEDDED SYSTEM FOR AUTOMOTIVE APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals and building of Electronic Engine Control systems.
- To teach on functional components and circuits for vehicles.
- To discuss on programmable controllers for vehicles management systems.
- To teach logics of automation & commercial techniques for vehicle communication.
- To introduce the embedded systems concepts for E-vehicle system development.

PRE REQUISITE:

- Digital Logic Circuits, Microprocessor and microcontroller

UNIT I BASICS OF ELECTRONICALLY CONTROLLED ENGINE	**9**
Overview of Automotive systems, fuel economy, air-fuel ratio, emission limits and vehicle performance; Automotive microcontrollers- Electronic control Unit- Hardware & software selection- Introduction to AUTOSAR.	
UNIT II SENSORS AND ACTUATORS FOR AUTOMOTIVES	**9**
Review of sensors- sensors interface to the ECU, conventional sensors and actuators, Modern sensor and actuators - LIDAR sensor- smart sensors- MEMS/NEMS sensors and actuators for automotive applications.	
UNIT III VEHICLE MANAGEMENT SYSTEMS	**9**
Electronic Engine Control-engine mapping, air/fuel ratio spark timing control strategy, fuel control, electronic ignition- Adaptive cruise control - speed control-anti-locking braking system-electronic suspension - electronic steering, Automatic wiper control.	
UNIT IV ONBOARD DIAGONSTICS AND TELEMATICS	**9**
On board diagnosis of vehicles -System diagnostic standards and regulation requirements Vehicle communication protocols MOST, KWP2000 and recent trends in vehicle communications- Navigation- Connected Cars technology – Tracking- Security for data communication- dashboard display and Virtual Instrumentation.	
UNIT V ELECTRIC VEHICLES	**9**
Electric vehicles –Components- Plug in Electrical vehicle- Charging station – Aggregators- Fuel cells/Solar powered vehicles- Autonomous vehicles.	

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Insight into the significance of the role of embedded system for automotive applications.
- Illustrate the need, selection of sensors and actuators and interfacing with ECU
- Develop the Embedded concepts for vehicle management and control systems.

- Demonstrate the need of Electrical vehicle and able to apply the embedded system technology for various aspects of EVs Understand the concepts of smart System design and its present developments.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design and its application in automotive systems.

TEXT BOOKS:

1. William B. Ribbens ,"Understanding Automotive Electronics", Elseiver,8th Edition, 2017.
2. Jurgen, R., "Automotive Electronics Hand Book", McGraw Hill, 2nd Edition, 1999.
3. L.Vlacic,M.Parent,F.Harahima,"Intelligent Vehicle Technologies",SAE International, 2001, 1st Edition, 2017.

REFERENCE BOOKS:

1. Ali Emedi, Mehrdedehsani, John M Miller , "Vehicular Electric power system- land, Sea, Air and Space Vehicles" Marcel Decker, 2004.
2. Jack Erjavec,JeffArias,"Alternate Fuel Technology-Electric ,Hybrid& Fuel Cell Vehicles",Cengage , 2nd Edition, 2012.
3. Automotive Electricals / Electronics System and Components, Tom Denton, 5th Edition, 2017.
4. Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", Springer; 1st Edition, 2005.
5. Robert Bosch Gmbh, "Automotive Electricals Electronics System and Components", 5 th Edition, 2014.
6. Robert Bosch "Automotive Hand Book", Bently Publishers, 10th Edition, 2018.

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4. https://youtu.be/rlWVYBR-W54
5. https://youtu.be/Yjf77P062BU

Mapping of CO with PO/PSO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	1	2	2	2	-	-	-	-	2	2	2	2
CO2	2	1	2	1	1	1	-	-	-	-	2	2	2	1
CO3	1	1	1	1	2	2	-	-	-	-	2	1	2	2
CO4	2	2	2	2	2	2	-	-	-	-	2	2	1	2
CO5	2	2	1	1	2	2	-	-	-	-	2	2	1	1
Avg.	1.6	1.6	1.4	1.4	1.8	1.8	-	-	-	-	2	1.8	1.6	1.6

Vertical III- Control Engineering

JEE2017	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and system in the Fourier and Laplace domain
- To analyze discrete time signals and system in the Fourier and Z transform domain
- To analyze Linear time variant discrete time system

Pre-Requisites: Engineering Mathematics, Control Systems

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

UNIT II NEURAL NETWORKS FOR CONTROL 9

Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and Properties

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 9

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 9

Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT)– Properties of DTFT - Z Transform & Properties

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 9

Impulse response–Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

TOTAL: 45 PERIODS

Course Outcomes: At the end of the course, the student will be able to

- Determine if a given system is linear/causal/stable
- Determine the frequency components present in a deterministic signal
- Characterize continuous LTI systems in the time domain and frequency domain
- Characterize discrete LTI systems in the time domain and frequency domain
- Compute the output of an LTI system in the time and frequency domains

TEXT BOOKS:

1. Oppenheim, Willsky and Hamid, "Signals and Systems", Second Edition, Pearson Education, New Delhi, 2015.
2. Simon Haykin, Barry Van Veen, "Signals and Systems", Second Edition, Wiley, 2002

REFERENCE BOOKS:

1. B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009.
2. M. J. Roberts, "Signals and Systems Analysis using Transform methods and MATLAB", Mc Graw- Hill Education, 2018.
3. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.

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CO –PO & PSO MAPPING:

CO\PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	3	3	2	-	-	-	-	-	3	-	-	1
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CO4	3	3	-	3	2	-	-	-	-	-	3	-	3	1
CO5	3	3	-	3	2	-	-	-	-	-	3	-	3	1
AVG	3	3	3	3	2	-	-	-	-	-	3	2	3	1

JEE2018 ADVANCED CONTROL SYSTEMS L T P C
3 0 0 3

Course Objectives:

- To impart knowledge on state-space modeling.
- To provide an overview of the phase plane analysis.
- To learn the concept behind describing function analysis.
- To study the design of an optimal controller.
- To educate in the design of optimal estimators including Kalman

Pre-Requisites: Engineering Mathematics, Basic Engineering, Control Systems

UNIT I STATE VARIABLE DESIGN 9

Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle servo design: -State Feedback with integral control.

UNIT II PHASE PLANE ANALYSIS 9

Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of linear and nonlinear control systems

UNIT III DESCRIBING FUNCTION ANALYSIS 9

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations.

UNIT IV OPTIMAL CONTROL 9

Introduction - Time varying optimal control – LQR steady state optimal control – Solution of Ricatti's equation – Application examples

UNIT V OPTIMAL ESTIMATION 9

Optimal estimation – Kalman Bucy Filter-Solution by duality principle-Discrete systems-Kalman Filter- Application examples.

TOTAL: 45 PERIODS

Course Outcomes: At the end of the course, the student will be able to

- Design a state feedback controller and state observer.
- Analyze linear and nonlinear systems using the phase plane method
- Analyze nonlinear systems using describing function method.
- Design an optimal controller.
- Optimize the optimal estimator including Kalman Filter.

TEXT BOOKS:

1. Nagarath. I.J and Gopal.M," Control Systems Engineering", New Age International (P)Ltd., 2017

2.Richard Dorf, "Modern Control system", Global Technical Publishers, 2017.

3.G. J. Thaler, "Automatic Control Systems", Jaico Publishing House, 1993.

REFERENCE BOOKS:

1.Ogata. K, "Modern Control Engineering", Fourth edition, PHI, New Delhi, 2015

2. Gopal.M, "Modern Control System Theory", New Age International Publishers, 2002

3.Ashish Tewari, "Modern Control Design with Matlab and Simulink", John Wiley, New Delhi, 2002.

4.William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011

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CO-PO&PSO MAPPING:

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CO5	3	1	2	3	-	-	-	-	-	-	2	-	-	1
AVG	2.6	1.8	2.4	2.4	-	-	-	-	-	-	1.6	-	1	1.6

JEE2019 DIGITAL SIGNAL PROCESSING SYSTEM DESIGN L T P C
3 0 0 3

Course Objectives:

- To introduce the concept of analyzing discrete-time signals & systems in the time and frequency domain through mathematical representation.
- To study the various time-to-frequency domain transformation techniques.
- To understand the computation algorithmic steps for Fourier Transform.
- To study filters and their design for digital implementation.
- To introduce the programmable digital signal processor & its application.

Pre-Requisites: Engineering Mathematics, Basic Engineering, Control Systems

UNIT I INTRODUCTION 9

Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect. Digital signal representation.

UNIT II DISCRETE TIME SYSTEM ANALYSIS 9

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z-transform, application to discrete systems - Stability analysis, frequency response – Convolution –Introduction to Fourier Transform– Discrete-time Fourier transform.

UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION 9

DFT properties, magnitude, and phase representation - Computation of DFT using FFT algorithm –DIT & DIF - FFT using radix 2 – Butterfly structure.

UNIT IV DESIGN OF DIGITAL FILTERS 9

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. IIR design: Analog filter design – Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation - Warping, pre-warping -Frequency transformation.

UNIT V DIGITAL SIGNAL PROCESSORS 9

Introduction – Architecture of one DSP processor for motor control – Features – Addressing Formats– Functional modes - Introduction to Commercial Processors

TOTAL: 45 PERIODS

Course Outcomes: At the end of the course, the student will be able to

- Work with digital signal processing
- Illustrate the system representation using transforms
- Work with transformation techniques for time-to-frequency conversion
- Design suitable digital FIR, IIR algorithm for the given specification
- Use digital signal processor for application development

TEXT BOOKS:

1. J.G. Proakis and D.G. Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Fourth Edition ,Pearson Education, New Delhi, 2007.
2. Robert J. Schilling& Sandra L. Harris, "Introduction to Digital Signal Processing using MATLAB" , Second Edition ,Cengage Learning, 2013.
3. Emmanuel. C. Ifeachor and Barrie W Jervis, "Digital Signal Processing – A Practical Approach" Second edition , Pearson Education, 2002.
4. Alan V. Oppenheim, Ronald W. Schafer, and John R. Buck, "Discrete – Time Signal Processing", Second Edition , Pearson Education, New Delhi, 2012.
5.SenM.Kuo, Woonsen, s.gan, "Digital Signal Processors, Architecture, Implementations & Applications", First Edition , Pearson, 2004.

REFERENCE BOOKS:

1. S.K. Mitra, "Digital Signal Processing – A Computer Based Approach", Fourth Edition Tata McGraw Hill, New Delhi, 2013.
2. B. Venkataramani, M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications", First Edition, Tata McGraw Hill, New Delhi, 2003.

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5. https://www.electronicshub.org/introduction-to-fpga/

CO-PO&PSO MAPPING:

CO\PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO1 0	PO11	PSO1	PSO2	PSO3
CO1	1	3	2	2	1	-	-	-	-	-	-	1	2	1
CO2	2	3	3	2	2	-	-	-	-	-	-	2	3	1
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	3
CO5	3	3	3	2	1	-	-	-	-	-	-	2	2	3
AVG	2.4	3	2.8	2.4	2	-	-	-	-	-	-	1.8	2.2	2

JEE2020 MODEL BASED CONTROL L T P C
3 0 0 3

Course Objectives:

- To introduce the Knowledge about Multivariable and Multiloop systems.
- To understand the Model predictive control schemes and its elements.
- To get exposed to state space MPC along with case studies.
- To acquire knowledge on various constrained MPC.
- To make the student design simple adaptive controllers for linear systems

Pre-Requisites: Engineering Mathematics, Basic Engineering, Control Systems

UNIT I INTRODUCTION TO MIMO CONTROL 9

Introduction to MIMO Systems-Multivariable Control-Multiloop Control-Multivariable IMC-IMCPID Case studies.

UNIT II MODEL PREDICTIVE CONTROL SCHEMES 9

Introduction to Model Predictive Control - Model Predictive Control Elements – Generalized Predictive Control Scheme – Multivariable Generalized Predictive Control Scheme – Multiple Model-based Model Predictive Control Scheme Case Studies.

UNIT III STATE SPACE-BASED MODEL PREDICTIVE CONTROL SCHEME 9

State Space Model Based Predictive Control Scheme - Review of Kalman Update-based filters – State Observer Based Model Predictive Control Schemes – Case Studies.

UNIT IV CONSTRAINED MODEL PREDICTIVE CONTROL SCHEME 9

Constraints Handling: Amplitude Constraints and Rate Constraints –Constraints and Optimization – Constrained Model Predictive Control Scheme – Case Studies.

UNIT V ADAPTIVE CONTROL SCHEME **9**

Introduction to Adaptive Control-Gain Scheduling-Self tuning regulators–MARS-Adaptive Model Predictive Control Scheme –Case Studies.

TOTAL: 45 PERIODS

Course Outcomes: At the end of the course, the student will be able to

- Apply engineering knowledge to understand the control schemes on MIMO systems.
- Design a controller for the MIMO system.
- Analyze the control schemes available in industries.
- Design MPC, Adaptive controllers for practical engineering problems.
- Choose suitable controllers for the given problems.

TEXT BOOKS:

1. Coleman Brosilow, Babu Joseph, “Techniques of Model-Based Control”, First Edition, Prentice Hall PTR Pub ,2002.
2. E. F. Camacho, C. Bordons, “Model Predictive Control”, Springer-Verlag London Limited 2007,
3. K.J. Astrom and B. J. Witten mark, “Adaptive Control”, Second Edition, Pearson Education Inc., 2013.
4. Paul Serban Agachi, Zoltan K. Nagy, Mircea Vasile Cristea, and Arpad Imre-Lucaci , “Model Based Control Case Studies in Process Engineering”, Second Edition, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim 2007.
5. Ridong Zhang, Anke Xue Furong Gao, “Model Predictive Control Approaches Based on the Extended State Space Model and Extended Non-minimal State Space Model”, First Edition, Springer Nature Singapore Pte Ltd.,2019.

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3 https://youtu.be/XMfH2P2Fc6Q?list=PLWPirh4EWFpGpH_Rb6Q4iQ6vGGRA6MORZ

CO-PO&PSO MAPPING:

CO\PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO1 0	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	-	-	-	2	2	2
CO2	3	3	3	3	-	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	-	-	-	-	-	-	-	2	2	2
CO5	3	3	3	3	-	-	-	-	-	-	-	2	2	2
AVG	3	2.8	2.8	2.6	-	-	-	-	-	-	-	2	2	2

JEE2021 SYSTEM IDENTIFICATION L T P C
3 0 0 3

Course Objectives:

- To elaborate the concept of estimating the state variables of a system using state estimation algorithms.
- To elaborate the concept of estimating the parameters of the Input-output models using parameter estimation algorithms.
- To make the student understand the various closed-loop system identification techniques.
- To make the student understand the various closed-loop system identification techniques.
- To provide the background on the practical aspects of conducting experiments for real-time system identification.

Pre-Requisites: Engineering Mathematics, Basic Engineering, Control Systems

UNIT I NON-PARAMETRIC METHODS 9

Nonparametric methods: Transient analysis - frequency analysis - Correlation analysis – Spectral analysis.

UNIT II PARAMETRIC METHODS **9**

Parametric model structures: ARX, ARMAX, OE, BJ models - The Least square estimate - Best linear unbiased estimation under linear constraints - Updating the Parameter estimates for linear regression models - Prediction error methods: Description of Prediction error methods - Optimal Prediction – Relationships between prediction error methods and other identification methods –a theoretical analysis.

UNIT III RECURSIVE IDENTIFICATION METHODS **9**

The recursive least squares method - Recursive Instrumental variable method-the recursive prediction error method-model validation and model structure determination. Identification of systems operating in closed loop: Identifiability considerations - Direct identification – Indirect identification - Joint input – Output identification.

UNIT IV CLOSED-LOOP IDENTIFICATION **9**

Identification of systems operating in closed loop: direct identification and indirect identification – Subspace Identification methods: classical and innovation forms – Relay feedback identification of stable processes.

UNIT V NONLINEAR SYSTEM IDENTIFICATION **9**

Modeling of nonlinear systems using ANN- NARX & NARMAX - Training Feed-forward and Recurrent Neural Networks – TSK model – Adaptive Neuro-Fuzzy Inference System (ANFIS) - Introduction to Support Vector Regression.

TOTAL: 45 PERIODS

Course Outcomes: At the end of the course, the student will be able to

- Design and implement state estimation schemes.
- Develop various models (Linear & Nonlinear) from the experimental data.
- Choose a suitable model and parameter estimation algorithm for the identification of systems.
- Illustrate verification and validation of the identified model.
- Develop the model for prediction and simulation purposes using suitable control schemes.

TEXT BOOKS:

1. Karel J. Keesman, “System Identification an Introduction”, First Edition, Springer, 2011.
2. Dan Simon, “Optimal State Estimation Kalman, H-infinity and Non-linear Approaches”, John Wiley and Sons, 2006,

3. Tangirala, A.K., “Principles of System Identification: Theory and Practice”, First Edition , CRC Press, 2014.
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5. Tao Liu and Furong Gao, “Industrial Process Identification and Control Design, Step-test and relay-experiment-based methods”, First Edition , Springer- Verlag London Ltd., 2012.

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2. Miller, W.T., Sutton, R.S., and Webrose, P.J., “Neural Networks for Control”, First Edition , MIT Press, , 1996.
3. Lennart Ljung, “System Identification: Theory for the user”, Second Edition, Prentice Hall, 1999.

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3.https://in.mathworks.com/help/curvefit/nonparametric-fitting.html
4.https://youtu.be/uaGkKv4D3Lw

CO-PO&PSO MAPPING:

CO\PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO1 0	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	2	2	2
CO2	3	3	3	3	-	-	-	-	-	-	-	2	2	2
CO3	3	2	2	2	-	-	-	-	-	-	-	2	2	2
CO4	3	2	2	2	-	-	-	-	-	-	-	2	2	2
CO5	3	3	3	3	-	-	-	-	-	-	-	2	2	2
AVG	3	2.6	2.6	2.6	-	-	-	-	-	-	-	2	2	2

JEE2022	ADAPTIVE CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart knowledge about basic adaptive controllers.
- To impart knowledge of gain scheduling controllers.
- To make the student understand the deterministic self-tuning regulators.
- To make the student understand the stochastic and predictive self-tuning regulators.
- To make the student design simple adaptive controllers for linear systems using STR, MRAC, and Gain scheduling

Pre-Requisites: Engineering Mathematics, Basic Engineering, Control Systems

UNIT I INTRODUCTION **9**

Introduction - Adaptive Schemes - The adaptive Control Problem – Applications-Parameter estimation:-LS, RLS: and ERLS

UNIT II GAIN SCHEDULING **9**

Introduction- The principle - Design of gain scheduling controllers- Nonlinear transformations - application of gain scheduling - Auto-tuning techniques: Methods based on Relay feedback.

