SYLLABUS

B.Tech.

ELECTRICAL AND ELECTRONICS ENGINEERING

FOR WORKING PROFESSIONALS - Semester III

2024 SCHEME

SEMESTER III

SLOT	COURSE NO	COURSES	L-T-P	HOURS	CREDIT
A	24SJMAT201	PARTIAL DIFFERENTIAL EQUATION AND COMPLEX ANALYSIS	3-1-0	4	4
B	24SJEET201	CIRCUITS AND NETWORKS	2-2-0	4	4
C	24SJEET203	MEASUREMENTS AND INSTRUMENTATION	3-1-0	4	4
D	24SJEET205	ANALOG ELECTRONICS	3-1-0	4	4
E 1/2	24SJEST200	DESIGN & ENGINEERING	2-0-0	2	2
	24SJHUT200	PROFESSIONAL ETHICS	2-0-0	2	2
F	24SJMCN201	SUSTAINABLE ENGINEERING	2-0-0	2	—
S	24SJEEL201	CIRCUITS AND MEASUREMENTS LAB	0-0-3	3	2
T	24SJEEL203	ANALOG ELECTRONICS LAB	0-0-3	3	2
		TOTAL		**26**	**22**

NOTE:

1. Design & Engineering and Professional Ethics shall be offered in both S3 and S4.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJMAT201	PARTIAL DIFFERENTIAL EQUATIONS AND COMPLEX ANALYSIS	BASIC SCIENCE COURSE	3	1	0	4

Preamble: This course introduces basic ideas of partial differential equations which are widely used in the modelling and analysis of a wide range of physical phenomena and has got application across all branches of engineering. To understand the basic theory of functions of a complex variable, residue integration and conformal transformation.

Prerequisite: A basic course in partial differentiation and complex numbers.

Course Outcomes: After the completion of the course the student will be able to

CO1	Understand the concept and the solution of partial differential equation.
CO2	Analyse and solve one dimensional wave equation and heat equation.
CO3	Understand complex functions, its continuity differentiability with the use of Cauchy- Riemann equations.
CO4	Evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula, understand the series expansion of analytic function
CO5	Understand the series expansion of complex function about a singularity and Apply residue theorem to compute several kinds of real integrals.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	3	2	1				2		2
CO 2	3	3	3	3	2	1				2		2
CO 3	3	3	3	3	2	1				2		2
CO 4	3	3	3	3	2	1				2		2
CO 5	3	3	3	3	2	1				2		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests(%)		End Semester Examination(%)
	1	2	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate	10	10	10
Create			

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Assignments

Assignment: Assignment must include applications of the above theory in the concerned engineering

Syllabus

Module 1 (Partial Differential Equations) (8 hours)

(Text 1-Relevant portions of sections 17.1, 17.2, 17.3, 17.4, 17.5, 17.7, 18.1, 18.2)

Partial differential equations, Formation of partial differential equations –elimination of arbitrary constants-elimination of arbitrary functions, Solutions of a partial differential equations, Equations solvable by direct integration, Linear equations of the first order-Lagrange's linear equation, Non-linear equations of the first order -Charpit's method, Solution of equation by method of separation of variables.

Module 2 (Applications of Partial Differential Equations) (10 hours)

(Text 1-Relevant portions of sections 18.3,18.4, 18.5)

One dimensional wave equation- vibrations of a stretched string, derivation, solution of the wave equation using method of separation of variables, D'Alembert's solution of the wave equation, One dimensional heat equation, derivation, solution of the heat equation

Module 3 (Complex Variable – Differentiation) (9 hours)

(Text 2: Relevant portions of sections13.3, 13.4, 17.1, 17.2 , 17.4)

Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations, harmonic functions, finding harmonic conjugate, Conformal mappings- mappings $w = z^2,, w = e^z,$. Linear fractional transformation $w = \frac{1}{z}$, fixed points, Transformation $w = sinz$

(From sections 17.1, 17.2 and 17.4 only mappings $w = z^2,, w = e^z, w = \frac{1}{z}$, $w = sinz$ and problems based on these transformation need to be discussed)

Module 4 (Complex Variable – Integration) (9 hours)

(Text 2- Relevant topics from sections14.1, 14.2, 14.3, 14.4,15.4**)**

Complex integration, Line integrals in the complex plane, Basic properties, First evaluation method-indefinite integration and substitution of limit, second evaluation method-use of a representation of a path, Contour integrals, Cauchy integral theorem (without proof) on simply connected domain,Cauchy integral theorem (without proof) on multiply connected domain Cauchy Integral formula (without proof), Cauchy Integral formula for derivatives of an analytic function, Taylor's series and Maclaurin series.,

Module 5 (Complex Variable – Residue Integration) (**9 hours**)

(Text 2- Relevant topics from sections16.1, 16.2, 16.3, 16.4 **)**

Laurent's series(without proof), zeros of analytic functions, singularities, poles, removable singularities, essential singularities, Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral using residue theorem, Residue integration of real integrals – integrals of rational functions of $cos\theta$ and $sin\theta$, integrals of improper integrals of the form $\int_{-\infty}^{\infty} f(x)\,dx$ with no poles on the real axis. ($\int_A^B f(x)\,dx$ whose integrand become infinite at a point in the interval of integration is excluded from the syllabus),

Textbooks:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018.

2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2016.

References:

1. Peter V. O'Neil, Advanced Engineering Mathematics, Cengage, 7th Edition, 2012

Assignments

Assignment: Assignment must include applications of the above theory in the concerned engineering branches

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Partial Differential Equations**	
1.1	Partial differential equations, Formation of partial differential equations –elimination of arbitrary constants-elimination of arbitrary functions, Solutions of a partial differential equations, Equations solvable by direct integration,	3
1.2	Linear equations of the first order- Lagrange's linear equation, Non-linear equations of the first order - Charpit's method	3
1.3	Boundary value problems, Method of separation of variables.	2
2	**Applications of Partial Differential Equations**	
2.1	One dimensional wave equation- vibrations of a stretched string, derivation,	1
2.2	solution of the wave equation using method of separation of variables, D'Alembert's solution of the wave equation	4
2.3	One dimensional heat equation, derivation,	1
2.4	solution of the heat equation, (excluding problems in steady state conditions)	4
3	**Complex Variable – Differentiation**	
3.1	Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations,	4
3.2	harmonic functions, finding harmonic conjugate,	2
3.3	Conformal mappings- mappingsof $w = z^2,, w = e^z, w = \frac{1}{z}, w = sinz.$	3
4	**Complex Variable – Integration**	
4.1	Complex integration, Line integrals in the complex plane, Basic properties, First evaluation method, second evaluation method, use of representation of a path	4
4.2	Contour integrals, Cauchy integral theorem **(without proof)** on simply connected domain, on multiply connected domain**(without proof)** .Cauchy Integral formula **(without proof)**,	2
4.3	Cauchy Integral formula for derivatives of an analytic function,	2
4.3	Taylor's series and Maclaurin series.	1
5	**Complex Variable – Residue Integration**	

5.1	Laurent's series**(without proof)**	2
5.2	zeros of analytic functions, singularities, poles, removable singularities, essential singularities, Residues,	2
5.3	Cauchy Residue theorem (**without proof**), Evaluation of definite integral using residue theorem	2
5.4	Residue integration of real integrals – integrals of rational functions of $cos\theta$and $sin\theta$, integrals of improper integrals of the form $\int_{-\infty}^{\infty} f(x)dx$with no poles on the real axis. ($\int_A^B f(x)dx$**whose integrand become infinite at a point in the interval of integration is excluded from the syllabus**),	3

CODE	COURSE NAME	CATEGORY	L	T	P	CREDITS
24SJEET201	CIRCUITS AND NETWORKS	PCC	2	2	0	4

Preamble : This course introduces circuit analysis techniques applied to DC and AC electric circuits. Analyses of electric circuits in steady state and dynamic conditions are discussed. Network analysis is introduced with network parameters and transfer functions. This course serves as the most important prerequisite of all many advanced courses in electrical engineering.

Prerequisite : Basics of Electrical Engineering / Introduction to Electrical Engineering

Course Outcomes : After the completion of the course the student will be able to:

CO1	Apply circuit theorems to simplify and solve complex DC and AC electric networks.
CO2	Analyse dynamic DC and AC circuits and develop the complete response to excitations.
CO3	Solve dynamic circuits by applying transformation to s-domain.
CO4	Analyse three-phase networks in Y and A configurations.
CO5	Solve series /parallel resonant circuits.
CO6	Develop the representation of two-port networks using network parameters and analyse.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										2
CO2	3	3										2
CO3	3	3										2
CO4	3	3										2
CO5	3	3										2
CO6	3	3										2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (KI)	10	10	10
Understand (K2)	20	20	40
Apply (K3)	20	20	50
Analyse (K4)		-	-
Evaluate (K5)	-		-
Create (K6)	-	-	-

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module 1

Circuit theorems: DC and Sinusoidal steady state analysis of circuits with dependent and independent sources applying Superposition principle, Source transformation, Thevenin's, Norton's and Maximum Power Transfer theorems - Reciprocity theorem.

Module 2

Analysis of first and second order dynamic circuits: Formulation of dynamic equations of RL, RC and RLC series and parallel networks with de excitation and initial conditions and complete solution using Laplace Transforms - Time constant - Complete solution of RL, RC and RLC circuits with sinusoidal excitation using Laplace Transforms - Damping ratio - Over damped, under damped, critically damped and undamped RLC networks.

Module 3

Transformed circuits in s-domain: Transform impedance/admittance of R, L and C - Mesh analysis and node analysis of transformed circuits in s-domain. Transfer Function representation - Poles and zeros.

Analysis of Coupled Circuits: - Dot polarity convention - Sinusoidal steady state analysis of coupled circuits - Linear Transformer as a coupled circuit - Analysis of coupled circuits in s-domain.

Module 4

Three phase networks and resonance:Complex Power in sinusoidal steady state. Steady state analysis of three-phase three-wire and four-wire unbalanced Y circuits, Unbalanced Delta circuit, Neutral shift.

Resonance in Series and Parallel RLC circuits - Quality factor - Bandwidth - Impedance Vs Frequency, Admittance Vs Frequency, Phase angle Vs frequency for series resonant circuit.

Module 5

Two port networks: Driving point and transfer functions - Z, Y, h and T parameters - Conditions for symmetry & reciprocity - relationship between parameter sets - interconnections of two port networks (series, parallel and cascade) — T-n transformation.

Text Books

1. Joseph A. Edminister and MahmoodNahvi, "Theory and Problems in Electric
2. Ravish R. Singh, "Network Analysis and Synthesis", McGraw-Hill Education, 2013

References:

1. Hayt and Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, New Dftihi RthFd ?nn
2. Van Valkenberg, "Network Analysis", Prentice Hall India Learning Pvt. Ltd., 3 edition, 1980.
3. K. S. Suresh Kumar, "Electric Circuit Analysis”, Pearson Publications, 2013.
4. Chakrabarti, "Circuit Theory Analysis and Synthesis", DhanpatRai& Co., Seventh - Revised edition, 2018
5. R. Gupta, "Network Analysis and Synthesis", S. Chand & Company Ltd, 2010.

Course Contents and Lecture Schedule:

No	Topic	No. of Lectures
1	**Network theorems - DC and AC steady state analysis (12 hours)**	
1.1	Linearity and Superposition principle - *1* Application to the analysis of DC and AC (sinusoidal excitation) circuits, Application of source s. transformation in electric circuit analysi	2
1.2	Thevenin's theorem - Application to the analysis of DC and AC circuits . with dependent and independent sources	3
1.3	Norton's theorem - Application to the analysis of DC and AC circuits with dependent and independent sources.	3
1.4	Maximum power transfer theorem - DC and AC steady state analysis with dependent and independent sources.	2
1.5	Reciprocity Theorem - Application to the analysis of DC and AC Circuits.	2
2	**First order and second order dynamic circuits. (9 hours)**	
2.1	Review of Laplace Transforms - Formulae of Laplace Transforms of common functions/signals, Initial value theorem and final value theorem, Inverse Laplace Transforms - partial fraction method. *(Questions to evaluate the Laplace/inverse transforms of any function /partial fractions method shall not be given in tests/final examination. Problems with application to circuits can be given).*	2
2.2	Formulation of dynamic equations of RL series and parallel networks and solution using Laplace Transforms - with DC excitation and initial	1

	conditions. Natural response and forced response. Time constant.	
2.3	Formulation of dynamic equations of RC series networks and solution using Laplace Transforms - with DC excitation and initial conditions. Natural response and forced response. Time constant.	1
2.4	Formulation of dynamic equations of RLC series networks jvith DC excitation and initial conditions, and solution using Laplace Transforms - Natural response and forced response. Damping coefficient. Underdamped, Overdamped, critically damped and undamped cases.	1
2.5	Formulation of dynamic equations of RL, RC and RLC series networks and solution with sinusoidal excitation. Complete solution (Solution using Laplace transforms).	2
2.6	Formulation of dynamic equations of RL, RC and RLC parallel networks and solution using Laplace Transforms - with DC and Sinusoidal excitations. Damping ratio.	2
3	**Transformed Circuits in s-domain and Coupled circuits (9 Hours)**	
3.1	Transformed circuits in s-domain: Transformation of elements (R, L, and C) with and without initial conditions.	2
3.2	Mesh analysis of transformed circuits in s-domain.	1
3.3	Node analysis of transformed circuits in s-domain.	1
3.4	Transfer Function representation - Poles and zeros.	1
3.5	Analysis of coupled circuits: mutual inductance - Coupling CoefficientDot polarity convention — Conductively coupled equivalent circuits. Linear Transformer as a coupled circuit.	2
3.6	Analysis of coupled circuits in s-domain.	2
4	**Three phase networks and resonance. (6 Hours)**	
4.1	Review of power, power factor, reactive and active power in sinusoidally excited circuits. Concept of complex power.	1
4.2	Steady state analysis of three-phase unbalanced 3-wire and 4-wire Y circuits, Unbalanced A circuits, Neutral shift.	2
4.3	Resonance in Series and Parallel RLC circuits - Quality factor - Bandwidth - Impedance Vs Frequency, Admittance Vs Frequency and Phase angleVs frequency for series resonant circuit.	3

5	**Two port networks (9 Hours)**	
5.1	Two port networks: Terminals and Ports, Driving point and transfer functions. Voltage transfer ratio, Current transfer ratio, transfer impedance, transfer admittance, poles and zeros.	2
5.2	Z-parameters. equivalent circuit representation.	1
5.3	Y parameters. Equivalent circuit representation.	1
5.4	h parameters. Equivalent circuit representation.	1
5.5	T parameters.	1
5.6	Conditions for symmetry & reciprocity, relationship between network parameter sets.	1
5.7	Interconnections of two port networks (series, parallel and cascade).	1
5.8	T- 7i Transformation.	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET203	MEASUREMENTS AND INSTRUMENTATION	PCC	3	1	0	4

Preamble : This course introduces principle of operation and construction of basic instruments for measurement of electrical quantities. Measurement of basic circuit parameters, magnetic quantities, and passive parameters by using bridge circuits, sensors and transducers will be discussed.Familiarization of modem digital measurement systems are also included.

Prerequisite :Nil

Course Outcomes :After the completion of the course the student will be able to

CO 1	Identify and analysethe factors affecting performance of measuring system
CO 2	Choose appropriate instruments for the measurement of voltage, current in ac and de measurements
CO 3	Explain the operating principle of power and energy measurement
CO 4	Outline the principles of operation of Magnetic measurement systems
CO 5	Describe the operating principle of DC and AC bridges, transducersbased systems.
CO 6	Understand the operating principles of basic building blocks of digital systems, recording and display units

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO 3	PO4	PO5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12
CO1	2	1	-	-		-		-	-	-	-	-
CO 2	3	1	-	-		-	-		-	-	-	-
CO 3	3	1	-	-	-	-	-		-		-	-
CO 4	3		-		-		-		-		-	-
CO 5	3		-	-	1				-	-	-	2
CO 6	3	-	-	-	2		-		-	-	-	2

Assessment Pattern

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	03 Hrs

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	20	30
Understand	20	20	50
Apply	15	10	20

Analyse			
Evaluate			
Create			

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module 1

Measurement standards-Errors-Types of Errors- Statistics of errors, Need for calibration.

Classification of instruments, secondary instruments-indicating, integrating and recordingoperating forces - essenuals of indicating instruments - deflecting, damping, controlling torques.

Ammeters and voltmeters - moving coil, moving iron, constructional details and operation, principles shunts and multipliers - extension of range.

Module 2

Measurement of power: Dynamometer type wattmeter -Construction and working - 3- phase power measurement-Low Powerfactor wattmeters.

Measurement of energy: Induction type watt-hour meters- Single phase energy meter - construction and working, two element three phase energy meters,

Digital Energymeters -Time of Day(TOD) and Smart metering (description only).

Current transformers and potential transformers - principle of working -ratio and phase angle errors. Extension of range using instrument transformers, Hall effect multipliers.

Module 3

Classification, measurement of low, medium and high resistance- Ammeter voltmeter method(for low and medium resistance measurements)-Kelvin's double bridgeWheatstones bridge- loss of charge method, measurement of earth resistance.

Measurement of self inductance-Maxwell's Inductance bridge, Measurement of capacitance -Schering's, Measurement of frequencyA Vien's bridge.

Calibration of Ammeter, Voltmeter and Wattmeter using DC potentiometers.

High voltage and high current in DC measurements- voltmeters, Sphere gaps, DC Hall effect sensors.

Module 4

Magnetic Measurements: Measurement of flux and permeability - flux meter, BH curve and permeability measurement - hysteresis measurement- ballistic galvanometer - principle-determination of BH curve - hysteresis loop. Lloyd Fisher square — measurement of iron losses.

Measurement luminous intensity-Photoconductive Transducers-Photovoltaic cells

Temperature sensors-Resistance temperature detectors-negative temperature coefficient Thermistors-thermocouples-silicon temperature sensors.

Module 5

Transducers - Definition and classification. LVDT, Electromagnetic and Ultrasonic flow meters, Piezoelectric transducers-modes of operation-force transducer, Load cell, Strain gauge.

Oscilloscopes- Principal of operation of general purpose CRO-basics of vertical and horizontal deflection system, sweep generator etc. DSO-Characteristics-Probes and Probing techniques.

Digital voltmeters and frequency meters using electronic counters, DMM, Clamp on meters.

Phasor Measurement Unit (PMU) (description only).

Introduction to Virtual Instrumentation systems- Simulation software's (description only)

Text Books

1. Sawhney A.K., A course in Electrical and Electronic Measurements & instrumentation, DhanpatRai.
2. J. B. Gupta, A course in Electrical & Electronic Measurement & Instrumentation., S K Kataria& Sons
3. Kalsi H. S., Electronic Instrumentation, 3/e, Tata McGraw Hill, New Delhi, 2012
4. S Tumanski, Principles of electrical measurement, Taylor & Francis.
5. David A Bell, Electronic Instrumentation and Measurements,3/e, Oxford

Reference Books

1. Golding E.W., Electrical Measurements & Measuring Instruments, Wheeler Pub.
2. Cooper W.D., Modem Electronics Instrumentation, Prentice Hall of India
3. Stout M.B., Basic Electrical Measurements, Prentice Hall
4. Oliver & Cage, Electronic Measurements & Instrumentation, McGraw Hill
5. E.O Doebelin and D.N Manik, Doebelin's Measurements Systems, sixth edition, McGraw Hill Education (India) Pvt. Ltd.
6. P.Purkait, B.Biswas, S.Das and C. Koley, Electrical and Electronics Measurements and Instrumentation, McGraw Hill Education (India) Pvt. Ltd.,2013

Course Contents and Lecture Schedule

Module	Topic coverage	No. of Lectures	No of hours
1	**General principles of measurements and classification of meters**		
1.1	Measurement standards-Errors-Types of Errors- Statistics of errors, Need for calibration.	3	**10**
1.2	Classification of instruments, secondary instruments- indicating, integrating and recording- operating forces -	1	
1.3	Essentials of indicating instruments - deflecting, damping, controlling torques.	3	
1.4	Ammeters and voltmeters - moving coil, moving iron, constructional details and operation, principles shunts and multipliers - extension of range.	3	
2	**Measurement of Resistance, Power and Energy**		
2.1	Measurement of power: Dynamometer type wattmeter - Construction and working - 3-phase power measurement- Low Powerfactorwattmeters.	3	**09**
2.2	Measurement of energy: Induction type watt-hour meters- Single phase energy meter - construction and working, two element three phase energy meters, Digital Energymeters - Time of Day (TOD) and Smart metering (description only).	3	
2.3	Current transformers and potential transformers - principle of working -ratio and phase angle errors. Extension of range using instrument transformers, Hall effect multipliers.	3	
3	**Measurement of circuit parameters using bridges, High voltage and high current measurements**		
3.1	Classification of resistance, low resistance, Ammeter voltmeter method, Kelvin's double bridge Medium resistance- Ammeter voltmeter method - Wheatstones bridge High resistance- loss of charge method- measurement of earth resistance.	3	**09**
3.2	Measurement of self inductance-Maxwell's Inductance bridgeMeasurement of capacitance-Schering's bridge Measurement of frequency-Wien's bridge.	2	
3.3	Calibration of Ammeter, Voltmeter and Wattmeter using DC potentiometers.	2	
3.4	High voltage and high current in DC measurements- voltmeters, Sphere gaps, DC Hall effect sensors.	2	

4	**Magnetic, Lumen and Temperature Measurements**		
4.1	Measurement of flux and permeability - flux meter, BH curve and permeability measurement - hysteresis measurement	2	**08**
4.2	Ballistic galvanometer - principlecurve determination of BH - hysteresis loop. Lloyd Fisher square - measurement of iron losses.	2	
4.3	Measurement luminous intensity-Photoconductive Transducers-Photovoltaic cells	2	
4.4	Temperature sensors-Resistance temperature detectors-negative temperature coefficient Thermistors-thermocouples-silicon temperature sensors.	2	
5	Transducers and Digital Instruments including medern recording and displaying instruments		
5.1	Transducers - Definition and classification. LVDT, Electromagnetic and Ultrasonic flow meters, Piezoelectric transducers-modes of operation-force transducer, Load cell, Strain gauge.	2	**09**
5.2	Oscilloscopes- Principal of operation of general purpose CRO-basics of vertical and horizontal deflection system, sweep generator etc. DSO-Characteristics-Probes and Probing techniques.	3	
5.3	Digital voltmeters and frequency meters us ins > electronic counters, DMM, Clamp on meters.	2	
5.4	Phasor Measurement Unit (PMU) (description only). Introduction to Virtual Instrumentation systems- Simulation software's (description only)	2	

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET205	ANALOG ELECTRONICS	PCC	3	1	0	4

Prerequisite: Fundamentals of Electronics and semiconductor devices

CO1	Design biasing scheme for transistor circuits.
CO2	Model BJT and FET amplifier circuits.
CO3	Identify power amplifier with appropriate specifications for electronic circuit applications.
CO4	Describe the operation of oscillator circuits using BJT.
CO5	Explain the basic concepts of Operational amplifier(OPAMP)
CO6	Design and developvarious OPAMP application circuits.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2									
CO2	2	2	2									
CO3			1	2								
CO4	2	2	2									
CO5			1	2								
CO6	2	2	2									

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	50
Apply	20	20	40
Analyse	-		-
Evaluate	-		-
Create	-	-	-

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module 1

Bipolar Junction Transistors: Review of BJT characteristics- Operating point of BJT - Factors affecting stability of Q point. DC Biasing-Biasing circuits: fixed bias, collector to base bias, voltage divider bias, role of emitter resistance in bias stabilisation. Stability factor (Derivation of stability factors for Voltage Divider Biasing only).Numerical problems. Bias compensation using diode and thermistor.

BJT Model- h-parameter model of BJT in CE configuration. Small signal low frequency ac equivalent circuit of CE amplifier -Role of coupling capacitors and emitter bypass capacitor. Calculation of amplifier gains and impedances using h parameter equivalent circuit.

Module 2

Field Effect Transistors: Review of JFET and MOSFET(enhancement mode only) construction, working and characteristics- JFET common drain amplifier-Design using voltage divider biasing.

Frequency response of Amplifiers: Internal Capacitances at high frequency operations of BJT- Hybrid Pi model of BJT. Low and high frequency response of Common Emitter amplifier. Frequency response of CE amplifier, Gain bandwidth product.

Module 3

Multistage amplifiers: Direct, RC, transformer coupled Amplifiers, Applications.

Power amplifiers using BJT: Class A, Class B, Class AB, Class C and Class D. Conversion efficiency - derivation(Class A and Class B). Distortion in power amplifiers. Feedback in Amplifiers-Effect of positive and negative feedbacks.
Oscillators :Barkhausen'scriterion- (RC Phaseshift oscillatorand Wein Bridge Oscillator) -LC oscillators (Hartley and Colpitt's)- Derivation of frequency of oscillation- Crystal oscillator.

Module 4

Operational Amplifiers: Fundamental differential amplifier- Modes of operation.

Properties of ideal and practical Op-amp - Gain, CMRR and Slew rate. Parameters of a typical Op-amp IC 741.

Open loop and Closed loop Configurations-Concept of virtual short. Negative feedback in Op-amps. Inverting and non- inverting amplifier circuits. Summing and difference amplifiers, Instrumentation amplifier.

Module 5

OP-AMP Circuits: Differentiator and Integrator circuits-practical circuits - Design

Comparators: Zero crossing and voltage level detectors, Schmitt trigger. Comparator IC: LM311. Wave form generation using Op-Amps: Square, triangular and ramp generator circuits using Op-Amp- Effect of slew rate on waveform generation.

Timer 555IC: Internal diagram of 555IC-Astable and Monostable multi-vibrators using 555 IC.

Text Books

1. Bell D. A., Electronic Devices and Circuits, Prentice Hall oflndia, 2007.
2. Malvino A. and D. J. Bates, Electronic Principles7/e, Tata McGraw Hill, 2010. PearsonEducation India, 2009.
3. Choudhury R.,Linearintegrated Circuits, New Agelnternauonal Publishers. 2008.

Reference Books

1. Floyd T.L., Fundamentals of Analog Circuits,, Pearson Education, 2012.
2. Robert T. Paynter and John Clemons, Paynter's Introductory electronic devices & circuits, Prentice Hall Career & Technology, New Jersey.
4. Millman J. and C. C. Halkias,Integrated Electronics: Analog and Digital Circuits andSystems, Tata McGraw-Hill, 2010.
5. Streetman B. G. and S. Baneijee,Solid State Electronic Devices, Pearson Education Asia,2006.
6. Gayakward R. A., Op-Amps and Linearlntegrated Circuits, PHILearning Pvt.Ltd., 2012.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1		10
1.1	Bipolar Junction Transistors: Review of BJT characteristics	1
1.2	Operating point of BJT - Factors affecting stability of Q point.	1
1.3	Biasing circuits fixed bias, collector to base bias, voltage divider bias, role of emitter resistance in bias stabilisation. Stability factor (Derivation of stability factors for Voltage Divider Biasing only). Numerical problems.	4
1.4	Bias compensation using diode and thermistor.	1
1.5	BJT Model- h-parameter model of BJT in CE configuration. Small signal low frequency ac equivalent circuit of CE amplifier	1
1.6	Role of coupling capacitors and emitter bypass capacitor.	1
1.7	Calculation of amplifier gains and impedances using h parameter equivalent circuit.	1
2		8
2.1	Field Effect Transistors: Review of JFET and MOSFET (enhancement mode)-construction, working and characteristics	2
2.2	JFET common drain amplifier-Design using voltage divider biasing.	1
2.3	FET as switch and voltage controlled resistance.	1
2.4	Frequency response of Amplifiers: Internal Capacitances at high frequency operations of BJT- Hybrid Pi model of BJT. Low and high frequency response of Common Emitter amplifier	3
2.5	Frequency response of CE amplifier, Gain bandwidth product	1
3		9
3.1	Multistage amplifiers: Direct, RC, Applications.	1
3.2	Transformer coupled Amplifiers, Applications.	1
3.3	Derivation of conversion efficiency of Class A and Class B amplifiers.	2

3.4	Class AB, Class C and Class D amplifiers. Distortion in power amplifiers(Class A, Class B, Class AB, Class C and Class D)	2
3.5	Oscillators: Barkhausen's criterion-RC oscillators (RC Phase shift oscillator and Wein Bridge oscillator) Derivation of frequency of	2
3.6	LC oscillators (Hartley and Colpitt's) Derivation of frequency of oscillation- Crystal oscillator.	1
4		10
4.1	Operational Amplifiers: Fundamental differential amplifier- Modes of operation.	2
4.2	Properties of ideal and practical Op-amp - Gain, CMRR and Slew rate. Parameters of a typical Op-amp IC 741.	3
4.3	Open loop and Closed loop Configurations-Concept of virtual short.	2
4.4	Negative feedback in Op-amps.	1
4.5	Inverting and non- inverting amplifier circuits	1
4.6	Summing and difference amplifiers, Instrumentation amplifier.	1
5	8	
5.1	OP-AMP Circuits: Differentiator and Integrator circuits-practical circuits - Design	1
5.2	Comparators: Zero crossing and voltage level detectors, Schmitt trigger. Comparator IC: LM311.	2
5.3	Wave form generation using Op-Amps: Square, triangular and ramp generator circuits using Op-Amp- Effect of slew rate on waveform generation.	2
5.4	Timer 555IC: Internal diagram of 555IC-Astable and Monostable multi-vibrators using 555 IC.	3

CODE	COURSE NAME	L	T	P	Hrs	CREDIT
24SJHUT200	PROFESSIONAL ETHICS	2	0	0	2	2

Preamble: To enable students to create awareness on ethics and human values.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Understand the core values that shape the ethical behaviour of a professional.
CO2	Adopt a good character and follow an ethical life.
CO3	Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.
CO4	Solve moral and ethical problems through exploration and assessment by established experiments.
CO5	Apply the knowledge of human values and social values to contemporary ethical values and global issues.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								2			2	
CO2								2			2	
CO3								3			2	
CO 4								3			2	
CO5								3			2	

Assessment Pattern

Bloom's category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	30
Understood	20	20	40
Apply	15	15	30

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (2 Nos)	25 marks
Assignments/Quiz	15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module 1 - Human Values.

Morals, values and Ethics - Integrity- Academic integrity-Work Ethics- Service Learning- Civic VirtueRespect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitmentEmpathy-Self Confidence -Social Expectations.

Module 2 - Engineering Ethics & Professionalism.

Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas -Moral Autonomy - Kohlberg's theory- Gilligan's theory- Consensus and Controversy-Profession and Professionalism- Models of professional roles-Theories about right action -Self interest-Customs and Religion- Uses of Ethical Theories.

Module 3- Engineering as social Experimentation.

Engineering as Experimentation - Engineers as responsible Experimenters- Codes of Ethics- Plagiarism- A balanced outlook on law - Challenges case study- Bhopal gas tragedy.

Module 4- Responsibilities and Rights.

Collegiality and loyalty - Managing conflict- Respect for authority- Collective bargaining- ConfidentialityRole of confidentiality in moral integrity-Conflicts of interest- Occupational crime- Professional rights- Employee right- IPR Discrimination.

Module 5- Global Ethical Issues.

Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics -Role in Technological Development-Engineers as Managers- Consulting Engineers- Engineers as Expert witnesses and advisors-Moral leadership.

Text Book

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.

2. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited ,New Delhi,2006.

Reference Books

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014.
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics-Concepts and cases, Wadsworth Thompson Learning, United states,2005.
4. http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics.

Course Contents and Lecture Schedule

SL.N o	Topic	No. of Lectures 25
1	**Module 1 - Human Values.**	
1.1	Morals, values and Ethics, Integrity, Academic Integrity,Work Ethics	1
1.2	Service Learning, Civic Virtue, Respect for others, Living peacefully	1
1.3	Caring and Sharing, Honesty, Courage, Co-operation commitment	2
1.4	Empathy, Self Confidence, Social Expectations	1
2	**Module 2- Engineering Ethics & Professionalism.**	
2.1	Senses of Engineering Ethics, Variety of moral issues, Types of inquiry	1
2.2	Moral dilemmas, Moral Autonomy, Kohlberg's theory	1
2.3	Gilligan's theory, Consensus and Controversy,Profession& Professionalism, Models of professional roles, Theories about right action	2
2.4	Self interest-Customs and Religion, Uses of Ethical Theories	1
3	**Module 3- Engineering as social Experimentation.**	
3.1	Engineering as Experimentation, Engineers as responsible Experimenters	1
3.2	Codes of Ethics,Plagiarism, A balanced outlook on law	2
3.3	Challenger case study, Bhopal gas tragedy	2
4	**Module 4- Responsibilities and Rights.**	
4.1	Collegiality and loyalty, Managing conflict, Respect for authority	1
4.2	Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest	2
4.3	Occupational crime, Professional rights, Employee right, IPR Discrimination	2
5	**Module 5- Global Ethical Issues.**	
5.1	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics	2
5.2	Role in Technological Development, Moral leadership	1
5.3	Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	2

CODE	SUSTAINABLE ENGINEERING	L	T	P	CREDIT
24SJMCN201		2	0	0	NIL

Preamble: Objective of this course is to inculcate in students an awareness of environmental issues and the global initiatives towards attaining sustainability. The student should realize the potential of technology in bringing in sustainable practices.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the relevance and the concept of sustainability and the global initiatives in this direction
CO 2	Explain the different types of environmental pollution problems and their sustainable solutions
CO 3	Discuss the environmental regulations and standards
CO 4	Outline the concepts related to conventional and non-conventional energy
CO 5	Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2	3					2
CO 2						2	3					2
CO 3						2	3					2
CO 4						2	3					2
CO 5						2	3					2

Assessment Pattern

Mark distribution

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two Parts;Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question.
Students should answer all questions.Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Syllabus

Sustainability- need and concept, technology and sustainable development-Natural resources and their pollution, Carbon credits, Zero waste concept. Life Cycle Analysis, Environmental Impact Assessment studies, Sustainable habitat, Green buildings, green materials, Energy, Conventional and renewable sources, Sustainable urbanization, Industrial Ecology.

Module 1

Sustainability: Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

Module 2

Environmental Pollution: Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection.

Module 3

Environmental management standards: ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.

Module 4

Resources and its utilisation: Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy.

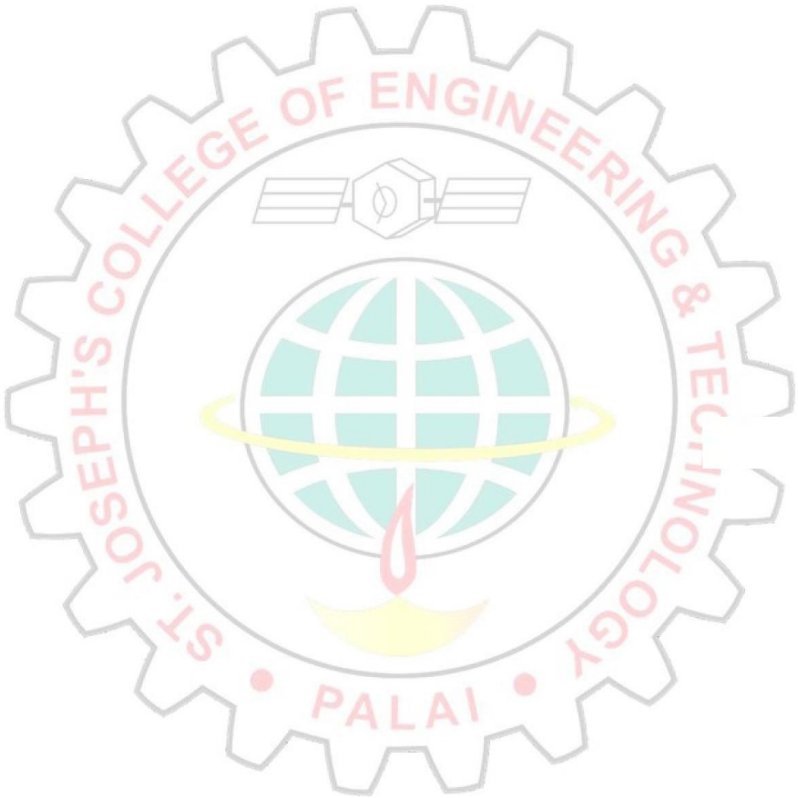
Module 5

Sustainability practices: Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanisation, Sustainable cities, Sustainable transport.

Reference Books

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
3. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
4. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
5. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency

Publications-Rating System, TERI Publications - GRIHA Rating System
6. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
7. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
8. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios publication



Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Sustainability	
1.1	Introduction, concept, evolution of the concept	1
1.2	Social, environmental and economic sustainability concepts	1
1.3	Sustainable development, Nexus between Technology and Sustainable development	1
1.4	Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs)	1
1.5	Clean Development Mechanism (CDM)	1
2	Environmental Pollution	
2.1	Air Pollution and its effects	1
2.2	Water pollution and its sources	1
2.3	Zero waste concept and 3 R concepts in solid waste management	1
2.4	Greenhouse effect, Global warming, Climate change, Ozone layer depletion	1
2.5	Carbon credits, carbon trading and carbon foot print.	1
2.6	Legal provisions for environmental protection.	1
3	Environmental management standards	
3.1	Environmental management standards	1
3.2	ISO 14001:2015 frame work and benefits	1
3.3	Scope and Goal of Life Cycle Analysis (LCA)	1
3.4	Circular economy, Bio-mimicking	1
3.5	Environment Impact Assessment (EIA)	1
3.6	Industrial Ecology, Industrial Symbiosis	1
4	Resources and its utilisation	
4.1	Basic concepts of Conventional and non-conventional energy	1
4.2	General idea about solar energy, Fuel cells	1
4.3	Wind energy, Small hydro plants, bio-fuels	1
4.4	Energy derived from oceans and Geothermal energy	1
5	Sustainability Practices	
5.1	Basic concept of sustainable habitat	1
5.2	Methods for increasing energy efficiency of buildings	1
5.3	Green Engineering	1
5.4	Sustainable Urbanisation, Sustainable cities, Sustainable transport	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEEL201	CIRCUITS AND MEASUREMENTS LAB	PCC	0	0	3	2

Preamble : This laboratory course is designed to train the students to familiarize and practice various measuring instruments and different transducers for measurement of physical parameters. Students will also be introduced to a team working environment where they develop the necessary skills for planning, preparing and implementing basic instrumentation systems.

Prerequisite : Basic Electrical Engineering

Course Outcomes : After the completion of the course the student will be able to

CO1	Analyse voltage current relations of RLC circuits
CO2	Verify DC network theorems by setting up various electric circuits
CO3	Measure power in a single and three phase circuits by various methods
CO4	Calibrate various meters used in electrical systems
CO5	Determine magnetic characteristics of different electrical devices
CO6	Analyse the characteristics of various types of transducer systems
CO7	Determine electrical parameters using various bridges

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2						2			3
CO2	3	3	-	-	-	-	-	-	2	-	-	3
CO3	3	3	-	-	-	-	-	-	2	-	-	3
CO4	3	3	2	-	-	-	-		2	-	-	3
CO5	3	3	-	-	-		-		2		-	3
CO6	3	3	2	-	-		-	-	2	-	-	3
CO7	3	3	-	-	-		-	-	2	-	-	3

ASSESSMENT PATTERN:

Mark distribution:

Total Marks	CIE marks	ESE marks	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation (CIE) Pattern:

Attendance	Regular Lab work	Internal Test	Total
15	30	30	75

Internal Test Evaluation (Immediately before the second series test)
End Semester Examination (ESE) Pattern:

The following guidelines should be followed regarding award of marks

(a)	Preliminary work	: 15 Marks
(b)	Implementing the work/Conducting the experiment	: 10 Marks
(c)	Performance, result and inference (usage of equipments and trouble shooting)	: 25 Marks
(d)	Viva voce	: 20 marks
(e)	Record	: 5 Marks

General instructions : Practical examination is to be conducted immediately after the second series test after conducting 12 experiments from the list of experiments given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the examination only on submitting the duly certified record. The external examiner shall endorse the record.

LIST OF EXPERIMENTS:

(12 experiments are mandatory)

1. Verification of Superposition theorem and Thevenin's theorem.
2. Determination of impedance, admittance and power factor in RLC series/ parallel circuits.
3. 3-phase power measurement using one wattmeter and two-wattmeter methods, and determination of reactive/apparent power drawn.
4. Resistance measurement using Kelvin's Double Bridge and Wheatstone's Bridge and extension of range of voltmeters and ammeters.
5. Extension of instrument range by using Instrument transformers(CT and PT)
6. Calibration of ammeter, voltmeter, wattmeter using Potentiometers
7. Calibration of 1-phase Energy meter at various power factors (minimum 4 conditions)
8. Calibration of 3-phase Energy meter using standard wattmeter
9. Determination of B-H curve, p-H curve and p-B curve of a magnetic specimen
10. Measurement of Self inductance, Mutual inductance and Coupling coefficient of a 1- phase transformer
11. a. Measurement of Capacitance using AC bridge

    b. Setup an instrumentation amplifier using Opamps.
12. Determination of characteristics of LVDT, Strain gauge and Load-cell.
13. Determination of characteristics of Thermistor, Thermocouple and RTD
14. Verification of loading effect in ammeters and voltmeters with current measurement using Clamp on meter.
15. Demo Experiments/Simulation study:

    (a) Measurement of energy using TOD meter

(b) Measurement of electrical variables using DSO
(c) Harmonic analysers
(d) Simulation of Circuits using software platform
(e) Computer interfaced measurements of circuit parameters.

Reference Books:

1. A. K. Sawhney: A course in Electrical and Electronic Measurements & Instrumentation, Dhanpat Rai Publishers
2. J. B. Gupta: A course in Electrical & Electronic Measurement & Instrumentation., S. K. Kataria & Sons Publishers
3. Kalsi H. S.: Electronic Instrumentation, 3/e, Tata McGraw Hill, New Delhi.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEEL203	ANALOG ELECTRONICS LAB	PCC	0	0	3	2

CO1	Use the various electronic instruments and for conducting experiments.
CO2	Design and develop various electronic circuits using diodes and Zener diodes.
CO3	Design and implement amplifier and oscillator circuits using BJT and JFET.
CO4	Design and implement basic circuits using IC (OPAMP and 555 timers).
CO5	Simulate electronic circuits using any circuit simulation software.
CO6	Use PCB layout software for circuit design

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2								2			
CO2	2	2	2						2			
CO3	2	2	2						2			
CO4	2	2	2						2			
CO5	1	1			3				3			
CO6	1				3				3			

LIST OF EXPERIMENTS

1. Measurement of current, voltage, frequency and phase shift of signal in a RC network using oscilloscope.
2. Clipping circuits using diodes.
3. Clamping circuits using diodes.
4. Design and testing of simple Zener voltage regulator.
5. RC coupled amplifier using BJT in CE Configuration-Measurement of gain, BW and plotting of frequency response.
6. JFET amplifier- Measurement of gain, BW and plotting of frequency response.
7. Op-amp circuits - Design and set up of invertingand non-inverting amplifier, scale changer, adder, integrator, and differentiator.
8. Op-amps circuits - Scale changer, adder, integrator, and differentiator.
9. Precision rectifier using Op-amps.
10. Phase shift oscillator using Op-amps.
11. Wein'sBridgeoscillator using Op-amps.
12. Waveform generation- Square, triangular and saw- tooth wave form generation using OP AMPs.
13. Basic comparator and Schmitt trigger circuits using Op-amp (Use comparator ICs such as LM311).
14. Design and testing of series voltage regulator using Zener diode.
15. Astable and Monostable circuit using555IC.
16. RC phase shift oscillator using Op-amp.
17. Introduction to circuit simulation using any circuit simulation software.
18. Introduction to PCB layout software.

Text Books

1. Bell D. A., Electronic Devices and Circuits, Prentice Hall of India, 2007.
2. Malvino A. and D. J. Bates, Electronic Principles7/e, Tata McGraw Hill, 2010.
3. Boylestad R. L. and L. Nashelsky, Electronic Devices and Circuit Theory, 10/e, Pearson Education India, 2009.
4. Choudhury R., Linear Integrated Circuits, New Age International Publishers. 2008.

Reference Books

1. Floyd T.L., Fundamentals of Analog Circuits,, Pearson Education, 2012.
2. Robert T. Paynter and John Clemons, Paynter's Introductory electronic devices & circuits, Prentice Hall Career & Technology, New Jersey.
3. Millman J. and C. C. Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, Tata McGraw-Hill, 2010.
4. Gayakward R. A., Op-Amps and Linear Integrated Circuits, PHI Learning Pvt. Ltd., 2012.

Assessment Pattern :

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation (CIE) Pattern:

Attendance	Regular Lab work	Internal Test	Total
15	30	30	75

End Semester Examination Pattern:

The following guidelines should be followed regarding award of marks

(a) Preliminary work: 15 Marks

(b) Implementing the work/Conducting the experiment: 10 Marks

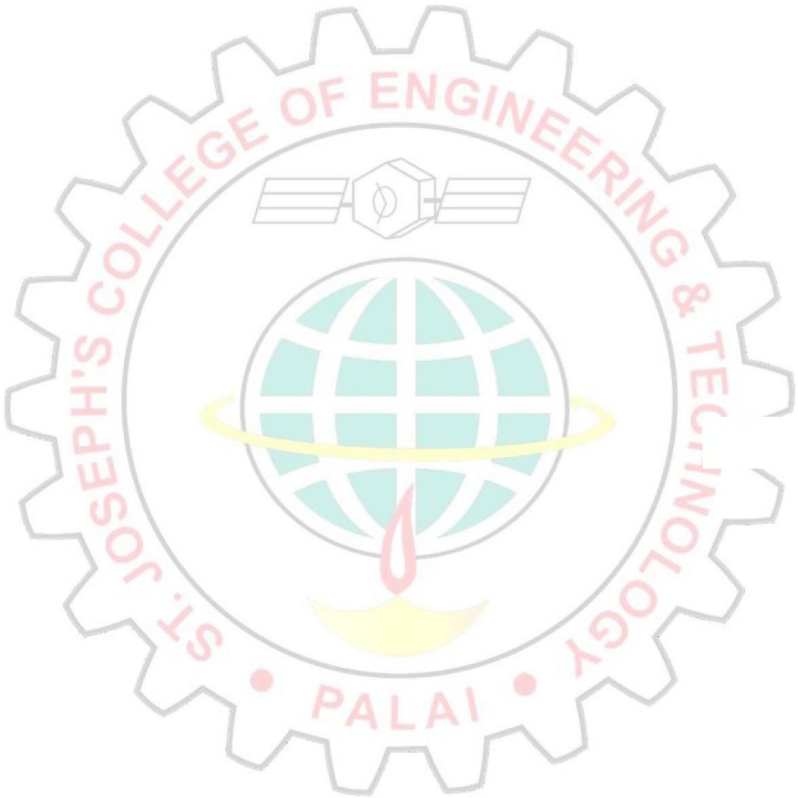
(c) Performance, result and inference (usage of equipment and troubleshooting) : 25 Marks

(d) Viva voc: 20 Marks

(e) Record : 05 Marks

General Instructions:

Practical examination to be conducted immediately after the second series test covering entire syllabus. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the examination only on submitting the duly certified record. The external examiner shall endorse the record.



SYLLABUS

B.Tech.

ELECTRICAL AND ELECTRONICS ENGINEERING

FOR WORKING PROFESSIONALS - Semester IV

2024 SCHEME

SEMESTER IV

SLOT	COURSE NO	COURSES	L-T-P	HOURS	CREDIT
A	24SJMAT 204	PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS	3-1-0	4	4
B	24SJEET202	DC MACHINES AND TRANSFORMERS	2-2-0	4	4
C	24SJEET204	ELECTROMAGNETIC THEORY	3-1-0	4	4
D	24SJEET206	DIGITAL ELECTRONICS	3-1-0	4	4
E 1/2	24SJEST200	DESIGN & ENGINEERING	2-0-0	2	2
	24SJHUT200	PROFESSIONAL ETHICS	2-0-0	2	2
F	24SJMCN202	CONSTITUTION OF INDIA	2-0-0	2	—
S	24SJEEL202	ELECTRICAL MACHINES LAB 1	0-0-3	3	2
T	24SJEEL204	DIGITAL ELECTRONICS LAB	0-0-3	3	2
		TOTAL		**26**	**22**

NOTE:

1. Design & Engineering and Professional Ethics shall be offered in both S3 and S4.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJMAT204	PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS	BASIC SCIENCE COURSE	3	1	0	4

Preamble: This course introduces students to the modern theory of probability and statistics, covering important models of random variables and analysis of random processes using appropriate time and frequency domain tools. A brief course in numerical methods familiarises students with some basic numerical techniques for finding roots of equations, evaluating definite integrals solving systems of linear equations and solving ordinary differential equations which are especially useful when analytical solutions are hard to find.

Prerequisite: A basic course in one-variable and multi-variable calculus.

Course Outcomes: After the completion of the course the student will be able to

CO1	Understand the concept, properties and important models of discrete random variables and, using them, analyse suitable random phenomena.
CO2	Understand the concept, properties and important models of continuous random variables and, using them, analyse suitable random phenomena.
CO3	Analyse random processes using autocorrelation, power spectrum and Poisson process model as appropriate.
CO4	Compute roots of equations, evaluate definite integrals and perform interpolation on given numerical data using standard numerical techniques
CO5	Apply standard numerical techniques for solving systems of equations, fitting curves on given numerical data and solving ordinary differential equations.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2					2		1
CO2	3	2	2	2	2					2		1
CO3	3	2	2	2	2					2		1
CO4	3	2	2	2	2					2		1
CO5	3	2	2	2	2					2		1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests(%)		End Semester Examination(%)
	1	2	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate	10	10	10
Create			

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should

answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module 1 (Discrete probability distributions) 9 hours

(Text-1: *Relevant topics* from sections-3.1-3.4, 3.6, 5.1)

Discrete random variables and their probability distributions, Expectation, mean and variance, Binomial distribution, Poisson distribution, Poisson approximation to the binomial distribution, Discrete bivariate distributions, marginal distributions, Independent random variables, Expectation (multiple random variables)

Module 2 (Continuous probability distributions) 9 hours

***(Text-l:Relevant topics* from sections-4.1-4.4, 3.6, 5.1)**

Continuous random variables and their probability distributions, Expectation, mean and variance, Uniform, exponential and normal distributions, Continuous bivariate distributions, marginal distributions, Independent random variables, Expectation (multiple random variables), i. i. d random variables and Central limit theorem (without proof).

Module 3 (Random Processes) 9 hours

(Text-2: *Relevant topics* from sections-8.1-8.5, 8.7, 10.5)

Random processes and classification, mean and autocorrelation, wide sense stationary (WSS) processes, autocorrelation and power spectral density of WSS processes and their properties, Poisson process-distribution of inter-arrival times, combination of independent Poisson processes(merging) and subdivision (splitting) of Poisson processes (results without proof).

Module 4 (Numerical methods -I) 9 hours

(Text 3- ***Relevant topics*** from sections 19.1, 19.2, 19.3, 19.5)

Errors in numerical computation-round-off, truncation and relative error, Solution of equations - Newton-Raphson method and Regula-Falsi method. Interpolation-finite differences, Newton's forward and backward difference method, Newton's divided difference method and Lagrange's method. Numerical integration-Trapezoidal rule and Simpson's l/3rd rule **(Proof or derivation of the formulae not required for any of the methods in this module)**

Module 5 (Numerical methods -II) 9 hours

(Text 3- *Relevant topics* from sections 20.3, 20.5, 21.1)

Solution of linear systems-Gauss-Seidel and Jacobi iteration methods. Curve fitting-method of least squares, fitting straight lines and parabolas. Solution of ordinary differential equations-Euler and Classical Runge-Kutta method of second and fourth order, Adams- Moulton predictor-correction method **(Proof or derivation of the formulae not required for any of the methods in this module)**

Text Books

1. (Text-1) Jay L. Devore, *Probability and Statistics for Engineering and the Sciences,* 8th edition, Cengage, 2012
2. (Text-2) Oliver C. Ibe, *Fundamentals of Applied Probability and Random Processes,* Elsevier, 2005.
3. (Text-3) Erwin Kreyszig, *Advanced Engineering Mathematics,* 10 th Edition, John Wiley & Sons, 2016.

Reference Books

1. Hossein Pishro-Nik, *Introduction to Probability, Statistics and Random Processes,* Kappa Research, 2014 (Also available online at www.probabilitycourse.com)
2. V. Sundarapandian, *Probability, Statistics and Queueing theory,* PHI Learning, 2009
3. Gubner, *Probability and Random Processes for Electrical and Computer Engineers,* Cambridge University Press,2006.
4. B.S. Grewal, *Higher Engineering Mathematics,* Khanna Publishers, 36 Edition, 2010.

Assignments

Assignments should include specific problems highlighting the applications of the methods introduced in this course in physical sciences and engineering

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Discrete Probability distributions**	**9 hours**
1.1	Discrete random variables and probability distributions, expected value, mean and variance (discrete)	3
1.2	Binomial distribution-mean, variance, Poisson distribution-mean, variance, Poisson approximation to binomial	3
1.3	Discrete bivariate distributions, marginal distributions, Independence of random variables (discrete), Expected values	3
2	**Continuous Probability distributions**	**9 hours**
2.1	Continuous random variables and probability distributions, expected value, mean and variance (continuous)	2
2.2	Uniform, exponential and normal distributions, mean and variance of these distributions	4
2.3	Continuous bivariate distributions, marginal distributions, Independent random variables, Expected values, Central limit theorem.	3
3	**Random processes**	**9 hours**
3.1	Random process -definition and classification, mean , autocorrelation	2
3.2	WSS processes its autocorrelation function and properties	2
3.3	Power spectral density	2
3.4	Poisson process, inter-distribution of arrival time, merging and splitting	3
4	**Numerical methods-I**	**9 hours**
4.1	Roots of equations- Newton-Raphson, regulafalsi methods	2
4.2	Interpolation-finite differences, Newton's forward and backward formula,	3
4.3	Newton's divided difference method, Lagrange's method	2
4.3	Numerical integration-trapezoidal rule and Simpson's 1/3-rd rule	2
5	**Numerical methods-II**	**9 hours**
5.1	Solution of linear systems-Gauss-Siedal method, Jacobi iteration	2

	method	
5.2	Curve-fitting-fitting straight lines and parabolas to pairs of data points using method of least squares	2
5.3	Solution of ODE-Euler and Classical Runge-Kutta methods of second and fourth order	4
5.4	Adams-Moulton predictor-corrector method	1

CODE	COURSE NAME	CATEGORY	L	T	P		CREDIT
24SJEET202	DC MACHINES AND TRANSFORMERS	PCC	2	2	0		4

Preamble : The purpose of the course is to provide the fundamentals of DC generators, DC motors and transformers and giving emphasis to applications in engineering field.

Prerequisite : Basics of Electrical Engineering

Course Outcomes : After the completion of the course the student will be able to:

CO1	Acquire knowledge about constructional details of DC machines
CO2	Describe the performance characteristics of DC generators
CO3	Describe the principle of operation of DC motors and select appropriate motor types for different applications
CO4	Acquire knowledge in testing of DC machines to assess its performance
CO5	Describe the constructional details anc modes of operation of single phase and three phase transformers
CO6	Analyse the performance of transformers under various conditions

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2			2							3
CO2	3	2				2						3
CO 3	3	2	2			2						3
CO4	3	3				2						3
CO5	3					2						3
CO6	3					2						3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	20
Understand	10	10	30
Apply	10	10	30
Analyse	10	10	20
Evaluate			
Create			

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module 1

Constructional details of dc machines - armature winding- single layer winding, double layer winding- lap and wave, equalizer rings, dummy coils, MMF of a winding, EMF developed, electromagnetic torque - numerical problems.