UNIT III DETERMINISTIC SELF-TUNING REGULATORS **9**

Introduction- Pole Placement design - Indirect Self-tuning regulators - direct self-tuning regulators – Disturbances with known characteristics.

UNIT IV STOCHASTIC AND PREDICTIVE SELF-TUNING REGULATORS **9**

Introduction – Design of minimum variance controller - Design of moving average controller - stochastic self-tuning regulators.

UNIT V MODEL – REFERENCE ADAPTIVE SYSTEM **9**

Introduction- MIT rule – Determination of adaptation gain - Lyapunov theory –Design of MRAS using Lyapunov theory – Relations between MRAS and STR.

TOTAL:45 PERIODS

Course Outcomes: At the end of the course, the student will be able to

- Apply the estimation algorithm to estimate the parameters of the process.
- Apply adaptive control concepts to control a process.
- Use appropriate software tools to design adaptive controllers and analyze the process.
- Identify, formulate, and carry out research by designing suitable adaptive schemes for complex instrumentation problems.
- Apply the concepts to design adaptive control for multidisciplinary problems

TEXT BOOKS:

1. K.J. Astrom and B. J. Wittenmark, "Adaptive Control", Second Edition, Pearson Education Inc., 2013.
2. Dan Simon, "Optimal State Estimation Kalman, H-infinity and Non-linear Approaches", John Wiley and Sons, 2006,
3. Tangirala, A.K., "Principles of System Identification: Theory and Practice", First Edition ,CRC Press, 2014.
4. Van der Heijden, F., Duin, R.P.W., De Ridder, D., and Tax, D.M.J., "Classification, Parameter Estimation, and State Estimation- An Engineering Approach Using MATLAB", Second Edition, John Wiley & Sons Ltd., , 2017.
5. Tao Liu and Furong Gao, "Industrial Process Identification and Control Design, Step-test and relay-experiment-based methods", First Edition, Springer- Verlag London Ltd., 2012.

REFERENCE BOOKS:

1. T. Soderstorm and Petre Stoica, "System Identification", Prentice Hall International(UK) Ltd., 1989.
2. Lennart Ljung, "System Identification: Theory for the User", Second Edition, Prentice Hall, 1999.

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3.https://in.mathworks.com/videos/nonlinear-model-based-adaptive-robust-controller in- an-oil-and-gas-wireline-operation-1637577967956.html
4.https://www.dynalog-us.com/adaptive-robot-control.htm
5 .https://www.vlab.co.in/

CO –PO & PSO MAPPING:

CO\PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO1 0	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	-	-	-	2	2	2
CO2	3	2	2	2	-	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	-	-	-	-	-	-	-	2	2	2
CO5	3	2	2	2	-	-	-	-	-	-	-	2	2	2
AVG	3	2.4	2.4	2.4	-	-	-	-	-	-	-	2	2	2

JEE2023 MACHINE MONITORING SYSTEM L T P C
3 0 0 3

Course Objectives:

- To familiarize the students with the concept of condition-based maintenance for effectively utilizing machines.
- To impart knowledge of artificial intelligence for machinery fault diagnosis.
- To give basic knowledge on vibration monitoring.
- To study the machinery vibrations using signal processing techniques.
- To provide knowledge on FMECA.

Pre-Requisites: Engineering Mathematics, Basic Engineering, Control Systems

UNIT I INTRODUCTION TO MACHINE CONDITION MONITORING 9

Machinery condition monitoring - Present status - Fault prognosis - Future needs.

UNIT II MACHINERY MAINTENANCE 9

Maintenance strategies – Reactive, Preventive, and Predictive – Benefits of planned maintenance – Bathtub curve – Failure Modes Effects and Criticality Analysis (FMECA).

UNIT III INTRODUCTION TO MACHINERY VIBRATION AND MONITORING 9

Characteristics of Vibration systems – Mode shapes & operational deflection shapes – Experimental modal analysis – Principles of vibration monitoring – Machinery faults diagnosed by vibration analysis.

UNIT IV SIGNAL PROCESSING IN MACHINERY MONITORING **9**

FFT analysis – Time domain analysis – Time-frequency analysis – Signal filtering – Cepstrum analysis – Health condition of compressor & engine.

UNIT V MACHINE LEARNING FOR CONDITION MONITORING **9**

Machine Learning: Feature extraction and feature selection methods – Feature reduction – Classification techniques – Case studies of condition monitoring in Nuclear plant components, Distillation column.

TOTAL: 45 PERIODS

Course Outcomes: At the end of the course, the student will be able to

- Identify faults in machinery.
- Choose the proper maintenance strategies and condition monitoring techniques forthe identification of failure in the machine.
- Construct a classifier model for machine learning-based fault diagnosis.
- Predict the faulty component in a machine by analyzing the acquired vibration signals.
- Analyze & build a model using modern tools.

TEXT BOOKS:

1. Cornelius Scheffer and Paresh Girdhar, "Practical Machinery Vibration Analysis and Predictive Maintenance", First Edition, Elsevier, 2004.
2. A. R. Mohanty, "Machinery Condition Monitoring: Principles and Practices", CRC Press, Taylor & Francis, 2017.
3. Davies, "Handbook of Condition Monitoring – Techniques and Methodology", First Edition, Springer, 2011.
4. Ian H. Witten, Eibe Frank, Mark A. Hall, "Data Mining: Practical Machine Learning Tools and Techniques", Third Edition , Elsevier, 2011.
5. Ferdinand van der Heijden, Robert Duin, Dick de Ridder, David M. J. Tax, "Classification, Parameter Estimation and State Estimation: An Engineering Approach Using MATLAB", Second Edition, John Wiley & Sons, 2017.

REFERENCE BOOKS:

1 Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Second Edition, CRC, Press, 2014.
2. Collacot, "Mechanical Fault Diagnosis and Condition Monitoring", Second Edition, Chapman- Hall, 2011.

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2 https://www.udemy.com/topic/maintenance-management/
3 https://www.vi-institute.org/analyst-categories/
4.https://in.mathworks.com/help/predmaint/ug/condition-monitoring-and-prognostics-usingvibration- signals.html

CO-PO&PSO MAPPING:

CO\PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO1 0	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	-	-	-	-	-	-	-	1	2	2
CO2	3	2	2	2	-	-	-	-	-	-	-	1	2	2
CO3	3	3	3	3	-	-	-	-	-	-	-	1	2	2
CO4	2	2	1	2	-	-	-	-	-	-	-	1	2	2
CO5	3	3	3	2	-	-	-	-	-	-	-	1	2	2
AVG	2.4	2.2	2	2	-	-	-	-	-	-	-	1	2	2

JEE2024 COMPUTER CONTROL OF PROCESSES L T P C
3 0 0 3

Course Objectives:

- To provide knowledge of state-space modeling techniques for discrete-time systems.
- To impart the principles of system identification and model development using least squares and recursive least squares techniques
- To design digital controllers that satisfy specified performance and stability requirements.
- To describe the performance of multi-loop and multivariable control systems for interacting processes.
- To provide an understanding of multivariable Dynamic Matrix Control strategies and their application in industrial process control.

Pre-Requisites: Engineering Mathematics, Basic Engineering, Control Systems

UNIT I DISCRETE STATE-VARIABLE TECHNIQUE **9**

State equation of discrete data system with sample and hold – State transition equation – Methods of computing the state transition matrix – Decomposition of discrete data transfer functions – State diagrams of discrete data systems – System with zero-order hold – Controllability and observability of linear time-invariant discrete data system–Stability tests of the discrete-data system.

UNIT II SYSTEM IDENTIFICATION **9**

Identification of Non-Parametric Input-Output Models: -Transient analysis–Frequency analysis– Correlation analysis– Spectral analysis – Identification of Parametric Input-Output Models:- Least Squares Method – Recursive Least Square Method.

UNIT III DIGITAL CONTROLLER DESIGN **9**

Review of z-transform – Modified of z-transform – Pulse transfer function – Digital PID controller – Dead beat controller and Dahlin's controller – Kalman's algorithm, Pole Placement Controller.

UNIT IV MULTI-LOOP REGULATORY CONTROL **9**

Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs -The Relative Gain Array (RGA) – Properties and Application of RGA - Multi-loop PID Controller – Biggest Log Modulus Tuning Method – De-coupler.

UNIT V MULTIVARIABLE REGULATORY CONTROL **9**

Introduction to Multivariable control –Multivariable PID Controller – Multivariable Dynamic Matrix Controller – Case Studies: - Distillation Column, CSTR, and Four-tank system.

TOTAL: 45 PERIODS

Course Outcomes: At the end of the course, the student will be able to

- Apply state variable techniques to develop mathematical models of discrete-time systems and their stability characteristics
- Develop models from input-output data using least squares and recursive least squares methods
- Design different digital controllers to satisfy the required criterion.
- Analyze the performance characteristics of multi-loop and multivariable controllers for multivariable systems.

- Investigate the control performance of multivariable Dynamic Matrix Controllers in industrial applications.

TEXT BOOKS:

1. Stephanopoulos, G., "Chemical Process Control -An Introduction to Theory and Practice", First Edition, Prentice Hall of India, 2015.
2. Sigurd Skogestad, Ian Postlethwaite, "Multivariable Feedback Control: Analysis and Design", Second Edition, John Wiley and Sons, 2005.
3. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, "Process Dynamics and Control", Fourth Edition, Wiley John and Sons, 2016.
4. P. Albertos and A. Sala, "Multivariable Control Systems An Engineering Approach", First Edition, Springer Verlag, 2004.
5. Bequette, B.W., "Process Control Modeling, Design and Simulation", First Edition, Prentice Hall of India, 2003.

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1. Thomas E. Marlin, "Process Control –Designing Processes and Control Systems for Dynamic Performance", Second Edition, Mc-Graw-Hill, 2000.
2. Gopal, M., "Digital Control and State Variable Methods", Fourth Edition, Tata Mc Graw Hill, 2017.

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4 https://youtu.be/49RET0N-ITY.

CO-PO&PSO MAPPING:

	Program Outcomes											**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	2	2	1	1	1	1	-	1	2	1	1
CO2	2	2	3	2	2	1	1	1	1	-	1	2	1	1
CO3	1	1	1	2	2	2	1	1	1	-	1	2	1	1
CO4	1	2	2	3	2	2	1	1	1	-	1	2	1	1
CO5	1	2	2	3	2	2	1	1	1	-	1	2	1	1
AVG	1.4	1.8	2.2	2.4	2	1.6	1	1	1	-	1	2	1	1

Vertical IV – Instrumentation and Industrial Automation

JEE2025	SENSORS AND TRANSDUCERS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To study the characteristics of transducers and sensors
- To learn the various sensors used to measure various physical parameters.
- To learn the concepts of force, magnetic and heading sensors.
- To impart knowledge on optical, pressure and temperature sensors
- To provide an overview about data acquisition systems

Pre-Requisites: Basic Engineering.

UNIT I BASICS OF SENSORS AND TRANSDUCERS 6

Basics of Measurement- Classification of errors-Error analysis – Static and dynamic characteristics of transducers–Performance measures of sensors–Sensor calibration techniques – Sensor Output Signal Types

UNIT II MOTION, PROXIMITY AND RANGING SENSORS 6

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT– RVDT – Synchro – Microsyn, Accelerometer., – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR)

UNIT III FORCE, MAGNETIC AND HEADING SENSORS 6

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive–Hall Effect –Eddy Current sensor, Heading Sensors–Compass, Gyroscope, Inclinometers

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 6

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezo electric–Tactile sensors, Temperature–IC, Thermistor, RTD, Thermocouple. Acoustic Sensors– flow and level measurement, Radiation Sensors- Smart Sensors-Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS 6

Amplification – Filtering –Sample and Hold circuits – Data Acquisition: Single channel and multichanneldata acquisition – Data logging-Applications-Automobile, Aerospace, Home

appliances, Manufacturing, Environmental monitoring, Medical diagnosis

TOTAL 30 Periods

LIST OF EXPERIMENTS

1. Displacement versus output voltage characteristics of a potentiometric transducer.
2. Characteristics of Strain gauge and Load cell.
3. Characteristics of LVDT, Hall Effect transducer and photo electric tachometer.
4. Characteristics of LDR, thermistor and thermocouple.
5. Step response characteristic of RTD and thermocouple.
6. Temperature measurements using RTD with three leads.
7. Measurement of Angular displacement using resistive and capacitive transducer.
8. Fiber optic temperature Measurement
9. Calibration of pressure gauge
10. Vacuum pressure measurement

TOTAL: 30 Periods

COURSE OUTCOMES: At the end of the course, the student will be able to

- Expertise in various calibration techniques and signal types of sensors
- Acquire the knowledge about the various sensors used to measure various physical parameters
- Interpret the concepts of force, magnetic and heading sensors
- Infer the knowledge on optical, pressure and temperature sensors
- Acquire the concepts about the data acquisition systems.

TEXT BOOKS:

1. Ernest O Doebelin, "Measurement Systems–Applications and Design", Third Edition, Tata McGraw-Hill,2018.
2. Sawney AK and Puneet Sawney," A Course in Mechanical Measurements and Instrumentation and Control", Twelth edition, Dhanpat Rai & Co, New Delhi, 2013.
3. Patranabis D, "Sensors and Transducers", Third Edition, PHI, New Delhi, 2017
4. Renganathan S., "Transducer Engineering" First Edition, Allied Publishers Limited, 2003.
5. D.V.S.Murty, "Transducers and Instrumentation",First Edition, PHI learning, 2012.

REFERENCE BOOKS:

1. Jacob Fraden, "Hand book of Modern Sensors Physics, Designs, and Applications", First edition, SpringerPublication, 2016.
2. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", First Edition Oxford Science Publications, 1999
3. Richard Zurawski, "Industrial Communication Technology Handbook ", Second edition Press, 2015.

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2. https://youtu.be/DAwXk77DXUM
3. https://youtube.com/playlist?list=PLVsrfTSlZ_40qYhVeqtLiNhnQ_40IfOyM
4. https://youtube.com/playlist?list=PLwdnzlV3ogoXJLQ8lSGb1hsztt24l9kZZ
5. https://youtu.be/v-3TmN4HhLc

CO-PO & PSO MAPPING:

CO\PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO1 0	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	-	-	-	-	-	-	2	1	1	2
CO2	2	3	1	2	-	-	-	-	-	-	2	1	1	2
CO3	3	2	2	3	-	-	-	-	-	-	2	1	1	3
CO4	3	2	3	2	-	-	-	-	-	-	3	1	1	3
CO5	2	1	1	1	-	-	-	-	-	-	3	1	1	3
AVG	2.6	2	1.6	2	-	-	-	-	-	-	2.4	1	1	2.6

JEE2026	ANALYTICAL INSTRUMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the fundamentals of analytical instruments, signal conditioning techniques, and methods of chemical analysis.
- To explain the principles, construction, and applications of spectrophotometric instruments used in industrial and laboratory measurements.
- To illustrate chromatographic techniques and their applications in qualitative and quantitative analysis.
- To develop an understanding of dissolved component analyzers and industrial gas analysis techniques.
- To evaluate advanced analytical instruments such as NMR, mass spectrometers, radiation detectors, and X-ray spectroscopy systems.

Pre-Requisites: Sensors and Transducers

UNIT I INSTRUMENTAL ANALYSIS **9**

Fundamentals of Analytical Instrumental: Elements, Signal Conditioning, Readout Devices, Methods of Analysis: Chemical Instrumental analysis, Spectral analysis, Electro analytical analysis, Instrumental methods of analysis: basic components and their classification - Ion selective electrodes - conductivity meters - pH meters.

UNIT II SPECTROPHOTOMETRY **9**

Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy – IR Spectrophotometry - FTIR spectrophotometry – Atomic absorption spectrophotometry - Flame emission and atomic emission photometry – Construction, working principle, sources detectors and applications

UNIT III CHROMATOGRAPHY **9**

General principles – classification – chromatographic behavior of solutes – quantitative determination – Gas chromatography – Liquid chromatography – High-pressure liquid chromatography – Applications.

UNIT IV DISSOLVED COMPONENT AND GAS ANALYSIS **9**

Dissolved oxygen analyser, sodium analyser, silica analyser, Moisture measurement, Oxygen analyser, CO monitor, NO2 analyser, H2S analyser, dust and smoke measurement, thermal conductivity type, thermal analyser, industrial analysers

UNIT V NUCLEAR MAGNETIC RESONANCE AND RADIATION TECHNIQUES 9

NMR spectrometers and its applications, Mass spectrophotometers and its applications, GM counter, Proportional counter, Scintillation counter, Detectors: Nuclear radiation detector, Solid state detector, X- ray spectroscopy.

TOTAL 45 Periods

Course Outcomes: At the end of the course, the student will be able to

- Explain the principles of analytical instrumentation, signal conditioning, electrochemical analysis, conductivity meters, and pH measurement systems.
- Apply spectrophotometric techniques, including UV-Visible, IR, FTIR, atomic absorption, and emission spectroscopy, for analytical measurements.
- Analyze chromatographic methods such as gas chromatography, liquid chromatography, and high-performance liquid chromatography for component separation and quantification.
- Analyze dissolved component analyzers, industrial gas analyzers, moisture measurement systems, and thermal conductivity-based analyzers used in process industries.
- Assess the performance and applications of NMR spectrometers, mass spectrometers, radiation detectors, GM counters, scintillation counters, and X-ray spectroscopy systems.

TEXT BOOKS:

1. Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A., "Instrumental methods of analysis", seven Edition, CBSpublishing & distribution, 2012.
2. Braun, R.D., "Introduction to Instrumental Analysis", Pharma Book Syndicate , Singapore, 2006
3. Robert E. Sherman., "Analytical Instrumentation", Instruments Society of America, 1996.

REFERENCE BOOKS:

1. Khandpur, R.S., "Handbook of Analytical Instruments", second Edition Tata McGraw-Hill publishing Co. Ltd., 2007.
2. Ewing, G.W., "Instrumental Methods of Chemical Analysis", fifth Edition reprint, McGraw-Hill, 1985.
3. Liptak, B.G., "Process Measurement and Analysis", fifth Edition ,CRC Press, 2015
4. Abirami., "Analytical Instruments", Third Edition, Anuradha Publications.
5. Gillian McMahon., "Analytical Instrumentation", First Edition, Wiley Publications, 2007.

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CO-PO & PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	3	1	1	1	1	-	1	2	1	1
CO2	3	3	2	3	3	1	1	1	1	-	1	2	2	2
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CO4	3	3	2	3	3	1	1	1	1	-	1	3	3	2
CO5	3	3	2	3	3	1	1	1	1	-	1	3	3	3
AVG	3.0	2.8	1.8	2.8	3.0	1.0	1.0	1.0	1.0	-	1.0	2.6	2.2	2.0

JEE2027	PLC PROGRAMMING	L	T	P	C
		2	0	2	3

COURSE **OBJECTIVES:**

- To know about the basics of PLC and Automation
- To provide a fundamental understanding of the PLC programming language.
- To understand the importance of SCADA and its parts.
- To impart the various types of PLC communication protocols
- To introduce types of programming languages of PLC and programming using ladderlanguage for few applications.

Pre-Requisites: Electronic Devices
Basics of C programming

UNIT I INTRODUCTION **6**

Programmable Logic Controller (PLC)- Block diagram of PLC- Programming languages of PLC Basic instruction set- Networking of PLC- Overview of safety of PLC with case studies- Process Safety Automation: Levels of process safety through use of PLCs

UNIT II BASICS OF PLC PROGRAMMING **6**

Basics of PLC programming-Ladder Logic- Relay type Instruction – Timers/ Counter Instructions- Program Control Instructions-Data manipulation and Math Instructions-Development and simulation of PLC programming with examples-FBD - IL- SFC-ST.

UNIT III SCADA **6**

Elements of SCADA system - History of SCADA, Remote Terminal Unit- Discrete control - Analog control, Master Terminal Unit- Operator interface.

UNIT IV HART AND FIELD BUS **6**

Introduction- Evolution of signal standards- HART communication protocol- communication modes- HART networks- HART commands- HART and OSI model- Field bus- Architecture-Basic requirements of field Bus standard- Field bus Topology- Interoperability-Interchangeability.

UNIT V APPLICATIONS OF PLC PROGRAMMING **6**

Exercise in Programming Languages from IEC 61131-3: Traffic Light Control- Two way-Four way – Water Level Control- Automatic Material Sorting System- Automatic Bottle

Filling System, Code Converters- DC motor Control- Alarm Circuit.

TOTAL: 30 Periods

LIST OF EXPERIMENTS:

1. Study of PLC field device interface modules (AI, AO, DI, DO modules)
2. Programming Logic Gates Function in PLC
3. PLC program to implement various Boolean functions
4. PLC program to latch and unlatch output
5. Implementing Mathematical Operations in PLC
6. Programming Jump-to-subroutine & return operations in PLC
7. PLC program to drive motor in forward and reverse direction
8. PLC program to control traffic lights and pedestrian lights
9. PLC program for a car parking system
10. Implementation of ON/OFF delay timers.

TOTAL: 30 Periods

COURSE OUTCOMES: At the end of the course, the student will be able to

- Interpret the basics and need for Automation in industries.
- Analyze the logic and flow of any particular instruction for programming using PLC languages.
- Acquire the knowledge about the SCADA architecture and its parts.
- Analyse the concepts of PLC programming and communication protocols.
- Build the logic in any of the programming languages using standards.

TEXT BOOKS:

1. Frank D. Petruzella, “Programmable Logic Controllers”, fifth Edition, McGraw- Hill, New York, 2019.

2. Stuart Boyer A, “SCADA: Supervisory control and data Acquisition”, fourth Edition, ISA- The Instrumentation, Systems, and Automation Society, 2016.

3. Bolton. W, “Programmable Logic Controllers”, sixth Edition, Elsevier Newnes publication, 2015.

4. Katariya Sanjay,” Industrial Automation Solutions for PLC, SCADA and Field Devices”, first Edition,Notion Press, 2020

5.K.S. Manoj, “Industrial Automation with SCADA Concepts, Communications and Security” , second

Edition, Notion Press, 2019

REFERENCE BOOKS:

1. John W. Webb and Ronald A. Reis, “Programmable Logic Controllers: Principles and Applications”,fifth Edition, Prentice Hall Inc., New Jersey, 2003

2.Krishna Kant, “Computer - Based Industrial Control”, second Edition, Prentice Hall, New Delhi, 2011

3. Liptak B.G., “Instrument and Automation Engineers' Handbook: Process Measurement and Analysis”,Fifth Edition, CRC Press, 2016.

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5. https://new.siemens.com/global/en/products/automation/systems/industrial/plc/logo/logosoftware.
6. https://componentsearchengine.com/library/proteus?gclid=CjwKCAjw_ISWBhBkEiwAdqxb9o

CO-PO & PSO MAPPING:

CO\PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO1 0	PO11	PSO1	PSO2	PSO3
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CO3	3	2	2	3	-	-	-	-	-	-	2	1	1	3
CO4	3	2	3	2	-	-	-	-	-	-	3	1	1	3
CO5	2	1	1	1	-	-	-	-	-	-	3	1	1	3
AVG	2.6	2	1.6	2	-	-	-	-	-	-	2.4	1	1	2.6

JEE2028 ADVANCED INTEGRATED AUTOMATION L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn the components of totally integrated automation system.
- To provide an overview about the human machine interface system.
- To study the basic architecture of SCADA and report generation using it.
- To impart knowledge about communication protocols in an integrated system
- To familiarize with distributed control system and its applications

Pre-Requisites: PLC Programming

UNIT I TOTALLY INTEGRATED AUTOMATION 9

Need, components of TIA systems, advantages, Programmable Automation Controllers (PAC), Vertical Integration structure.

UNIT II HUMAN MACHINE INTERFACE SYSTEMS 9

Necessity and Role in Industrial Automation, Need for Human Machine Interface (HMI) systems. Types of HMI-Text display-operator panels-Touch panels-Panel PCs-Integrated displays (PLC&HMI).Check with PLC 502 and remove.

UNIT III SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) 9

Overview – Developer and runtime packages – architecture – Tools – Tag – Internal &External graphics, Alarm logging – Tag logging – structured tags– Trends – history– Report generation, VB & C Scripts for SCADA application.

UNIT IV COMMUNICATION PROTOCOLS OF SCADA 9

Proprietary and open Protocols – OLE / OPC – DDE – Server / Client Configuration – Messaging– Recipe–User administration–Interfacing of SCADA with PLC, drive, and other field device.

UNIT V DISTRIBUTED CONTROL SYSTEMS (DCS) 9

DCS – architecture – local control unit- programming language – communication facilities – operator interface-engineering interfaces. APPLICATIONS OF DCS: Case studies of Machine automation, Process automation, Comparison between SCADA and DCS.

Total: 45 Periods

Course Outcomes: At the end of the course, the student will be able to

- Describe the components involved in totally integrated automation system
- Acquire knowledge in HMI systems and to integrate it with other systems.
- Apply SCADA and usage of C programming for report generation
- Acquire information about the usage of communication protocols in an integrated system
- Design and develop automated control system using distributed control systems.

TEXT BOOKS:

1. John.W. Webb& Ronald A. Reis, "Programmable logic controllers: Principles and Applications", first edition, Pearson publication,2015.

2. Michael P. Lukas, "Distributed Control systems", second edition, Nostrand Reinfold Company, 1995.

3. 3.Popovic.D. and BhatkarV.P, "Distributed computer control for industrial Automation", first edition,Marcel Dekker, Inc., Newyork,2001 .

4. Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3,4. 60870.5 andRelated Systems", first edition, Newnes publications, 2004.

5. Mc Millan, G.K., "Process /Industrial Instrument and Controls Handbook" , fifth Edition, McGraw- Hillhand book, New York, 1999

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1. Mano.M and Ciletti, "Digital Design", fourth edition, Prentice Hall, 2007

2. M.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", fifth edition,Pearson Education, 2009

3.Himanshu Kumar, "Advanced Industrial Automation", Kindle Edition, Notion Press,2020.

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2.https://youtu.be/usQuFNUzobQ
3.https://youtu.be/nM1qTzlePSo
4.https://youtu.be/nlFM1q9QPJw
5.https://youtu.be/w5eCKv6iUIk

CO-PO & PSO MAPPING:

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CO2	2	3	1	2	-	-	-	-	-	-	2	1	1	2
CO3	2	2	2	2	-	-	-	-	-	-	2	1	1	3
CO4	2	2	3	2	-	-	-	-	-	-	3	1	1	3
CO5	2	1	1	1	-	-	-	-	-	-	3	1	1	3
AVG	2.2	2	1.6	1.8	-	-	-	-	-	-	2.6	1	1	2.4

JEE2029 INTELLIGENT AUTOMATION L T P C
3 0 0 3

COURSE OBJECTIVES:

- To identify potential areas for automation and justify the need for automation.
- To study the concepts of Artificial Intelligence.
- To learn the methods of solving problems using Artificial Intelligence.
- To understand about the expert systems and their architectures.
- To apply the concept of AI to attain control in industrial systems.

Pre-Requisites: Applied Soft Computing

UNIT I INDUSTRIAL AUTOMATION BASICS 9

Introduction to Industrial Automation - Automation in Production System- Principles and Strategies of Automation - Basic Elements of an Automated System- Advanced Automation Functions- Levels of Automations- Production Economics - Methods of Evaluating Investment Alternatives.

UNIT II ARTIFICAL INTELLIGENCE FUNDAMENTALS 9

Introduction to Artificial Intelligence -Introduction-Foundations of AI- History of AI- Intelligent agents: Agents and Environment- Reactive agent- deliberative- goal driven- utility driven and learning agents - Artificial Intelligence programming techniques. Introduction to ML and DL Concepts.

UNIT III KNOWLEDGE AND REASONING 9

Knowledge Representation and Reasoning - Ontologies-foundations of knowledge representation and reasoning-representing and reasoning about objects- relations- event sections- time- and space- predicate logic. Representing Knowledge and reasoning in an Uncertain Domain-Bayes rule-Bayesian networksprobabilistic inference sample applications.

UNIT IV EXPERT SYSTEMS 9

Expert systems -Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge- Heuristics. Typical expert systems – MYCIN – ARTXOON.

UNIT V AI IN CONTROL SYSTEMS 9

Industrial AI applications and Case studies - Applications of Industrial AI in Monitoring optimization and control- AI applications in Industry Automation using -natural language processing-computer vision- speech recognition-computer vision.

Total: 45 Periods

Course Outcomes: At the end of the course, the student will be able to

- Acquire and understand the basics AI algorithms.
- Identify the appropriate AI methods.
- Illustrate about AI/ML/DL techniques in Industrial Automation.
- Summarize about the expert levels of automation.
- Apply the AI concepts for industrial optimization and control.

TEXT BOOKS:

1. Rich and Knight, "Artificial Intelligence", third Edition, Tata McGraw Hill, 2014.

2. M.P. Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, fifth edition,Pearson Education, 2019.

3.Anuradha Srinivasa Raghavan, Vincy Joseph “Machine Learning”, first edition, Wiley

publications,2019.

4. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, second Edition, PrenticeHall, 2003.

5 .Rajiv Chopra, “Deep Learning”, first edition, Khanna Publishing House, 2018.

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1. Pascal Bornet, Ian Barkin, Jochen Wirtz , “ INTELLIGENT AUTOMATION”, first edition , Kindle publications,2020

2. M. P. Grover “Automation, Production Systems and Computer-Integrated Manufacturing” fourth Edition, Pearson Education, 2016.

3. N. Viswanandham, Y. Narhari “Performance Modeling of Automated Manufacturing Systems”, first Edition,Prentice-Hall, 1994.

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2.https://nptel.ac.in/courses/108105063

3 https://aws.amazon.com/free/machine-learning

4 https://www.tensorflow.org/

CO-PO & PSO MAPPING:

CO\PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO1 0	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	-	-	-	-	-	-	2	1	1	2
CO2	2	3	1	2	-	-	-	-	-	-	2	1	1	2
CO3	3	2	2	3	-	-	-	-	-	-	2	1	1	3
CO4	3	2	3	2	-	-	-	-	-	-	3	1	1	3
CO5	2	1	1	1	-	-	-	-	-	-	3	1	1	3
AVG	2.6	2	1.6	2	-	-	-	-	-	-	2.4	1	1	2.6

JEE2030	ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge on the evolution of robotic systems and their mathematical representations.
- To develop the ability to demonstrate the operation of various power sources, sensors, and actuators used in robots.
- To understand the operation of manipulators and grippers used for the control of robots for specific applications
- To provide knowledge for determining appropriate rotor configurations for various robotic systems and applications.
- To develop an understanding of the dynamics and control of robotic manipulators for assessing their operational performance

Pre-Requisites: Electrical Machines
Engineering Physics

UNIT I BASIC CONCEPTS 9

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Robot classifications and specifications- Asimov's laws of robotics – dynamic stabilization of robots

UNIT II POWER SOURCES, SENSORS AND ACTUATORS 9

Hydraulic, pneumatic and electric drives: Design and control issues – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors

UNIT III MANIPULATORS AND GRIPPERS DIFFERENTIAL MOTION 9

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

UNIT IV KINEMATICS AND PATH PLANNING **9**

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance Solution kinematics problem – robot programming languages.

UNIT V DYNAMICS AND CONTROL AND APPLICATIONS **9**

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation -Linear control schemes - PID control scheme-Force control of robotic manipulator. Multiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.

Total: 45 Periods

Course Outcomes: At the end of the course, the student will be able to

- Apply the knowledge of robot evolution to identify and mathematically represent different types of robotic systems
- Demonstrate the various power sources, sensors and actuators used in Robots
- Analyze the performance and characteristics of various robotic control schemes for different applications
- Evaluate different rotor configurations and determine the most suitable configuration for a specific application.
- Investigate the dynamics and control aspects of robotic manipulators to understand their operational performance.

TEXT BOOKS:

1. Mikell P. Weiss G.M., Nagel R.N.,Odraj N.G., “Industrial Robotics”, second edition, McGraw-HillSingapore, 2018.
2. Saeed B Niku, “Introduction to Robotics, Analysis, Systems, Applications”, Third edition Prentice Hall, 2018.
3. John.J.Craig, “Introduction to Robotics Mechanics and Control”, Fourth edition, Pearson Education,2022.

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2. Lentin Joseph,” Robot Operating System (ROS)”, first Edition, A press publication, 2018.

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4. http://site.ieee.org/scv-css/files/2015/04/IEEE-Robotics-Talk.pdf
5. https://www.intel.com/content/www/us/en/robotics/types-and-applications.html

CO-PO & PSO MAPPING:

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CO2	2	2	3	2	2	1	1	1	1	-	1	2	1	2
CO3	1	2	2	3	2	2	1	1	1	-	1	2	1	2
CO4	1	2	2	3	2	2	1	1	1	-	1	2	1	1
CO5	1	2	2	3	2	2	1	1	1	-	1	2	1	1
AVG	1.4	2.0	2.4	2.8	2	1.6	1	1	1	-	1	2	1	1.4

JEE2031 ARTIFICIAL INTELLIGENCE FOR ROBOTICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To study the concepts of Artificial Intelligence in robotics.
- To impart the methods of solving problems using Artificial Intelligence.
- To introduce the concepts of algorithms used for reasoning.
- To learn about different forms of learning and communication.
- To impart the knowledge of risks involved in artificial intelligence for robotics.

Pre-Requisites: Applied Soft Computing
Robotics

UNIT I INTRODUCTION 9

History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. PROBLEM SOLVING: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems–Adversarial search, knowledge and reasoning– knowledge representation – first order logic.

UNIT II PLANNING **9**

Planning with forward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.

UNIT III REASONING **9**

Uncertainty – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters– Dynamic Bayesian Networks, Speech recognition, making decisions.

UNIT IV LEARNING **9**

Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception.

UNIT V AI IN ROBOTICS **9**

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

Total: 45 Periods

Course Outcomes: At the end of the course, the student will be able to

- Identify problems that are amenable to solution by AI methods.
- Acquire the appropriate AI methods to solve a given problem.
- Formalise a given problem in the language/framework of different AI methods.
- Apply and implement basic of AI algorithms.
- Design and carry out an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", first edition, Pearson Education, India,2003.

2. Negne vitsky, M, "Artificial Intelligence: A guide to Intelligent Systems",first edition, Harlow: Addison-Wesley, 2002.

3. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1992.

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5. Francis X. Govers, "Artificial Intelligence for Robotics", standard edition, Packt Publishing Limited,2018.

REFERENCE BOOKS:

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CO-PO & PSO MAPPING:

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CO4	3	2	3	2	-	-	-	-	-	-	3	1	1	3
CO5	2	1	1	1	-	-	-	-	-	-	3	1	1	3
AVG	2.6	2	1.6	2	-	-	-	-	-	-	2.4	1	1	2.6

JEE2032 **INDUSTRY 4.0** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To study about an introduction to Industry 4.0 and its applications.
- To gain deep insights into how smartness is being harnessed from data.
- To get information about robotics and its security.
- To understand the cloud computing organizations.
- To familiarize in Industry 4.0 in various applications.

Pre-Requisites: Internet of Things

UNIT I INTRODUCTION **9**

Introduction to Industry 4.0 The Various Industrial Revolutions - Digitalization and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 - Comparison of Industry 4.0 Factory and Today's Factory.

UNIT II INTEGRATED IoT **9**

Road to Industry 4.0 - Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services - Smart Manufacturing - Smart Devices and Products - Smart Logistics – Smart Cities -Predictive Analytics

UNIT III ROBOTICS AND SECURITY 9

System, Technologies for enabling Industry 4.0 – Cyber Physical Systems – Robotic Automation and Collaborative Robots - Support System for Industry 4.0 - Mobile Computing - Cyber Security

UNIT IV CLOUD COMPUTING 9

Role of data, information, knowledge and collaboration in future organizations – Resource based view of a firm - Data as a new resource for organizations - Harnessing and sharing knowledge in organizations - Cloud Computing Basics -Cloud Computing and Industry 4.0

UNIT V CASE STUDY AND APPLICATIONS 9

Industry 4.0 case studies - Opportunities and Challenges - Future of Works and Skills for Workers inthe Industry 4.0 Era - Strategies for competing in an Industry 4.0 world – Society 5.0

Total: 45 Periods

Course Outcomes: At the end of the course, the student will be able to

- Acquire the insights of Industry 4.0.
- Compare the smartness in smart factories, smart cities, smart products and smart services.
- Analyze the outlines of the various robotic systems used in a manufacturing plant and theirrole in an Industry 4.0 world.
- Describe a strategic framework to exploit new technologies to enable cloud-based systems.
- Apply industry 4.0 concepts to real time applications.