Module 2

DC generator -principle of operation, EMF equation, excitation,armature reaction demagnetising and cross magnetising ampere turn,compensating windings, interpoles, commutation,OCC, voltage build up and load characteristics, parallel operation. Power flow diagram- numerical problems.

Module 3

DC motor -back emf, generation of torque,torque equation,performance characteristics - numerical problems.

Starting of DC motors- starters -3point and 4 point starters(principle only).

Speed control of DC motors - field control, armature control. Braking of DC motors. Power flow diagram - losses and efficiency.Testing of DC motors - Swinburne's test, Hopkinson's test, and retardation test.DC motor applications - numerical problems.

Module 4

Ideal transformer,dot convention, magnetising current, transformation ratio, phasor diagram, operation on no load and on load, equivalent circuit, percentage and per unit impedance, voltage regulation. Transformer losses and efficiency, condition for ,′ ,
short circuit test, Sumpner's test - separation of losses, all day efficiency.Parallel operation of single-phase transformers- numerical problems

Module 5

Autotransformer - saving of copper -ratingof autotransformers.

Three phase transformer - construction- difference between power transformer and distribution transformer -Different connections of 3-phase transformers. Y-Y, A-A,Y-A, A-Y, V-V. Vector groupings - YyO, DdO, Ydl, Ydll, Dyl, Dyl 1.Parallel

operation of three phase transformers.

Three winding transformer - stabilization by tertiary winding. Tap changing transformers - no load tap changing, on load tap changing, dry type transformers.

Text Books

1. Bimbra P. S., Electrical Machinery, 7/e, Khanna Publishers, 2011.
2. Nagrath J. and D. P. Kothari, Theory of AC Machines, Tata McGraw Hill, 2017.

Reference Books

1. Fitzgerald A. E., C. Kingsley and S. Umans, Electric Machinery, 6/e, McGraw Hill, 2003.
2. Langsdorf M. N., Theory of Alternating Current Machinery, Tata McGraw Hill, 2001.
3. Deshpande M. V., Electrical Machines, Prentice Hall India, New Delhi, 2011.
4. B. L. Theraja, Electrical Technology Vol II,S.Chand Publications.
5. A. E. Clayton & N. N. Hancock, The Performance and design of Direct Current Machines,CBS Publishers& Distributors, NewDelhi.

Course Contents and Lecture Schedule

SI.No.	Topic	No. of Hours
1	**Constructional details of dc machines**	**8**
1.1	Constructional details of DC machines	2
1.2	Armature winding - single layer	1
1.3	Armature winding- double layer-wave and lap, equaliser rings, dummy coils.	3
1.4	MMF of a winding, EMF developed, electromagnetic torque.	2
2	**DC Generator**	**9**
2.1	DC generators- principle of operation, EMF equation, methods of excitation -separately and self-excited - shunt, series, compound machines.Numerical problems	3

2.2	Armature reaction - effects of armature reaction, demagnetising and cross magnetising ampere-turns, compensating windings ,interpoles. Numerical problems.	3
2.3	Load characteristics, losses and efficiency power flow diagram. Parallel operation - applications of dc generators. Numerical problems.	3
3	**DC Motor**	**10**
3.1	DC motor- principle of operation, back emf, classification- torque equation. Numerical problems.	2
3.2	Starting of DC motors - necessity of starters. Numerical problems. Types of starters - 3 point and 4 point starters(principle only).	2
3.3	Speed control - field control, armature control- Numerical problems. Braking of de motors (Description only)	2
3.4	Losses and efficiency - power flow diagram. Numerical problems	1
3.5	Swinburne's test - Numerical problems.	1
3.6	Hopkinson's test, separation of losses - retardation test. Applications of de motors.	2
4	**Single phase Transformer**	**10**
4.1	Transformers - principle of operation, construction, core type and shell type construction.	1
4.2	EMF equation, transformation ratio, ideal transformer,transformer with losses, phasor diagram - no load and on load operation. Numerical problems.	2
4.3	Equivalent circuit, percentage and per unit impedance, voltage regulation. Numerical problems.	2
4.4	Transformer losses and efficiency, Condition for maximum efficiency, all day efficiency - Numerical problems.	2
4.5	Dot convention - polarity test, OC & SC test, Sumpner's test,separation of losses. Numerical problems.	2
4.6	kVA rating of transformers,parallel operation of single phase transformers	1
5	**Autotransformer & Three phase transformer**	**8**

5.1	Autotransformer - ratings, saving of copper.Numerical problems.	2
5.2	Three phase transformer construction, three phase transformer connections, power transformer and distribution transformer.	2
5.3	Vector groupings YyO, DdO, Ydl, Ydll, Dyl, Dyll.	1
5.4	Three winding transformer - tertiary winding. Percentage and per unit impedance. Parallel operation.	2
5.5	On load and off load tap changers, dry type transformers.	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET204	ELECTROMAGNETIC THEORY	PCC	3	1	0	4

Preamble : The purpose of the course is to familiarize the students with the fundamentals of electrostatics, magnetostatics, time-varying fields and electromagnetic waves.

Prerequisite : Engineering Mathematics,Engineering Physics

Course Outcomes :After the completion of the course the student will be able to:

CO1	Apply vector analysis and coordinate systems to solve static electric and magneticfield problems.
CO2	Apply Gauss Law, Coulomb's law and Poisson's equation to determine electrostatic field parameters
CO3	Determine magnetic fields from current distributions by applying Biot-Savart's law and Amperes Circuital law.
CO4	Apply Maxwell Equations for the solution of timevarying fields
CO5	Analyse electromagnetic wave propagation in different media.

Mapping of course outcomes with programme outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3										
CO2	2	3										
CO3	2	3										
CO4	2	3										
CO5	2	3										

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	20
Understand*	20	20	50
Apply*	20	20	30
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

*Numerical problems to test the understanding and application of principles to be asked.

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions

from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module 1:

Introduction to Co-ordinate Systems - Rectangular, Cylindrical and Spherical Co- ordinate Systems - Co-ordinate transformation; Gradient of a Scalar field, Divergence of a Vector field and Curl of , Vector field- their physical interpretation; Divergence Theorem, Stokes' Theorem;

Module 2:

Coulomb's Law, Electric field intensity, Field due to a line charge, surface charge distribution. Electric Flux and Flux Density; Gauss's law and its application to determine the field due to an infinite line charge, infinite sheet charge; Electric Potential-Potential Gradient, conservative property of electric field, Equipotential surfaces; Electric Dipole; Capacitance - capacitance of co-axial cable, two wire line; Poisson's and Laplace's equations;

Module 3:

Biot-Savart's Law, Magnetic Field intensity due to a finite and infinite wire carrying current; Magnetic field intensity on the axis of a circular and rectangular loop carrying current; Magnetic flux Density; Magnetic Vector Potential; Ampere's circuital law and simple applications; Inductance and mutual inductance. Boundary conditions for electric fields and magnetic fields;

Conduction current and displacement current densities; Continuity equation for current; Maxwell's Equation in Differential and Integral form from Modified form of Ampere's circuital law, Faraday's Law and Gauss's Law.

Module 4:

Wave Equations from Maxwell's Equations; Uniform Plane Waves, Wave equations in Phasor form; Propagation of Uniform Plane waves in free space, loss-less and lossy, phase velocity and groupvelocity, Intrinsic Impedance, Attenuation constant and Propagation Constant in all medium;Poynting Vector and Poynting Theorem.

Module 5:

Transmission line: Waves in transmission line, Line parameters, Transmission line equation & solutions, Propagation constants, Characteristic impedance, Wavelength, Velocity of propagation. Standing Wave Ratio(SWR), impedance matching.Solution of problems. Electromagnetic interference.

Text Books

1 . Matthew N.O. Sadiku, *Principles of Electromagnetics,* Oxford University Press, 6th Edition.

2 Hayt W. H. and J. A. Buck, *Engineering Electromagnetics,* McGraw-Hill, 8th Edition.

Reference Books

1 Joseph A. Edminister, *Electromagnetics, Schaum's Outline Series,* Tata McGraw-Hill, Revised 2nd Edition.

2 John Kraus and Daniel Fleisch, *Electromagnetics with Applications,* McGraw-Hill, 5thedition

3 Cheng D ^*Fundamentals of Engineering Electromagnetic^KA^on-^*lesley.

4 Guru B. S. and H. R.Hizroglu, *Electromagnetic Field Theory Fundamentals*,PWS Publication Company,Boston, 1998.

5 Gangadhar K. A. and P. M. Ramanathan, *Electromagnetic Field Theory,* Khanna Publishers, 2009

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1:**	**9**
1.1	Introduction to coordinate systems - Rectangular, cylindrical and spherical coordinate Systems - Coordinate transformation. Numerical Problems.	3
1.2	Gradient of a scalar field, Divergence of a vector field and curl of a vector field-physical interpretation. Numerical Problems.	3
1.3	Divergence Theorem, Stokes' Theorem.Numerical Problems.	3
2	**Module 2:**	**9**
2.1	Coulomb's Law, Electric field intensity, Field due to a line charge, surface charge distribution. Numerical Problems.	2
2.2	Electric Flux and Flux Density; Gauss's law and its application to determine the field due to an infinite line charge, Infinite sheet charge. Numerical problems.	3

2.3	Electric Potential-Potential Gradient, conservative property of electric field, Equipotential surfaces. Numerical Problems.	2
2.4	Electric Dipole, Capacitance, Poisson's and Laplace's equations.Numerical Problems.	2
3	**Module 3:**	**11**
3.1	Biot-Savart's Law, Magnetic Field intensity due to a finite and infinite wire carrying current.Magnetic field intensity on the axis of a circular and rectangular loop carrying current.Numerical Problems.	3
3.2	Magnetic flux Density; Magnetic Vector Potential; Ampere's circuital law and simple applications, Numerical Problems.	3
3.3	Boundary conditions for electric fields and magnetic fields. Conduction current and displacement current densities; Continuity equation for current; Electrostatic Energy Density.; Numerical Problems.	3
3.5	Maxwell's Equation in Differential and Integral form from Modified form of Ampere's circuital law, Faraday's Law and Gauss's Law; Numerical Problems.	2
4	**Module 4:**	**8**
4.1	Wave Equations from Maxwell's Equations; Uniform Plane Waves, Wave equations in Phasor form. Numerical Problems.	3
4.2	Propagation of Uniform Plane waves in free space, loss-less and lossy dielectric medium, Uniform Plane waves in good conductor-properties in different medium.Numerical Problems.	3
4.3	Skin effect and skin depth, Poynfing Vector and Poynting Theorem. Numerical Problems.	2
5	**Module 5:**	**8**
5.1	Transmission line: Waves in transmission line, Line parameters.Numerical Problems.	3
5.2	Transmission line equation &solutions, Physical significance of solutions,Propagation constants, Characteristic impedance, Wavelength, Velocity of propagation.Numerical Problems.	3
5.3	SWR, impedance matching .Solution of problems. Electromagnetic interference Solution of problems.	2

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET206	DIGITAL ELECTRONICS	PCC	3	1	0	4

Preamble : Nil

Prerequisite : Nil

Course Outcomes : After the completion of the course the student will be able to:

CO1	Identify various number systems, binary codes and formulate digital functions using Boolean algebra.
CO2	Design and implement combinational logiccircuits.
CO3	Design and implement sequential logic circuits.
CO4	Compare the operation of various analog to digital and digital to analog conversion circuits.
CO5	Explain the basic concepts of programmable logic devices and VHDL.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1										
CO2	3	3	2									
CO3	3	3	2									
CO4	3	2	1									
CO5	3	2	2		2							

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module 1

Number Systems and Codes: Binary, Octal and hexadecimal conversions- ASCII code, Excess -3 code, Gray code, BCD, Error detection codes-Parity method.

Signed numbers- representation, addition and sub traction,Fixed point and floating-point representation.

Logic gates, Universal gates, TTL and CMOS logic families-Internal diagram of TTL NAND gate and CMOS NOR gate. Comparison of CMOS and TTL performance.

Module 2

Boolean Laws and theorems, Sum of Products method, Product of Sum method - K map representation and simplification(up to four variables) - Pairs, Quads, Octets, Don't care conditions.

Combinational circuits: Adders -Full adder and half adder, Subtractors- half subtractor and full subtractor, 4 bit parallel binary adder/subtractor, Carry Look ahead adders.

Module 3

Comparators, Parity generators and checkers, Encoders, Decoders, , BCD to seven segment decoder, Code converters, Multiplexers, Demultiplexers, Architecture of Arithmetic Logic Units (Block schematic only).

Module 4

Conversion of flip-flops. Registers -SISO, SIPO, PISO, PIPO. Up/Down Counters: Asynchronous Counters - Modulus of a counter - Mod-N counters Ring counter, Johnson Counter Synchronous counters,Design of Synchronous counters.

Module 5

State Machines: State transition diagram, Moore and Mealy Machines Digital to Analog converter -Specifications, Weighted resistor type, R-2R Ladder type.Analog to Digital Converter - Specifications, Flash type, Successive approximation type.

Programmable Logic Devices - PAL, PLA, FPGA (Introduction and basic concepts only) Introduction to Verilog, Implementation of AND, OR, half adder and full adder.
Note: Course assignments may be given in Verilog programming

Text Books

1. Floyd T.L, Digital Fundamentals, 10/e, Pearson Education, 2011.
2. C.H.Roth and L.L.Kimney Fundamentals of Logic Design, 7/e, Cengage Learning, 2013.
3. Mano M.M, Logic and Computer Design Fundamentals, 4/e, Pearson Education.
4. A Anand Kumar, Fundamental of Digital Electronics ,Prentice Hall
5. Roy Chaudari,Linear Integrated Circuits, New Age International Publications
6. S. Salivahanan , Digital Circuits and Design, Oxford University Press

Reference Books

1. Donald P. Leach, Albert Paul Malvino and GoutamSaha, Digital Principles and Applications, 8/e, by McGraw Hill. Pearson Education.
2. John F. Wakerly, Digital Design: Principles and Practices, 4/e, Pearson, 2005.
3. Taub& Schilling: Digital Integrated Electronics, McGraw Hill, 1997.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Number systems and Binary code**	**10**
1.1	Introduction, Binary, Octal and hexadecimal conversions	2
1.2	ASCII code, Excess -3 code, Gray code BCD.	1
1.3	Error detection codes -Parity Codes.	1
1.4	Signed numbersrepresentation, addition and subtraction	1
1.5	Fixed point and floating-point representation	2
1.6	Logic gates and universal gates	1
1.7	TTL and CMOS logic families-Internal diagram of TTL NAND gate and CMOS NOR gate. Comparison of CMOS and TTL performance.	2
2	**Boolean Algebra and Adders**	**9**

2.1	Boolean Laws and theorems.	1
2.2	Standard forms and canonical forms, Sum of Products method, Product of Sums method.	2
2.3	K-map representation and simplification (upto four variables) -Pairs, Quads, Octets, Don't care conditions. Realisation using universal gates.	2
2.4	Adders - Full adder and half adder - Subtractors, half subtractor and full subtractor.	2
2.5	4-bit parallel binary adder/subtractor.	1
2.6	Carry Look-ahead adders.	1
3	**Combinational Logic Circuit**	**9**
3.1	2- and 4-bit magnitude comparator.	2
3.2	Parity generators and checkers.	1
3.3	Encoder, Decoder-BCD to decimal decoders.and BCD to seven segment	2
3.4	Realisation of Code converters.	1
3.5	Multiplexers and implementation of functions, Demultiplexers	2
3.6	Architecture of Arithmetic Logic Units (Block schematic only)	1
4	**Sequential circuits**	**10**
4.1	Flip-Flops, SR, JK, D and T flip-flops, JK Master Slave Flip-flop, Preset and clear inputs	2
4.2	Conversion of Flipflop	2
4.3	Registers -SISO, SIPO, PISO, PIPO.	1
4.4	Up/Down Counters: Asynchronous Counters - Modulus of a counter - Mod-N counters.	2
4.5	Ring counter, Johnson Counter.	1
4.6	Design of Synchronous counters	2
5	**State Machines, D/A and A/D converters and PLDs**	**7**
5.1	State Machines: State transition diagram, Moore and Mealy Machines	1
5.2	Digital to Analog converter - R-2R ladder, weighted resistors.	1
5.3	Analog to Digital Converter - Flash ADC, Successive approximation.	1
5.4	Programmable Logic Devices - PAL, PLA-function implementation FPGA (Introduction and basic concepts only).	2
5.5	Introduction to VHDL, Implementation of AND, OR, half adder and full adder.	2

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEST200	DESIGN & ENGINEERING	HMC	2	0	0	2

Preamble:

The purpose of this course is to

i) introduce the undergraduate engineering students the fundamental principles of design engineering,

ii) make them understand the steps involved in the design process and

iii) familiarize them with the basic tools used and approaches in design.

Students are expected to apply design thinking in learning as well as while practicing engineering, which is very important and relevant for today. Case studies from various practical situations will help the students realize that design is not only concerned about the function but also many other factors like customer requirements, economics, reliability, etc. along with a variety of life cycle issues.

The course will help students to consider aesthetics, ergonomics and sustainability factors in designs and also to practice professional ethics while designing.

Prerequisite:

Nil. The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines.

Course Outcomes:

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

CO1	Explain the different concepts and principles involved in design engineering.
CO2	Apply design thinking while learning and practicing engineering.
CO3	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1					1			1		
CO2		2				1		1				2
CO3			2			1	1		2	2		1

Assessment Pattern

Continuous Internal Evaluation (CIE) Pattern:

Attendance :10 marks

Continuous Assessment Test(2 numbers) : 25 marks

Assignment/Quiz/Course project :15 marks

End Semester Examination (ESE) Pattern: There will be two parts; Part A and Part B.

part A : 30marks

part B : 70marks

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.

Part B contains 2 case study questions from each module of which student should answer any one. Each question carry 14 marks and can have maximum 2 sub questions.

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	10	10	20
Apply	35	35	70
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Syllabus

Module 1

Design Process:- Introduction to Design and Engineering Design, Defining a Design Process-:Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

Module 2

Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment.

Module 3

Design Communication (Languages of Engineering Design):-Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design.

Module 4

Design Engineering Concepts:-Project-based Learning and Problem-based Learning in Design.Modular Design and Life Cycle Design Approaches. Application of Bio-mimicry,Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.

Module 5

Expediency, Economics and Environment in Design Engineering:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design

Text Books

1) YousefHaik, SangarappillaiSivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning 2003, Third Edition, ISBN-10: 9781305253285,

2) Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

Reference Books

1) Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition,
2) Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5
3) Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361
4) Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1: Design Process**	
1.1	Introduction to Design and Engineering Design. *What does it mean to design something? How Is engineering design different from other kinds of design? Where and when do engineers design? What are the basic vocabularyin engineering design? How to learn and do engineering design.*	1
1.2	*Defining a Design Process*-: Detailing Customer Requirements. *How to do engineering design? Illustrate the process with an example. How to identify the customer requirements of design?*	1
1.3	*Defining a Design Process*-: Setting Design Objectives, Identifying Constraints, Establishing Functions. *How to finalize the design objectives? How to identify the design constraints? How to express the functions a design in engineering terms?*	1
1.4	*Defining a Design Process*-: Generating Design Alternatives and Choosing a Design. *How to generate or create feasible design alternatives? How to identify the "bestpossible design"?*	1
1.5	Case Studies:- Stages of Design Process. *Conduct exercises for designing simple products going through the different stages of design process.*	1
2	**Module 2: Design Thinking Approach**	
2.1	Introduction to Design Thinking *How does the design thinking approach help engineers in creating innovative and efficient designs?*	1
2.2	Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. *How can the engineers arrive at better designs utilizing the iterative design thinking process (in which knowledge acquired in the later stages can be applied back to the earlier stages)?*	1
2.3	Design Thinking as Divergent-Convergent Questioning. *Describe how to create a number of possible designs and then how to refine and narrow down to the 'best design'.*	1
2.4	Design Thinking in a Team Environment. *How to perform design thinking as a team managing the conflicts ?*	1
2.5	Case Studies: Design Thinking Approach. *Conduct exercises using the design thinking approach for*	1

	designing any simple products within a limited time and budget	
3	**Module 3: Design Communication (Languages of Engineering Design)**	
3.1	Communicating Designs Graphically. *How do engineering sketches and drawings convey designs?*	1
3.2	Communicating Designs Orally and in Writing. *How can a design be communicated through oral presentation or technical reports efficiently?*	1
	First Series Examination	
3.3	Mathematical Modelling in Design. *How do mathematics and physics become a part of the design process?*	1
3.4	Prototyping and Proofing the Design. *How to predict whether the design will function well or not?*	
3.5	Case Studies: Communicating Designs Graphically. *Conduct exercises for design communication through detailed 2D or 3D drawings of simple products with design detailing, material selection, scale drawings, dimensions, tolerances, etc.*	1
4	**Module 4: Design Engineering Concepts**	
4.1	Project-based Learning and Problem-based Learning in Design. *How engineering students can learn design engineering through projects?* *How students can take up problems to learn design engineering?*	1
4.2	Modular Design and Life Cycle Design Approaches. *What is modular approach in design engineering? How it helps?* *How the life cycle design approach influences design decisions?*	1
4.3	Application of Bio-mimicry, Aesthetics and Ergonomics in Design. *How do aesthetics and ergonomics change engineering designs?* *How do the intelligence in nature inspire engineering designs?* *What are the common examples of bio-mimicry in engineering?*	1
4.4	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design. *How do concepts like value engineering, concurrent engineering and reverse engineering influence engineering designs?*	1
4.5	Case Studies: Bio-mimicry based Designs. *Conduct exercises to develop new designs. for simple*	1

	products using bio-mimicry and train students to bring out new nature inspired designs.	
5	**Module 5: Expediency, Economics and Environment in Design Engineering**	
5.1	Design for Production, Use, and Sustainability. *How designs are finalized based on the aspects of production methods, life span, reliability and environment?*	1
5.2	Engineering Economics in Design. *How to estimate the cost of a particular design and how will economics influence the engineering designs?*	1
5.3	Design Rights. *What are design rights and how can an engineer put it into practice?*	1
5.4	Ethics in Design. *How do ethics play a decisive role in engineering design?*	1
5.5	Case Studies: Design for Production, Use, and Sustainability. *Conduct exercises using simple products to show how designs change with constraints of production methods, life span requirement, reliability issues and environmental. factors.*	1
Second Series Examination		

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJMCN202	CONSTITUTION OF INDIA	HMC	2	0	0	NIL

Preamble:

The study of their own country constitution and studying the importance environment as well as understanding their own human rights help the students to concentrate on their day to day discipline. It also gives the knowledge and strength to face the society and people.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the the background of the present constitution of India and features.
CO2	Utilize the fundamental rights and duties.
CO3	Understand the working of the union executive, parliament and judiciary.
CO4	Understand the working of the state executive, legislature and judiciary.
CO5	Utilize the special provisions and statutory institutions.
CO6	Show national and patriotic spirit as responsible citizens of the country

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2	2	2		2		
CO2						3	3	3		3		
CO3						3	2	3		3		
CO4						3	2	3		3		
CO5						3	2	3		3		
CO6						3	3	3		2		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module 1 Definition, historical background, features, preamble, territory, citizenship.

Module 2 State, fundamental rights, directive principles, duties.

Module 3 The machinery of the union government.

Module 4 Government machinery in the states

Module 5 The federal system, Statutory Institutions, miscellaneous provisions.

Text Books

1 D D Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi, 24e, 2019

2 PM Bhakshi, The constitution of India, Universal Law, 14e, 2017

Reference Books

1 Ministry of law and justice, The constitution of India, Govt of India, New Delhi, 2019.

2 JN Pandey, The constitutional law of India, Central Law agency, Allahabad, 51e, 2019

3 MV Pylee, India's Constitution, S Chand and company, New Delhi, 16e, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1**	
1.1	Definition of constitution, historical back ground, salient features of the constitution.	1
1.2	Preamble of the constitution, union and its territory.	1
1.3	Meaning of citizenship, types, termination of citizenship.	2

2	**Module 2**	
2.1	Definition of state, fundamental rights, general nature, classification, right to equality,right to freedom , right against exploitation	2
2.2	Right to freedom of religion, cultural and educational rights, right to constitutional remedies. Protection in respect of conviction for offences.	2
2.3	Directive principles of state policy, classification of directives, fundamental duties.	2
3	**Module 3**	
3.1	The Union executive, the President, the vice President, the council of ministers, the Prime minister, Attorney-General, functions.	2
3.2	The parliament, composition, Rajya sabha, Lok sabha, qualification and disqualification of membership, functions of parliament.	2
3.3	Union judiciary, the supreme court, jurisdiction, appeal by special leave.	1
4	**Module 4**	
4.1	The State executive, the Governor, the council of ministers, the Chief minister, advocate general, union Territories.	2
4.2	The State Legislature, composition, qualification and disqualification of membership, functions.	2
4.3	The state judiciary, the high court, jurisdiction, writs jurisdiction.	1
5	**Module 5**	
5.1	Relations between the Union and the States, legislative relation, administrative relation, financial Relations, Inter State council, finance commission.	1
5.2	Emergency provision, freedom of trade commerce and inter course, comptroller and auditor general of India, public Services, public service commission, administrative Tribunals.	2
5.3	Official language, elections, special provisions relating to certain classes, amendment of the Constitution.	2

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEEL202	ELECTRICAL MACHINES LAB I	PCC	0	0	3	2

Preamble : The purpose of this lab is to provide practical experience in operation and testing of DC machines and transformers.

Note : A minimum of **TWELVE** experiments are mandatory out of the Fifteen listed.

Prerequisite :

1. Fundamentals of Electrical Engineering
2. D.C Machines and Transformers (Theory)

Course Outcomes: After the completion of the course the student will be able to

CO1	Analyse the performance of DC motors and DC generators by performing load test.
CO2	Sketch the Open Circuit Characteristics of *c* self excited DC shunt generator and check conditions of voltage build up by performing suitable experiment.
CO3	Develop equivalent circuit and predetermine their regulation and efficiency by performing OC & SC tests on transformer.
CO4	Analyse the efficiency and regulation of the transformer by performing load test.
CO5	Analyse the efficiency of a DC machine when working as motor and generator by conducting suitable test.
CO6	Examine the efficiency by performing Sumpner's test on two similar transformers.

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	3	2	-	3
CO2	3	3	2	2	-	-		-	3	2	-	3
CO3	3	3	2	2	-		-	-	3	2	-	3
CO4	3	3	2	2	-		-	-	3	2	-	3
CO5	3	3	2	2	-		-	-	3	2	-	3
CO6	3	3	2	2	-		-	-	3	2	-	3

Assessment Pattern

Marks distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance:	15 marks
Continuous Assessment:	30 marks
Internal Test (Immediately before the second series test) :	30 marks

End Semester Examination Pattern:

The following guidelines should be followed regarding award of marks:

(a)	Preliminary work	: 15 Marks
(b)	Implementing the work/Conducting the experiment	: 10 Marks
(c)	Performance, result and inference (usage of equipment and troubleshooting)	: 25 Marks
(d)	Viva voce	: 20 marks
(e)	Record	: 5 Marks

The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the End Semester Examination only on submitting the duly certified record. The examiner shall endorse the record.