TEXT BOOKS:

1. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, A press, 2016.

2. Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies RapidPrototyping to Direct Digital Manufacturing”, Springer, 2010

3. ArsheepBahga, Internet of Things: A Hands-on Approach”, Orient Blackswan Private Limited - NewDelhi,2015

4. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, RapidManufacturing”, Hanser Publisher, 2011

5. J. Chanchaichujit, A. Tan, Meng, F., Eaimkhong, S. “Healthcare 4.0 Next Generation Processes withthe Latest Technologies”, Palgrave Pivot, 2019.

REFERENCE BOOKS:

1. Bahga and V. Madisetti, “Internet of Things, A hands-on approach”, first edition, Create

SpaceIndependent Publishing Platform, 2014.
2. Bahga and V. Madisetti, “Cloud Computing”, first edition, Create Space Independent PublishingPlatform, 2013
3. M. Skilton and F. Hovsepian, “the 4th Industrial Revolution: Responding to the Impact of ArtificialIntelligence on Business”, Springer Nature, 2017.

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4 https://www.epicor.com/en-in/blog/learn/what-is-industry-4-0/
5 https://www.iare.ac.in/sites/default/files/IoT_LECTURE_NOTES_MODIFIED_0.pdf
6 https://nptel.ac.in/courses/10610614

CO-PO & PSO MAPPING:

CO\PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO1 0	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	-	-	-	-	-	-	2	1	1	2
CO2	2	3	1	2	-	-	-	-	-	-	2	1	1	2
CO3	3	2	2	3	-	-	-	-	-	-	2	1	1	3
CO4	3	2	3	2	-	-	-	-	-	-	3	1	1	3
CO5	2	1	1	1	-	-	-	-	-	-	3	1	1	3
AVG	2.6	2	1.6	2	-	-	-	-	-	-	2.4	1	1	2.6

Vertical V – Power Systems

JEE2033	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge about the Planning of DC power transmission and comparison with AC power transmission
- To study about HVDC converters.
- To provide knowledge about HVDC system control techniques.
- To teach the necessity of reactive power requirement and design of filters.
- To inculcate knowledge about Power flow in HVDC systems under steady state

Prerequisites: Transmission & Distribution

UNIT I INTRODUCTION TO HVDC 9

DC Power transmission technology–Comparison of AC and DC transmission–Application of DC transmission–Description of DC transmission system–Planning for HVDC transmission–Modern trends in HVDC technology–DC breakers–Operating problems– HVDC transmission based on VSC –Types and applications of MTDC systems

UNIT II ANALYSIS OF HVDC CONVERTERS 9

Line commutated converter -Analysis of Graetz circuit with and without overlap –Pulse number– Choice of converter configuration – Converter bridge characteristics– Analysis of a 12 pulse converters–Analysis of VSC topologies and firing schemes

UNIT III CONVERTER AND HVDC SYSTEM CONTROL 9

Principles of DC link control–Converter control characteristics–System control hierarchy– Firing angle control–Current and extinction angle control–Starting and stopping of DC link–Power control –Higher level controllers –Control of VSC based HVDC link.

UNIT IV REACTIVE POWER AND HARMONICS CONTROL 9

Reactive power requirements in steady state–Sources of reactive power–Static Var systems-Reactive power Control during transients-Generation of harmonics–Design of AC and DC filters–Carrier Frequency and RI noise

UNIT V POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

Modelling of DC links-Solution of DC load flow–Per unit System for DC quantities- Solution of AC-DC Power flow, Power flow analysis–case study

Total: 45 Periods

COURSE OUTCOMES: At the end of the course, the student will be able to

- Describe the basic concepts about the planning of DC power transmission and its comparison with AC Power transmission.
- Formulate and solve mathematical problems related to rectifier and inverter control methods.
- Interpret the different types of converter control techniques.
- Outline the concepts of reactive power management, harmonics and design of filters.
- Comprehend the importance of power flow in HVDC system under steady state

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TEXT BOOKS:

1.Padiyar, K.R., "HVDC power transmission system", Second Edition, New Age International (P) Ltd. New Delhi, 2010.

2.JosArrillaga, "HighVoltage Direct Current Transmission", The Institution of Engineering and Technology, 2008.

3.Kamakshaiah.S, Kamaraju.V, "HVDC Transmission", Tata McGraw Hill Education Private Limited, New Delhi, 2011

4.Nilanjan Ray Chaudhuri, "Integrating Wind Energy to Weak Power Grids using High Voltage Direct Current Technology", Springer, 2019.

5.DraganJovcic, "High Voltage Direct Current Transmission Converters, Systems and DC Grids",John Wiley & Sons Ltd, 2019

REFERENCE BOOKS :

1. Kundur P., "Power System Stability and Control", McGraw-Hill,1993.

2.Colin Adamson and Hingorani NG, "High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960

3.Edward Wilson Kimbark, "Direct Current Transmission", Vol.I, Wiley interscience, New York,1971

4.Minxiao Han and Aniruddha M.Gole,"Modelling and Simulation of HVDC Transmission", The Institution of Engineering and Technology, 2020.

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3.https://youtu.be/pRZ2ygbbyTg

4.https://youtu.be/k69WlxwmgyI

5.https://youtu.be/BszRwKj7rtc

CO-PO & PSO MAPPING:

CO\PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	1	-	-	-	1	2	3	1	2
CO2	2	3	1	2	-	1	-	-	-	1	2	2	1	2
CO3	3	2	2	3	-	1	-	-	-	-	2	3	1	3
CO4	3	2	3	2	-	1	-	-	-	-	3	3	1	3
CO5	2	1	1	1	-	1	-	-	-	1	3	2	1	3
AVG	2.6	2	1.6	2	-	1	-	-	-	1	2.4	2.6	1	2.6

JEE2034 **ELECTRIC ENERGY GENERATION, UTILIZATION AND CONSERVATION**

L T P C
3 0 0 3

COURSE OBJECTIVES:

- To develop the ability to perform lighting calculations and design illumination schemes for residential, commercial, industrial, street, and flood-lighting applications.
- To impart knowledge on refrigeration and air conditioning
- To explain the operating principles and applications of various electric heating and welding methods.
- To discuss electric traction systems, their components, control methods, and performance characteristics
- To familiarize students with domestic electrical installations, power quality issues, UPS systems, batteries, and earthing practices.

Prerequisites : Basic Engineering

UNIT I ILLUMINATION 9

Importance of lighting – properties of good lighting scheme – laws of illumination – photometry - types of lamps – lighting calculations – basic design of illumination schemes for residential, commercial, street lighting, factory lighting and flood lighting- LED lighting and energy efficient lamps. Case Study - Analysis of insufficient lighting in Substation, Replacement of conventional lights by led lights

UNIT II REFRIGERATION AND AIR CONDITIONING 9

Refrigeration-Domestic refrigerator and water coolers - Air-Conditioning-Various types of air-conditioning system and their applications, smart air conditioning units - Energy Efficient motors: Standard motor efficiency, need for efficient motors, Motor life cycle, Direct Savings and payback analysis, efficiency evaluation factor.

UNIT III HEATING AND WELDING 9

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding.

UNIT IV ELECTRIC TRACTION 9

Merits of electric traction – requirements of electric traction system – supply systems – mechanics of train movement – traction motors and control – braking – recent trends in electric traction.

UNIT V DOMESTIC UTILIZATION OF ELECTRICAL ENERGY 9

Domestic utilization of electrical energy – House wiring , Induction based appliances, Online and OFF line UPS, Batteries - Power quality aspects – nonlinear and domestic loads – Earthing system for Domestic, Industrial and Substation.

Total: 45 Periods

COURSE OUTCOMES: At the end of the course, students will able to

- Design energy-efficient illumination schemes and perform lighting calculations for various applications.
- Explain the operation and applications of refrigeration, air-conditioning systems, and energy-efficient motors.
- Analyze and select appropriate electric heating and welding methods for practical applications..
- Evaluate the performance and control of electric traction systems under different operating conditions.
- Apply domestic wiring, UPS, battery, power quality, and earthing principles for safe electrical installations.

TEXT BOOKS:

1. C.L.Wadhwa, “Generation, Distribution and Utilisation of Electrical Energy”, Seventh Edition ,New Age international Pvt. Ltd, 2016 .
2. Dr. Uppal S.L. and Prof. S. Rao, 'Electrical Power Systems', Fifteenth Edition, Khanna Publishers, New Delhi, 2014.
3. J.B.Gupta, “Utilisation Electric power and Electric Traction”, Twelth Edition , S.K.Kataria and sons, 2013.

4. D.P.Kothari, K.C.Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", Third Edition, PHI Learing Private Limited, 2022.
5. S C Bhatia, Sarvesh Devraj, " Industrial Energy Conservation, Volume I-II" , First Edition ,Wood head Publishing India in Energy , 2018.

REFERENCE BOOKS:

1.R.K.Rajput, "Utilisation of Electric Power", second Edition , Laxmi publications ,2016.

2. H.Partab, " Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New Delhi-2004.

3.N.V. Suryanarayana, "Utilisation of Electric Power", Second Edition, New Age International Limited, 2014

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4. https://youtu.be/Fv0Di_a_JbY
5. https://youtu.be/TvNyBocu1do
6. https://youtu.be/cvQ5tss5sfA

CO-PO & PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	1	1	1	-	-	1	3	-	1
CO2	2	1	-	1	1	1	1	1	-	-	1	3	-	1
CO3	3	3	2	3	-	1	-	1	-	-	1	3	-	-
CO4	3	3	2	3	-	1	-	1	-	-	1	3	-	-
CO5	3	2	1	2	1	1	1	1	-	-	1	3	-	1
AVG	2.8	2.2	2	2.2	1	1	1	1	-	-	1	3	-	1

JEE2035	POWER SYSTEM TRANSIENTS	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To provide an overview of the nature of power system transients and their effects on power systems
- To study the generation of switching transients phenomena.
- To provide the knowledge about the lightning phenomena and its protection methods.
- To inculcate knowledge about the concept of travelling waves and their effects.
- To impart knowledge of load rejection and different software packages to analyse about transients

Prerequisites: Power System Analysis

UNIT I INTRODUCTION TO TRANSIENTS 9

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

UNIT II SWITCHING TRANSIENTS 9

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.

UNIT III LIGHTNING TRANSIENTS 9

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

UNIT IV TRAVELING WAVES ON TRANSMISSION LINE 9

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

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM 9

The short line and kilometric fault-distribution of voltages in a power system-Line dropping and load rejection-voltage transients on closing and reclosing lines-over voltage induced by faults–switching surges on integrated system Qualitative application of EMTP for transient computation-case studies on simulation of various types of transients using EMTP and insulation co-ordination

Total: 45 Periods

COURSE OUTCOMES: At the end of the course, the student will be able to

- Review the concepts of power system transients.
- Comprehend the different issues related to resistance switching, capacitance switching, and load switching.
- Explain the mechanism of lighting strokes and also discuss about the protection of lighting surges.
- Gain knowledge on the propagation, reflection and refraction of travelling waves.
- Acquire knowledge on the impact of voltage transients caused by faults, circuit breaker action and load rejection on integrated power systems.

TEXT BOOKS:

1. Allan Greenwood, 'Electrical Transients in Power Systems', Second Edition, Wiley Inter Science, New York, 1991.

2. PritindraChowdhari, "Electromagnetic transients in Power System", Second Edition, John Wiley and Sons Inc., 2009

3. J.L.Kirtley,"Electric Power Principles, Sources, Conversion, Distribution and use", First Edition,Wiley, 2010.

REFERENCE BOOKS:

1. Heydt.G.T., "Electric Power Quality", Second Edition, Starsina Circle Publications,1994

2. Naidu. M.S and Kamaraju.V, "High Voltage Engineering", Fifth Edition, Tata Mc Graw Hill, 2013.

3. Begamudre . R.D, "Extra High Voltage AC Transmission Engineering", Fourth Edition, New age International (P) Ltd., New Delhi, 2009

4. Hase.Y, "Hand book of Power System Engineering ", Wiley India, 2012.

5. Ramanujam. R., "Computational Electromagnetic Transients: Modelling, Solution Methods and Simulation", IK International Publishing House pvt.Ltd , 2014.

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4.https://youtu.be/gklhqNdxOsk

5.https://youtu.be/1L2uAFO7l1A

6.https://youtu.be/1jIH5_RT1Cw

CO-PO & PSO MAPPING:

CO\PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	3	2	-	-	-	-	-	-	2	2	-	1
CO2	2	2	2	2	-	-	-	-	-	-	1	3	-	2
CO3	2	2	2	2	-	-	-	-	-	-	2	3	-	3
CO4	3	3	3	3	2	-	-	-	-	-	1	3	-	2
CO5	2	3	3	3	2	-	-	-	-	-	2	2	-	3
AVG	2.2	2.4	2.6	2.4	2	-	-	-	-	-	1.6	2.6	-	2.2

JEE2036 POWER QUALITY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge about power quality issues
- To study the concepts of Mitigation techniques of various power quality events.
- To learn the concepts of Harmonics in power systems.
- To educate about passive filters and compensation techniques
- To study about monitoring of power quality

Prerequisites: Power system analysis, Power System Transients

UNIT I INTRODUCTION TO POWER QUALITY 9

Terms and definitions & Sources – Overloading, under voltage, over voltage - Concepts of transients - Short duration variations such as interruption - Long duration variation such as sustained interruption - Sags and swells - Voltage sag - Voltage swell - Voltage imbalance–Voltage fluctuations-Power frequency variations-Wave form Distortion-International standards of power quality– CBEMA & ITI curves

UNIT II VOLTAGE SAG AND SWELL 9

Estimating voltage sag performance – Thevenin's equivalent source - Analysis and calculation of various faulted condition-Estimation of the sag severity-Mitigation of voltage sag, Static transfer switches and fast transfer switches.-Motor-Starting Sags- Transient Over voltages-Capacitor switching–Lightning-Ferro resonance-Mitigation of voltage swell

UNIT III HARMONICS 9

Harmonic sources from commercial and industrial loads - Locating harmonic sources – Power system response characteristics- Harmonics Vs transients. Effect of harmonics – Harmonic distortion - Voltage and current distortions - Harmonic indices - Interharmonics– Resonance Harmonic distortion evaluation, IEEE and IEC standards - Devices for Controlling Harmonic Distortion.

UNIT IV PASSIVE POWER COMPENSATORS 9

Principle of Operation of Passive Shunt and Series Compensators-Analysis and Design of Passive Shunt Compensators - Simulation and Performance of Passive Power Filters - Limitations of Passive Filters -Parallel Resonance of Passive Filters with the Supply System and Its Mitigation – Fundamentals of load compensation–voltage regulation & power factor correction–Introduction to FACTS

UNIT V POWER QUALITY MONITORING AND CUSTOM POWER DEVICES 9

Monitoring considerations - Monitoring and diagnostic techniques for various power quality problems - Quality measurement equipment - Assessment of Power Quality Measurement Data - Harmonic / spectrum analyzer - Flicker meters Disturbance analyzer - Applications of expert systems for power quality monitoring. Principle & Working of DSTATCOM – DSTATCOM in Voltage control mode, current control mode, DVR Structure – Rectifier supported DVR – DC Capacitor supported DVR-Unified power quality conditioner

Total: 45 Periods

COURSE OUTCOMES: At the end of the course, the student will be able to

- Identify the various power quality issues.
- Apply and analyse the causes & mitigation techniques of various Power quality events.
- Gain knowledge on harmonics and its controlling devices.
- Design the passive filters and compensation techniques.
- Use the equipment's required for measuring the quality of power.

TEXT BOOKS:

1.Roger.C .Dugan, Mark.F. Mc Granagham, Surya Santoso, H.WayneBeaty, "Electrical Power Systems Quality", Third Edition, McGrawHill, 2012

2.JosArrillaga, Neville R.Watson, "Power System Quality Assessment", Wiley, 2003

3.Bhim Singh, Ambrish Chandra, Kamal Al-Haddad," Power Quality Problems & Mitigation Techniques" John Wiley & Sons, 2015.

REFERENCE BOOKS :

1.G.T.Heydt, "Electric Power Quality", second Edition , Starsina CirclePublications,1994

2. M.H.J Bollen, "Understanding Power Quality Problems: Voltage Sags and interruption", Wiley,1999

3. Alexander Kusko, "Power Quality in Electrical Systems", McGraw-Hill Publications,2007

4. Arindam Ghosh "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, 2002

5.Derek A. Paice , "Power Electronics Converter Harmonics :Multipulse Methods for Clean Power",Wiley,1999.

6.Ewald Fuchs, Mohammad A. S. Masoum, "Power Quality in Power Systems and Electrical Machines", Elseveir academic press publications, 2011

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3.https://www.youtube.com/watch?v=HGKEaAkAceE

4.https://www.youtube.com/watch?v=n46aDV2h-gs

5.https://www.youtube.com/watch?v=Sw-YoBMGMuQ

CO-PO& PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	2	3	-	2
CO2	3	3	2	2	-	-	-	-	-	-	2	3	-	2
CO3	3	3	2	2	1	-	-	-	-	-	3	3	-	2
CO4	2	3	1	1	1	-	-	-	-	-	2	3	-	2
CO5	2	2	1	1	1	-	-	-	-	-	3	3	-	2
AVG	2.4	2.6	1.4	1.4	1	-	-	-	-	-	2.4	3	-	2

JEE2037 FLEXIBLE AC TRANSMISSION SYSTEMS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the concept of flexible AC transmission and the associated problems.
- To know the necessity of static devices for shunt control.
- To study the operation of controllers for enhancing the transmission capability.
- To provide knowledge on voltage source converter based FACTS controller.
- To Impart knowledge on Emerging FACTS controller and its coordination

Prerequisites: Power Quality

UNIT I INTRODUCTION OF FACTS 9

Basic types of FACTS controllers, benefits from FACTS controllers - Real and reactive power control electrical power transmission lines – loads & system compensation – Uncompensated transmission line– shunt and series compensation.

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS 9

Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator–TCR-FC-TCR-Modeling of SVC for power flow and fast transient stability– Applications: Enhancement of transient stability - Steady state power transfer–Enhancement of power system damping.

UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS 9

Operation of the TCSC–Different modes of operation–Modelling of TCSC, Variability reactance model– Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit–Enhancement of system damping.

UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 9

Static Synchronous Compensator (STATCOM)–Principle of operation–V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability-prevention of voltage instability. SSSC-operation of SSSC and the control of power flow–modelling of SSSC in load Flow and transient stability studies-Dynamic voltage restorer (DVR).

UNIT V ADVANCED FACTS CONTROLLERS AND CO- ORDINATION OF FACTS CONTROLLERS 9

Interline DVR (IDVR) - Unified Power flow controller (UPFC) - Interline power flow controller (IPFC) - Unified Power quality conditioner (UPQC). FACTs Controller interactions – SVC–SVC interaction-co-ordination of multiple controllers using linear control techniques.

Total: 45 Periods

COURSE OUTCOMES: At the end of the course, the student will be able to

- Relate real and reactive power Control in electrical power transmission lines and the importance of FACTS devices
- Design and model the shunt controller SVC for transient stability condition.
- Interpret the control circuits of series controller TCSC for various functions like transient stability Enhancement and power oscillation damping
- Analyse the performance of VSC based FACTS devices
- Acquire knowledge on advanced FACTS Controller, interactions and its Coordination

TEXT BOOKS:

1.MohanMathur, R., Rajiv. K. Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc, 2002.

2.NarainG.Hingorani,Laszio.Gyugyl,"Understanding FACTS Concepts and Technology of Flexible AC Transmission System", StandardPublishers,Delhi2001

3.Padiyar. K.R.,"FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi,

REFERENCE BOOKS:

1.John . A.T., "Flexible AC Transmission System", Institution of Electrical and Electronic Engineers (IEEE), 1999.

2.2008Miller.T.J.E, "Power Electronics in power systems" ,First Edition,Newnes,2001

3.Sood . V.K., "HVDC and FACTS controllers–Applications of Static Converters in Power System" , Kluwer Academic Publishers, 2004.

4.Singh, S.N., "Electric Power Generation Transmission and Distribution" , PHI, New Delhi, 2003.

5.Narain G. Hingorani, "High power Electronics and Flexible AC Transmission Systems", IEEE High Power Engineering Review, 1998.

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3.https://youtu.be/EFjUn85495E
4.https://youtu.be/4JYxtQo1nKM
5.https://youtu.be/OgWdcBe5urE
6.https://youtu.be/VfZzaY2YC70

CO-PO & PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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CO2	1	2	3	1	2	-	-	-	-	-	1	3	2	3
CO3	1	2	2	2	1	-	-	-	-	-	1	3	2	3
CO4	2	1	3	2	1	-	-	-	-	-	1	3	1	3
CO5	2	2	2	2	2	-	-	-	-	-	1	3	2	3
AVG	1.6	1.8	2.4	1.6	1.4	-	-	-	-	-	1	2.8	1.6	2.8

JEE2038 UNDER GROUND CABLE ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES :

- To impart knowledge on power cable characteristics and its applications.
- To provide knowledge about cable architecture and cable standards.
- To study about the types of distribution cables and its applications.
- To know about cables used in Transmission System
- To impart knowledge on cable fault detection, rectification, testing and maintenance.

Prerequisites: Transmission and Distribution

UNIT I INTRODUCTION TO ELECTRICAL POWER CABLES 9

Development of Underground Cables - Electric Lighting- Distribution of Energy for Lighting- Paper Insulated Cables - Underground Residential Distribution - Medium Voltage Cable Development.

UNIT II CABLE ARCHITECHTURE AND CABLE CHARACTERISTICS 9

Architecture of Underground Cabling System - Basic Dielectric Theory of Cable – Conductors - Armour and Protective Finishes - Cable Characteristics: Electrical Fundamentals of Electrical Insulation Materials - Electrical Properties of Cable Insulating Materials - Cable Standards and Quality Assurance - Cable design parameters- Current Carrying Capacity - Short-circuit Ratings.

UNIT III SUPPLY DISTRIBUTION SYSTEMS AND CABLES 9

Supply Distribution Systems - Distribution Cable Types, Design and Applications - Paper Insulated Distribution Cables - PVC Insulated Cables - Polymeric Insulated Distribution Cables for 6-30 kV - Manufacture of Distribution Cables - Joints and Terminations for Distribution Cables - Testing of Distribution Cables.

UNIT IV TRANSMISSION SYSTEMS AND CABLES 9

Basic Cable Types for A.C. Transmission - Gas Pressure Cables - High Pressure Fluid-filled Pipe Cables - Polymeric Insulated Cables for Transmission Voltages - Techniques for Increasing Current Carrying Capacity - Transmission Cable Accessories and Jointing for Pressure assisted and Polymeric Cables.

UNIT V CABLE INSTALLATION, TESTING, MAINTENANCE 9

Installation of Transmission Cables -Splicing, Terminating, and Accessories - Sheath Bonding and Grounding-Testing of Transmission Cable Systems - Underground System Fault Locating - Field Assessment of Power Cable Systems- Condition monitoring tests – PD measurements.

Total: 45 Periods

COURSE OUTCOMES: At the end of the course, the student will be able to

- Understand the fundamental of underground cable system.
- Gain knowledge on the architecture, physical and electrical characteristics of the underground cable.
- Explain the different types of cables used in distribution system.
- Acquire knowledge on Underground cables used in transmission system
- Outline the methodology used for cable fault detection, rectification, testing and maintenance

TEXT BOOKS:

1. William Thue, 'Electrical Power Cable Engineering', Third Edition, CRC Press Taylor & Francis Group, 2017.
2. G. F. Moore, "Electric Cables Handbook", Third edition, Blackwell Science Ltd, 2017.
3. Chowdhury S.P. and Crossley P, "Microgrids and Active Distribution Networks" The Institution of Engineering and Technology, London, U.K, 2009

REFERENCE BOOKS:

1. Leonard L. Grigsby, "Electrical Power Cable Engineering" , Third Edition, CRC Press, ,2012.
2. Christian Flytkjaer Jensen, Online Location of Faults on AC Cables in Underground Transmission Systems (Springer Theses), 2014.
3. R. W. Deltenre, J. J. Schwarz, and H. J. Wagnon, ''Underground cable fault location: A handbook to TD- 153,'' BDM Corp., Albuquerque, NM, USA, Final Rep. EPRI EL-363, 1977. [Online]. Available: https://www.osti.gov/servlets/purl/7233049, doi: 10.2172/7233049, January 1997.

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4. **https://youtu.be/Xh9WcieJChI**
5. **https://youtu.be/30DLpesnDDk**
6. **https://youtu.be/su2wlj877Kc**

CO-PO & PSO MAPPING:

CO\PO ,PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	2	-	-	-	-	-	2	-	3
CO2	3	2	-	-	-	2	-	-	-	-	-	3	-	3
CO3	3	2	-	-	-	2	-	-	-	-	-	3	-	3
CO4	3	2	-	-	-	2	-	-	-	-	-	2	-	3
CO5	3	2	-	-	-	2	-	-	-	-	-	3	-	3
AVG	3	2	-			2	-	-	-	-		2.6	-	3

JEE2039 DISTRIBUTED GENERATION AND MICROGRIDS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide an overview on the various conventional and non-conventional energy resources
- To illustrate the concept of distributed generation.
- To accord the basic knowledge about the impact of grid integration.
- To study the concept of micro grid and its configuration
- To learn the power quality issues in micro grids.

Prerequisites : Power system, Renewable Energy systems

UNIT I INTRODUCTION TO CONVENTIONAL AND NON-CONVENTIONAL ENERGY RESOURCES 9

Conventional power generation: advantages and disadvantages, Energy crises, Non-conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

UNIT II DISTRIBUTED GENERATIONS (DG) 9

Concept of distributed generations, topologies, selection of sources, regulatory standards/ frame work, Standards for interconnecting Distributed resources to electric power systems: IEEE1547.DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, fly wheels.

UNIT III IMPACT OF GRID INTEGRATION 9

Requirements for grid interconnection, limits on operational parameters, : voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

UNIT IV MICROGRIDS 9

Concept and definition of micro grid, micro grid drivers and benefits, review of sources of micro grids, typical structure and configuration of a micro grid, AC and DC micro grids, Power Electronics interfaces in DC and AC micro grids, communication infrastructure, modes of operation and control of micro grid: grid connected and is landed mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication-based techniques.

UNIT V POWER QUALITY ISSUES IN MICRO GRIDS 9

Power quality issues in micro grids- Modelling and Stability analysis of Micro grid, regulatory standards -IEEE519 standard, Micro grid economics, Introduction to smart micro grids

Total: 45 Periods

COURSE OUTCOMES: At the end of the course, the student will be able to

- Acquire knowledge on the various conventional and non-conventional energy resources
- Comprehend the concept of distributed generation
- Gain knowledge about the impact of grid integration.
- Interpret the micro grid configuration and its benefits
- To explicate the power quality issues in micro grids

TEXT BOOKS:

1. Tomás Gómez Román, José Pablo Chaves-Áila , " Integration of Renewable and Distributed Energy Resources in Power Systems", Mdpi AG publisher 2020

2. AmirnaserYezdani, and RezaIravani, “Voltage Source Converter sin Power Systems: Modeling, Control and Applications”, IEEE John Wiley Publications, 2009.
3. DorinNeacsu, “Power Switching Converters: Medium and High Power”, CRC Press, Taylor &Francis,2006.
4. Chetan Singh Solanki, “Solar Photo Voltaics”, Third Edition , PHI learningPvt.Ltd.,NewDelhi, ,2015

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1. Chowdhury S.P. and Crossley P, “Microgrids and Active Distribution Networks” The Institution of Engineering and Technology, London, U.K, 2009
2. ManwellJ.F,“Wind Energy Explained, theory design and applications”, J.G.McGowan Wiley publication, 2009.
3. Hall D.D. and Grover R.P.,“Bio mass Regenerable Energy”, John Wiley, NewYork,1987.
4. NikosHatziargyriou , “Micro grids: Architectures and Control”, Wiley-IEEE Press, 2014
5. John T widel land Tony Weir, “Renewable Energy Resources” ,Taylor and Francis Publications, 2005
6. GodfreyBoyle , “ Renewable Energy- Power for a sustainable future”, Third edition, Oxford University Press, 2013.

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3. https://youtu.be/f1rAtLauMbc
4. https://youtu.be/ZgUK9yZtMTw
5. https://youtu.be/4D2HzRBDg14
6. https://youtu.be/3DmThppGRv4

CO-PO & PSO MAPPING:

CO\PO, PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	-	-	-	-	-	2	3	2	2
CO2	2	3	1	2	1	-	-	-	-	1	2	2	2	2
CO3	2	2	2	2	1	-	-	-	-	1	2	2	1	2
CO4	1	1	2	2	1	-	-	-	-	-	-	2	1	2
CO5	1	1	2	2	1	-	-	-	-	-	1	2	2	1
AVG	1.6	1.8	1.8	1.8	1	-	-	-	-	1	1.4	2.2	1.6	1.8

JEE2040	SMART GRID	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide an overview on the concepts of smart grid and its present developments.
- To study about smart grid technologies
- To familiarize with various smart meters and advanced metering infrastructure
- To learn the power quality management in smart grids
- To introduce the concepts about LAN, WAN and Cloud Computing for smart grid applications

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid.

UNIT II SMART GRID TECHNOLOGIES 9

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Outage management.

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Introduction to Smart Meters, Advanced Metering infrastructure(AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices(IED) & their application for monitoring & protection.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Local Area Network(LAN), House Area Network(HAN), Wide Area Network(WAN), Broad band over Power line(BPL),IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

Total: 45 Periods

COURSE OUTCOMES: At the end of the course, the student will be able to

- Interpret the concepts of smart grid and its present developments.
- Acquire knowledge on smart grid technologies
- Gain knowledge about different smart meters and advanced metering infrastructure.
- Evaluate power quality management in Smart Grids
- Explain the concepts of LAN, WAN and Cloud Computing for Smart Grid applications.

TEXT BOOKS:

1. Shunmugalatha .A ,Chandrasekar.T , Ashok Kumar .B ,Rajeswari.J, "Smart Grids", Technical Publication , 2021
2. JamesMomoh, "Smart Grid– fundamentals of design and analysis", John Wiley and Sons,2012
3. JanakaEkanayake, "Smart Grid-Technology and Applications", John Wiley and Sons,2012
4. ClarkW.Gellings,"TheSmartGrid-Enabling energy efficiency and demand response" , CRC press, 2009.

REFERENCE BOOKS:

1. Fereidoon P.Sioshansi, "Smart grid-integrating renewable, distributed and efficient energy", Elsevier, 2012
2. StuartBorlase," Smart Grids, Infratructure, technology and solutions", CRC press ,2013
3. Vehbi C. Gungor ,DilanSahin, TaskinKocak, SalihErgüt, ConcettinaBuccella, Carlo Cecati, and Gerhard P. Hancke, "Smart Grid Technologies: Communication Technologies and Standards" IEEE Transactions On Industrial Informatics, Vol.7,No.4, November2011.
4. Xi Fang, Satyajayant Misra, GuoliangXue, and DejunYang , "SmartGrid –The New and Improved Power Grid: A Survey" ,IEEE Transaction on Smart Grids,vol.14,2012.

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4. https://youtu.be/XVK6eseBcjQ
5. https://youtu.be/tbi8LyvN2CM
6. https://youtu.be/MX_9srBXj1w

CO-PO&PSO MAPPING:

CO\PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	-	-	-	-	-	-	3	2	2
CO2	2	3	3	2	1	-	-	-	-	1	2	2	1	2
CO3	2	2	2	2	1	-	-	-	-	1	2	2	1	2
CO4	1	1	2	3	1	-	-	-	-	-	-	2	1	2
CO5	1	1	2	3	1	-	-	-	-	-	1	2	2	1
AVG	1.6	1.8	2.2	2.4	1	-	-	-	-	1	2.6	2.2	1.4	1.8

Vertical VI – Electric Vehicle Technology

JEE2041	ELECTRIC VEHICLE ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the history, fundamentals, construction, charging mechanisms, and advantages of Hybrid Electric Vehicles (HEVs) and Plug-in Hybrid Electric Vehicles (PHEVs).
- To explain various electric vehicle architectures, including series, parallel, series-parallel, micro, and mild hybrid configurations, and their applications in different types of electric vehicles.
- To demonstrate the principles of vehicle mechanics, including vehicle dynamics, propulsion power requirements, tire-road interactions, and propulsion system design.
- To differentiate the sizing and operation of EV/HEV powertrain components such as motors, batteries, gears, transmissions, differentials, and braking systems.
- To evaluate the economic feasibility and environmental impacts of electric and hybrid electric vehicles using life cycle cost analysis and greenhouse gas emission assessment.

UNIT I INTRODUCTION TO HYBRID ELECTRICAL VECHICLE 9

Introduction-History-Comparison with electrical and hybrid electrical vehicle-Construction and working of PHEV- Block diagram and components-Charging mechanisms-Advantages of PHEVs.

UNIT II VEHICLE ARCHITECTURE AND SIZING 9

Electric Vehicle History, and Evolution of Electric Vehicles. Series, Parallel and Series parallel Architecture, Micro and Mild architectures. Mountain Bike – Motorcycle - Electric Cars and Heavy Duty EVs. - Details and Specifications.

UNIT III VEHICLE MECHANICS 9

Vehicle mechanics- Roadway fundamentals, Laws of motion, Vehicle Kinetics, Dynamics of vehicle motion, propulsion power, velocity and acceleration, Tire –Road mechanics, Propulsion System Design.

UNIT IV POWER COMPONENTS AND BRAKES 9

Power train Component sizing- Gears, Clutches, Differential, Transmission and Vehicle Brakes. EV power train sizing , HEV Power train sizing - Example.

UNIT V ECONOMIC & ENVIRONMENTAL IMPACT ANALYSIS 9

Introduction to Vehicle Selection, Life Cycle Cost Analysis, LCC Data Requirements, LCC Sensitivity Analysis, Environmental Impact Analysis - GHG Emissions in the Vehicle Production Phase, GHG Emissions in the Vehicle Operation Phase, GHG Emissions in the Vehicle End-of-Life Phase, Environmental Impact Analysis Data Requirements

TOTAL: 45 Periods

COURSE OUTCOMES: At the end of the course, the student will be able to

- Explain the fundamentals, construction, charging mechanisms, and advantages of HEVs and PHEVs.
- Discuss various EV and HEV architectures and their applications.
- Apply vehicle mechanics principles to determine vehicle dynamics and propulsion requirements.
- Analyze the sizing and operation of EV/HEV powertrain and braking systems.
- Assess the economic and environmental impacts of electric and hybrid electric vehicles.

TEXT BOOKS:

1. Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press, First edition 2017.
2. Bob Brant, SethLeitman ,"Build Your Own Electric Vehicle", Third Edition, McGraw Hill, 2013.
3.Mehrdad Ehsani, YiminGao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2004.

REFERENCE BOOKS:

1. Mark Warner, "The Electric Vehicle Conversion Handbook: How to Convert Cars, Trucks, Motorcycles, and Bicycles - Includes EV Components, Kits, and Project Vehicles", HP Books, 2011.
2. Shashank Arora, Alireza Tashakori Abkenar, Shantha Gamini Jayasinghe, Kari Tammi, "Heavy-duty Electric Vehicles from Concept to Reality", Elsevier Science, 2021.
3. Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm, Nil Patel, Akash Kumar " Electric Vehicles Modern Technologies and Trends", Nielsen Springer, 2020

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3. https://www.csie.ntu.edu.tw/~cyy/courses/assembly/12fall/lectures/handouts/lec08_ARMarch.pdf
4. https://www.youtube.com/watch?v=J4fhE4Pp55E&list=PLGs0VKk2DiYypuwUUM2wxzcI9B

CO - PO & PSO MAPPING :

CO\PO & PSO	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	1	2	1	3	1	2	2	-	1	2	2	1
CO2	1	2	1	2	1	3	1	2	2	-	1	2	2	1
CO3	1	2	1	2	1	3	1	2	2	-	1	3	3	1
CO4	2	3	2	3	2	3	1	2	2	-	1	3	3	2
CO5	3	3	3	3	3	3	1	2	2	-	1	3	3	3
AVG	1.6	2.4	1.6	2.4	1.6	3	1	2	2	-	1	2.6	2.6	1.6

JEE2042 ENERGY STORAGE SYSTEM FOR E-MOBILITY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To present an overview of Electric vehicles (EV), and their architecture.
- To study the EV system.
- To demonstrate the basics of battery energy storage systems and super capacitor storage systems.
- To demonstrate the basics of Fuel cell and Hydrogen storage systems.
- To demonstrate the basics of battery testing and management systems.