LIST OF EXPERIMENTS

PART A- DC MACHINES

1) **Open Circuit Characteristics of a DC Shunt Generator**

Objectives:

a) Predetermine the OCC at different speeds
b) Determine the critical field resistance
c) Obtain maximum voltage built up with given shunt field
d) Obtain critical speed for a given shunt field resistance

2) **Load Test on a DC Shunt Generator**

Objectives:

a) Determine the external & internal characteristics of the given DC Shunt Generator

3) **Brake Test on a DC Shunt Motor**

Objectives: Plot the following characteristics

a) Performance characteristics
b) Electrical characteristics
c) Mechanical characteristics.

4) **Brake Test on a DC Series Motor**

Objectives:

Plot the following characteristics

a) Performance characteristics
b) Electrical characteristics
c) Mechanical characteristics.

5) **Load Characteristics of a DC Compound Generator**

Objectives:

a) To plot the load characteristics of the given DC Compound generator when cumulatively compounded.
b) To plot the load characteristics of the given DC Compound generator when differentially compounded

6) **Swinburne's Test on a DC Shunt Machine**

Objectives:

To predetermine the efficiency of a D.C. shunt machine when the machine operates as a motor and as a generator for various load conditions

To plot the efficiency curves of the given DC machine.

7) **Hopkinson's test on a pair of DC machines**

Objectives:

Determination of the efficiency of the given de shunt machine working as a motor and generator under various load conditions.

8) **Retardation test on a DC machine**

Objectives:

Separation of hysteresis, eddy current, friction &windage losses
Find the moment of inertia of the rotating system

9) **Separation of losses in a DC shunt motor**

Objectives:

Separation of hysteresis, eddy current, friction &windage losses
Plot the losses vs speed curves

PART B - TRANSFORMERS

10) **OC & SC Tests on a Single Phase Transformer**

Objectives:

To pre-determine the regulation and efficiency of the given single phase transformer at different loads and power factors
To obtain the equivalent circuit of the given transformer
To plot regulation vs power factor curves

To determine the power factors at which regulation is zero

11) **DirectLoad Test on a Single Phase Transformer**

Objectives:

To determine the efficiency of the given transformer at unity power factor at different loads

To determine the regulation of the given transformer at unity power factor at **different loads**

12) **To plot the efficiency vs output and regulation vs output curves**

. **Separation of Constant losses of a Single Phase Transformer**

Objectives:

To separate hysteresis and eddy current losses of a single phase transformer, keeping V/f constant.

To plot losses vs. frequency curves, by separating the hysteresis and eddy current losses at normal voltage and different frequencies.

13) **Sumpner's Test**

Objectives:

To predetermine efficiency at different loads and power factors

To predetermine regulation at different loads and power factors

To determine the equivalent circuit

14) **Parallel Operation of two dissimilar Single Phase Transformers**

Objectives:

To determine the load sharing of each transformer by their equivalent impedances.

To verify the load sharing by actual measurement.

15) **OC & SC Tests on a Three Phase Transformer**

Objectives:

To predetermine the efficiency at different load conditions and power factors.

To predetermine the regulation at different power factors.

To develop the per phase equivalent circuit.

Reference Books

Bimbra P. S., Electrical Machinery, 7/e, Khanna Publishers, 2011.

Theraja B. L., A Textbook of Electrical Technology, S. Chand & Company, New Delhi,

CODE 24SJEEL204	DIGITAL ELECTRONICS LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Course Outcomes : After the completion of the course the student will be able to:

CO 1	Formulate digital functionsusing Boolean Algebra and verify experimentally.
CO 2	Design and implement combinational logic circuits.
CO 3	Design and implement sequential logic circuits.
CO 4	Design and fabricate a digital circuit using the knowledge acquired from the laboratory.

Mapping of course outcomes with program outcomes

	PO 11	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	1	1	3	3			2	3	3		1
CO 2	3	3	3	3	3			2	3	3		1
CO 3	3	3	3	3	3			2	3	3		1
CO 4	3	2	1	3	2			2	3	3	2	3

LIST OF EXPERIMENTS

Pre-lab assignment :Familiarisation of Logic Gates, Identification of typical logic ICs, Interpreting IC datasheets.

1. Verification & Realisation of De Morgan's theorem.
2. Realisation of SOP & POS functions after K-map reduction.
3. Half adder & Full adder using gates.
4. 4-bit adder/subtractor & BCD adder using IC 7483.
5. Realisation of 2-bit comparator using gates and study of four-bit comparator IC 7485.
6. BCD to decimal decoder and BCD to 7-segment decoder & display.
7. Study of multiplexer IC and realization of combinational circuits using multiplexers.
8. Realization of RS, T, D & JK flip flops using gates.
9. Study of flip flop ICs (7474 & 7476).
10. Realisation of ripple up and down counters and modulo-N counter using flip-flops.
11. Study of counter ICs (7490, 7493).
12. Design of synchronous up, down & modulo-N counters.
13. Realization of 4-bit serial IN serial OUT registers using flip flops.
14. Study of shift register IC 7495, ring counter and Johnsons counter.
15. VHDL implementation of full adder, 4 bit magnitude comparator

Assessment Pattern :

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation (CIE) Pattern:

Attendance	Regular Lab work	Internal Test	Total
15	30	30	75

End Semester Examination Pattern:

The following guidelines should be followed regarding award of marks:

(a) Preliminary work : 15 Marks
(b) Implementing the work/Conducting the experiment : 10 Marks
(c) Performance, result and inference (usage of equipment and troubleshooting) : 25 Marks
(d) Viva voce : 20 marks
(e) Record : 5 Marks

The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the End Semester Examination only on submitting the duly certified record. The examiner shall endorse the record.

Reference Books:

1. Floyd T.L, Digital Fundamentals, 10/e, Pearson Education, 2011.
2. C.H.Roth and L.L.Kimney Fundamentals of Logic Design, 7/e, Cengage Learning, 2013.

Department of Electrical and Electronics Engineering

Vision

Develop technically competent, emotionally strong and socially committed Electrical & Electronics Engineering professionals of international excellence.

Mission

- To develop and maintain a conducive infrastructure and learning-environment, to bring out good quality Electrical & Electronics Engineering graduates.
- To appoint and retain a team of competent, dedicated and research-oriented faculty.
- To inculcate ethical & moral values among students and faculty.

Program Specific Outcomes (PSOs):

Graduates of the program will be able to:

- Apply knowledge of mathematics, science and engineering to design, commission and maintain various types of electrical systems and address challenges in the field.
- Derive sustainable solutions to complex electrical engineering problems that meet the specified needs with ethical, social and environmental considerations.
- Empower the students for lifelong learning so as to adapt to dynamic changes in Electrical Engineering.

ST. JOSEPH'S
COLLEGE OF ENGINEERING AND TECHNOLOGY, - PALAI -
AUTONOMOUS

Vision

Developing into a world class, pace setting institute of Engineering and Technology with distinct identity and character, meeting the goals and aspirations of the society.

Mission

- To maintain a conducive infrastructure and learning environment for world class education.
- To nurture a team of dedicated, competent and research-oriented faculty.
- To develop students with moral and ethical values, for their successful careers, by offering variety of programs and services.

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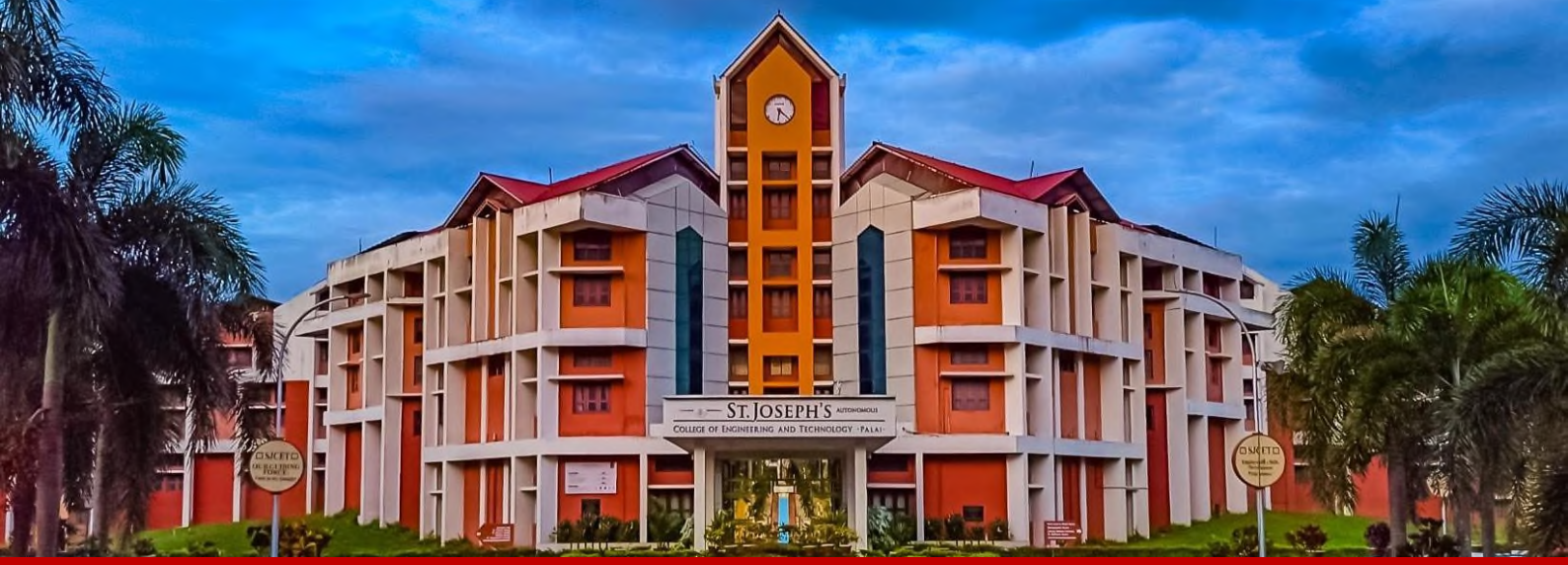

SYLLABUS

B.Tech.

ELECTRICAL AND ELECTRONICS ENGINEERING

FOR WORKING PROFESSIONALS - Semester V

2024 SCHEME

COURSES

SEMESTER–V

SLOT	COURSE NO	COURSES	L-T-P	HOURS	CREDIT
A	24SJEET301	POWER SYSTEMS 1	3-1-0	4	4
B	24SJEET303	MICROPROCESSORS AND MICROCONTROLLERS	3-1-0	4	4
C	24SJEET305	SIGNALS AND SYSTEMS	3-1-0	4	4
D	24SJEET307	SYNCHRONOUS AND INDUCTION MACHINES	3-1-0	4	4
E 1/2	24SJHUT300	INDUSTRIAL ECONOMICS AND FOREIGN TRADE	3-0-0	3	3
	24SJHUT310	MANAGEMENT FOR ENGINEERS	3-0-0	3	3
F	24SJMCN301	DISASTER MANAGEMENT	2-0-0	2	_
S	24SJEEL331	MICROPROCESSORS AND MICROCONTROLLERS LAB	0-0-3	3	2
T	24SJEEL333	ELECTRICAL MACHINES LAB II	0-0-3	3	2
TOTAL				**27**	**23**

NOTE:

1. Industrial Economics and Foreign Trade and Management for Engineers shall be offered in both S5 and S6.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET301	POWER SYSTEMS I	PCC	3	1	0	4

Preamble: The basic objective of this course is to deliver fundamental concepts in power system components. The basic principle of generation, transmission and distribution of electrical power is comprehensively covered in this course ranging extensively from the conventional ones to the modern discoveries. Deregulated systems in the smart grid and micro-grid with details of grid connected energy storages are also introduced to the students through this course.

Prerequisite : 24SJEET 201 Circuits and Networks

Course Outcomes : After the completion of the course the student will be able to:

CO1	Identify the power generating system appropriate for a given area.
CO2	Evaluate the electrical performance of any transmission line.
CO3	Compute various physical characteristics of underground and overhead transmission systems.
CO4	Select appropriate switchgear for protection schemes.
CO5	Design a simple electrical distribution system as per the standards.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					2		2			1	2
CO2	3	3										
CO3	3	2				2	2	2				
CO4	3	1				2		2				1
CO5	3	1				2	2	2			1	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	10	10	20
Understand (K2)	10	10	20
Apply (K3)	30	30	60
Analyse (K4)	-	-	-
Evaluate (K5)	-	-	-
Create (K6)	-	-	-

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module I (12 Hours)

Power System evolution–Load curve -Load factor, diversity factor, Load curve (brief description only) - Numerical Problems.

Generation-conventional (block schematic details, special features, environmental and ethical factors, advantages, disadvantages) -hydro, thermal, nuclear –renewable energy(block schematic details, special features, environmental factors, regulations, advantages, disadvantages) –solar and wind –Design of a rooftop/ground mounted solar farm (concepts only) – Energy storage systems as alternative energy sources- grid storage systems- bulk power grids –smart grids – micro grids.

Module II (10 hours)

Power Transmission System (Electrical Model): Line parameters -resistance- inductance and capacitance (Derivation of three phase double circuit) - Transmission line modelling- classifications -short line, medium line, long line- transmission line as two port network- parameters- derivation and calculations

Module III (10 hours)

Power Transmission System: Calculation of Sag and tension-Insulators –string efficiency- grading–corona-Characteristics of transmission lines-Surge Impedance Loading- Series and shunt compensation.

Underground cables-ratings- classification- Capacitance –grading-testing

Introduction to EHVAC, HVDC and FACTS: Principle, classification and advantages/disadvantages

Module IV (10 hours)

Switchgear: Need for protection-circuit breakers-rating- SF6,VCB – Principle of GIS- protective relays – Demonstration of a typical electromechanical relay - Static, Microprocessor and Numeric types –Principles of overcurrent, directional, distance and differential- Types of protection schemes (Numeric relays) - causes of over voltages– Insulation co-ordination- Communication: PLCC - Fibre Optic-Introduction to IEC61850.

Module V (8 hours)

Power Distribution Systems– Distribution systems- Aerial Bunched Cables -Insulated conductors- Network standards-Earthing- transformer location – balancing of loads.

Methods of power factor improvement using capacitors- Tariff mechanisms– Introduction to energy markets (regulated and deregulated systems) -Distribution Automation systems

References:

1. Cotton H. and H. Barber, *Transmission & Distribution of Electrical Energy*, 3/e, Hodder and Stoughton, 1978.
2. Gupta J.B., Transmission & *Distribution of Electrical Power*, S.K. Kataria& Sons, 2009.
3. Kothari D. P. and I. J. Nagrath, *Power System Engineering*, McGraw Hill, 3rd Edition, 2019
4. Soni, M.L., P. V. Gupta and U. S. Bhatnagar, *A Course in Electrical Power*, DhanpatRai& Sons, New Delhi, 1984.
5. Stevenson W. D., *Elements of Power System Analysis*, 4/e, McGraw Hill, 1982.
6. Uppal S. L. and S. Rao, *Electrical Power Systems*, Khanna Publishers, 2009.
7. Wadhwa C. L., *Electrical Power Systems*, 33/e, New Age International, 2009.
8. Weedy B. M., B. J. Cory, N. Jenkins, J. B. Ekanayake and G. Strbac, *Electric Power System*, John Wiley & Sons, 2012.
9. O. I. Elgerd, *Electric Energy Systems Theory*, McGraw Hill, 1995.
10. John J. Grainger and William D. Stevenson, *Power System Analysis*,McGraw Hill, 1994.
11. IEC 61850 Communication Protocol Manual.
12. IEEE 1547 and 2030 Standards.
13. IEC 61724-1:2017 Performance of Solar Power Plants.
14. Dhirendra Kumar Tyagi, *Design, Installation and Operation of Solar PV Plants*, Published by Walnut Publication, Bhubaneswar, India, January 2019.
15. Souraph Kumar Rajput, *SOLAR ENERGY – Fundamentals, Economic and Energy Analysis*, NITRA Publication, 2017.
16. AS Kapur, *A Practical Guide for Total Engineering of MW capacity Solar PV Power Project*, White Falcon Publishing, 2015.
17. Joshua Eranest, Tore Wizelius, *Wind Power Plants and Project Development*, PHI Learning Pvt. Ltd., 2011.
18. G S Sawhney, *Non-Conventional Resources of Energy*, PHI Learning Pvt. Ltd., 2012
19. Arun G Phadke, James S Thorp, *Computer Relaying for Power Systems*, Wiley Publications, 2009.
20. JanakaEkanayake, KithsiriLiyanageJianzhong Wu, Akihiko Yokoyama and Nick Jenkins, *Smart Grid: Technology and Applications*, Print ISBN:9780470974094 |Online ISBN:9781119968696 |DOI:10.1002/9781119968696, John Wiley & Sons, Ltd, 2012.
21. Badri Ram and D. N. Viswakarma, *Power System Protection and Switchgear*, 2/e, Tata McGraw Hill Publication, 2011.
22. A. S. Pabla, *Electric Power Distribution*, 6/e, Tata McGraw Hill Publication, 2011 (or 5/e 2004).

Course Contents and Lecture Schedule:

No	Topic	No. of Lectures
1	**Power System evolution and Generation (12 hours)**	
1.1	Power System evolution- Load curve- Economic factors - Numerical Problems.	3
1.2	Hydroelectric -Thermal and Nuclear power plant- (Block schematic details, special features, environmental and ethical factors, advantages, disadvantages)	3
1.3	Nonconventional energy sources-Wind farm –(Block schematic details, special features, environmental factors, regulations, advantages, disadvantages).	2
1.4	Renewable energy sources – Solar–(Block schematic details, special features, environmental factors, regulations, advantages, disadvantages) - Design of a rooftop– Design of a ground mounted solar farm	2
1.5	Energy storage systems as alternate energy sources- Grid Storage systems - Bulk power grids - micro-grids	2
2	**Power Transmission System(Electrical Model) (10 hours)**	
2.1	Line parameters -resistance- inductance and capacitance (Derivation of single phase, three phase, single circuit and double circuit) - Numerical Problems.	5
2.2	Transmission line modelling- classifications -short line, medium line, long line-models- Transmission line as two port network-ABCD parameters- derivation and calculations- Numerical Problems.	5
3	**Power Transmission (Physical Aspects) (10 Hours)**	
3.1	Calculation of Sag and tension- Numerical Problems.	2
3.2	Insulators –string efficiency- grading- Numerical Problems.	2
3.3	Corona- Numerical Problems.	1
3.4	Surge Impedance Loading- Series and shunt compensation- Principle only.	1
3.5	Underground cables-ratings- classification- Capacitance –grading-testing- Numerical Problems.	2
3.6	Introduction to EHVAC, HVDC and FACTS: Principle, classification and advantages/disadvantages	2

4	**Switchgear (10 Hours)**	
4.1	Need for protection-formation of arc-Arc quenching theory- Restriking Voltage-Recovery voltage, RRRV - Interruption of Capacitive currents and current chopping (Numerical Problems) Circuit breakers-rating- SF6,VCB- (Diagram, construction, working, advantages, disadvantages) - Principle of GIS	3
4.2	Protective relays –Demonstration of a typical electromechanical relay - Static-Comparison and duality of Amplitude and Phase comparators-(Circuit Diagram, working, advantages, disadvantages) Microprocessor -(Flow Chart, working, advantages, disadvantages) and Numeric-(Block Diagram, working, advantages, disadvantages) Overcurrent, directional, distance and differential-(Principle, circuit diagram) Types of protection schemes (Using Numeric relays)	4
4.3	Causes of over voltages–Surge Protection	1
4.4	Transmission System -Communication- Fibre Optic - Abstract ideas only)	1
4.5	Introduction to IEC 61850	1
5	**Power Distribution Systems (8 Hours)**	
5.1	Distribution systems- DC and AC distribution: Types of distributors- bus bar arrangement-Numerical problems. Aerial Bunched Cables -Insulated conductors-(Abstract ideas only)	2
5.2	Network-standards -Earthing- transformer location – balancing of loads-(Abstract ideas only)	2
5.3	Tariff – regulated and deregulated systems- Numerical Problems	2
5.4	Methods of power factor improvement using capacitors- Numerical Problems	1
5.5	Distribution Automation systems	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET303	MICROPROCESSORS AND MICROCONTROLLERS	PCC	3	1	0	4

Preamble: This course helps the students to understand 8085 microprocessor and 8051 microcontroller architecture as well as to design hardware interfacing circuit. This also aids to thrive their programming skills to solve real world problems.

Prerequisite: Fundamentals of Digital Electronics, C Programming

Course Outcomes: After the completion of the course the student will be able to:

CO1	Describe the architecture and timing diagram of 8085 microprocessor.
CO2	Develop assembly language programs in 8085 microprocessor.
CO3	Identify the different ways of interfacing memory and I/O with 8085 microprocessor.
CO4	Understand the architecture of 8051 microcontroller and embedded systems.
CO5	Develop assembly level and embedded C programs in 8051 microcontroller.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	3	2	3	2	1							
CO3	3	2	2	2	2							
CO4	3	2										
CO5	3	2	3	2	1	1						1

Assessment Pattern:

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	03 Hrs

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	10	10	20
Understand (K2)	10	10	20
Apply (K3)	30	30	60

Analyse (K4)			
Evaluate (K5)			
Create (K6)			

End Semester Examination Pattern : There will be two parts; Part A and Part B. **Part A** contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.
Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Syllabus

Module 1

Internal architecture of 8085 microprocessor–Functional block diagram, Instruction set- Addressing modes - Classification of instructions - Status flags. Machine cycles and T states – Fetch and execute cycles- Timing diagram for instruction and data flow.

Module 2

Introduction to assembly language programming- Data transfer operations, arithmetic operations, logic operations, branching operations, I/O and machine control operations. Assembly language programmes (ALP) in 8085 microprocessor- Data handling/Data transfer, Arithmetic operations, Code conversion- BCD to Binary - Binary to BCD, Sorting - Ascending and descending including bubble sorting. Stack and subroutines – Conditional CALL and Return instructions Time delay subroutines using 8 bit register, 16 bit register pair and Nested loop control.

Module 3

Interrupt & interrupt handling - Hardware and Software interrupts. I/O and memory interfacing – Address decoding– Interfacing I/O ports -Programmable Peripheral Interface PPI 8255 - Modes of operation- Interfacing of seven segment LED. Introduction to embedded systems, Current trends and challenges, Applications of embedded systems- Hard and soft real time systems. Introduction to microcontrollers- Microprocessor Vs Microcontroller- 8051 Microcontrollers – Hardware - Microcontroller architecture and programming model - I/O port structure - Register organization -General purpose RAM - Bit addressable RAM - Special Function Registers (SFRs).

Module 4

Instruction set - Instruction types - Addressing modes of 8051 microcontrollers. 8051 microcontroller data types and directives - Time delay programmes and I/O port programming. Introduction to embedded C Programming - time delay in C - I/O port programming in embedded C.

Module 5

8051 Timer/counter programming - Serial port programming - Interrupt programming in assembly language and embedded C. Interfacing –ADC - DAC and temperature sensor

Text Books

1. Ramesh Gaonkar, "Microprocessor Architecture Programming and Applications", Penram International Publishing; Sixth edition, 2014.
2. Mohamed Ali Mazidi, Janice GillispieMazidi, "The 8051 microcontroller and embedded systems using Assembly and C", second edition, Pearson/Prentice hall of India.
3. Kenneth J. Ayala, "The 8051 microcontroller", 3rd edition, Cengage Learning, 2010
4. Lyla B Das, "Embedded Systems - An Integrated Approach", Pearson Education India

Reference Books

1. B Ram, "Fundamentals of Microprocessors and Microcontrollers", 9e, DhanpatRai Publications, 2019.
2. Wadhwa, "Microprocessor 8085 microprocessor: Architecture, Programming and Interfacing", PHI 2010
3. Shibu K V, "Introduction to Embedded systems", TMH

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Architecture and Instruction set of 8085 microprocessor (9 hours)**	
1.1	Internal architecture of 8085 microprocessor– functional block diagram	2
1.2	Instruction set- Addressing modes, Classification of instructions - Status flags.	4
1.3	Machine cycles and T states – Fetch and execute cycles - timing diagram for instruction and data flow.	3
2	**Assembly language programming (9 hours)**	
2.1	Introduction to assembly language programming- data transfer operations, arithmetic operations, logic operations, branching operations, I/O and machine control operations.	2

2.2	Assembly language programmes (ALP) in 8085 microprocessor-Data handling/Data transfer - Arithmetic operations - Code conversion - BCD to Binary - Binary to BCD, Sorting - Ascending and descending including bubble sorting.	4
2.3	Stack and subroutines – Conditional call and return instructions – Stack operations.	2
2.4	Time delay subroutines using 8bit register, 16 bit register pair and Nested loop control.	1
3	**Interfacing circuits for 8085 microprocessor and introduction to 8051 Microcontroller (10 hours)**	
3.1	Interrupt and interrupt handling - Hardware and Software interrupts.	1
3.2	I/O and memory interfacing – Address decoding – Interfacing I/O ports-Programmable peripheral interface PPI 8255 - Modes of operation -Interfacing of seven segment LED.	4
3.3	Introduction to embedded systems - Current trends and challenges - Applications of embedded systems - Hard and Soft real time systems.	1
3.4	Introduction to microcontrollers - Microprocessor Vs Microcontroller - 8051- Microcontrollers - Hardware	1
3.5	Microcontroller Architecture and programming model: I/O Port structure - Register organization - General purpose RAM -Bit Addressable RAM -Special Function Registers (SFRs).	3
4	**Programming of 8051 Microcontroller (10 hours)**	
4.1	Instruction Set - Instruction Types - Addressing modes	3
4.2	8051- Data types and directives -Time delay programmes and I/O port programming.	4
4.3	Introduction to embedded C Programming - Time delay in C - I/O port programming in embedded C.	3
5	**Interfacing circuits of 8051 Microcontroller (10 hours)**	
5.1	Timer/counter programming in assembly language and embedded C	3
5.2	Serial port programming in assembly language and embedded C	3
5.3	Interrupt programming in assembly language and embedded C	2
5.4	Interfacing –ADC - DAC and temperature sensor	2

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET305	SIGNALS AND SYSTEMS	PCC	3	1	0	4

Preamble : **This course introduces the concept of signals and systems. The time domain and frequency domain representation, operations and analysis** of both the continuous time and discrete time systems are discussed. The application of Fourier analysis, Laplace Transform and Z- Transforms are included. Stability analysis of continuous time systems and discrete time systems are also introduced.

Pre-requisite : Basics of Circuits and Networks

Course Outcomes: After the completion of the course the student will be able to:

CO 1	Explain the basic operations on signals and systems.
CO 2	Apply Fourier Series and Fourier Transform concepts for continuous time signals.
CO 3	Analyse the continuous time systems with Laplace Transform.
CO 4	Analyse the discrete time system using Z Transform.
CO 5	Apply Fourier Series and Fourier Transform concepts for Discrete time domain.
CO 6	Describe the concept of stability of continuous time systems and sampled data systems.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12
CO1	3	3	-	-	2	-	-	-	-	-	-	1
CO2	3	3	3	-	-	-	-	-	-	-	-	1
CO3	3	3	3	-	2	-	-	-	-	-	-	2
CO4	3	3	3	-	2	-	-	-	-	-	-	2
CO5	3	3	3	-	-	-	-	-	-	-	-	2
CO6	3	3	-	-	2	-	-	-	-	-	-	1

Assessment Pattern:

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	03 Hrs

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (KI)	10	10	20
Understand (K2)	10	10	20
Apply (K3)	**30**	**30**	**60**
Analyse (K4)			
Evaluate (K5)			
Create (K6)			

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.
Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Syllabus

Module 1

Introduction to Signals and Systems (12 hours):

Classification of signals: Elementary signals- Basic operations on continuous time and discrete time signals

Concept of system: Classification of systems- Properties of systems- Time invariance, Linearity -Causality - Memory- Stability-Convolution Integral- Impulse response Representation of LTI systems: Differential equation representations of LTI systems Basics of Non linear systems- types and properties

Introduction to random signals and processes (concepts only)

Module 2

Fourier Analysis and Laplace Transform Analysis (12 hours):

Fourier analysis of continuous time signals: Fourier Series- Harmonic analysis of common signals Fourier transform: Existence- Properties of Continuous time Fourier transform- Energy spectral density and power spectral density

Concept of Frequency response - Laplace transform analysis of system transfer function: Relation between the transfer function and differential equation- Transfer function of LTI systems- Electrical, translational and rotational mechanical systems- Force voltage, Force current and Torque Voltage analogy

Module 3

System Models and Response (10 hours):

Block diagram representation - block diagram reduction -Signal flow graph - Mason's gain formula

Type and Order of the systems- Characteristic equation - Determining the time domain and frequency response from poles and zeros -Concepts of Positive real functions and Hurwitz polynomial- Routh stability criterion.

Module 4

Sampled Data Systems and Z-Transform (10 hours):

Sampling process-impulse train sampling-sampling theorem- Aliasing effect

Zero order and First order hold circuits- Signal reconstruction

Discrete convolution and its properties - Z Transform: Region of convergence- Properties of Z Transform - Inverse ZT: Methods

Module 5

Analysis of Sampled Data Systems (8 hours):

Difference equation representations of LTI systems - Analysis of difference equation of LTI systems- Z Transfer function- Delay operator and block diagram representation- Direct form, cascade and parallel representations of 2^{nd} order systems

Stability of sampled data system: Basic idea on stability- Jury's test- Use of bilinear

transformation

Text Books

1. Oppenheim A.V., Willsky A.S. & Nawab S.H., Signals and Systems, 2/e, Prentice Hall
2. Nagrarth I. J, Saran S. N and Ranjan R, Signals and Systems, 2/e, Tata McGraw Hill
3. Haykin S. & Veen B.V., Signals & Systems, 2/e, John Wiley
4. Nise N. S., Control Systems Engineering, 6/e, Wiley Eastern
5. Nagarath I. J. and Gopal M., Control System Engineering, 5/e, New Age Publishers

Reference Books

1. Bracewell R.N., Fourier Transform & Its Applications, McGraw Hill
2. Farooq Husain, Signals and Systems, Umesh publications.
3. Papoulis A., Fourier Integral & Its Applications, McGraw Hill
4. Taylor F.J., Principles of Signals & Systems, McGraw Hill

Course Contents and Lecture Schedule:

Module	Topic coverage	No. of Lectures
1	**Introduction to Signals and Systems (12 hours)**	
1.1	Classification of signals - Elementary signals- Basic operations on continuous time and discrete time signals	3
1.2	Concept of systems - Classification of systems- Properties of systems - Time invariance- Linearity -Causality - Memory- Stability.	3
1.3	Convolution Integral- Impulse response-	2
1.4	Representation of LTI systems - Differential equation representations of LTI systems	2
1.5	Basics of Non linear systems- types and properties Introduction to random signals and processes (concepts only)	2
2	**Fourier Analysis and Laplace Transform Analysis (12 hours)**	
2.1	Fourier Analysis of continuous time signals: Fourier Series- Harmonic analysis of common signals	2
2.2	Fourier transform: Existence- Properties of Continuous time Fourier transform- Energy spectral density and power spectral density	2
2.3	Concept of Frequency response- Frequency response of simple LTI systems.	2
2.4	Laplace transform analysis of system transfer function: Relation between the transfer function and differential equation	2
2.5	Transfer function of LTI systems: Electrical, Translational and rotational Mechanical systems	2
2.6	Force Voltage, Force Current and Torque Voltage analogy	2
3	**System Models and Response (10 hours)**	
3.1	Block diagram representation - block diagram reduction	2
3.2	Signal flow graph - Mason's gain formula	2
3.3	Type and Order of the systems- Characteristic equation.	2
3.4	Determining the time domain and frequency response from poles and zeros.	2
3.5	Concepts of Positive real functions and Hurwitz polynomial- Basic idea on Stability- Routh stability criterion	2

4	**Sampled Data Systems and Z-Transform (10 hours)**	
4.1	Sampling process-impulse train sampling-sampling theorem- Aliasing effect	2
4.2	Zero order and First order hold circuits- Signal reconstruction-	2
4.3	Discrete convolution and its properties	2
4.4	Z Transform: Region of convergence- Properties of Z Transform	2
4.5	Inverse ZT: Methods	2
5	**Analysis of Sampled Data Systems (8 hours)**	
5.1	Difference equation representations of LTI systems - Analysis of difference equation of LTI systems- Z Transfer function	2
5.2	Delay operator and block diagram representation- Direct form, cascade and parallel representations of 2^{nd} order systems.	2
5.3	Stability of sampled data system: Basic idea on Stability- Jury's test	2
5.4	Use of bilinear transformation.	2

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET307	SYNCHRONOUS AND INDUCTION MACHINES	PCC	3	1	0	4

Preamble: Nil

Prerequisite: DC Machines and Transformers

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Analyse the performance of different types of alternators.
CO 2	Analyse the performance of a synchronous motor.
CO 3	Analyse the performance of different types of induction motors.
CO 4	Describe operating principle of induction machine as generator.
CO 5	Explain the types of single phase induction motors and their working principle.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2	-	-	-	2	-	-	-	-	-	2
CO 2	3	3	2	-	-	2	-	-	-	-	-	2
CO 3	3	3	2	-	-	2	-	-	-	-	-	2
CO 4	3	3	2	-	-	2	-	-	-	-	-	2
CO 5	2	2	-	-	-	2	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	20
Understand	15	15	30
Apply	25	25	50
Analyse			
Evaluate			
Create			

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions (each carrying 3 marks) with 2 questions from each module. Students should answer all questions. Part B contains 2 questions from each module, out of which students should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Part A: 10 Questions x 3 marks=30 marks, **Part B:** 5 Questions x 14 marks =70 marks

Syllabus

Module 1

Principle of Operation of three phase alternators, Constructional features, Types of Armature Windings (detailed winding diagram not required), EMF equation, Numerical Problems.

Harmonics-causes, suppression, Rating of alternators, Parameters of armature winding, Armature reaction, Equivalent Circuit, Phasor Diagram, Load characteristics, Power Flow Equations.

Module 2

Voltage regulation of three phase Alternators-Direct loading, EMF Method, MMF Method, Potier Method, ASA Method -Numerical Problems.

Blondel's two reaction theory, Phasor Diagram under lagging power factor, Determination of X_d and X_q by slip test, Power developed by a Salient pole machine, Numerical Problems.

Parallel Operation of Alternators- Necessary Conditions, Synchronisation- Synchronising current, Power and Torque, Effect of reactance, Numerical Problems, Methods of Synchronisation.

Module 3

Principle of Synchronous Motor, Equivalent circuit, Phasor diagrams, Power flow diagram and equations, Losses and efficiency -Numerical Problems, Power-angle Characteristics, V Curve and Inverted V Curves.

Three phase Induction motor – Constructional features, Expressions for Power and Torque-Torque- Slip characteristics, Phasor diagram, Equivalent Circuit of Induction motor- Tests on Induction motors for determination of equivalent circuit-Numerical Problems.

Module 4

Performance of three phase Induction motors using Circle diagram, Numerical Problems. Cogging and Crawling in cage motors, Double cage Induction motor-Torque-Slip Characteristics.

Starting of Induction motors – Types of Starters – DOL starter, Autotransformer Starter, Star-Delta starter, Rotor Resistance Starter-Numerical Problems.

Braking of Induction motors – Plugging, Dynamic braking, Regenerative braking, Speed control – Stator Voltage control, V/f control, Rotor Resistance Control.

Module 5

Induction generator – Principle of operation, Grid Connected and Self Excited Operation of Induction Generators, Torque-Slip Characteristics of an Induction machine.

Single phase Induction motors-Double field revolving theory, Equivalent Circuit, Torque-Slip Characteristics, Types of Single Phase Induction motor, Applications.

Selection of AC motors for different applications.

Text Books

1. Bimbra P S, Electric Machines, Khanna Publishers, 2nd edition, 2017.
2. KothariD. P., NagrathI. J., Electric Machines, Tata McGraw Hill, 5th edition.2017.
3. Say M G, The Performance and Design of AC Machines, CBS Publishers, New Delhi, 3rd edition, 2002.
4. Alexander SLangsdorf, "Theory of Alternating Current Machinery", Tata McGraw Hill,2nd revised edition, 2001.

Reference Books

1. Deshpande M. V., Electrical Machines, Prentice Hall India, New Delhi, Eastern Economy Edition, 2011.
2. Gupta B R, VandanaSinghal, "Fundamentals of Electric Machines", New Age International,.2010.
3. Ashfaq Husain, HaroonAshfaq, Electric Machines, DhanpatRai and Co., 3rd edition,2002.
4. Gupta J B, "Theory and Performance of Electrical Machines", S K Kataria& Sons, 14th edition, 2013.

Course Contents and Lecture Schedule

Sl. No.	Topic	No. of Lectures
1	**Basics of Alternators (12 hours)**	
1.1	Principle of operation and classification of alternators, Synchronous speed.	2
1.2	Construction of synchronous machines. Salient and Cylindrical types, Turbogenerators. Stationary and Rotating armature types.	2
1.3	Armature windings-Types.: Single layer, Double layer, Full pitched winding, Short pitched winding, Concentrated and Distributed winding	2
1.4	EMF Equation, Pitch factor and Distribution factor, Numerical problems	3
1.5	Harmonics in Alternators: Space and slot harmonics, Suppression, Effect of pitch factor on harmonics.	1
1.6	Armature Reaction, Equivalent Circuit and Phasor Diagrams, Power Flow Equations	2
2	**Voltage Regulation and Synchronisation of Alternators (12 hours)**	
2.1	Voltage Regulation of Alternators: EMF, MMF, Potier and ASA Method.	4
2.2	Blondel's Two Reaction Theory, Phasor Diagram under lagging power	3

	factor based on two reaction theory, Slip Test	
2.3	Parallel Operation of Alternators, Necessity of Parallel Operation. Advantages.	3
2.4	Synchronisation of Alternators: Dark Lamp and Bright Lamp Method.	2
3	**Three Phase Synchronous and Induction Motors (10 hours)**	
3.1	Synchronous Motors-Principle, Equivalent Circuit, Phasor Diagrams, Power Flow Diagram, Power and Torque Equations, Numerical Problems	3
3.2	Effects of excitation on armature current and power factor- V and Inverted V Curves, advantages, disadvantages and applications of Synchronous motors.	1
3.3	Three phase Induction Motors-Principle, Constructional details, Slip ring and Cage types.	1
3.4	Slip, frequency and rotor current, Expression for torque and Power-Starting torque, Full load and Pull out torque, Torque- Slip characteristics, Phasor diagram.	3
3.5	Tests on Induction motors for determination of Equivalent circuit, Equivalent Circuit of Induction motor-Numerical Problems.	2
4	**Three Phase Induction Motors Contd. (8 hours)**	
4.1	Circle Diagram, Numerical Problems.	2
4.2	Cogging, Crawling-–remedial measures, Double Cage Induction Motor-Principle.	2
4.3	Starters for three phase Induction Motors: DOL, Autotransformer, Star Delta and Rotor Resistance Starters.	2
4.4	Speed Control in Induction Motors	1
4.5	Braking in Induction Motors	1
5	**Induction Generators and Single Phase Induction Motors (8 hours)**	
5.1	Induction Generators: Grid Connected and Self Excited types.	2
5.2	Single phase induction motors-principle, Double field revolving theory, Torque-Slip characteristics, Applications	2
5.3	Types-Split phase, Capacitor Start, Capacitor Start and Run types, Shaded pole motor, Shaded Pole Motor-Principle of operation and applications.	2
5.4	Selection of AC motors for different Applications.	2

24SJHUT300	Industrial Economics & Foreign Trade	Category	L	T	P	CREDIT
		HSMC	3	0	0	3

Preamble: To equip the students to take industrial decisions and to create awareness of economic environment.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the problem of scarcity of resources and consumer behaviour, and to evaluate the impact of government policies on the general economic welfare. (Cognitive knowledge level: Understand)
CO2	Take appropriate decisions regarding volume of output and to evaluate the social cost of production. (Cognitive knowledge level: Apply)
CO3	Determine the functional requirement of a firm under various competitive conditions. (Cognitive knowledge level: Analyse)
CO4	Examine the overall performance of the economy, and the regulation of economic fluctuations and its impact on various sections in the society. (Cognitive knowledge level: Analyse)
CO5	Determine the impact of changes in global economic policies on the business opportunities of a firm. (Cognitive knowledge level: Analyse)

Mapping **of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2										3	
CO2	2	2			2	2	3				3	
CO3	2	2	1								3	
CO4	2	2	1			1					3	
CO5	2	2	1								3	

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	20	20	40
Apply	15	15	30

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance (10marks) , Continuous Assessment - Test (2 numbers) (25 marks) and Continuous Assessment – Assignment (15 marks)

End Semester Examination Pattern:

There will be two parts; Part A and Part B.

Part A : 30 marks

Part B : 70 marks

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 3 sub-divisions and carries 14 marks.

SYLLABUS

Module 1 (Basic Concepts and Demand and Supply Analysis)

Scarcity and choice - Basic economic problems- PPC — Firms and its objectives — types of firms — Utility — Law of diminishing marginal utility — Demand and its determinants — law of demand — elasticity of demand — measurement of elasticity and its applications — Supply, law of supply and determinants of supply — Equilibrium — Changes in demand and supply and its effects — Consumer surplus and producer surplus (Concepts) — Taxation and deadweight loss.

Module 2 (Production and cost)

Production function — law of variable proportion — economies of scale — internal and external economies — Isoquants, isocost line and producer's equilibrium — Expansion path — Technical progress and its implications — Cobb-Douglas production function - Cost concepts — Social cost: private cost and external cost — Explicit and implicit cost — sunk cost - Short run cost curves - long run cost curves — Revenue (concepts) — Shutdown point — Break-even point.

Module 3 (Market Structure)

Perfect and imperfect competition — monopoly, regulation of monopoly, monopolistic completion (features and equilibrium of a firm) — oligopoly — Kinked demand curve — Collusive oligopoly (meaning) — Non-price competition — Product pricing — Cost plus pricing — Target return pricing — Penetration pricing — Predatory pricing — Going rate pricing — Price skimming.

Module 4 (Macroeconomic concepts)

Circular flow of economic activities — Stock and flow — Final goods and intermediate goods - Gross Domestic Product - National Income — Three sectors of an economy- Methods of measuring national income — Inflation- causes and effects — Measures to control inflation- Monetary and fiscal policies — Business financing- Bonds and shares -Money market and Capital market — Stock market — Demat account and Trading account - SENSEX and NIFTY.

Module 5 (International Trade)

Advantages and disadvantages of international trade - Absolute and Comparative advantage theory - Heckscher - Ohlin theory - Balance of payments — Components — Balance of Payments

deficit and devaluation — Trade policy — Free trade versus protection — Tariff and non-tariff barriers.

Reference

1. Gregory N Mankiw, 'Principles of Micro Economics', Cengage Publications
2. Gregory N Mankiw, 'Principles of Macro Economics', Cengage Publications
3. Dwivedi D N, 'Macro Economics', Tata McGraw Hill, New Delhi.
4. Mithani D M, 'Managerial Economics', Himalaya Publishing House, Mumbai.
5. Francis Cherunilam, 'International Economics', McGraw Hill, New Delhi.

Teaching Plan

Module 1 (Basic concepts and Demand and Supply Analysis)		**7 Hours**
1.1	Scarcity and choice — Basic economic problems - PPC	1 Hour
1.2	Firms and its objectives — types of firms	1 Hour
1.3	Utility — Law of diminishing marginal utility — Demand — law of demand	1 Hour
1.4	Measurement of elasticity and its applications	1 Hour
1.5	Supply, law of supply and determinants of supply	1 Hour
1.6	Equilibrium — changes in demand and supply and its effects	1 Hour
1.7	Consumer surplus and producer surplus (Concepts) — Taxation and deadweight loss.	1 Hour
	Module 2 (Production and cost)	**7 Hours**
2.1	Productions function — law of variable proportion	1 Hour
2.2	Economies of scale — internal and external economies	1 Hour
2.3	producers equilibrium — Expansion path	1 Hour
2.4	Technical progress and its implications — cob Douglas Production function	1 Hour
2.5	Cost concepts — social cost: private cost and external cost — Explicit and implicit cost — sunk cost	1 Hour
2.6	Short run cost curves & Long run cost curves	1 Hour

2.7	Revenue (concepts) — shutdown point — Break-even point.	1 Hour
	Module 3 **(Market Structure)**	**6 hours**
3.1	Equilibrium of a firm, MC — MR approach and TC — TR approach	1 Hour
3.2	Perfect competition & Imperfect competition	1 Hour
3.3	Monopoly — Regulation of monopoly — Monopolistic competition	1 Hour
3.4	Oligopoly — kinked demand curve	1 Hour
3.5	Collusive oligopoly (meaning) — Non price competition	1 Hour
3.6	Cost plus pricing — Target return pricing — Penetration, Predatory pricing — Going rate pricing — price skimming	1 Hour
Module 4 (Macroeconomic concepts)		**7 Hours**
4.1	Circular flow of economic activities	1 Hour
4.2	Stock and flow — Final goods and intermediate goods — Gross Domestic Product - National income — Three sectors of an economy	1 Hour
4.3	Methods of measuring national income	1 Hour
4.4	Inflation — Demand pull and cost push — Causes and effects	1 Hour
4.5	Measures to control inflation — Monetary and fiscal policies	1 Hour
4.6	Business financing — Bonds and shares — Money market and capital market	1 Hour
4.7	Stock market — Demat account and Trading account — SENSEX and NIFTY	i Hour
	Module 5 **(International Trade)**	**8 Hours**
5.1	Advantages and disadvantages of international trade	1 Hour
5.2	Absolute and comparative advantage theory	2 Hour
5.3	Heckscher — Ohlin theory	1 Hour
5.4	Balance of payments - components	1 Hour
5.5	Balance of payments deficit and devaluation	1 Hour
5.6	Trade policy — Free trade versus protection	1 Hour
5.7	Tariff and non tariff barriers.	1 Hour

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJHUT 310	MANAGEMENT FOR ENGINEERS	HMC	3	0	0	3

Preamble **:** This course is intended to help the students to learn the basic concepts and functions of management and its role in the performance of an organization and to understand various decision-making approaches available for managers to achieve excellence. Learners shall have a broad view of different functional areas of management like operations, human resource, finance and marketing.

Prerequisite: Nil

Course Outcomes After the completion of the course the student will be able to

CO1	Explain the characteristics of management in the contemporary context (Cognitive Knowledge level: **Understand).**
CO2	Describe the functions of management (Cognitive Knowledge level: **Understand).**
CO3	Demonstrate ability in decision making process and productivity analysis (Cognitive Knowledge level: **Understand).**
CO4	Illustrate project management technique and develop a project schedule (Cognitive Knowledge level: **Apply).**
CO5	Summarize the functional areas of management (Cognitive Knowledge level: **Understand).**
CO6	Comprehend the concept of entrepreneurship and create business plans (Cognitive Knowledge level: **Understand).**

Mapping of course outcomes with program outcomes

	POl	PO2	PO3	PO4	POS	PO6	PO7	PO8	PO9	POlO	POll	PO12
COl	2				1	2	2	2		2	1	1
CO2	2				1	1		2	1	2	1	1
CO3	2	2	2	2	1							
CO4	2	2	2	2	1						2	1
CO5	2					1	1		1	2	1	
CO6		2	2	2	1	1	1	1	1	1	1	1

Assessment Pattern

Bloom's Category	Test 1 (Marks in percentage)	Test 2 (Marks in percentage)	End Semester Examination (Marks in percentage)
Remember	15	15	30
Understand	15	15	30
Apply	20	20	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance :10

Continuous Assessment - Test :25

Assignment : 15

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

Module 1 (Introduction to management Theory)

Introduction to management theory, Management Defined, Characteristic of Management, Management as an art-profession, System approaches to Management, Task and Responsibilities of a professional Manager, Levels of Manager and Skill required.

Module 2 (management and organization)

Management Process, Planning types, Mission, Goals, Strategy, Programmes, Procedures, Organising, Principles of Organisation, Delegation, Span of Control, Organisation Structures, Directing, Leadership, Motivation, Controlling.

Module 3 (productivity and decision making)

Concept of productivity and its measurement; Competitiveness; Decision making process; decision making under certainty, risk and uncertainty; Decision trees; Models of decision making.

Module 4 (project management)

Project Management, Network construction, Arrow diagram, Redundancy. CPM and PERT Networks, Scheduling computations, PERT time estimates, Probability of completion of project, Introduction to crashing.

Module 5 (functional areas of management)

Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management, Entrepreneurship, Business plans,

Corporate social responsibility, Patents and Intellectual property rights.

References:

1. H. Koontz, and H. Weihrich, Essentials of Management: An International Perspective. 8th ed., McGraw-Hill, 2009.
2. PC Tripathi and P N Reddy, Principles of management, TMH, 4th edition, 2008.
3. P. Kotler, K. L. Keller, A. Koshy, and M. Jha, Marketing Management: A South Asian Perspective. 14th ed., Pearson, 2012.
4. M. Y. Khan, and P. K. Jain, Financial Management, Tata-McGraw Hill, 2008.
5. R. D. Hisrich, and M. P. Peters, Entrepreneurship: Strategy, Developing, and Managing a New Enterprise, 4th ed., McGraw-Hill Education, 1997.
6. D. J. Sumanth, Productivity Engineering and Management, McGraw-Hill Education, 1985.
7. K.Ashwathappa, 'Human Resources and Personnel Management', TMH, 3 rd edition, 2005.
8. R. B. Chase, Ravi Shankar and F. R. Jacobs, Operations and Supply Chain Management, 14th ed. McGraw Hill Education (India), 2015.

Teaching Plan

SI.No	TOPIC	HOUR
	Module I	7
1.1	Introduction to management	1
1.2	Levels of managers and skill required	1
1.3	Classical management theories	1
1.4	neo-classical management theories	1
1.5	modem management theories	1
1.6	System approaches to Management,	1
1.7	Task and Responsibilities of a professional Manager	1
	Module 2	5
2.1	Management process - planning	1

2.2	Mission - objectives - goals - strategy - policies - programmes - procedures	1
2.3	Organizing, principles of organizing, organization structures	1
2.4	Directing, Leadership	1
2.5	Motivation, Controlling	1
	Module III	7
3.1	Concept of productivity and its measurement Competitiveness	1
3.2	Decision making process;	1
3.3	Models in decision making	1
3.4	Decision making under certainty and risk	1
3.5	Decision making under uncertainty	1
3.6	Decision trees	1
3.7	Models of decision making.	1
	Module IV	7
4.1	Project Management	1
4.2	Network construction	1
4.3	Arrow diagram, Redundancy	1
4.4	CPM and PERT Networks	1
4.5	Scheduling computations	1
4.6	PERT time estimates	1
4.7	Probability of completion of project	1
4.8	Introduction to crashing	
	Module V	8
5.1	Introduction to functional areas of management,	1
5.2	Operations management	1
5.3	Human resources management ,	1
5.4	Marketing management	1
5.5	Financial management	1
5.6	Entrepreneurship,	1

5.7	Business plans	1
5.8	Corporate social responsibility, Patents and Intellectual property rights	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJMCN301	DISASTER MANAGEMENT	Non-Credit	2	0	0	Nil

Preamble : The objective of this course is to introduce the fundamental concepts of hazards and disaster management.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

COl	Define and use various terminologies in use in disaster management parlance and organise each of these terms in relation to the disaster management cycle (Cognitive knowledge level: **Understand).**
CO2	Distinguish between different hazard types and vulnerability types and do vulnerability assessment (Cognitive knowledge level: **Understand).**
CO3	Identify the components and describe the process of risk assessment, and apply appropriate methodologies to assess risk (Cognitive knowledge level: **Understand).**
CO4	Explain the core elements and phases of Disaster Risk Management and develop possible measures to reduce disaster risks across sector and community (Cognitive knowledge level: **Apply)**
CO5	Identify factors that determine the nature of disaster response and discuss the various disaster response actions (Cognitive knowledge level: **Understand).**
CO6	Explain the various legislations and best practices for disaster management and risk reduction at national and international level (Cognitive knowledge level: **Understand).**

1

Mapping of course outcomes with program outcomes

	POl	P02	P03	PO4	POS	PO6	P07	PO8	PO9	POl0	PO11	POl2
COl		2				2				2		2
CO2	2	3	2		2	2	3			3		2
CO3	2	3	2	2	2	2	3			3		2
CO4	3	3	3		2	2	3					2
CO5	3	3			2	2	3					2
CO6	3					2	3	3				2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	20
Understand	25	25	50
Apply	15	15	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

2

Attendance	: 10 marks
Continuous Assessment - Test	: 25 marks
Continuous Assessment - Assignment	: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and **1** question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A.

Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

Module 1

Systems of earth

Lithosphere- composition, rocks, soils; Atmosphere-layers, ozone layer, greenhouse effect, weather, cyclones, atmospheric circulations, Indian Monsoon; hydrosphere- Oceans, inland water bodies; biosphere

Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard, exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, disaster risk management, early warning systems, disaster preparedness, disaster

prevention, disaster mitigation, disaster response, damage assessment, crisis counselling, needs assessment.

Module 2

Hazard types and hazard mapping; Vulnerability types and their assessment- physical, social, economic and environmental vulnerability.Disaster risk assessment -approaches, procedures

Module 3

Disaster risk management -Core elements and phases of Disaster Risk Management - Measures for Disaster Risk Reduction - prevention, mitigation, and preparedness. Disaster response- objectives, requirements; response planning; types of responses. Relief; international relief organizations.

Module 4

Participatory stakeholder engagement; Disaster communication- importance, methods, barriers; Crisis counselling

Capacity Building: Concept - Structural and Non-structural Measures, Capacity Assessment; Strengthening Capacity for Reducing Risk

Module 5

Common disaster types in India; Legislations in India on disaster management; National disaster management policy; Institutional arrangements for disaster management in India. The Sendai Framework for Disaster Risk Reduction- targets, priorities for action, guiding principles

Reference Text Books

R. Subramanian, Disaster Management, Vikas Publishing House, 2018

M. M. Sulphey, Disaster Management, PHI Leaming, 2016

UNDP, Disaster Risk Management Training Manual, 2016

United Nations Office for Disaster Risk Reduction, Sendai Framework for Disaster Risk Reduction 2015-2030, 2015.