UNIT I INTRODUCTION TO STORAGE & ELECTRIC VEHICLES 9

General background on alternative energy sources & sustainability - Overview of energy storage systems – Introduction to electric-based transportation, Overview of electric vehicles, Vehicle dynamics, sizing components, Fuel economy, emissions & electric mileage calculations – Applications –Land, space, and marine.

UNIT II SYSTEM COMPONENTS OF EV **9**

Classification of electric vehicles (EV) - General architecture, Layout & System components- Battery storage, Transmission system – Modelling of multimode electrically variable transmission .

UNIT III BATTERY STORAGE SYSTEMS **9**

Principle of operation of Lithium-ion battery, battery components & design, electrode, battery modules & packs, Advanced batteries, double layer & super capacitors for transportation applications, Design of battery & super capacitors for large vehicles.

UNIT IV FUEL CELL AND HYDROGEN STORAGE SYSTEMS **9**

Introduction to fuel cell – Types, Operation, Modelling & characteristics, proton exchange membrane (PEM) fuel cell for E-mobility, solid oxide fuel cell – Design of Fuel cell vehicles. Hydrogen storage system – solid state hydrogen storage tanks, gas phase hydrogen storage tanks, cryogenic & liquid phase hydrogen storage tanks.

UNIT V BATTERY TESTING & MANAGEMENT SYSTEMS **9**

Charging methods of battery – constant voltage, constant current and hybrid – Battery power testing for various vehicles - Battery management system & controls – Active & passive cooling of battery - Battery life & safety impacts – Code & standards.

TOTAL: 45 Periods

COURSE OUTCOMES: At the end of the course, the student will be able to

- Understand the concept of electric vehicle and energy storage systems.
- Describe the working and components of Electric Vehicle and Hybrid Electric Vehicle.
- Illustrate the operation of storage systems such as battery and super capacitors.
- Analyze the various energy storage systems based on fuel cells and hydrogen storage.
- Design and develop the battery management systems.

TEXT BOOKS:

1. Mehrdad Ehsani, YiminGao, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", Second Edition, CRC Press, 2010.
2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, "Hybrid Electric Vehicles Principles and Applications With Practical Perspectives", Wiley Publication, 2011.
3. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals", Second Edition', CRC Press, Taylor & Francis Group, 2011.

REFERENCE BOOKS:

1. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Wiley, 2003.

2. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013.
3. C.C. Chan and K.T. Chau, "Modern Electric Vehicle Technology", OXFORD University Press, 2001.

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2. https://www.cprogramming.com/
3. https://www.allaboutcircuits.com/technical-articles/introduction-to-the-c-programminglanguage- for-embedded-applications/
4. https://onlinecourses.nptel.ac.in/

CO - PO & PSO MAPPING :

CO\ PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	2	2	-	1	1	-	-	-	-	2	3	-	-
CO2	3	2	2	1	1	1	-	-	-	-	2	3	3	3
CO3	3	2	2	1	1	1	-	-	-	-	2	3	1	-
CO4	3	2	2	2	-	1	-	-	-	-	2	3	-	1
CO5	3	2	3	2	2	1	-	-	-	-	2	3	3	3
AV G	3	2	2.2	1.2	1	1	-	-	-	-	2	3	1.4	1.4

JEE2043 POWER CONVERTER FOR ELECTRIC VEHICLE DRIVE SYSTEMS **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To review the drive cycles and requirements of EVs
- To know the working of motors used in Electric Vehicle
- To analyze and model the buck/boost converter operation and to design the same
- To learn the simulation basics of control systems
- To derive transfer functions for DC-DC converters

UNIT I ELECTRIC VEHICLE DYNAMICS **9**

Standard drive cycles -Dynamics of Electric Vehicles-Tractive force-Maximum speed, torque, power, energy requirements of EVs.

UNIT II MOTORS FOR ELECTRIC VEHICLES **9**

Introduction – Speed And Torque control of above and below rated speed-Speed control of EV in the constant power region of electric motors. DC Motors, Induction Motor, Permanent Magnet Synchronous Motors (PMSM), Brushless DC Motors, Switched Reluctance Motors (SRMs) - Choice of electric machines for EVs.

UNIT III BASICS OF SIMULATION IN CONTROL SYSTEMS **9**

Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions).

UNIT IV MODELING OF DC-DC CONVERTERS **9**

Overview of PWM Converter Modelling -Power Stage Modelling - PWM Block Modelling – Voltage Feedback Circuit and Small-Signal Model of PWM Converter - Averaging Power Stage Dynamics - Average Models for buck/boost Converter - Small-Signal Model of Converter Power Stage - Frequency Response of Converter.

UNIT V POWER STAGE TRANSFER FUNCTIONS OF DC – DC CONVERTERS **9**

Power Stage Transfer Functions of buck-boost Converter in CCM Operation, Input-to-Output Transfer Function, Duty Ratio-to-Output Transfer Function, Load Current-to-Output Transfer Function.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will have to

- Use appropriate electric machine for electric vehicle application
- Compute transfer function with factors such as constant, integral, differential, first order factor and second order factor (both numerators & denominators)
- Design buck, boost and buck-boost converter.
- Compute a power stage transfer functions for DC-DC converters
- Simulate DC-DC converters and to obtain gain margin and phase margin.

TEXT BOOKS :

1. Teuvo Suntio, Tuomas Messo, Joonas Puukko, "Power Electronic Converters", Kindle Edition, 2017.
2. Randall Shaffer, "Fundamentals of Power Electronics with MATLAB", Second Edition, Lakshmi publications, 2013,
3. Dean Frederick and Joe Cho, "Feedback Control problems using MATLAB and the Control system tool box", First Edition, Cengage learning, 2000.

REFERENCE BOOKS:

1. Ali Emadi, "Handbook of Automotive Power Electronics and Motor Drives", First Edition, Taylor & Francis, 2005.
2. Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, "Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK", First Edition, Wiley,2021.
3. Md. Rabiul Islam,Md. Rakibuzzaman Shah, Mohd. Hasan Ali, "Emerging Power Converters for Renewable Energy and Electric Vehicles Modeling, Design, and Control", First Edition, CRC Press, 2021.
4. Iqbal Hussain, “Electric and Hybrid Vehicles: Design Fundamentals”, Third Edition, CRC Press, Taylor & Francis Group, 2021.

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2. https://onlinecourses.nptel.ac.in/noc20_cs15/preview
3.https://www.csie.ntu.edu.tw/~cyy/courses/assembly/12fall/lectures/handouts/lec08_ARMarch.pdf
4.https://www.youtube.com/watch?v=J4fhE4Pp55E&list=PLGs0VKk2DiYypuwUUM2wxzcI9B

CO - PO & PSO MAPPING :

CO\ PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	2	1	2	-	1	2	-	-	-	-	2	3	-	-
CO2	3	2	2	2	1	-	-	-	-	-	2	3	3	3
CO3	3	2	2	1	1	1	-	-	-	-	2	2	1	-
CO4	3	2	1	2	-	-	-	-	-	-	2	3	-	1
CO5	3	1	3	2	2	2	-	-	-	-	2	3	3	3
AVG	2.8	1.6	2	1.4	1	1	-	-	-	-	2	3	1.4	1.4

JEE2044 **VEHICLE DYNAMICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Understand the dynamics of vehicle ride under different riding condition.
- Present a problem oriented in depth knowledge of Vehicle Dynamics.
- Address the underlying concepts and methods behind Vehicle Dynamics
- Calculate and refer the loads and forces associated to the vehicles.
- Analyze the behaviour of the vehicles under acceleration, ride and braking

UNIT I BASICS OF VEHICLE DYNAMICS **9**

History, vehicle classifications, fundamental approaches to vehicle dynamics modelling; SAE Vehicle axis system, Forces & moments affecting vehicle, Earth Fixed coordinate system,

Dynamic axle loads, Equations of motion, transmission characteristics, vehicle performance, Brake proportioning, braking efficiency.

UNIT II ACCELERATION PERFORMANCE: 9

Power train components; power and traction limited acceleration; transverse weight shift; front wheel drive vs rear wheel drive vs. all-wheel drive vehicles

UNIT IV BRAKING PERFORMANCE: 9

Braking force analysis; brake design and analysis; federal regulation on braking performance; antilock braking system; wheel lock-up; tire/road friction; safety and maintenance issues in braking

UNIT IV ROAD LOADS: 9

Wind drag and car body design, rolling resistance; breakdowns of total road loads; gas mileage analysis and driving styles; Aerodynamics

UNIT V TIRE AND TIRE DYNAMICS 9

Tire specifications and constructions; tire motion analysis; tire force analysis; tire contact stress analysis; tire vibration analysis; tire models

Total: 45 Periods

COURSE OUTCOMES: At the end of the course, the student will have to

- Analyze the basic of vehicle dynamics.
- Understand acceleration in electric vehicle to understand the vehicle dynamics under various conditions.
- Analyze braking performance in electric vehicle to understand the vehicle dynamics under these conditions.
- Articulate road loads dynamics in electric vehicles.
- Articulate tire dynamics in electric vehicles.

TEXT BOOKS :

1. Thomas Gillespie , "Fundamentals of Vehicle Dynamics", SAE Publication, 2021

2. Mike Blundell and Damian Harty, "The Multibody systems Approach to Vehicle Dynamics", Elsevier, 2004.
3. Hans Pacejka, "Tire and Vehicle Dynamics", Elsevier, 2012

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CO - PO & PSO MAPPING :

CO\PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	2	1	2	1	2	-	-	-	-	2	3	1	3
CO2	3	2	1	1	1	1	-	-	-	-	2	3	1	3
CO3	3	2	1	2	-	1	-	-	-	-	2	3	1	3
CO4	3	2	2	2	1	1	-	-	-	-	2	3	1	3
CO5	3	2	2	2	2	1	-	-	-	-	2	3	2	3
AVG	3	2	1.4	1.8	1	1.2	-	-	-	-	2	3	1.2	3

JEE2045 ELECTRIC VEHICLE CHARGING SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know the charging station and standards
- To learn the concepts of power converters in charging
- To find the charging scheme in renewable based EV charging
- To demonstrate the wireless power transfer technique
- To design & simulate power factor correction circuits

UNIT I CHARGING STATIONS AND STANDARDS 9

Introduction-Charging technologies- Conductive charging, EV charging infrastructure, International standards and regulations - Inductive charging, need for inductive charging of EV, Modes and operating principle, Static and dynamic charging, various level of charging, International standards and regulations

UNIT II POWER ELECTRONICS FOR EV CHARGING 9

Layouts of EV Battery Charging Systems-AC charging-DC charging systems- Power Electronic Converters for EV Battery Charging- AC–DC converter with boost PFC circuit, with bridge and without bridge circuit

UNIT III EV CHARGING USING RENEWABLE AND STORAGE SYSTEMS 9

Introduction- - EV charger topologies , EV charging/discharging strategies - Integration of EV charging-home solar PV system , Operation modes of EVC-HSP system , Control strategy of EVCHSP system - fast-charging infrastructure with solar PV and energy storage.

UNIT IV WIRELESS POWER TRANSFER 9

Introduction - Inductive, Magnetic Resonance, Capacitive types. Wireless Chargers for Electric Vehicles -– Benefits of WPT. - WPT Operation Modes - Standards for EV Wireless Chargers, SAE J2954, IEC 61980. ISO 19363

UNIT V POWER FACTOR CORRECTION IN CHARGING SYSTEM 9

Need for power factor correction- Boost Converter for Power Factor Correction, Sizing the Boost Inductor, Average Currents in the Rectifier and calculation of power losses.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will have to

- To illustrate various charging techniques and to know charging standards and regulations.
- To demonstrate the working o DC-DC converters used for charging systems and principles
- To illustrate the advantages of renewable system based charging systems
- To demonstrate the principles of wireless power transfer.
- To analyze the standards for wireless charging
- To design and simulate boost converter based power factor correction.

TEXT BOOKS :

1. Miao Wang Ran Zhang Xuemin (Sherman) Shen, "Mobile Electric Vehicles Online Charging and Discharging", First Edition , Springer, 2016.
2. Alicia Triviño-Cabrera, José M. González-González, José A. Aguado, "Wireless Power Transferor Electric Vehicles: Foundations and Design Approach", First Edition, Springer Publisher, 2020.
3. Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen, "Electric Vehicles Modern Technologies and Trends", First Edition, Springer Publisher, 2021.

REFERENCE BOOKS:

1. Rajiv Singh, Sanjeevikumar Padmanaban, Sanjeet Dwivedi, Marta Molinas and Frede Blaabjerg, "Cable Based and Wireless Charging Systems for Electric Vehicles, Technology and control, management and grid integration", First Edition , IET, 2021.
2. James D Halderman,"Electric and Hybrid Electric Vehicles", First Edition Pearson, 2022.
3. Ali Emadi,"Handbook of Automotive Power Electronics and Motor Drives", Taylor & Francis, 2005.

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2. https://onlinecourses.nptel.ac.in/noc20_cs15/preview
3.https://www.csie.ntu.edu.tw/~cyy/courses/assembly/12fall/lectures/handouts/lec08_ARMarch.pdf
4.https://www.youtube.com/watch?v=J4fhE4Pp55E&list=PLGs0VKk2DiYypuwUUM2wxzcI9B

CO - PO & PSO MAPPING :

CO\PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
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CO2	3	3	3	3	1	1	-	-	-	-	3	3	3	3
CO3	3	2	2	2	2	1	-	-	-	-	2	3	3	3
CO4	3	3	3	3	1	1	-	-	-	-	1	3	3	3
CO5	3	2	2	2	2	1	-	-	-	-	2	3	3	3
AVG	3	2.8	2.6	2.6	1.6	1	-	-	-	-	2.2	3	2.8	2.8

JEE2046	GRID INTEGRATION OF ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know the basic details of V2G
- To study the benefits of V2G
- To study the challenges of V2G
- To learn EV & V2G on the smart grids renewable energy systems
- To know the grid integration

UNIT I DEFINITION AND STATUS OF V2G **9**

Defining Vehicle to Grid (V2G) - History and Development of V2G. Incorporating V2G to the EV, Auditing and Metering, V2G in Practice, V2G - Power Markets and Applications. Electricity Markets and V2G Suitability, Long-Term Storage, Renewable Energy, Energy yield assessment and demand side assessment

UNIT II BENEFITS OF V2G **9**

Benefits of V2G, Technical Benefits: Storage Superiority and Grid Efficiency, Economic Benefits: EV Owners and Societal Savings, Environment and Health Benefits: Sustainability in Electricity and Transport, Other Benefits.

UNIT III CHALLENGES TO V2G **9**

Technical Challenges - Battery Degradation, Charger Efficiency, Aggregation and Communication, V2G in a Digital Society. The Economic and Business Challenges to V2G - Evaluating V2G Costs and Revenues - Regulatory and Political Challenges to V2G , V2G and Regulatory Frameworks .

UNIT IV IMPACT OF EV AND V2G **9**

Introduction - Types of Electric Vehicles - Motor Vehicle Ownership and EV Migration - Impact of Estimated EVs on Electrical Network - Impact on Drivers and the Smart Grid - Standardization and Plug-and-Play - IEC 61850 Communication Standard and IEC 61850-7-420 Extension.

UNIT V GRID INTEGRATION AND MANAGEMENT OF EVs 9

Introduction - Machine to Machine (M2M) in distributed energy management systems - M2M communication for EVs - M2M communication architecture (3GPP) - Electric vehicle data logging - Scalability of electric vehicles -M2M communication with scheduling.

Total: 45 Periods

Course Outcomes: At the end of the course, the student will have to

- Explain the concepts related with V2G
- Study the grid connection of 3 phase Q inverter
- Explain the technical, economics. business, regulatory & political challenges related with V2G
- Demonstrate the impact of EV and V2G on smart grid and renewable energy system
- Explain the concept of grid integration and management of EVs.

TEXT BOOKS:

1. Ali Emadi, "Advanced Electric Drive Vehicles", First Edition, CRC Press, 2017.
2. Sumedha Rajakaruna , Farhad Shahnia and Arindam Ghosh,"Plug In Electric Vehicles in Smart Grids, Charging Strategies", First Edition, Springer, 2015.
3. Nand Kishor, Jesus Fraile-Ardanuy, "ICT for Electric Vehicle Integration with the Smart Grid" , IET 2020.

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1. Junwei Lu and Jahangir Hossain, "Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid", First Edition , IET, 2015.
2. Lance Noel, Gerardo Zarazua de Rubens Johannes Kester, Benjamin K. Sovacool, Vehicleto, "Grid A Socio technical Transition Beyond Electric Mobility", First Edition , 2019.

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2. https://onlinecourses.nptel.ac.in/noc20_cs15/preview
3.https://www.csie.ntu.edu.tw/~cyy/courses/assembly/12fall/lectures/handouts/lec08_ARMarch.pdf
4.https://www.youtube.com/watch?v=J4fhE4Pp55E&list=PLGs0VKk2DiYypuwUUM2wxzcI9B

CO - PO & PSO MAPPING :

CO\PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	1	2	1	-	-	-	-	-	3	3	1
CO2	3	3	1	1	3	1	-	-	-	-	-	3	2	1
CO3	3	3	3	1	2	1	-	-	-	-	-	3	2	1
CO4	3	3	2	1	2	1	-	-	-	-	-	3	2	2
CO5	3	3	2	1	2	1	-	-	-	-	-	3	2	1
AVG	3	3	2	1	2.2	1	-	-	-	-	-	3	2.2	1.2

JEE2047 BATTERY MANAGEMENT SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- Describe battery parameters, measurement techniques, and sensing methods used in battery management systems.
- Explain charging strategies, thermal management techniques, and operational modes of battery management systems.
- Illustrate charge balancing techniques and balancing optimization methods employed in battery packs.
- Develop the ability to analyze State-of-Charge (SOC) estimation algorithms and observer-based techniques.
- Evaluate State-of-Health (SOH) estimation methods and predictive models for battery life assessment.