Teaching Plan

	Module 1	**5 Hours**
1.1	Introduction about various Systems of earth, Lithosphere-composition, rocks, Soils; Atmosphere-layers, ozone layer, greenhouse effect, weather	1 Hour
1.2	Cyclones, atmospheric circulations, Indian Monsoon; hydrosphere-Oceans, inland water bodies; biosphere	1 Hour
1.3	Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard,	1 Hour
1.4	Exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, Disaster risk management, early warning systems	1 Hour
1.5	Disaster preparedness, disaster prevention, disaster, Mitigation, disaster response, damage assessment, crisis counselling, needs assessment.	1 Hour
	Module 2	**5 Hours**
2.1	Various Hazard types, Hazard mapping; Different types of Vulnerability types and their assessment	1 Hour
2.2	Vulnerability assessment and types, Physical and social vulnerability	1 Hour
2.3	Economic and environmental vulnerability, Core elements of disaster risk assessment	1 Hour
2.4	Components of a comprehensive disaster preparedness strategy approaches, procedures	1 Hour
2.5	Different disaster response actions	1 Hour
	Module 3	**5 Hours**
3.1	Introduction to Disaster risk management, Core elements of Disaster Risk Management	1 Hour
3.2	Phases of Disaster Risk Management, Measures for Disaster Risk Reduction	1 Hour
3.3	Measures for Disaster prevention, mitigation, and preparedness.	1 Hour
3.4	Disaster response- objectives, requirements. Disaster response	1 Hour

	planning; types of responses.	
3.5	Introduction- Disaster Relief, Relief; international relief organizations.	1 Hour
	Module 4	**5 Hours**
4.1	Participatory stakeholder engagement	1 Hour
4.2	Importance of disaster communication.	1 Hour
4.3	Disaster communication- methods, barriers. Crisis counselling	1 Hour
4.4	Introduction to Capacity Building. Concept - Structural Measures, Non-structural Measures.	1 Hour
4.5	Introduction to Capacity Assessment, Capacity Assessment; Strengthening, Capacity for Reducing Risk	1 Hour
	Module 5	**5 Hours**
5.1	Introduction-Common disaster types in India.	1 Hour
5.2	Common disaster legislations in India on disaster management	1 Hour
5.3	National disaster management policy, Institutional arrangements for disaster management in India.	1 Hour
5.4	The Sendai Framework for Disaster Risk Reduction and targets	1 Hour
5..5	The Sendai Framework for Disaster Risk Reduction-priorities for action, guiding principles	1 Hour

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEEL331	MICROPROCESSORS AND MICROCONTROLLERS LAB	PCC	0	0	3	2

Preamble : This laboratory course is designed to train the students to familiarize and program microprocessors and microcontrollers. Students will also be introduced to a team working environment where they develop the necessary skills for planning, preparing and implementing embedded systems.

Prerequisite : Fundamentals of Digital Electronics and C programming

Course Outcomes : After the completion of the course the student will be able to

CO1	Develop and execute assembly language programs for solving arithmetic and logical problems using microprocessor/microcontroller.
CO2	Design and Implement systems with interfacing circuits for various applications.
CO3	Execute projects as a team using microprocessor/microcontroller for real life applications.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	-	-	2	2	3	-	2
CO2	3	3	2	2	3	-	-	2	2	3	-	2
CO3	3	3	3	3	3	3	3	3	3	3	2	2

ASSESSMENT PATTERN:

Mark distribution:

Total Marks	CIE marks	ESE marks	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation (CIE) Pattern:

Attendance	Regular Lab work	Internal Test	Course Project	Total
15	30	25	5	**75**

Internal Test Evaluation (Immediately before the second series test)

End Semester Examination (ESE) Pattern:

The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks

(b) Implementing the work/Conducting the experiment : 10 Marks

(c) Performance, result and inference (usage of equipments and trouble shooting) : 25 Marks

(d) Viva voce : 20 marks

(e) Record : 5 Marks

General instructions : Practical examination is to be conducted immediately after the second series test after conducting 12 experiments from the list of experiments given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

LIST OF EXPERIMENTS:

(12 experiments are mandatory)

8085 Microprocessor Programming

1. Data transfer using different addressing modes and block transfer.
2. (a) Arithmetic operations in binary and BCD: addition, subtraction, multiplication and division

   (b) Logical instructions- sorting of arrays in ascending and descending order.

   (c) Binary to BCD conversion and vice versa.

8051 Microcontroller Programming

3. ALP programming for

   (a) Data transfer: Block data movement, exchanging data, sorting, finding largest element in an array.

   (b) Arithmetic operations: Addition, subtraction, multiplication and division. Computation of square and cube of 16-bit numbers.

4. ALP programming for the implementation of counters: HEX up and down counters, BCD up/down counters

5. (a) ALP programming for implementing Boolean and logical instructions: bit manipulation.

   (b) ALP programming for implementing conditional call and return instructions: Toggle the bits of port 1 by sending the values 55H and AAH continuously, Factorial of a number

6. ALP programming for

   (a) Generation of delay

(b) Transmitting characters to a PC HyperTerminal using the serial port and displaying on the serial window

7. C Programs for stepper motor control.

8. C Programs for DC motor direction and speed control using PWM.

9. C Programs for Alphanumerical LCD panel/ keyboard interface.

10. C Programs for ADC interfacing.

11. Demo Experiments using 8085 Microprocessor Programming

(a) Digital I/O using PPI: square wave generation.

(b) Interfacing D/A converter- generation of simple waveforms-triangular, ramp etc.

(c) Interfacing A/D converter.

12. Demo Experiments using 8051 Microcontroller Programming

ALP programming for implementing code conversion– BCD to ASCII, ASCII to BCD, ASCII to decimal, Decimal to ASCII, Hexadecimal to Decimal and Decimal to Hexadecimal.

13. a) Familiarization of Arduino IDE

b) LED blinking with different ON/OFF delay timings with i) inbuilt LED ii) Externally interfaced LED

14. Arduino based voltage measurement of 12V solar PV module/ 12V battery and displaying the measured value using I2C LCD display.

15. Arduino based DC current measurement using Hall-effect current sensor like LEM LA-55P sensor and displaying the value using I2C LCD module.

16. DC motor speed control using MOSFET driven by PWM signal from Arduino module.

17. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thingspeak cloud.

18. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.

Mandatory Group Project Work : Students have to do a mandatory micro project (group size not more than 3 students) to realise an embedded system for Industrial Control/ day-to-day life applications. A report also is to be submitted. Performance can be evaluated along with the internal test and a maximum of 5 marks shall be awarded.

Example projects (Microcontroller based projects)

1. Temperature Monitoring and control System.
2. Home automation system
3. Remote health monitoring and emergency notification system
4. IoT based power monitoring
5. IoT based switching of power devices

Reference Books:

1. Ramesh Gaonkar, Microprocessor Architecture Programming and Applications, Penram International Publishing; Sixth edition, 2014.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi," The 8051 microcontroller and embedded systems using Assembly and C", second edition, Pearson/Prentice hall of India.
3. Kenneth. J. Ayala, The 8051 microcontroller, 3rd edition, Cengage Learning, 2010
4. Donald P. Leach, Albert Paul Malvino and Goutam Saha, Digital Principles and Applications, 8/e, by McGraw Hill.
5. A. P. Mathur, Introduction to Microprocessors, Tata McGraw Hill Publishing Company Limited, New Delhi.
6. Jeeva Jose, Internet of Things, Khanna Publishing House, Delhi
7. Raj Kamal, Internet of Things: Architecture and Design, McGraw Hill

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEEL333	ELECTRICAL MACHINES LAB II	PCC	0	0	3	2

Preamble: The purpose of this lab is to provide practical experience in the operation and testing of synchronous and induction machines.

Prerequisite : Fundamentals of Electrical Engineering

Course Outcomes: After the completion of the course the student will be able to:

CO 1	Analyse the performance of single phase and three phase induction motors by conducting suitable tests.
CO 2	Analyse the performance of three phase synchronous machine from V and inverted V curves.
CO 3	Analyse the performance of a three phase alternator by conducting suitable tests.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	2	2	-	-	-	-	3	2	-	3
CO 2	3	3	2	2	-	-	-	-	3	2	-	3
CO 3	3	3	2	2	-	-	-	-	3	2	-	3

Assessment Pattern

Marks distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation Pattern:

Attendance:	15 marks
Continuous Assessment:	30 marks
Internal Test (Immediately before the second series test) :	30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work	15 Marks
(b) Implementing the work/Conducting the experiment	10 Marks
(c) Performance, result and inference (usage of equipment and trouble-shooting)	25 Marks
(d) Viva voce	20 marks
(e) Record	5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified Laboratory Record. The external examiner shall endorse the record.

LIST OF EXPERIMENTS

(A minimum of **TWELVE** experiments are mandatory out of the fifteen listed.)

1. Load test on a three phase Slip Ring Induction Motor

Objectives:

a) Start the motor using auto transformer or rotor resistance starter
b) Plot the performance characteristics

2. No load and block rotor tests on a three phase Squirrel Cage Induction Motor

Objectives:

a) Predetermination of performance parameters from circle diagram
b) Determination of equivalent circuit

3. Starting of a three phase Squirrel Cage Induction Motor using Y-Δ Starter

Objectives:

a) Start the motor using Y-Δ Starter and perform load test
b) Plot the performance characteristics

4. Performance characteristics of a Pole Changing Induction Motor

Objectives:

a) Run the motor in two different pole configurations (example 4 pole and 8 pole)
b) Analyse the performance in the two cases by constructing circle diagrams and compare the results

5. No Load and Blocked Rotor Tests on a single phaseInduction Motor

Objectives:

a) Conduct no load and blocked rotor tests on the motor
b) Predetermine the equivalent circuit

6. Load Test on a single phaseInduction Motor

Objectives:

a) Perform load test on the motor
b) Plot the performance characteristics of the motor

7. Variation of starting torque with rotor resistance in Slip-Ring Induction Motors

Objectives:

a) Plot the variation of starting torque against rotor resistance in a three phase slip ring induction motor
b) Find the external rotor resistance for which maximum starting torque is obtained.

8. V and inverted V curves of a Synchronous Motor

Objectives:

Plot the V and inverted V curves of the Synchronous Motor at no load and full load.

9. Regulation of a three phase Alternator by direct loading

Objectives:

a) Determine the regulation of three phase alternator
b) Plot the regulation versus load curve

10. Regulation of a three phase Alternator by emf and mmf methods

Objectives:

Predetermine the regulation of alternator by emf and mmf methods at 0.8pf lag, upf and 0.8pf lead.

11. Regulation of a three phase alternator by Potier method

Objectives:

a) Synchronize the alternator by dark lamp method
b) Plot ZPF characteristics and determine armature reactance mmf and potier reactance
c) Predetermine the regulation by ZPF method

12. Reactive power control in grid connected Alternators

Objectives:

a) Synchronize the alternator by bright lamp method
b) Control the reactive power and plot the V and inverted V curves for generator operation

13. Slip Test on a three phase Salient Pole Alternator

Objectives:

a) Determine the direct and quadrature axis synchronous reactances
b) Predetermine the regulation at 0.8 lagging power factor

14. V/f control of three phase Squirrel Cage Induction Motor

Objectives:

Perform speed control of the given three phase induction motor by V/f control

15. Performance characteristics of a three phase Induction Generator

Objectives:

Plot the performance characteristics of the generator.

Reference Books

1) Bimbra P S, *Electric Machines*, Khanna Publishers, 2nd edition, 2017.
2). KothariD. P., NagrathI. J., *Electric Machines*, Tata McGraw Hill, 5th edition, 2017.
3) Say M.G, *The Performance and Design of AC Machines*, CBS Publishers, New Delhi, 3rd edition, 2002.
4) Alexander SLangsdorf, "Theory of Alternating Current Machinery", Tata McGraw Hill, 2nd revised edition, 2001.

SYLLABUS

B.Tech.

ELECTRICAL AND ELECTRONICS ENGINEERING

FOR WORKING PROFESSIONALS - Semester VI

2024 SCHEME

COURSES

SEMESTER–VI

SLOT	COURSE NO	COURSES	L-T-P	HOURS	CREDIT
A	24SJEET302	LINEAR CONTROL SYSTEMS	2-2-0	4	4
B	24SJEET304	POWER SYSTEMS II	3-1-0	4	4
C	24SJEET306	POWER ELECTRONICS	3-1-0	4	4
D	24SJEETXXX	PROGRAM ELECTIVE 1	2-1-0	3	3
E 1/2	24SJHUT300	INDUSTRIAL ECONOMICS AND FOREIGN TRADE	3-0-0	3	3
	24SJHUT310	MANAGEMENT FOR ENGINEERS	3-0-0	3	3
F	24SJEET308	COMREHENSIVE COURSE WORK	1-0-0	1	1
S	24SJEEL332	POWER SYSTEMS LAB	0-0-3	3	2
T	24SJEEL334	POWER ELECTRONICS LAB	0-0-3	3	2
TOTAL				**25**	**23**

PROGRAM ELECTIVE I

SLOT	COURSE NO	COURSES	L-T-P	HOURS	CREDIT
D	24SJEET312	BIOMEDICAL INSTRUMENTATION	2-1-0	3	3
	24SJEET322	RENEWABLE ENERGY SYSTEMS	2-1-0		
	24SJEET332	COMPUTER ORGANIZATION	2-1-0		
	24SJEET342	HIGH VOLTAGE ENGINEERING	2-1-0		
	24SJEET352	OBJECT ORIENTED PROGRAMMING	2-1-0		
	24SJEET362	MATERIAL SCIENCE	2-1-0		
	24SJEET372	SOFT COMPUTING	2-1-0		

NOTE:

1. Industrial Economics and Foreign Trade and Management for Engineers shall be offered in both S5 and S6.

2. Comprehensive Course Work: The comprehensive course work in the sixth semester of study shall have a written test of 50 marks. The written examination will be of objective type similar to the GATE examination. **Syllabus for comprehensive examination shall be prepared by the respective BoS choosing any 5 core courses studied from semester 3 to 5.** The pass minimum for this course is 25. The course should be mapped with a faculty and classes shall be arranged for practising questions based on the core courses listed in the curriculum

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET302	LINEAR CONTROL SYSTEMS	PCC	2	2	0	4

Preamble: This course aims to provide a strong foundation on classical control theory. Modelling, time domain analysis, frequency domain analysis and stability analysis of linear systems based on transfer function approach will be discussed. The compensator design of linear systems is also introduced.

Prerequisite : Basics of Circuits and Networks, Signals and Systems

Course Outcomes : After the completion of the course the student will be able to:

CO 1	Describe the role of various control blocks and components in feedback systems.
CO 2	Analyse the time domain responses of the linear systems.
CO 3	Apply Root locus technique to assess the performance of linear systems.
CO 4	Analyse the stability of the given LTI systems.
CO 5	Analyse the frequency domain response of the given LTI systems.
CO 6	Design compensators using time domain and frequency domain techniques.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	-	-	-	-	-	-	-	-	-	1
CO 2	3	3	3	-	-	-	-	-	-	-	-	2
CO 3	3	3	3	-	2	-	-	-	-	-	-	2
CO 4	3	3	3	-	-	-	-	-	-	-	-	3
CO 5	3	3	3	-	2	-	-	-	-	-	-	3
CO 6	3	3	3	2	-	-	-	-	-	-	-	3

Assessment Pattern:

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	03 Hrs

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	10	10	20
Understand (K2)	10	10	20
Apply (K3)	30	30	60
Analyse (K4)			
Evaluate (K5)			
Create (K6)			

End Semester Examination Pattern : There will be two parts; Part A and Part B.

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.

Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Syllabus

Module 1

Feedback Control Systems (9 hours)

Open loop and closed loop control systems- Examples of automatic control systems - Transfer function approach to feed back control systems – Effect of feedback

Control system components – Control applications of DC and AC servo motors, Tacho generator, Synchro, Gyroscope and Stepper motor

Controllers- Types of controllers & Compensators - Transfer function and basic characteristics of lag, lead and lag-lead phase compensators.

Module 2

Performance Analysis of Control Systems (9 hours)

Time domain analysis of control systems: Time domain specifications of transient and steady state responses- Impulse and Step responses of first and second order systems- Pole dominance for higher order systems.

Error analysis: Steady state error analysis and error constants -Dynamic error coefficients.

Stability Analysis: Concept of BIBO stability and Asymptotic stability- Time response for various pole locations- stability of feedback systems - Routh's stability criterion- Relative stability

Module 3

Root Locus Analysis and Compensator Design (11 hours)

Root locus technique: Construction of Root locus- stability analysis- effect of addition of poles and zeroes- Effect of positive feedback systems on Root locus

Design of Compensators: Design of lag lead compensators using Root locus technique.

PID controllers: PID tuning using Ziegler-Nichols methods.

Simulation based analysis: Introduction to simulation tools like MATLAB/ SCILAB or equivalent for Root locus based analysis (Demo/Assignment only)

Module 4

Frequency domain analysis (9 hours)

Frequency domain specifications- correlation between time domain and frequency domain responses

Polar plot: Concepts of gain margin and phase margin- stability analysis

Bode Plot: Construction- Concepts of gain margin and phase margin- stability analysis,

Effect of Transportation lag and Non-minimum phase systems.

Module 5

Nyquist stability criterion and Compensator Design using Bode Plot (9 hours)

Nyquist criterion: Nyquist plot- Stability criterion- Analysis

Introduction to Log magnitude vs. phase plot and Nichols chart (concepts only) - Compensator design using Bode plot: Design of lag, lead compensator using Bode plot.

Simulation based analysis: Introduction to simulation tools like MATLAB/ SCILAB or equivalent for various frequency domain plots and analysis (Demo/Assignment only).

Textbooks

1. Nagarath I. J. and Gopal M., Control System Engineering, 5/e, New Age Publishers
2. Ogata K, Modern Control Engineering, 5/e, Prentice Hall of India.
3. Nise N. S, Control Systems Engineering, 6/e, Wiley Eastern
4. Dorf R. C. and Bishop R. H, Modern Control Systems, 12/e, Pearson Education

Reference Books

1. Kuo B. C, Automatic Control Systems, 7/e, Prentice Hall of India
2. Desai M. D., Control System Components, Prentice Hall of India, 2008
3. Gopal M., Control Systems Principles and Design, 4/e, Tata McGraw Hill.
4. Imthias Ahamed T. P, Control Systems, Phasor Books, 2016

Course Contents and Lecture Schedule:

Module	Topic coverage	No. of Lectures
1	**Feedback Control Systems (9 hours)**	
1.1	Terminology and basic structure of Open loop and Closed loop control systems- Examples of Automatic control systems (block diagram representations only)	2
1.2	Transfer function approach to feed back control systems- Effect of feedback- Characteristic equation- poles and zeroes- type and order.	2
1.3	Control system components: Transfer functions of DC and AC servo motors –Control applications of Tacho generator, Synchro, Gyroscope and Stepper motor	3
1.4	Need for controllers: Types of controllers – Feedback, Cascade and Feed forward controllers Compensators: Transfer function and basics characteristics of lag, lead, and lag-lead phase compensators	2
2	**Performance Analysis of Control Systems (9 hours)**	
2.1	Time domain analysis of control systems: Time domain specifications of transient and steady state responses- Impulse and Step responses of First order systems- Impulse and Step responses of Second order systems- Pole dominance for higher order systems	3

2.2	Error analysis: Steady state error analysis - static error coefficient of Type 0, 1, 2 systems. Dynamic error coefficients	2
2.3	Stability Analysis: Concept of stability-BIBO stability and Asymptotic stability- Time response for various pole locations- stability of feedback systems	2
2.4	Application of Routh's stability criterion to control system analysis- Relative stability	2
3	**Root Locus Analysis and Compensator Design (11 hours)**	
3.1	Root locus technique: General rules for constructing Root loci – stability from root loci -	3
3.2	Effect of addition of poles and zeros on Root locus	1
3.3	Effect of positive feedback systems on Root locus	1
3.4	Design using Root locus: Design of lead compensator using root locus.	2
3.5	Design of lag compensator using root locus.	2
3.6	PID Controllers: Need for P, PI and PID controllers	1
3.7	Design of P, PI and PID controller using Ziegler-Nichols tuning method.	1
3.8	Simulation based analysis: Introduction to simulation tools like MATLAB/ SCILAB or equivalent simulation software and tool boxes for Root locus based analysis (Demo/Assignment only)	
4	**Frequency domain analysis (9 hours)**	
4.1	Frequency domain specifications- correlation between time domain and frequency domain responses	2
4.2	Polar plot: Concepts of gain margin and phase margin- stability analysis	2
4.3	Bode Plot: Construction of Bode plots- gain margin and phase margin- Stability analysis based on Bode plot	4
4.4	Effect of Transportation lag and Non-minimum phase systems	1
5	**Nyquist stability criterion and Compensator Design using Bode Plot (9 hours)**	
5.1	Nyquist stability criterion: Nyquist plot- Stability criterion- Analysis	3
5.2	Introduction to Log magnitude vs. phase plot and Nichols chart	1
5.3	Design using Bode plot: Design of lead compensator using Bode plot.	2
5.4	Design of Lag compensator using Bode plot.	2
5.5	Simulation based analysis: Introduction to simulation tools like MATLAB/ SCILAB or equivalent simulation software and tool boxes for various frequency domain plots and analysis (Demo/Assignment only).	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET304	POWER SYSTEMS II	PCC	3	1	0	4

Preamble: The basic objective of this course is to deliver fundamental concepts in power system analysis. The steady state and transient analysis of electrical power system is comprehensively covered in this course ranging extensively using the conventional methods as well as advanced mathematics.

Prerequisite: 24SJEET301 Power Systems I

Course Outcomes : After the completion of the course the student will be able to:

CO1	Apply the per unit scheme for any power system network and compute the fault levels.
CO2	Analyse the voltage profile of any given power system network using iterative methods.
CO3	Analyse the steady state and transient stability of power system networks.
CO4	Model the control scheme of power systems.
CO5	Schedule optimal generation scheme.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										2
CO2	3	3	2									2
CO3	3	3	2									1
CO4	3	2										
CO5	3	3	1								3	1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	10	10	20
Understand (K2)	10	10	20
Apply (K3)	30	30	60
Analyse (K4)	-	-	-
Evaluate (K5)	-	-	-
Create (K6)	-	-	-

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module I (10 hours)

Per unit quantities-single phase and three phase- Symmetrical components- sequence networks- Fault calculations- symmetrical and unsymmetrical- Fault level of installations- Limiters - Contingency ranking.

Module II (8 hours)

Load flow studies – Introduction-types-network model formulation and admittance matrix, Gauss-Siedel (two iterations), Newton-Raphson (Qualitative analysis only) and - principle of DC load flow - Introduction to distribution flow.

Module III (10 hours)

Power system stability - steady state, dynamic and transient stability-power angle curve-steady state stability limit -mechanics of angular motion-swing equation - solution of swing equation - Equal area criterion application - methods of improving stability limits - Phasor Measurement Units- Wide Area Monitoring Systems

Module IV (10 hours)

Turbines and speed governors-Inertia-Automatic Generation Control: Load frequency control: single area and two area systems - Subsynchronous Resonance - Automatic voltage control -Exciter Control- SCADA systems

Module V (8 hours)

Economic Operation - Distribution of load between units within a plant - transmission loss as a function of plant generation - distribution of load between plants - method of computing penalty factors and loss coefficients. Unit commitment: Introduction — constraints on unit commitments: spinning reserve, thermal unit constraints- hydro constraints.

References:

1. Hadi Saadat, *Power System Analysis*, 2/e, McGraw Hill, 2002.
2. D. P. Kothari and I. J. Nagrath, *Modern Power System Analysis*, 2/e, TMH, 2009.
3. Cotton H. and H. Barbera, Transmission & Distribution of Electrical Energy, 3/e, Hodder and Stoughton, 1978.
4. Gupta B. R., *Power System Analysis and Design*, S. Chand, New Delhi, 2006.
5. Gupta J.B., Transmission *& Distribution of Electrical Power*, S.K. Kataria& Sons, 2009.
6. John J Grainger and William D Stevenson, *Power System Analysis*, 4/e, McGraw Hill, 1994.
7. Uppal S. L. and S. Rao, *Electrical Power Systems*, Khanna Publishers, 2009.
8. Wadhwa C. L., *Electrical Power Systems*, 33/e, New Age International, 2004.

Course Contents and Lecture Schedule:

No	Topic	No. of Lectures
1	**Module I (10 hours)**	
1.1	Per unit quantities-single phase and three phase -Numerical Problems	2
1.2	Symmetrical components- sequence networks-Numerical Problems	3
1.3	Fault calculations-symmetrical and unsymmetrical-Numerical Problems	3
1.4	Fault level of installations- Limiters-Numerical Problems	2
2	**Module 2 (8 Hours)**	
2.1	Load flow studies – Introduction-types	1
2.2	Network model formulation and admittance matrix-Numerical Problems	2
2.3	Gauss-Siedel (two iterations) -Numerical Problems not more than three buses	1
2.4	Newton-Raphson (Qualitative analysis only)	2
2.5	Principle of DC load flow. Introduction to distribution flow.	2
3	**Module 3 (10 hours)**	
3.1	Power system stability steady state, dynamic and transient stability--Numerical Problems	2
3.2	power angle curve-steady state stability limit --Numerical Problems	2
3.3	Equal area criterion application-Numerical Problems.	2
3.4	Methods of improving stability limits-Numerical Problems	2
3.5	Contingency ranking-SSR-(Abstract idea only) – PMUs and Wide area monitoring systems	2
4	**Module 4 (10 hours)**	
4.1	Turbines and speed governors-inertia.	2
4.2	Automatic Generation Control: Load frequency control: single area and two area systems-Numerical Problems	3
4.3	Automatic voltage control -Exciter Control.	2
4.4	SCADA systems-(Abstract idea only)	1
4.5	Phasor Measurement Unit- Wide Area Monitoring Systems-(Abstract idea only)	2
5	**Module 5 (8 hours)**	

5.1	Economic Operation Distribution of load between units within a plant transmission loss as a function of plant generation distribution of load between plants-Numerical Problems	3
5.2	Method of computing penalty factors and loss coefficients-Numerical Problems	2
5.3	Unit commitment: Introduction — Constraints on unit commitments: Spinning reserve, Thermal unit constraints- Hydro constraints- Numerical Problems.	3

CODE	COURSE NAME	CATEGORY	L	T	P	CREDITS
24SJEET306	POWER ELECTRONICS	PCC	3	1	0	4

Preamble: To impart knowledge about the power semiconductor devices, the operation of various power converters and its applications.

Prerequisite: Basics of Electrical Engineering / Introduction to Electrical Engineering/ Basics of Electronics Engineering

Course Outcomes: After the completion of the course the student will be able to:

CO 1	Explain the operation of modern power semiconductor devices and its characteristics.
CO 2	Analyse the working of controlled rectifiers.
CO 3	Explain the working of AC voltage controllers, inverters and PWM techniques.
CO 4	Analyze the operation and evaluate the performance of various DC-DC converters, including Buck, Boost, and Buck-Boost topologies.
CO 5	Describe basic drive schemes for ac and dc motors.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	-	1	-	-	-	-	-	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	2
CO3	3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	2
CO5	3	2	-	-	-	-	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	10	10	20
Understand (K2)	20	20	30
Apply (K3)	20	20	50
Analyse (K4)	-	-	-
Evaluate (K5)	-	-	-
Create (K6)	-	-	-

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A

contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module 1 (11 hours)

Introduction to Power Electronics-Scope and applications-power electronics vs signal electronics (1 hr)

Structure and principle of operation of power devices- Power diode, Power MOSFET & IGBT – switching characteristics - comparison. Basic principles of wideband gap devices- SiC, GaN (4 hrs)

SCR- Structure, Static characteristics & Switching (turn-on & turn-off) characteristics - di/dt& dv/dt protection – Turn-on methods of SCR - Two transistor analogy (5 hr)

Gate triggering circuits – Requirements of isolation and synchronization in gate drive circuits- Opto and pulse transformer based isolation (1hr)

Module 2 (9 hours)

Controlled Rectifiers (Single Phase) – Half-wave controlled rectifier with R load– Fully controlled and half controlled bridge rectifier with R, RL and RLE loads (continuous & discontinuous conduction) – Output voltage equation- related simple problems(5 hrs)

Controlled Rectifiers (3-Phase) - 3-phase half-wave controlled rectifier with R load – Fully controlled & half-controlled bridge converter with RLE load (continuous conduction, ripple free) – Output voltage equation-Waveforms for various triggering angles (detailed mathematical analysis not required) (4 hrs)

Module 3 (9 hours)

AC voltage controllers (ACVC) – 1-phase full-wave ACVC with R, & RL loads – Waveforms – RMS output voltage, Input power factor with R load (2 hrs)

Inverters – Voltage Source Inverters– 1-phase half-bridge & full bridge inverter with R and RL loads – THD in output voltage – 3-phase bridge inverter with R load – 120° and 180° conduction modes– Current Source Inverters-1-phase capacitor commutated CSI.(5 hrs)

Voltage control in 1-phase inverters – Pulse width modulation – Single pulse width, Multiple pulse width and Sine-triangle PWM (unipolar & bipolar modulation) – Modulation Index - Frequency modulation ratio.(2 hrs)

Module 4 (8 hours)

DC-DC converters – Step down and Step up choppers – Single-quadrant, Two-quadrant and

Four quadrant chopper – Pulse width modulation & current limit control in dc-dc converters. (4 hrs)

Switching regulators – Buck, Boost & Buck-boost –Operation with continuous conduction mode – Waveforms – Design of Power circuits (switch selection, filter inductance and capacitance) (4 hrs)

Module 5 (11 hours)

Electric Drive: Introduction to electric drives – Block diagram – advantages of electric drives-types of load – classification of load torque (2 hrs)

DC Drives: Single phase semi converter and single phase fully controlled converter drives. Dual Converters for Speed control of DC motor-Simultaneous and Non-simultaneous operation. Chopper controlled DC drives- Single quadrant chopper drives- Regenerative braking control- Two quadrant chopper drives- Four quadrant chopper drives(6 hrs)

AC Drives: Three phase induction motor speed control. Stator voltage control – stator frequency control - Stator voltage and frequency control (v/f) (3 hrs)

(It is expected to emphasize the ease of independent control of field flux and armature flux in SEDC motor and relate the same with Induction motor)

Text Books

1. Muhammad H. Rashid, Power Electronics Circuits, Devices and Applications, Pearson Education
2. Daniel W. Hart, Power Electronics, Tata McGraw-Hill Education
3. P.S. Bimbhra, Power Electronics, Khanna Publishers, New Delhi

References:

1. Mohan N., T. M. Undeland and W. P. Robbins., Power Electronics, Converters.Applications & Design, Wiley-India
2. Fundamentals of Power Electronics, Erickson, Robert W., and Maksimovic, Dragan.
3. Krein P. T., Elements of Power Electronics, Oxford University Press, 1998.
4. L. Umanand, Power Electronics – Essentials & Applications, Wiley-India
5. Singh M. D. and K. B. Khanchandani, Power Electronics, Tata McGraw Hill, New Delhi, 2008.
6. Joseph Vithayathil, Power Electronics: Principles and Applications, McGraw-Hill College; International edition ,1995
7. Application notes on SiC and GaN, www.infineon.com. [online]
8. Evolution of wide Band-gap Semi-conductors for power devices expanding field of applications. Technical review, Vol 4, Toshiba Corporation, 2018
9. Milligan, J. W., Sheppard, S., Pribble, W., Wu, Y.-F., Muller, G., &Palmour, J. W. (2007). SiC and GaN Wide Bandgap Device Technology Overview, 2007 IEEE Radar Conference. doi:10.1109/radar.2007.374395.
10. Vedam Subramaniam “Electric drives (concepts and applications)”, Tata McGraw-Hill, 2001.
11. G. K. Dubey, Fundamentals of Electric Drives, Narosa publishers, second edition, 2010.

Course Contents and Lecture Schedule:

No.	Topic	No. of Lectures
1	**Power Devices (11 hours)**	
1.1	Introduction to Power Electronics: Scope and applications-power electronics vs signal electronics.	1
1.2	Structure, principle of operation, switching characteristics of Power Devices- Power Diode, Power MOSFET & IGBT – Comparison	3
1.3	Basic principles of wideband gap devices-SiC, GaN	1
1.4	SCR- Structure, Static characteristics & Switching (turn-on & turn-off) characteristics - di/dt& dv/dt protection – Turn-on methods of SCR - Two transistor analogy	5
1.5	Requirements of isolation and synchronization in gate drive circuits- Opto and pulse transformer based isolation	1
2	**Single phase and three phase controlled rectifiers (9 hours)**	
2.1	Half-wave controlled rectifier with R load	2
2.2	1-phase fully controlled bridge rectifier with R, RL and RLE loads (continuous & discontinuous conduction) – Output voltage equation	2
2.3	1-phase half controlled bridge rectifier with R, RL and RLE loads	1
2.4	3-phase half-wave controlled rectifier with R load	2
2.5	3-phase fully controlled & half-controlled converter with RLE load (continuous conduction, ripple free) – Output voltage equation.	2
3	**Inverters and Voltage control in single phase inverters (9 Hours)**	
3.1	Applications of AC-AC converters – Single phase full-wave AC voltage controllers with R, & RL loads- Waveforms	1
3.2	RMS output voltage, Input power factor with R load	1
3.3	Voltage Source Inverters– 1-phase Half-bridge & Full bridge inverter with R and RL loads– THD in output voltage	2
3.4	3-phase bridge inverter with R load – 120° and 180° conduction modes	2
3.5	Current Source Inverters-1-phase capacitor commutated CSI.	1
3.6	Pulse Width Modulation – Single pulse width, Multiple pulse width and Sine-triangle PWM (bipolar modulation) – Modulation Index - Frequency modulation ratio.	2
4	**DC-DC converters (8 Hours)**	
4.1	Step down and Step up choppers – Single-quadrant chopper	2
4.2	Two-quadrant and Four-quadrant chopper – Pulse width modulation &current limit control in dc-dc converters.	2
4.3	Buck, Boost & Buck-boost –Operation with continuous conduction mode – Waveforms	3

4.4	Design of Power circuits (switch selection, filter inductance and capacitance)	1
5	**Electric drives (11 Hours)**	
5.1	Electric Drive: Introduction to electric drives – Block diagram – advantages of electric drives- types of load – classification of load torque	2
5.2	DC Drives: Single phase semi converter and single phase fully controlled converter drives. Dual Converters for Speed control of DC motor- Simultaneous and Non- simultaneous operation.	3
5.3	Chopper controlled DC drives. Single quadrant chopper drives. Regenerative braking control. Two quadrant chopper drives. Four quadrant chopper drives	3
5.4	AC Drives: Three phase induction motor speed control. Stator voltage control – stator frequency control - Stator voltage and frequency control (v/f) (3 hrs)	3

SEMESTER VI

PROGRAM ELECTIVE I

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET312	BIOMEDICAL INSTRUMENTATION	PEC	2	1	0	3

Preamble :Nil

Prerequisite :Measurements and Instrumentation

Course Outcomes : After the completion of the course, the student will be able to:

CO1	Explain the basics of anatomy and physiology of human body.
CO2	Explain different techniques for the measurement of various physiological parameters.
CO3	Describe modern imaging techniques for medical diagnosis
CO4	Identify the various therapeutic equipment used in biomedical field
CO5	Discuss the patient safety measures and recent advancements in medical field.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	2	-	-	-	-	-	-
CO2	2	-	2	-	-	2	-	-	-	-	-	-
CO3	2	-	2	-	-	2	-	-	-	-	2	-
CO4	2	2	-	-	-	2	-	-	-	-	2	-
CO5	2	2	2	-	-	2	-	-	-	-	-	1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	20	20	40
Apply	15	15	30
Analyse			
Evaluate			
Create			

End Semester Examination Pattern : There will be two parts; Part A and Part B. **Part A** contain 10 questions (each carrying 3 marks) with 2 questions from each module. Students should answer all questions.

Part B contains 2 questions from each module, out of which students should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module 1

Human Physiological systems: Brief discussion of Heart and Cardio-vascular system- Physiology of Respiratory system - Anatomy of Nervous and Muscular systems -Problems encountered in measuring living systems

Bioelectric potential: Resting and action potential - Generation and propagation - Bioelectric potentials associated with physiology systems (ECG, EEG and EMG).

Bio potential Electrodes: Theory – Surface electrode – Microelectrode-Needle electrodes.

Transducers for biomedical applications: Transducers for the measurement of pressure, temperature and respiration rate.

Module 2

Measurement of blood pressure: Direct and indirect measurement – Oscillometric method – Ultrasonic method -Measurement of blood flow and cardiac output- Plethysmography –Photo electric and Impedance Plethysmographs-Measurement of heart sounds –Phonocardiography.

Cardiac measurements: Electro-conduction system of the heart- Electro-cardiography – Electrodes and leads – Einthoven triangle- ECG read out devices-ECG machine – block diagram

Module 3

Measurements from the nervous system: Neuronal communication-EEG waveforms and features - 10-20 electrode measurement- EEG Block diagram – Brain-Computer interfacing.

Muscle response: Electromyography- Block diagram of EMG recorders – Nerve conduction velocity measurement

Measurements of respiratory parameters: Spiro meter-Pneumograph

Module 4

Modern Imaging Systems: Basic X-ray machines - CAT scanner- Principle of operation - scanning components - Ultrasonic Imaging principle - types of Ultrasound Imaging - MRI and PET scanning (Principle only).

Therapeutic equipment: Cardiac Pacemakers - De-fibrillators - Hemodialysis machines - Artificial kidney – Lithotripsy - Short wave and Micro wave Diathermy machines

Module 5

Ventilators - Heart Lung machine - Infant Incubators

Instruments for clinical laboratory: Test on blood cells – Chemical tests

Electrical safety: Physiological effects of electric current – Shock hazards from electrical equipment – Method of accident prevention.

Introduction to Tele- medicine - Introduction to medical robotics

Text Books

L. Cromwell, F. J. Weibell and L. A. Pfeiffer, "Biomedical Instrumentation Measurements", Pearson education, Delhi, 1990.

J. G. Webster, "Medical Instrumentation, Application and Design", John Wiley and Sons

Reference Books

1. R. S. Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill
2. J. J. Carr and J. M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education
3. AchimSchweikard, "Medical Robotics", Springer

Course Contents and Lecture Schedule

Sl. No.	Topic	No. of Lectures
1	**Human Physiology Systems and Transducers (8 hours)**	
1.1	Problems encountered in measuring living systems - Cardio-vascular – Respiratory- nervous and muscular systems of the body.	2
1.2	Electrode theory-Bioelectric potential - Resting and action potential - Generation and propagation.	1
1.3	Bioelectric potentials associated with physiology systems (ECG, EEG and EMG).	1
1.4	Electrodes Theory - Surface electrode - Needle electrode - Microelectrode	2
1.5	Transducers for the measurement of Pressure, temperature and respiration rate.	2
2	**Cardio Vascular System Measurements (8 hours)**	
2.1	Measurement of blood pressure – direct and indirect measurement – Oscillometric measurement –Ultrasonic method	2
2.2	Measurement of blood flow and cardiac output -Plethysmography – Photo electric and Impedance Plethysmographs	3
2.3	Measurement of heart sounds –Phonocardiography.	1

2.4	Electro-conduction system of the heart - Electro Cardiography – Electrodes and leads – Einthoven triangle.	1
2.5	ECG read out devices - ECG machine – Block diagram	1
3	**Nervous System and its Measurements (7 hours)**	
3.1	Neuronal communication - Measurements from the nervous system.	1
3.2	Electroencephalography- Lead system -10-20 Electrode system,	1
3.3	EEG Block diagram - EEG waveforms and features – Brain-Computer interfacing.	2
3.4	Electromyography- Block diagram of EMG recorders - Nerve conduction velocity	2
3.5	Respiratory parameters measurements – Spiro meter - Pneumography.	1
4	**Modern Imaging Systems and Therapeutic Equipment (7 hours)**	
4.1	Basic X-ray machines	1
4.2	CAT Scanner- Principle of operation - Scanning components	1
4.3	Ultrasonic imaging principle - Types of Ultrasound imaging - MRI and PET scanning(Principle only).	2
4.4	Cardiac pace makers - De-fibrillators	1
4.5	Hemo-dialysis machines -Artificial kidney -Lithotripsy	1
4.6	Short wave and Micro wave diathermy machines	1
5	**Instrumentation for Patient Support and Safety (6 hours)**	
5.1	Ventilators - Heart lung machine - Infant incubators	1
5.2	Instruments for clinical laboratory – Test on blood cells – Chemical tests	1
5.3	Electrical safety– Physiological effects of electric current	1
5.4	Shock hazards from electrical equipment - Method of accident prevention	1
5.5	Introduction to tele- medicine	1
5.6	Introduction to medical robotics	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDITS
24SJEET322	RENEWABLE ENERGY SYSTEMS	PEC	2	1	0	3

Preamble : This course introduces about different new and renewable sources of energy. Design of some of the systems are also discussed

Prerequisite : **Power Systems I**

Course Outcomes : After the completion of the course the student will be able to:

CO1	Describe the environmental aspects of renewable energy resources.
CO2	Explain the operation of various renewable energy systems.
CO3	Design solar PV systems.
CO4	Explain different emerging energy conversion technologies and storage.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										2
CO2	3	3										2
CO3	3	3										2
CO4	3	3										2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	10	10	10
Understand (K2)	20	20	40
Apply (K3)	20	20	50
Analyse (K4)	-	-	-
Evaluate (K5)	-	-	-
Create (K6)	-	-	-

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module 1

Introduction, Environmental Aspects Energy-Ecology-Greenhouse Effect-Global Warming-Pollution-Various Pollutants and their Harmful Effects-Green Power-The United Nations Framework Convention on Climate Change (UNFCC)- Environment-Economy- Energy and Sustainable Development-Kyoto Protocol -Classification of Energy Resources; Conventional Energy Resources -Availability and their Limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources; World Energy Scenario; Indian Energy Scenario.

Module 2

SOLAR THERMAL SYSTEMS: Introduction, Solar Constant, Basic Sun-Earth Angles, Measurement of Solar Radiation Data (Numerical Problems)–Pyranometer and Pyrheliometer-Solar Thermal Collectors –General description and characteristics –Flat plate collectors – Heat transfer processes –Solar concentrators (Parabolic trough, Parabolic dish, Central Tower Collector)

SOLAR ELECTRIC SYSTEMS: Introduction- Solar Photovoltaic –Solar Cell fundamentals, Characteristics, Classification, Construction of Module, Panel and Array-Effect of Shadowing-Maximum Power Point Tracker (MPPT) using Buck-Boost Converter. Solar PV Systems – Stand-Alone and Grid connected-Design steps for a Stand-Alone system; Applications –Street Lighting, Domestic Lighting and Solar Water Pumping Systems.

Module 3

Wind Energy–Introduction–Wind Turbine Types (HAWT and VAWT) and their Construction- Wind Power Curve-Betz's Law-Power from a Wind Turbine (Numerical Problems)-Wind Energy Conversion System (WECS) – Fixed–Speed Drive Scheme-Variable speed drive scheme-Effect of wind speed and grid condition (system integration).

Small Hydro Power: Classification as micro, mini and small Hydro Projects -Basic Concepts and Types of Turbines - Classification, Characteristics and Selection

Module 4

ENERGY FROM OCEAN: Tidal Energy –Principle of Tidal Power, Components of Tidal Power Plant (TPP), Classification of Tidal Power Plants, Advantages and Limitations of TPP. Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC Power Generation –Open Cycle (Claude cycle), Closed Cycle (Anderson cycle) and Hybrid Cycle (block diagram description of OTEC); Site-selection Criteria, Biofouling, Advantages & Limitations of OTEC.

Module 5

BIOMASS ENERGY: Introduction, Photosynthesis Process, Biomass Fuels, Biomass Conversion Technologies, Urban Waste to Energy Conversion, Factors Affecting Biogas Generation, Types of Biogas Plants –KVIC and Janata Model.

EMERGING TECHNOLOGIES: Fuel Cell, Hydrogen Energy, Alcohol Energy and Power from Satellite Stations.

ENERGY STORAGE: Necessity of Energy Storage-Pumped Storage-Compressed A ir Storage-Flywheel Storage-Batteries Storage-Hydrogen storage.

References:

1. Thomas E. Kissell, David M. Buchla, Thomas L. Floyd, Renewable energy systems, Pearson 2017
2. Earnest J. and T. Wizelius, Wind Power Plants and Project Development, PHI Learning, 2011.
3. F. Kreith and J.F. Kreider: Principles of Solar Engineering, McGraw Hill, 1978
4. G.N. Tiwari: Solar Energy-Fundamentals, Design, Modelling and Applications, Narosa Publishers, 2002
5. J.A. Duffie and W.A. Beckman: Solar Energy Thermal Processes, J. Wiley, 1994
6. Johansson T. B., H. Kelly, A. K. N. Reddy and R. H. Williams, Renewable Energy – Sources for Fuel and Electricity, Earth scan Publications, London, 1993.
7. Khan B. H., Non-Conventional Energy Resources, Tata McGraw Hill, 2009.
8. D.P.Kothari, K.C.Singal, RakeshRanjan, *Renewable Energy Sources and Emerging Technologies*, Prentice Hall of India, New Delhi, 2009
9. Rao S. and B. B. Parulekar, Energy Technology, Khanna Publishers, 1999.
10. Sab S. L., Renewable and Novel Energy Sources, MI. Publications, 1995.
11. Sawhney G. S., Non-Conventional Energy Resources, PHI Learning, 2012.
12. Tiwari G. N., Solar Energy-Fundamentals, Design, Modelling and Applications, CRC Press, 2002.

Course Contents and Lecture Schedule:

No	Topic	No. of Lectures
1	**Environmental impacts of various energy resources. (7 hours)**	
1.1	Introduction, Environmental Aspects of Energy-Ecology-Greenhouse Effect-Global Warming	1
1.2	Pollution-Various Pollutants and their Harmful Effects-Green Power - The United Nations Framework Convention on Climate Change (UNFCC)	2
1.3	Environment-Economy-Energy and Sustainable development-Kyoto Protocol -Classification of Energy Resources	1
1.4	Conventional Energy Resources -Availability and their limitations	1
1.5	Non-Conventional Energy Resources –Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources; World Energy Scenario; Indian Energy Scenario.	2
2	**Solar radiation data, solar thermal and electric systems. (7 hours)**	
2.1	Introduction, Solar Constant, Basic Sun-Earth Angles, Measurement of Solar Radiation Data (Numerical Problems)–Pyranometer and Pyrheliometer	2
2.2	Solar Thermal Collectors –General description and characteristics –Flat plate collectors –Heat transfer processes	1
2.3	Solar concentrators (Parabolic trough, Parabolic dish, Central Tower Collector)	1

2.4	Solar Photovoltaic –Solar Cell fundamentals, characteristics, classification, construction of Module, Panel and Array-Effect of shadowing	1
2.5	Maximum Power Point Tracker (MPPT) using buck-boost converter. Solar PV Systems –stand-alone and grid connected-Design steps for a Stand-Alone system	1
2.6	Applications –Street lighting, Domestic lighting and Solar Water pumping systems.	1
3	**Wind energy and small hydro plant (6 Hours)**	
3.1	Wind Energy–Introduction–Wind Turbine Types (HAWT and VAWT) and their construction	1
3.2	-Wind power curve-Betz's Law-Power from a wind turbine (Numerical Problems)	1
3.3	Wind energy conversion system (WECS) – Fixed–speed drive scheme-	1
3.4	Variable speed drive scheme -Effect of wind speed and grid condition (system integration)	1
3.5	Small hydro power: Classification as micro, mini and small hydro projects -Basic concepts and types of turbines - Classification, Characteristics and Selection	2
4	**Energy from ocean (7 Hours)**	
4.1	Tidal Energy –Principle of Tidal Power, Components of Tidal Power Plant (TPP)	2
4.2	Classification of Tidal Power Plants, Advantages and Limitations of TPP.	1
4.3	Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation	1
4. 4	Open Cycle (Claude cycle), Closed Cycle (Anderson cycle)	1
4. 5	Hybrid cycle (block diagram description of OTEC)	1
4. 6	Site-selection criteria, Biofouling, Advantages & Limitations of OTEC.	1
5	**Emerging technologies (9 Hours)**	
5.1	Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies	2
5.2	Urban waste to Energy Conversion, factors affecting biogas generation, types of biogas plants –KVIC and Janata model	2
5.3	Types of biogas plants –KVIC and Janata model	1
5.4	Fuel Cell, Hydrogen Energy	1
5.5	Alcohol energy and power from satellite stations.	1
5.6	Necessity Of Energy Storage-Pumped Storage-Compressed air storage	1
5.7	Flywheel storage-Batteries Storage-Hydrogen storage.	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET332	COMPUTER ORGANIZATION	PEC	2	1	0	3

Prerequisite: The basic objective of this course is to lay the foundation of hardware organization of digital computers. The basic organizational concepts of Processor, Control Unit, Memory and I/O units are systematically included in this course. The knowledge on interplay between various building blocks of computer is also covered in this syllabus.

Course Outcomes: After the completion of the course, the student will be able to:

CO1	Identify the functional units of a digital computer and understand the bus structure to do data transfer.
CO2	Identify the pros and cons of different types of control unit design for various architectures
CO3	Explain the principle of operation of ALU for typical arithmetic and logic operations
CO4	Identify memory organization, Cache memory and virtual memory techniques.
CO5	Select appropriate interfacing standards for I/O devices.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1			1							1
CO2	3	1										1
CO3	3	1			1							1
CO4	2											1
CO5	2											1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	20
Understand	15	15	40
Apply	25	25	40
Analyse			
Evaluate			
Create			

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions (each carrying 3 marks) with 2 questions from each module. Students should answer all questions. Part B contains 2 questions from each module, out of which students should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

(6)

Syllabus

Module 1

Basic Structure of Computers- functional units--Von-Neumann architecture- basic operational concepts, Introduction to buses, Measuring performance: evaluating, comparing and summarizing. Representation of Instructions: Instruction formats -Operands- Addressing modes, Instruction set architectures - CISC and RISC architectures.

Module 2

Processor and Control Unit: Fundamental Concepts, multiple bus organization of CPU, memory read and memory write operations - Data transfer using registers. Execution of a complete instruction -sequencing of control signals. Hardwired Control, Micro programmed Control

Module 3

Data representation: Signed number representation, fixed and floating point representations, character representation. Computer Arithmetic: Integer Addition and Subtraction - Booths Multiplication- Division- non- restoring and restoring techniques.

Module 4

Memory Organization: - Memory cells- Basic Organization. Memory hierarchy - Caches - Cache performance - Virtual memory - Common framework for memory hierarchies Introduction to Pipelining- Pipeline Hazards

Module 5

Input/output organisation- Characteristics of I/O devices, Data transfer schemes - Programmed controlled I/O transfer, Interrupt controlled I/O transfer. Organization of interrupts - vectored interrupts – Servicing of multiple input/output devices – Polling and daisy chaining schemes. Direct memory accessing (DMA).

Text Books

1. Hamacher C., Z. Vranesic and S. Zaky, Computer Organization, 5/e, McGraw Hill, 2011.
2. William Stallings, Computer Organization and Architecture: Designing for Performance, Pearson, 9/e, 2013.
3.

Reference Books

1. Patterson D.A. and J. L. Hennessey, Computer Organization and Design, 5/e, Morgan Kauffmann Publishers, 2013.
2. Heuring V. P. and Jordan H. F., Computer System Design and Architecture, Addison Wesely, 2/e,

Course Contents and Lecture Schedule

Sl. No.	Topic	No. of Lectures
1	**Module 1 (8 hours)**	
1.1	Basic Structure of Computers- functional units-basic operational concepts	1
1.2	Introduction to buses,Performance of computer	2
1.3	Representation of Instructions: Machine instructions-Operands-Addressing modes	2
1.4	Instruction formats, Instruction sets, Instruction set architectures	2
1.5	CISC and RISC architectures.	1
2	**Module 2 (8 hours)**	
2.1	Processor and Control Unit : Some Fundamental Concepts	1
2.2	Execution of a Complete Instruction	2
2.3	Multiple Bus Organization	2
2.4	Hardwired Control, Microprogrammed Control	3
3	**Module 3 (8 hours)**	
3.1	Computer arithmetic: Signed and unsigned numbers - Addition and subtraction	2
3.2	Booths algorithm,	2
3.3	Division algorithm	2
3.4	Floating point representation	2
4	**Module 4 (6 hours)**	
4.1	Memory Organization: - Memory cells- Basic Organization	1
4.2	Memory hierarchy - Caches - Cache performance	2
4.3	Virtual memory	2
4.4	Introduction to pipelining-pipeline Hazards	1
5	**Module 5 (6 hours)**	
5.1	Input-Output Organization: Characteristics, data transfer schemes	2
5.2	Organization of interrupts - vectored interrupts	1
5.3	Polling and daisy chaining schemes.	1
5.4	Direct memory accessing (DMA).	2

CODE	COURSE NAME	CATEGORY	L	T	P	CREDITS
24SJEET342	HIGH VOLTAGE ENGINEERING	PEC	2	1	0	3

Preamble: This course introduces basic terms and techniques applicable to high voltage ac and dc networks. Generation of different type of High voltage waveforms, their measurement and analysis including the insulation coordination of different equipment and machinery used in HV applications. It also provides a basic idea of FACTS devices and testing with the help of different testing circuits.

Prerequisite: Basics of Electrical Engineering / Introduction to Electrical Engineering

Course Outcomes: After the completion of the course the student will be able to:

CO1	Identify different high voltage and current waveform generation circuits.
CO2	Implement different sensing & measurement techniques for high voltage and current measurement
CO3	Describe insulation coordination and surge arrestor design
CO4	Interpret different FACTS devices and their application in HV systems
CO5	Implement different testing methods for equipment and applications of HV systems

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										2
CO2	3	3										2
CO3	3	3					2					2
CO4	3	3					2					2
CO5	3	3					2					2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	10	10	10
Understand (K2)	20	20	40
Apply (K3)	20	20	50
Analyse (K4)	-	-	-
Evaluate (K5)	-	-	-
Create (K6)	-	-	-

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module 1

Generation of High Voltage and Currents

Generation of High DC and AC Voltages- half-wave rectifier circuit- Cockroft-Walton voltage multiplier circuit- Electrostatic generator- Generation of high AC voltages-Cascaded Transformers- Series resonant circuit

Generation of Impulse Voltages and Currents- Impulse voltage- Impulse generator circuits-Multistage impulse generator circuit- Construction of impulse generator- Triggering of impulse generator-Impulse current generation

Module 2

HV measuring techniques

High Voltage Measurement Techniques -Measuring Spark Gaps - Sphere-to-sphere Spark Gap -Rod-to-rod Spark Gap - Electrostatic Voltmeter- Field Sensors - Electrically Short Sensors, Electrically Long Sensors, Potential-free Probes, Generator-mode Sensors, Electro-optical and Magneto-optical Field Sensors - Voltage Dividers - Instrument Transformers - Measurements of R.M.S. Value, Peak Value and Harmonics - Current Measurement

Dielectric measurements- Dissipation Factor and Capacitance, Insulation Resistance, Conductivity, Dielectric System Response-Partial discharge measuring technique-Requirements on a partial discharge measuring system - Measuring systems for apparent charge Partial discharge measurements on high-voltage transformers, high-voltage cables, high-voltage gas-insulated substations

Module 3

Insulation Coordination and surge arresters

Classification of Voltages and Overvoltages-Origin of Overvoltages Representative Overvoltages- Performance Criterion Withstand voltage.