UNIT I MEASUREMENT OF BATTERY PARAMETERS 9

Cell Voltage Measurement, Current Measurement, Current Sensors Current Sense Measurements, Synchronization of Current and Voltage, Temperature Measurement, Measurement Uncertainty and Battery Management, System Performance

UNIT II BATTERY MANAGEMENT SYSTEM FUNCTIONALITY 9

Charging, Strategies, CC/CV Charging Method, Target Voltage Method, Constant Current Method, Thermal Management, Operational Modes

UNIT III CHARGE BALANCING **9**

Balancing Strategies, Balancing Optimization, Charge Transfer Balancing, Flying Capacitor, Inductive Charge Transfer Balancing, Transformer Charge Balancing, Dissipative Balancing, Balancing Faults

UNIT IV STATE-OF-CHARGE ESTIMATION ALGORITHMS **9**

Challenges, Definitions, Coulomb Counting, SOC Corrections, OCV Measurements, Temperature Compensation, Kalman Filtering, Other Observer Methods.

UNIT V STATE-OF-HEALTH ESTIMATION ALGORITHMS **9**

State of Health, Mechanisms of Failure, Predictive SOH Models Impedance Detection, Passive Methods, Active Methods, Capacity Estimation, Self-Discharge Detection Parameter Estimation, Dual-Loop System, Remaining Useful Life Estimation

Total**: 45 Periods**

COURSE OUTCOMES: At the end of the course, the student will have to

- Explain battery parameter measurements, sensing techniques, synchronization methods, and performance evaluation in battery management systems.
- Apply charging strategies, thermal management techniques, and operational modes for efficient battery management.
- Analyze charge balancing strategies, charge transfer methods, balancing optimization techniques, and balancing faults.
- Analyze State-of-Charge estimation algorithms using Coulomb Counting, OCV methods, Kalman Filtering, and observer-based approaches.
- Assess State-of-Health estimation techniques, predictive SOH models, remaining useful life estimation, and battery failure mechanisms.

TEXT BOOKS:

1. H. J. Bergveld, “Battery management systems : design by modelling”, University Press Facilities, Eindhoven,2001.
2. Phillip Weicker, “A Systems Approach to Lithium-Ion Battery Management”, artech house, 2014.
3. Gregory L. Plett, “Battery Management Systems: Battery Modeling”, Artech house, 2015

REFERENCE BOOKS:

1. M. Barak (Ed.), T. Dickinson, U. Falk, J.L. Sudworth, H.R. Thirsk, F.L. Tye, "Electrochemical Power Sources: Primary & Secondary Batteries", IEE Energy Series 1, A. Wheaton &Co, Exeter, 1980.
2. C.C Chan, K.T Chau, "Modern Electric Vehicle Technology", Oxford University Press Inc., New York, 2001.

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2. https://onlinecourses.nptel.ac.in/noc20_cs15/preview
3.https://www.csie.ntu.edu.tw/~cyy/courses/assembly/12fall/lectures/handouts/lec08_ARMarch.pdf
4.https://www.youtube.com/watch?v=J4fhE4Pp55E&list=PLGs0VKk2DiYypuwUUM2wxzcI9B

CO - PO & PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1	1	1	1	-	1	1	1	1
CO2	2	3	2	3	2	1	1	1	1	-	1	2	2	2
CO3	2	3	2	3	2	1	1	1	1	-	1	2	2	2
CO4	2	3	2	3	2	1	1	1	1	-	1	2	2	2
CO5	2	3	2	3	2	1	1	1	1	-	1	2	3	3
AVG	2.2	2.8	1.8	2.8	1.8	1.0	1.0	1.0	1.0	-	1.0	1.8	2.0	2.0

JEE2048 TESTING OF ELECTRIC VEHICLES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know various standardization procedures
- To learn the testing procedures for EV & HEV components
- To know the functional safety and EMC
- To realize the effect of EMC in EVs
- To study the effect of EMI in motor drives and in DC-DC converter system

UNIT I EV STANDARDIZATION **9**

Introduction - Current status of standardization of electric vehicles, electric Vehicles and Standardization - Standardization Bodies Active in the Field – Standardization activities in countries like Japan. The International Electro Technical Commission - Standardization of Vehicle Components.

UNIT II TESTING OF ELECTRIC AND HYBRID ELECTRIC VEHICLES **9**

Test Procedure Using M-G Set, electric motor, controller, application of Test Procedure, Analysis of Test Items for the Type Test - Motor Test and Controller Test (Controller Only). - Test Procedure Using Eddy Current Type Engine Dynamometer, Test Strategy, Test Procedure, Discussion on Test Procedure. Test Procedure Using AC Dynamometer.

UNIT III FUNDAMENTALS OF FUNCTIONAL SAFETY AND EMC **9**

Functional safety life cycle - Fault tree analysis - Hazard and risk assessment – software development - Process models - Development assessments - Configuration management – Reliability - Reliability block diagrams and redundancy - Functional safety and EMC - Functional safety and quality - Standards - Functional safety of autonomous vehicles.

UNIT IV EMC IN ELECTRIC VEHICLES **9**

Introduction - EMC Problems of EVs, EMC Problems of Motor Drive, EMC Problems of DC-DC Converter System, EMC Problems of Wireless Charging System, EMC Problem of Vehicle Controller, EMC Problems of Battery Management System, Vehicle EMC Requirements-

UNIT V EMI IN MOTOR DRIVE AND DC-DC CONVERTER SYSTEMS **9**

Overview -EMI Mechanism of Motor Drive System, Conducted Emission Test of Motor Drive System, IGBT EMI Source, EMI Coupling Path, EMI Modelling of Motor Drive System. EMI in DC-DC Converter, EMI Source, The Conducted Emission High-Frequency, Equivalent Circuit of DC-DC Converter System, EMI Coupling Path

Total: 45 Periods

COURSE OUTCOMES: At the end of the course, the student will have to

- Describe the status and other details of standardization of EVs
- Illustrate the testing protocols for EVs and HEV components
- Analyze the safety cycle and need for functions safety for EVs
- Analyze the problems related with EMC for EV components.
- Evaluate the EMI in motor drive and DC-DC converter system.

TEXT BOOKS:

1. Ali Emadi, “Handbook of Automotive Power Electronics and Motor Drives”, First Edition, Taylor & Francis, 2005.
2. Li Zhai,"Electromagnetic Compatibility of Electric Vehicle", First Edition, Springer, 2021.
3. Kai Borgeest, "EMC and Functional Safety of Automotive Electronics", First Edition, IET, 2018.

REFERENCE BOOKS:

1. Druce Archam beault, colin branch, Omar M.Ramachi, "EMI/EMC Computational Modeling Handbook", Second Edition , Springer, 2012.
2. Beate Müller, Gereon Meyer,"Electric Vehicle Systems Architecture and Standardization Needs, Reports of the PPP European Green Vehicles Initiative", Springer, 2015.

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2. https://onlinecourses.nptel.ac.in/noc20_cs15/preview
3.https://www.csie.ntu.edu.tw/~cyy/courses/assembly/12fall/lectures/handouts/lec08_ARMarch.pdf
4.https://www.youtube.com/watch?v=J4fhE4Pp55E&list=PLGs0VKk2DiYypuwUUM2wxzcI9B

CO - PO & PSO MAPPING :

CO\PO & PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	1	1	2	1	2	-	-	-	-	2	3	2	2
CO2	3	1	1	2	1	2	-	-	-	-	2	3	3	2
CO3	3	1	1	2	1	2	-	-	-	-	2	3	3	2
CO4	3	1	1	2	1	2	-	-	-	-	1	3	3	2
CO5	3	1	1	2	2	2	-	-	-	-	3	3	3	3
AVG	3	1	1	2	1.2	2	-	-	-	-	2	3	2.8	2.2

OPEN ELECTIVES

JEE9201	**ELECTRICAL SAFETY ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To summarize the electrical hazards
- To infer knowledge on prevention of electrical shocks.
- To explain awareness about various first aid methods
- To assess knowledge on fire protection.
- To describe Electrical safety management.

PREREQUISITE:

- Basic Engineering

UNIT I INTRODUCTION 9

General Back ground-Objectives of safety and security measures -Hazards associated with electric current and voltage- nature and cause of accidents - accident Prevention methods-personal protective equipments.

UNIT II ELECTRICAL SHOCKS AND THEIR PREVENTION 9

Primary and Secondary Electric Shocks-Occurrence of Electric Shock - Lightning Strokes on Overhead Transmission Lines - Safety Precautions in Small LV Installations, Residential Buildings, Shops -Description of Earthing System- Equipment Earthing -Substation Earthing

UNIT III FIRST AID 9

Introduction- Removal of Contact with Live Conductor- First Principles of Actions after Electric Shock-Artificial Respiration -Use of Artificial Resuscitator-External Cardiac Massage-Cardiac Pulmonary Resuscitation-First aid treatment of Heat Exhaustion and heat stroke.

UNIT IV INDUSTRIAL FIRE PROTECTION 9

Fire chemistry-classification of fires-fire prevention activities-fire risks-fire load-fire detection-industrial fire protection systems.

UNIT V	ELECTRICAL SAFETY MANAGEMENT	9

Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Explain Electrical safety, personal protective equipments.
- Defend knowledge on prevention of electrical shocks
- Discuss about various first aid measures.
- Explain fire protection in hazardous areas
- State about safety management.

TEXT BOOKS:

1. S.Rao, R.K.Jain and H.L.Saluja, "Electrical Safety, Fire Safety and Safety Management", Second Edition, Khanna Publishers, 2012.
2. W.F.Cooper, "Electrical Safety Engineering", Third Edition, Butterworth and Company, London, 2013.

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1. J.Cadick, D.Neitzel and A.Winfield, "Electrical Safety Hand Book", Fourth Edition, Mc Graw Hill, 2012.
2. J.Maxwell Adams, "Electrical Safety-A Guide to the Causes and Prevention of Electric Hazards", First Edition 3rd Reprint ,The Institution of Electric Engineers,2009.
3. Martha J. Boss and Gayle Nicoll, "Electrical Safety-Systems, Sustainability and Steward ship", First Edition, CRC Press, 2015.

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- https://www.electricalsafetyfirst.org.uk/
- https://www.youtube.com/watch?v=fxoYq5sBP4s

- https://www.youtube.com/watch?v=WoJBg6oEA3k
- https://www.youtube.com/watch?v=ZfkS0SnaLLo

Mapping of CO with PO/PSO

	Program outcomes											PSO		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	2	2	1	-	1	-	-	3	2	1	1
CO2	3	2	1	2	2	1	-	1	-	-	3	2	-	-
CO3	3	2	1	2	2	1	-	1	-	-	3	2	2	-
CO4	3	2	2	2	2	1	-	1	-	-	2	2	1	1
CO5	3	2	2	2	2	1	-	1	-	-	2	2	2	1
AVG	3	2	1.4	2	2	1	-	1	-	-	2.6	2	1.5	1

JEE9202	GREEN ENERGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the present and future role of renewable energy sources.
- To summarize the ecology and environmental issues
- To describe basic knowledge of renewable energy sources
- To summarize other energy resources
- To illustrate the various energy storage systems.

PREREQUISITE:

- Environmental Science and Sustainability

UNIT I ENERGY **9**

Environment and sustainable development – Energy sources overview and classification – sun as the source of energy – Fossil fuel reserves and resources – overview of global/India's energy scenario – Energy consumption models – Specific Energy Consumption.

UNIT II ECOLOGY AND ENVIRONMENT **9**

Concept and theories of ecosystems – Monitoring of carbon emission – Environmental Protection Act: Effluent standards and ambient air quality – innovation and sustainability – eco-restoration.

UNIT III RENEWABLE SOURCES OF ENERGY **9**

Solar Energy: Solar radiation-solar energy conversion principles and technologies – Wind Energy conversion system- Biomass – Ocean and Tidal Energy.

UNIT IV OTHER ENERGY SOURCES **9**

Hydropower – Nuclear fission and fusion- Geothermal energy: Origin, types of geothermal energy sites, site selection – geothermal power plants; hydrogen energy – Magneto-hydro-dynamic (MHD) energy.

UNIT V ENERGY STORAGE SYSTEMS **9**

Electrochemical Storage – Materials – Principle of Operation – Challenges and research survey Positive electrode materials, negative electrode materials – electrolytes. Fuel Cells and Hydrogen storage Principle of operation – challenges and Case studies

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- List the present and future role of renewable energy sources.
- Assess the ecology and environmental issues
- Develop knowledge of renewable energy sources
- Enhance understanding of other energy sources

- Identify and acquire knowledge of various energy storage systems

TEXT BOOKS:

1. Kothari D.P., Singal K.C, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI learning 2022
2. Bhadra S. N., Kastha D., Banerjee S., "Wind Electrical Systems", Oxford University Press, 2005.
3. KhanB.H. Non-conventional Energy sources Tata McGraw- hill Publishing Company, New Delhi, 2017.

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1. Manwell J.F, "Wind Energy Explained, theory design and applications, "J.G. Mc Gowan Wiley publication, 2009.
2. Hall D.D. and Grover R.P., "Biomass Regenerable Energy", John Wiley, NewYork,1987.
3. John T. Widel and Tony Weir, "Renewable Energy Resources" Taylor and Francis Publications, 2005.
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- https://www.youtube.com/watch?v=-HhdR9YRGxI
- https://www.youtube.com/watch?v=9tfLJ4taTKI

MAPPING OF CO WITH PO/PSO:

CO\PO &PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	1	1	2	1
CO2	3	3	2	3	2	1	-	-	-	-	-	1	2	1
CO3	3	3	2	3	2	1	-	-	-	-	-	1	2	1
CO4	3	3	2	3	2	1	-	-	-	-	-	1	2	1
CO5	2	2	2	2	2	1	-	-	-	-	1	1	2	1
AVG	2.8	2.8	2	2.8	2	1	-	-	-	-	1	1	2	1

JEE9203	INDUSTRIAL ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the various power semi-conductor devices and their switching characteristics.
- To summarize the operation and characteristics of controlled rectifiers.
- To classify the operation and characteristics of DC-to-DC converters
- To infer the working of single and three phase inverters.
- To outline the working of AC to AC converters.

PREREQUISITE:

- Basic Engineering.

UNIT I POWER DEVICES 9

Layer diagram, switching characteristics of BJT, MOSFET and IGBT-Layer diagram, V-I characteristics, turn on and turn off mechanisms of SCR

UNIT II CONTROLLED RECTIFIERS 9

Introduction to full wave bridge rectifier–Operation and Characteristics of Single phase and three phase–Half controlled and fully controlled converters–Applications-light dimmer, Excitation system.

UNIT III DC-DC CONVERTERS 9

Principle, modes of operation, performance parameters and characteristics of Buck Regulator, Boost Regulator, Buck- Boost Regulator and Chopper classification – Class A, B, C, D, E Choppers, Applications-Battery operated vehicles.

UNIT IV INVERTERS 9

Voltage Source Inverter (VSI) –Single and three phase–Voltage Source Inverters (VSI) - Voltage control using PWM–Current Source Inverter (CSI)-Applications –UPS.

UNIT V AC-AC CONVERTERS 9

Phase control–Integral Cycle Control–working and characteristics of Single-phase AC Chopper-working of Single phase and three phase cyclo converters-Applications – welding.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Discuss knowledge on power devices
- Analyze the operation and characteristics of various controlled rectifiers
- Explain various modes of operation of DC-DC converters.
- Assess knowledge about the working of inverters
- Discuss the operations of AC to AC converters.

TEXT BOOKS:

1. P. S. Bimbhra, "Power Electronics", fourth edition, Khanna Publishers, New Delhi,2022
2. Muhammad H. Rashid, "Power Electronics - circuits devices and applications", fourth edition, Prentice Hall of India,2017.
3. Ned Mohan, Tore M. Undeland, "Power electronics: converters, applications, and design", third edition, John Wiley &Sons.

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1. Vedam Subramanyam "Power Electronics – Devices, Converters and Applications", Revised second edition, New Age Publications
2. Joseph Vithayathil, "Power Electronics, Principles and Applications", sixth Reprint, McGraw Hill Series, 2013.
3. Uman and L., "Power Electronics Essentials and Applications", Wiley,2015.

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- https://www.youtube.com/watch?v=fOZ8bUrFJGk
- https://www.youtube.com/watch?v=P0MK7sWfs9k
- https://www.youtube.com/watch?v=7CReXeMAXHA
- https://www.youtube.com/watch?v=tMFFmmw3LTg

Mapping of CO with PO/PSO

	Program Outcomes											PSO		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	2	2	1	1	1	1	-	1	2	1	1
CO2	3	2	1	2	2	1	1	1	1	-	1	2	-	-
CO3	3	2	1	2	2	1	1	1	1	-	1	2	2	-
CO4	3	2	2	2	2	1	1	1	1	-	1	2	1	1
CO5	3	2	2	2	2	1	1	1	1	-	1	2	2	1
AVG	3	2	1.4	2	2	1	1	1	1	-	1	2	1.5	1

JEE9204	MEASUREMENT AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop a fundamental understanding of measurement principles, errors, and calibration techniques in electrical and electronic instrumentation.
- To enable students to effectively operate and apply various electrical measuring instruments for accurate parameter estimation.
- To build the ability to compare and select appropriate measurement techniques and instruments for different applications.
- To familiarize students with data acquisition, storage, and display devices for recording and analyzing measurement data.
- To introduce the principles, types, and applications of transducers and smart sensors in measurement systems.

PREREQUISITE:

- Basic Engineering.

UNIT I INTRODUCTION 9 Functional elements of an instrument–Errors in measurement–Statistical evaluation of measurement data-Standards and calibration-Principle and types of analog and digital voltmeters, ammeters.
UNIT II ELECTRICAL AND ELECTRONIC INSTRUMENTS 9 Classification of instruments – moving coil and moving iron meters – Induction type, dynamometer type watt meters – Energy meter – Megger – Instrument transformers (CT & PT).
UNIT III COMPARITIVE METHODS OF MEASUREMENTS 9 D.C & A.C potentiometers, DC bridges – Wheat stone, Kelvin's Double bridge, AC bridges - Maxwell, Anderson and Schering bridges – Instrumentation Amplifiers.
UNIT IV STORAGE AND DISPLAY DEVICES 9 Magnetic disk and tape–Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD – Data Loggers.
UNIT V TRANSDUCERS 9

Classification and Selection of transducers–Resistive, capacitive and inductive transducers Piezoelectric, optical and digital transducers– Smart sensors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to:

- Apply measurement principles to perform statistical analysis and calibrate standards.
- Investigate and apply electrical measuring instruments for different parameter estimations.
- Distinguish between various measurement techniques using potentiometers, bridges, and instrumentation amplifiers.
- Demonstrate the use of various storage and display devices.
- Analyze and select suitable transducers and sensors for measurement applications.

TEXT BOOKS:

1. Sawhney A. K,"A Course in Electrical & Electronic Measurements & Instrumentation", Seventh Edition, Dhanpat Rai and Co., 2015
2. Gupta J.B., "A Course in Electronic and Electrical Measurements", S.K. Kataria & Sons, Delhi ,2013.
3. Doebelin E.O. and Manik D.N., "Measurement Systems –Applications and Design", Special Indian Edition, Tata McGraw Hill Education Pvt.Ltd.,2007.

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1. Kalsi H.S., "Electronic Instrumentation", Third Edition, McGraw Hill ,2017.
2. Murthy D.V.S., "Transducers and Instrumentation", Second Edition, Prentice Hall of India Pvt Ltd, 2015.
3. David Bell, "Electronic Instrumentation & Measurements", Third Edition, Oxford University Press, 2013.
4. Martin Reiss land, "Electrical Measurements", First edition, New Age International (P) Ltd., Delhi, 2001.
5. Alan S.Morris, Principles of Measurements and Instrumentation, Third Edition, Butterworth Heinemann, 2003

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- https://www.youtube.com/watch?v=3c_uDCnnBXc
- https://nptel.ac.in/courses/108/105/108105153/
- https://www.youtube.com/watch?v=I5k66ESHJHM

Mapping of CO with PO/PSO

	Program outcomes											PSO		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	1	2	1	1	1	1	1	-	1	1	1	1
CO2	2	3	2	3	2	1	1	1	1	-	1	2	2	2
CO3	2	3	2	3	2	1	1	1	1	-	1	2	2	2
CO4	1	2	1	2	1	1	1	1	1	-	1	1	1	1
CO5	2	3	2	3	2	1	1	1	1	-	1	2	2	2
AVG	**1.6**	**2.6**	**1.6**	**2.6**	**1.6**	**1**	**1**	**1**	**1**	-	**1**	**1.6**	**1.6**	**1.6**

JEE9205	RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the fundamentals of energy sources, distinguishing between conventional and non-conventional (renewable) sources.
- To formulate and provide adequate knowledge about wind energy potential, wind power plants and grid connectivity.
- To outline and provide a comprehensive understanding of solar thermal systems.
- To infer an in-depth understanding of solar photovoltaic systems, encompassing their applications.
- To relate with the knowledge and skills to understand, utilize, and analyze various measurement instruments and standards used in renewable energy systems.

PREREQUISITE:

- Basic Engineering
- Environmental Science and Sustainability

UNIT I RENEWABLE ENERGY SOURCES 9

Introduction to Energy Sources-Conventional Energy Sources-Non-Conventional (Renewable) Energy Sources-Limitations of RE sources-Energy Storage and Grid Integration-Environmental and Economic Aspects- Future Trends and Innovations.

UNIT II WIND ENERGY 9

Power in the Wind – wind energy potential - performance characteristics-Types of Wind Power Plants (WPPs)–Horizontal and Vertical axis wind mills -Components of WPPs- Working of WPPs–Site selection of WPPs-Grid integration issues of WPPs.

UNIT III SOLAR THERMAL SYSTEMS 9

Solar Radiation-Fundamentals- Solar Thermal Collectors - Flat plate, Evacuated Tube and Concentrating collectors, Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds -Thermal Energy storage system with PCM.

UNIT IV SOLAR PV SYSTEMS 9

Solar Photo voltaic systems: Basic Principle – Types of PV Systems- Types of Solar Cells – Photo voltaic cell concepts-IV Characteristics, Efficiency and Quality of the Cell, Series and parallel connections-Maximum power point tracking, Applications.

UNIT V MEASURING DEVICES AND STANDARDS 9

Solar Radiation Measurement Devices: Pyranometer, Pyrheliometer, Sunshine Recorder, Albedometer, Solar Power Meters - Wind Energy Measurement Devices: Anemometers and its

types, Wind Vane - Wind Profiling Radar, Power Curve Measurement Device - General Renewable Energy Standards:ISO 50001,IEC 61850 - Solar Energy Standards:IEC 61215,IEC 61730 ,IEC 62109, IEEE 1547 - Wind Energy Standards: IEC 61400-1, IEC 61400-2, IEC 61400-11.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Explain renewable energy sources, grid integration, and their environmental and economic aspects.
- Analyze the working, performance, and grid integration aspects of wind energy conversion systems.
- Describe the construction and operation of solar thermal energy systems and thermal energy storage methods.
- Apply photovoltaic principles to understand PV cell characteristics and solar PV system performance.
- Outline the operation of renewable energy measuring instruments and interpret applicable energy standards.

TEXT BOOKS:

1. Twidell & Wier, "Renewable Energy Resources",Fourth Edition, CRC Press (Taylor & Francis), 2021.
2. D.P. Kothari, K.C Singal, Rakesh Ranjan,"Renewable Energy Sources and Emerging Technologies", Third Edition, PHI Learning Pvt. Ltd, New Delhi, 2021.
3. Rai G.D.- "Non-Conventional Energy Sources" Sixth Edition, Khanna Publishers-2018.
4. B.H. Khan, "Non-Conventional Energy Resources" Third Edition, Tata McGraw-Hill Education India , 2016.
5. Scott Grinnell, "Renewable Energy & Sustainable Design", First Edition, CENGAGE Learning, 2015.

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1. Ramesh R & Kumar K.U, "Renewable Energy Technologies", Second Edition, Narosa

Publishing House, 2019.

2. Chetan Singh Solanki, "Solar Photo voltaic Fundamentals, Technologies and Application", Third Edition, PHI Learning Pvt.,Ltd., 2015.
3. Jha.A.R, "Solar Cell Technology and Applications", First Edition, Auerbach Publications CRC Press, 2009.
4. Tiwari and Ghosal, "Renewable energy resources", First Edition, Narosa Publishing House, 2007.
5. Mittal K M, "Non, Conventional Energy Systems", First Edition, Wheeler Publishing Co.Ltd, 2003.

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- https://www.youtube.com/watch?v=9tfLJ4taTKI

MAPPING OF CO WITH PO/PSO:

	Program Outcomes											PSO		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	-	2	2	1	1	1	1	-	1	-	-	1
CO2	3	3	2	3	2	2	1	1	1	-	1	2	2	1
CO3	2	2	-	2	2	1	1	1	1	-	1	-	-	1
CO4	3	2	1	2	3	2	1	1	1	-	1	1	1	1
CO5	3	2	1	2	3	2	1	1	1	-	1	1	1	1
AVG	2.6	2.2	1.3	2.2	2.4	1.6	1	1	1	-	1	1.3	1.3	1

JEE9206	INTELLIGENT CONTROLLERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the concepts of intelligent control systems and their distinction from conventional methods.
- To formulate the understanding and implementation skills of fuzzy logic systems for designing rule-based intelligent controllers.
- To provide adequate knowledge about neural network architectures, training methods, and their integration into adaptive and feedback control systems.
- To demonstrate genetic algorithms and their application in solving optimization problems in control systems.
- To generate a comprehensive knowledge of reinforcement learning techniques and hybrid intelligent systems for advanced autonomous control applications.

PREREQUISITE:

- Basic Engineering

UNIT I FUNDAMENTALS OF INTELLIGENT CONTROL SYSTEM 9 Overview of Control Systems-Motivation for Intelligent Control-Characteristics of ICS-Architecture and Components-Role of Knowledge-Based Systems-Types of Intelligent Controllers-Role of Artificial Intelligence in Intelligent Control-Comparison with Conventional Control Methods.
UNIT II FUZZY LOGIC CONTROL 9 Introduction to Fuzzy Logic-Fuzzy Sets and Operations-Fuzzy Relations and Reasoning-Components of a Fuzzy Inference System- Fuzzy Models - Membership Function Design-Fuzzy Controller Design-Implementation and Simulation-Applications.
UNIT III NEURAL NETWORK-BASED CONTROL 9 Introduction to Neural Networks-Neural Network Architectures-Learning and Training Algorithms- Control System Integration-Neural Network Control Types and ANN-based Controllers Adaptive and Feedback Control Using NN.
UNIT IV GENETIC ALGORITHMS 9 Basic concept of Genetic algorithm and detail algorithmic steps - adjustment of free Parameters -Solution of typical control problems using genetic algorithm- Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems.

UNIT V REINFORCEMENT LEARNING AND HYBRID INTELLIGENT SYSTEMS 9

Introduction to RL- Q-Learning Basics-Applications in Control- Hybrid Intelligent Systems - Neuro-Fuzzy Systems- GA Tuned Fuzzy and Neural Controllers-Case Studies in Autonomous Systems-Intelligent Robotics,Smart Vehicles,UAVs and Drones.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Record the over view of architecture, and types of intelligent control systems and compare them with conventional approaches.
- Identify and implement fuzzy logic controllers and apply them to real-world control problems.
- Demonstrate and train, and integrate neural networks into control systems for adaptive and nonlinear control tasks.
- Create and apply genetic algorithms and other heuristic search techniques to optimize control system performance.
- Design and apply reinforcement learning and hybrid intelligent systems in designing autonomous and intelligent control solutions.

TEXT BOOKS:

1. Laurance Fausett, Engle wood Cliffs, N.J., "Fundamentals of Neural Networks: Architectures, Algorithms, and Applications", First Edition,Pearson Education,2006.
2. TimothyJ.Ross,'Fuzzy Logic with Engineering Applications',Fourth Edition, Wiley Publishers, October 2016.
3. S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Third Edition, Wiley India,June 2018.

REFERENCES:

1. Simon Haykin, "Neural Networks and Learning Machines", Third Edition, Pearson Education, 2016.
2. Hagan, Demuth, Beale, "Neural Network Design", Second Edition, Martin Hagan Publisher, September 2014.
3. William S.Levine, "The Control Systems Handbook: Control System Advanced Methods , Second Edition, CRC Press, 2011.
4. P.Padhy, "Artificial Intelligence and Intelligent Systems",First Edition, Oxford University Press.,2005.

5. Genand R,Cheng, “Genetic Algorithms and Engineering Optimization”, First Edition, Wiley Series in Engineering Design and Automation,January 2000.
6. JohnYen & Reza Langari, ‘Fuzzy Logic–Intelligence Control & Information’, First Edition,Prentice Hall,1998.

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- https://swayam.gov.in
- http://mooc.org
- http://www.edx.org

MAPPING OF CO WITH PO/PSO:

	Program Outcomes										**PSO**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	2	2	1	1	1	-	-	1	2	1	1
CO2	3	2	1	2	2	1	1	1	-	-	1	3	1	2
CO3	3	2	1	2	2	1	1	1	-	-	1	3	1	1
CO4	3	2	2	2	2	1	1	1	-	-	1	3	2	2
CO5	3	2	2	2	2	1	1	1	-	-	1	2	2	2
AVG	3	2	1.4	2	2	1	1	1	-	-	1	2.6	1.4	1.6

JEE9207	INTRODUCTION TO E-VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To define, describe, and list the fundamentals of electric vehicles and vehicle mechanics.
- To outline, categorize, and explain the architecture, powertrain components, and speed control systems in EVs.
- To classify, differentiate, and compare various electric machines used in EV applications.
- To construct, demonstrate, and illustrate the control methods for DC and AC drives used in electric mobility.
- To develop, formulate, and relate battery energy storage systems, fuel cells, and ultracapacitors to electric vehicle performance.

PREREQUISITE:

- Power Electronics and Drives

UNIT I ELECTRIC VEHICLES AND VEHICLE MECHANICS	**9**
Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings, Comparisons of EV with internal combustion Engine vehicles, Fundamentals of vehicle mechanics.	
UNIT II ARCHITECTURE OF EVS AND POWER TRAIN COMPONENTS	**9**
Architecture of Electric Vehicle and HEV – Plug-n Hybrid Electric Vehicles (PHEV)- Power train components and sizing, speed control, Transmission and Brakes.	
UNIT III ELECTRIC MACHINES FOR EV APPLICATIONS	**9**
DC machines, induction machines, permanent magnet synchronous machines, switched Reluctance machines and synchronous reluctance machines- configuration, control, and application in E-Vehicle.	
UNIT IV CONTROL OF DC AND AC DRIVES	**9**
DC/DC chopper-based four-quadrant operations of DC drives – Inverter-based V/f Operation (motoring and braking) of induction motor drive system – Induction motor and permanent motor-based vector control operation – Switched reluctance motor (SRM) drives.	
UNIT V BATTERY ENERGY STORAGE SYSTEM	**9**
Battery Basics, Different types, Battery Parameters, Battery modelling, Traction Batteries, Fuel cell – Characteristics- Types, hydrogen Storage Systems and Ultracapacitors.	

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Identify types of electric vehicles and explain their fundamental mechanical and performance characteristics.
- Distinguish the powertrain elements, such as gears, clutches, and transmissions, in EV systems.
- Differentiate between machine types and apply their control strategies in EV applications.
- Practice inverter and chopper-based control techniques and analyze drive performance under different operating modes.
- To review different energy storage technologies and assess their performance through modelling and parameter analysis.

TEXT BOOKS:

1. Iqbal Hussain, "Electric and Hybrid Vehicles-Design Fundamentals", Third Edition, CRC Press, 2021

2. Mehrdad Ehsani, Yimin Gao, and Ali Emadi, "Modern Electric, Hybrid and Fuel Cell Vehicles: Fundamentals, CRC Press,2019.

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1. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2015.
2. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2012.
3. Chris Mi, MA Masrur, and D W Gao, "Hybrid Electric Vehicles- Principles and Applications with Practical Perspectives”, Wiley,2017.

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4. https://youtu.be/GFpEXekI-BM
5. https://youtu.be/Blo9vyV_QDE
6. https://youtu.be/LDRq-odYAbA

Mapping of CO with PO/PSO

	Program Outcomes											PSO		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	-	-	1	-	-	-	-	-	3	2	2
CO2	3	2	3	-	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO5	3	2	2	3	2	1	-	-	-	-	-	2	3	3
AVG	3	2.4	2.6	2..6	2.5	1	-	-	-	-	-	2.6	2.6	2.6

JEE9208	ENERGY MANAGEMENT AND SCADA	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the need for energy management and outline the process of energy auditing and performance assessment.
- To analyse economic factors and evaluate the energy efficiency of electrical systems and components.
- To describe lighting system concepts and assess the feasibility and performance of cogeneration.
- To outline SCADA architectures and demonstrate the components, functions, and communication technologies.
- To discuss SCADA applications in utility systems and explain substation automation and wide area protection.

PREREQUISITE:

- Basic Engineering

UNIT I ENERGY MANAGEMENT FUNCTIONS 9

Need for energy management – energy management program - Energy accounting – Energy monitoring- Targeting and Reporting – Energy audit process- Energy Management Centres and their Functions- Architectures of Centres and their Functions- Energy performance assessment of HVAC system.

UNIT II ECONOMIC ANALYSIS 9

Important concepts in an economic analysis: Electricity tariff, Electrical Load Management and Maximum Demand Control, Systems and equipment, Electric motors, Transformers, Capacitors, and Energy efficiency analysis of electrical power systems, motors, and transformers.

UNIT III LIGHTING AND COGENERATION 9

Concept of lighting systems – the task and the working space - Light sources – ballasts – luminaries - Lighting controls - Optimising lighting energy, lighting and energy standards - Forms of cogeneration – Feasibility of cogeneration - Energy performance analysis of lighting and cogeneration.

UNIT IV SUPERVISORY CONTROL AND DATA ACQUISITION 9

SCADA - Functional requirements and Components - General features, Functions and Applications, Benefits - Various SCADA architectures - SCADA Communication: various industrial communication technologies.

UNIT V SCADA APPLICATIONS **9**

SCADA Applications: Utility Applications—Transmission and distribution sector—Operations, Monitoring, Analysis, and Improvement—Substation automation structure—Substation automation architecture—Introduction to wide area protection.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Explain the importance of energy management and describe the steps involved in energy auditing and performance assessment of systems.
- Analyze economic factors such as payback period, life cycle costing, and assess the energy efficiency of electrical systems and components.
- Describe the principles of lighting systems and evaluate the feasibility and performance of cogeneration systems in industrial and utility sectors.
- Outline the architecture of SCADA systems and demonstrate knowledge of its components, functions, and communication technologies used.
- Discuss real-time SCADA applications in utility systems and explain the concepts of substation automation and wide area protection schemes.

TEXT BOOKS:

1. Chaudari.M.A, Chaudari.S.M, ASARKAR.S.A, "Energy Conservation And Audit", NiraliPrakashan, 2019

2. Waynec.Turner, Steve Doty, "Energy Management Handbook", Sixth Edition, The Fairmont Press, 2007.

3. Amit K. Tyagi, "Handbook on Energy Audits and Management", Second reprint Tata Energy Research Institute, 2003.

4. Stuart A. Boyer: "SCADA Supervisory Control and Data Acquisition", Fourth Edition, Instrument Society of America Publications, USA, The Instrumentation System and Automation Society, 2010.

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1. Venkataseshaiah P., Sharma K.V. Energy Management and conservation", Dream tech Press, 2020.

2. Gordon Clarke, Deon Reynders" First Edition,Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes, an imprint of Elsevier Publications, 2004.

3. Mini S Thomas, John Douglas McDonald, " Power system SCADA and smart grid", CRC Press, 2015.

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4. **https://youtu.be/2mw2h7FMPh8**
5. **https://youtu.be/nlFM1q9QPJw**
6. **https://youtu.be/nITuv0ePq_k**

Mapping of CO with PO/PSO

	Program Outcomes											**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	-	-	1	-	-	-	-	-	3	2	2
CO2	3	2	3	-	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO5	3	2	2	3	2	1	-	-	-	-	-	2	3	3
AVG	3	2.4	2.6	2.6	2.5	1	-	-	-	-	-	2.6	2.6	2.6