Insulation Coordination Procedure- Determination of Representative Voltages and Overvoltages-Continuous Power Frequency Voltage, Temporary Overvoltages, Slow-Front Overvoltages, Fast-Front Overvoltages

Determination of Coordination Withstand Voltage (Ucw)-Deterministic Approach, Statistical Approach: Risk of Failure - Determination of Required Withstand Voltage (Urw)-Altitude Correction Factor, Safety Factor (Ks)- Selection of Standard Withstand Voltage (Uw)- Surge Arresters- Rated Voltage- Discharge Current- Impulse Current Tests- Residual Voltages-

Arrester Durability Requirements

Module 4

HVDC and FACTS

HVDC transmission –General principles-VSC HVDC-Main components of HVDC links-Thyristor valves, Converter transformer, Control equipment, AC filters and reactive power control, Smoothing reactor and DC filter, Switchgear, Surge arresters, Valve cooling, Auxiliary supplies

Converter building - Power electronic support for AC systems- Static var compensators (SVCs), STATCOM, Series compensators, Unified power flow controller (UPFC)

Module 5

Testing of HV Systems

High voltage Testing of insulators, bushings, isolators, circuit breakers, transformers, surge diverters, cables

Insulation Systems for AC Voltages -Cables, bushings and transformers-Insulation Systems for DC Voltages- Capacitors, HVDC bushings and Cables-Insulation Systems for Impulse Voltages -Electrical Stress and Strength -Energy Storage -Impulse Capacitors (Energy Storage or Surge Capacitors)

Lightning Protection- Light and Laser Technology- X-ray Technology-Electrostatic Particle Precipitation, Ionization- Spark plugs

Text Books

1. C L Wadhwa, "High Voltage Engineering", New Age International Publishers, 2011.
2. Andreas Kuchler, " High Voltage Engineering Fundamentals – Technology – Applications", Springer, 2018

References:

1. Naidu M.S. and Kamaraju V., “High voltage Engineering”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2004.
2. Farouk A.M. Rizk&Giao N. Trinh, “High Voltage Engineering”, CRC Press, 2014.
3. Kuffel, E., Zaengl, W.S. and Kuffel J., “High Voltage Engineering Fundamentals”, Elsvier India P Ltd, 2005.
4. Hugh M. Ryan, “High-Voltage Engineering and Testing”, IET Power and energy series, 2013.
5. N.G. Hingorani and L.Gyugyi,“Understanding FACTS”,IEEE Press, 2000.

Course Contents and Lecture Schedule:

No	Topic	No. of Lectures
1	**Generation of High Voltage and Currents(7 hours)**	
1.1	Generation of High DC and AC Voltages- half-wave rectifier circuit- Cockcroft-Walton voltage multiplier circuit	2
1.2	Electrostatic generator- Generation of high AC voltages-Cascaded Transformers - Series resonant circuit	2
1.3	Generation of Impulse Voltages and Currents- Impulse voltage- Impulse generator circuits	1
1.4	Multistage impulse generator circuit- Construction of impulse generator- Triggering of impulse generator-Impulse current generation	2
2	**HV measuring techniques (7hours)**	
2.1	High Voltage Measurement Techniques -Measuring Spark Gaps - Sphere-to-sphere Spark Gap -Rod-to-rod Spark Gap	1
2.2	Electrostatic Voltmeter- Field Sensors - Electrically Short Sensors, Electrically Long Sensors, Potential-free Probes, Generator-mode Sensors, Electro-optical and Magneto-optical Field Sensors	1
2.3	Voltage Dividers - Instrument Transformers - Measurements of R.m.s. Value, Peak Value and Harmonics - Current Measurement	2
2.4	Dielectric measurements- Dissipation Factor and Capacitance, Insulation Resistance, Conductivity,	1
2.5	Dielectric System Response-Partial discharge measuring technique- Requirements on a partial discharge measuring system	1
2.6	Measuring systems for apparent charge – Partial discharge measurements on high-voltage transformers, high-voltage cables, high-voltage gas-insulated substations	1
3	**Insulation Coordination and surge arresters (8 Hours)**	
3.1	Classification of Voltages and Overvoltages-Origin of Overvoltages – Representative Overvoltages- Performance Criterion –Withstand voltage.	2
3.2	Insulation Coordination Procedure- Determination of Representative Voltages and Overvoltages-Continuous Power Frequency Voltage, Temporary Overvoltages, Slow-Front Overvoltages, Fast-Front Overvoltages	2

3.3	Determination of Coordination Withstand Voltage (Ucw)-Deterministic Approach, Statistical Approach: Risk of Failure - Determination of Required Withstand Voltage (Urw)-Altitude Correction Factor, Safety Factor (Ks)- Selection of Standard Withstand Voltage (Uw)	2
3.4	Surge Arresters- Rated Voltage- Discharge Current- Impulse Current Tests- Residual Voltages-Arrester Durability Requirements	2
4	**HVDC and FACTS (6 Hours)**	
4.1	HVDC transmission –General principles-VSC HVDC -Main components of HVDC links- Thyristor valves, Converter transformer,	2
4.2	Control equipment, AC filters and reactive power control, Smoothing reactor and DC filter, Switchgear, Surge arresters, Valve cooling, Auxiliary supplies	2
4.3	Converter building - Power electronic support for AC systems- Static var compensators (SVCs), STATCOM, Series compensators, Unified power flow controller (UPFC)	2
5	**Testing of HV Systems (8 Hours)**	
5.1	High voltage Testing of insulators, bushings, isolators, circuit breakers, transformers, surge diverters, cables	2
5.2	Insulation Systems for AC Voltages -Cables, bushings and transformers- Insulation Systems for DC Voltages- Capacitors	2
5.3	HVDC bushings and Cables-Insulation Systems for Impulse Voltages - Electrical Stress and Strength-Energy Storage -Impulse Capacitors (Energy Storage or Surge Capacitors)	2
5.4	Applications-Lightning Protection- Light and Laser Technology- X-ray Technology-Electrostatic Particle Precipitation, Ionization- Spark plugs	2

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET352	OBJECT ORIENTED PROGRAMMING	PEC	2	1	0	3

Preamble : Nil

Prerequisite : Nil

Course Outcomes : After the completion of the course the student will be able to:

CO1	Explain object oriented programming concepts and creation of classes for Java applications
CO2	Develop Java programs using arrays, strings, packages and inheritance concepts
CO3	Build Java applications using abstract classes, interfaces, run time errors and exceptions
CO4	Develop Java applets and applications for file I/O operations
CO5	Apply the concept of multithreading in Java applications.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											1
CO2	2	2			3							2
CO3	2	2			3							2
CO4	2	2			3							2
CO5	2	3			3							2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	10	10	20
Understand (K2)	10	10	20
Apply (K3)	20	20	40
Analyse (K4)	10	10	20
Evaluate (K5)	-	-	-
Create (K6)	-	-	-

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which

student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module 1:

Review of object-oriented concepts- Java features – Java Virtual Machine - Objects and classes in Java - defining classes – methods – access specifiers - static members- command line arguments– constructors

Module 2:

Arrays – Strings -Packages - Inheritance – class hierarchy – polymorphism – static binding - dynamic binding – final keyword

Module 3:

Abstract classes – the Object class – Reflection – interfaces – object cloning – inner classes - Exception handling

Module 4:

Applet Basics-

Life cycle - The Applet HTML Tags and Attributes, Creating and running applets – Multimedia support, The Applet Context, JAR Files

File I/O - Concept of Streams - Use of character / byte Streams and stream classes - Writing and Reading characters / bytes

Module 5: –

Multithreaded programming-

Life cycle of a thread -Thread properties – Creating a thread -Interrupting threads – Thread priority- thread synchronization – Synchronized method -Inter thread communication

Database Programming -The Design of JDBC, The Structured Query Language, JDBC Installation, Basic JDBC Programming Concepts, Query Execution

Text Books

1. Herbert Schildt, "Java – The Complete Reference ", 8th Edition, Tata McGraw Hill
2. Cay S. Horstmann and Gary Cornell, "Core Java: Volume I & II– Fundamentals", Pearson Education, 2008.
3. E Balaguruswamy, "Programming with Java – A primer", 5th Edition, McGraw Hill

Reference Books

1. P.J.Deitel and H.M.Deitel, "Java: How to Program", PHI.

2. Programming in Java, S.Malhotra and S.Choudhary, Oxford Univ. Press, 2018
3. K. Arnold and J. Gosling, "The JAVA programming language", Pearson Education
4. Bruce Eckel, Thinking in Java, Pearson Education
5. David H Friedel,Jr. and Anthony Potts, Java Programming Language Handbook, Coriolis Group Books
6. Doug Lowe, Java all-in-one for Dummies, John Wiley & Sons
7. Laura Lemay and Charles L Perkins, Teach yourself Java in 21 days, Sams Publishing

Course Content and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1 (9 hours)**	
1.1	Review of Object-Oriented Concepts	1
1.2	Java features - Java Virtual Machine	1
1.3	Objects and classes in Java	1
1.4	Defining classes – methods	1
1.5	Access specifiers	1
1.6	Static variables, static blocks	1
1.7	Static methods, static classes	1
1.8	Command line arguments	1
1.9	Constructors	1
2	**Module 2 (8 hours)**	
2.1	Arrays – 1D	1
2.2	Arrays – 2D	1
2.3	Strings	1
2.4	Packages	1
2.5	Inheritance – class hierarchy	1
2.6	Polymorphism- static binding	1
2.7	Dynamic binding	1
2.8	Final keyword	1
3	**Module 3 (7 hours)**	
3.1	Abstract classes	1
3.2	The Object class	1
3.3	Reflection	1
3.4	Interfaces	1
3.5	Object cloning	1
3.6	Inner classes	1

3.7	Exception handling	1
4	**Module 4 (7 hours)**	
4.1	**Applet Basics**- Life cycle- The Applet HTML Tags and Attributes	1
4.2	Creating and running applets	1
4.3	Multimedia support	1
4.4	The AppletContext - JAR Files	1
4.5	**File I/O** - Concept of Streams	1
4.6	Use of character / byte Streams and stream classes	1
4.7	Writing and Reading characters / bytes	1
5	**Module 5 (5 hours)**	
5.1	**Multithreaded programming**– Life cycle of a thread -Thread properties	1
5.2	Creating a thread - Interrupting threads –Thread priority	1
5.3	Thread synchronization – Synchronized method -Inter thread communication	1
5.4	**Database Programming** -The Design of JDBC, The Structured Query Language, JDBC Installation	1
5.5	Basic JDBC Programming Concepts, Query Execution	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET362	MATERIAL SCIENCE	PEC	2	1	0	3

Preamble: This course introduces different types of materials used in electrical engineering such as conductors, semiconductors, insulators, solar energy materials, biomaterials, nanomaterials, superconducting materials and magnetic materials. Also, this gives a detailed explanation on dielectrics, polarisation, modern techniques in material science and their applications.

Prerequisite : Basic Electrical Engineering, Basic Electronics Engineering

Course Outcomes : After the completion of the course, the student will be able to:

CO1	Describe the characteristics of conductor, semiconductor and solar energy materials.
CO2	Classify different insulating materials and describe polarisation in dielectrics.
CO3	Explain the mechanisms of breakdown in solids, liquids and gases.
CO4	Classify and describe magnetic materials and superconducting materials.
CO5	Explain the recent developments in materials science, modern techniques and their applications in important walks of life.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	-	-	-	2	-	-	-	-	-
CO2	3	-	1	-	-	-	-	-	-	-	-	-
CO3	3	-	1	-	-	-	1	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	2	2	2	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	35	35	70
Apply			
Analyse			
Evaluate			
Create			

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions (each carrying 3 marks) with 2 questions from each module. Students

should answer all questions. Part B contains 2 questions from each module, out of which students should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module 1

Conducting Materials: Conductivity- dependence on temperature and composition – Materials for electrical applications such as resistance, machines, solders etc.

Semiconductor Materials: Concept, materials and properties– Basic ideas of Compound semiconductors, amorphous and organic semiconductors- applications.

Solar Energy Materials: Solar selective coatings for enhanced solar thermal energy collection. Solar cells -Silicon, Cadmium sulphide and Gallium arsenic – Organic solar cells.

Module 2

Dielectrics: Introduction to Dielectric polarization and classification–Clausius-Mosotti relation.

Insulating materials and classification- properties- Common insulating materials used in electrical apparatus-Inorganic, organic, liquid and gaseous insulators- capacitor materials.

Electro-negative gases- properties and applications of SF6 gas and its mixtures with nitrogen Ferro electricity.

Module 3

Dielectric Breakdown: Mechanism of breakdown in gases, liquids and solids –basic theories including Townsend's criterion, Streamer mechanism.

Mechanism of breakdown in liquids and solids - suspended particle theory, Bubble theory, Stressed oil Volume Theory, intrinsic breakdown, electro-mechanical breakdown, Thermal breakdown, Treeing and Tracking.

Application of vacuum insulation- Breakdown in high vacuum.
Basics of treatment and testing of transformer oil.

Module 4

Magnetic Materials: Classification of magnetic materials -Curie-Weiss law-Application of iron and its alloys- Hard and soft magnetic materials– Ferrites- Magnetic materials used in electrical apparatus.

Superconductor Materials:-Basic Concept- types, characteristics- applications.

Module 5

Novel materials: Introduction to Biomaterials, Nano-materials and their significance. Growth techniques of nano-materials – Top-down and Bottom-up techniques, Lithographic and Non-lithographic processes (qualitative study only), Characterisation tools of nanomaterials – SPM, AFM, SEM and TEM (qualitative study only), Special topics in nanotechnology – nanostructures of carbon, nanoelectronics, nano-biometrics (qualitative study only).

1. Dekker A.J.: Electrical Engineering Materials, Prentice Hall of India.
2. G.K.Mithal: Electrical Engineering Material Science. Khanna Publishers.
3. K.K. Chattopadhyay, A. N. Banerjee: Introduction to nanoscience and nanotechnology, PHI Learning Pvt. Ltd.

Reference Books

1. Naidu M. S. and V. Kamaraju, *High Voltage Engineering*, Tata McGraw Hill, 2004
2. Indulkar O.S.&Thiruvegadam S., An Introduction to Electrical Engineering Materials, S.Chand.
3. Joon Bu Park, Biomaterials Science and Engineering, Plenum Press, New York, 1984

Course Contents and Lecture Schedule

Sl. No.	Topic	No. of Lectures
1	**Conducting Materials, Dielectrics, Semiconductors (8 hours)**	
1.1	Conducting Materials: Conductivity	1
1.2	Dependence on temperature and composition – Materials for electrical applications such as resistance, machines, solders etc.	2
1.3	Semiconductor Materials: Concept, materials and properties	2
1.4	Basic ideas of Compound semiconductors, amorphous and organic semiconductors- applications.	1
1.5	Solar Energy Materials: Solar selective coatings for enhanced solar thermal energy collection.	1
1.6	Solar cells -Silicon, Cadmium sulphide and Gallium arsenic – Organic solar cells.	1
2	**Insulating materials (8 hours)**	
2.1	Dielectrics: Introduction to Dielectric polarization and classification.	1
2.2	Clausius- Mosotti relation.	1

2.3	Insulating materials and classification- properties	2
2.4	Common insulating materials used in electrical apparatus- Inorganic, organic, liquid and gaseous insulators- capacitor materials.	1
2.5	Electro-negative gases- properties and applications of SF6 gas and its mixtures with nitrogen.	2
2.6	Ferro electricity	1
3	**Dielectric Breakdown (8 hours)**	
3.1	Mechanism of breakdown in gases– Townsend's criterion	2
3.2	Streamer theory	1
3.3	Mechanism of breakdown in liquids - suspended particle theory, Bubble theory, Stressed oil Volume Theory.	1
3.4	Mechanism of breakdown in solids - intrinsic breakdown, electro-mechanical breakdown, Thermal breakdown, Treeing and Tracking.	1
3.5	Application of vacuum insulation- Breakdown in high vacuum.	1
3.6	Basics of treatment and testing of transformer oil	2
4	**Magnetic Materials, Superconductors, Solar Energy materials (5 hours)**	
4.1	Magnetic Materials: Classification of magnetic materials –Curie-Weiss law	1
4.2	Application of iron and its alloys- Hard and soft magnetic materials– Ferrites- Magnetic materials used in electrical apparatus.	2
4.3	Superconductor Materials:-Basic Concept- types, characteristics- applications.	2
5	**Novel materials (7 hours)**	
5.1	Introduction to biomaterials, nanomaterials and their significance	2
5.2	Growth techniques of nano materials-Top-down and Bottom-up techniques, Lithographic and Non-lithographic processes	2
5.3	Characterisation tools of nanomaterials – SPM, AFM, SEM and TEM	2
5.4	Special topics in nanotechnology – nanostructures of carbon, nanoelectronics, nano-biometrics	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET372	SOFT COMPUTING	PEC	2	1	0	3

Preamble: This course gives an introduction to some new fields in soft computing. It combines the fundamentals of neural network, fuzzy logic, and genetic algorithm which in turn offers the superiority of humanlike problem solving capabilities. This course provides a broad introduction to machine learning, data clustering algorithms and support vector machines.

Prerequisite: Digital Electronics

Course Outcomes: After the completion of the course, the student will be able to:

CO1	Explain various constituents of soft computing and artificial neural networks.
CO2	Explain the different learning methods for training of ANNs.
CO3	Apply fuzzy logic techniques to control a system.
CO4	Utilize genetic algorithm techniques to find the optimal solution of a given problem.
CO5	Explain the basics of machine learning, data clustering algorithms and support vector machines.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	1	1	1	-	-	-	-	-	-	-	2
CO3	3	1	1	1	2	-	-	-	-	-	-	2
CO4	3	1	1	1	-	-	-	-	-	-	-	2
CO5	3	1	2	1	2	-	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			
Create			

Syllabus

Module 1

Introduction: Soft and Hard Computing, Evolution of soft computing, Soft computing constituents.

Artificial Neural Networks: Biological foundations –ANN models - Characteristics of ANN- Types of activation function - McCulloch-Pitts neuron model, Realization of logic gates using McCulloch-Pitts neuron model - simple perceptron, Adaline and Madaline.

Module 2

Neural network architectures - single layer, multilayer, recurrent networks.

Knowledge representation - Learning process - Supervised and unsupervised learning, Learning algorithms–Errorcorrection learning - Hebbian learning – Boltzmann learning - competitive learning- Backpropagation algorithm- Case study-Radial basis function networks - Hopfield network- Kohonen Self organizing maps

Module 3

Fuzzy Logic: Introduction to crisp sets and fuzzy sets, examples, Properties, Basic fuzzy set operations, examples. Fuzzy relations - Cardinality of Fuzzy relations - Operations on Fuzzy relations - Properties of Fuzzy relations. Membership functions - triangular, trapezoidal, bell shaped, Gaussian, sigmoidal.

Fuzzy logic controller (Block Diagram), Fuzzification, rule base, inference engine and defuzzification - Max-membership principle, Centroid method, Weighted Average Method, Mean-Max membership, Center of Sums, and Center of Largest area, First and Last of Maxima.

Simple fuzzy logic controllers with examples.

Module 4

Genetic Algorithm: Introduction - basic concepts of Genetic Algorithm, encoding, fitness function, reproduction, cross over, mutation operator, bit-wise operators, generational cycle.

Hybrid Systems: Adaptive Neuro Fuzzy Inference System (ANFIS), Genetic algorithm based back propagation networks, fuzzy back propagation networks.

Module 5

Machine Learning- Machine learning model-Approaches to machine learning- Machine learning architecture- Data Clustering Algorithms -Hierarchical clustering, K-Means Clustering

Support Vector Machines for Learning – Linear Learning Machines – Support Vector Classification – Support Vector Regression - Applications.

Reference Books

1. S.Rajasekharan, G.A.Vijayalakshmi Pai, *Neural Network, Fuzzy Logic and Genetic Algorithms Synthesis and Applications*, Prentice Hall India, 2003.
2. S.N.Sivanandam, S.N.Deepa, *Principles of Soft Computing*, Wiley India, 2007.
3. Bart Kosko, *Neural Network and Fuzzy Systems*, Prentice Hall of India, 2002
4. Zurada J.M., *Introduction to Artificial Neural Systems*, Jaico Publishers, 2003.
5. Hassoun Mohammed H, *Fundamentals of Artificial Neural Networks*, Prentice Hall of India, 2002.J.-S.R.Jang, C.-T.Sun,E.Mizutani, *Neuro-Fuzzy and Soft Computing*, Prentice Hall, 1997.
6. Timothy J Ross, *Fuzzy logic with Engineering Applications*, McGraw Hill, New York.
7. Driankov D., Hellendoorn H., Reinfrank M, *An Introduction to Fuzzy Control*, Narosa Publications, 1993.
8. Ronald R Yager and Dimitar P Filev, *Essentials of Fuzzy Modelling & Control*, John Wiley & Sons, Inc, 2002.
9. SuranGoonatilake& Sukhdev Khebbal (Eds.), *Intelligent Hybrid Systems*, John Wiley,1995.
10. Margaret H. Dunham, *Data Mining- Introductory & Advanced Topics*, Pearson Publication

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	***Introduction to Artificial Neural Networks (5 hours)***	**5 hrs**
1.1	Introduction to soft computing, soft and hard Computing, Soft computing constituents	1
1.2	ANN- Biological foundations - ANN models - Characteristics of ANN - Types of activation function.	1
1.3	McCulloch-Pitts neuron model, Realization of logic gates using McCulloch-Pitts neuron model.	2
1.4	Simple perceptron, Adaline and Madaline.	1
2	***Neural network architectures and Learning (7 hours)***	
2.1	Neural network architectures - single layer, multilayer, recurrent networks, Knowledge representation.	1
2.2	Learning process: Supervised and unsupervised learning. Learning algorithms- Error correction learning.	1
2.3	Hebbian learning – Boltzmann learning - competitive learning.	1
2.4	Back propagation networks	1
2.5	Radial basis function networks - Hopfield network.	2

2.6	Kohonen Self organizing maps	1
3	***Introduction to Fuzzy Logic (11 hours)***	
3.1	Introduction to crisp sets and fuzzy sets, examples, Properties.	1
3.2	Basic fuzzy set operations, examples.	1
3.3	Fuzzy relations- Cardinality of Fuzzy relations - Operations on Fuzzy relations - Properties of Fuzzy relations.	2
3.4	Membership functions - triangular, trapezoidal, bell shaped, Gaussian, sigmoidal.	1
3.5	Fuzzy logic controller (Block Diagram), Fuzzification, rule base, inference engine	2
3.6	Defuzzification - Max-membership principle, Centroid method, Weighted Average Method, Mean-Max membership, Center of Sums, and Center of Largest area, First and Last of Maxima, Example problems.	2
3.7	Simple fuzzy logic controllers with examples	2
4	***Introduction to Genetic Algorithms and Hybrid Systems (7 hours)***	
4.1	Basic concepts of Genetic Algorithm – encoding - fitness function – reproduction - cross over - mutation operator - bit-wise operators, generational cycle.	3
4.2	Hybrid Systems: Adaptive Neuro fuzzy Inference System (ANF1S)	2
4.3	Genetic algorithm based back propagation networks	1
4.4	Fuzzy back propagation networks	1
5	***Introduction to Machine Learning (6hours)***	
5.1	Machine Learning- Machine learning model- Approaches to machine learning- Machine learning architecture	**2**
5.2	Data Clustering Algorithms - Hierarchical clustering, K-Means Clustering	**2**
5.3	Support Vector Machines for Learning Support Vector Classification – Support Vector Regression - Applications	**2**

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
24SJEET308	COMPREHENSIVE COURSE WORK	PCC	1	0	0	1

Preamble: The objective of this Course work is to ensure the comprehensive knowledge of each student in the most fundamental Program core courses in the curriculum. Five core courses credited from Semesters 3, 4 and 5 are chosen for the detailed study in this course work. This course has an End Semester Objective Test conducted by the University for 50 marks. One hour is assigned per week for this course for conducting mock tests of objective nature in all the listed five courses.

Prerequisite:
1.24SJEET201 Circuits and Networks
2. 24SJEET202 DC Machines and Transformers
3. 24SJEET206 Digital Electronics
4. 24SJEET301 Power Systems I
5. 24SJEET305 Signals and Systems

Course Outcomes: After the completion of the course the student will be able to

COl	Apply the knowledge of circuit theorems to solve the problems in electrical networks
CO2	Evaluate the performance of DC machines and Transformers under different loading conditions
CO3	Identify appropriate digital components to realise any combinational or sequential logic.
CO4	Apply the knowledge of Power generation, transmission and distribution to select appropriate components for power system operation.
CO5	Apply appropriate mathematical concepts to analyse continuous time and discrete time signals and systems

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	POS	PO6	PO7	PO8	PO9	PO10	PO11	PO12
COl	3	3										2
CO2	3	2										2
CO3	3	3	1		1							2
CO4	3	3				1	1	1			1	2
CO5	3	3	1		1							2

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	10
Understand	20
Apply	20
Analyse	
Evaluate	
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
50	0	50	1 hour

End Semester Examination Pattern: Objective Questions with multiple choice (Four). Question paper include Fifty Questions of One mark each covering the five identified courses.

Syllabus

Full Syllabus of all Five selected Courses.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Circuits and Networks**	
1.1	Mock Test on Module 1 and Module 2	**1**
1.2	Mock Test on Module 3, Module 4 and Module 5	**1**
1.3	Feedback and Remedial	**1**
2	**DC Machines and Transformers**	
2.1	Mock Test on Module 1, Module 2 and Module 3	**1**
2.2	Mock Test on Module 4 and Module 5	**1**
2.3	Feedback and Remedial	**1**
3	**Digital Electronics**	
3.1	Mock Test on Module 1 and Module 2	**1**
3.2	Mock Test on Module 3, Module 4 and Module 5	**1**
3.3	Feedback and Remedial	**1**
4	**Power Systems I**	

4.1	Mock Test on Module 1, Module 2 and Module 3	**1**
4.2	Mock Test on Module 4 and Module 5	**1**
4.3	Mock Test on Module 1, Module 2 and Module 3	**1**
5	**Signals and Systems**	
5.1	Mock Test on Module 1, Module 2 and Module 3	**1**
5.2	Mock Test on Module 4 and Module 5	**1**
5.3	Feedback and Remedial	**1**

CODE	COURSE	CATEGORY	L	T	P	CREDIT
24SJEEL332	POWER SYSTEMS LAB	PCC	0	0	3	2

Preamble: This Laboratory Course will provide a perfect platform for the students to do the experiments include simulation of power system analysis in steady state and transient state. The Hardware experiments cover Protective Relaying and High Voltage Testing. Successful completion of this lab will certainly make the students equipped for any Power Industry.

Prerequisite: 24SJEET301 - Power Systems I

Course Outcomes: After the completion of the course the student will be able to:

CO 1	Develop mathematical models and conduct steady state and transient analysis of power system networks using standard software.
CO 2	Develop a frequency domain model of power system networks and conduct the stability analysis.
CO 3	Conduct appropriate tests for any power system component as per standards.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	3	3			3	2	3		3
CO 2	3	2	1	3	3			1	2	3		2
CO 3	3	1	1	3	3	3	1	3	3	3		3

ASSESSMENT PATTERN:

Marks

Total Marks	CIE	ESE	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation (CIE) Pattern:

Attendance	Regular Lab work	Internal Test	Total
15	30	30	75

Internal Test Evaluation (Immediately before the second series test)

End Semester Examination Pattern:

The following guidelines should be followed regarding award of marks:

(a) Preliminary work (Type of Test, circuit diagram and diagram for simulation): 15 Marks (b) Simulation in software and Conducting the experiment (Procedure) : 10 Marks (c) Performance, result and inference (usage of equipment and troubleshooting): 25 Marks (d) Viva voce: 20 marks(e) Record: 5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering the entire syllabus given. Each student has to do both software and hardware parts for the examination. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

LIST OF EXPERIMENTS:

Part A: POWER SYSTEM SIMULATION EXPERIMENTS

1. Y-Bus Formulation (Basic Programming): Effect of change in topology
2. Transmission Line Modelling (Basic Programming): ABCD constants
3. Load Flow Analysis -Gauss-Siedel Method, Newton-Raphson Method, Fast Decoupled Method - Effect of change in load/generation schedule
4. Load Flow Analysis -Gauss-Siedel Method, Newton-Raphson Method, Fast Decoupled Method - Effect of change in real power/reactive power limits
5. Short Circuit Analysis - Symmetrical Faults and Unsymmetrical Faults
6. Automatic Generation Control - Single Area, Two Area
7. Ferranti Effect and Reactive Power Compensation.
8. Plot the IV characteristics of a PV module and determine Maximum Power Point.

Part B: POWER SYSTEM COMPONENT TESTING (Hardware experiments)

1. Relay Testing - Over current relay /Earth fault(Electromechanical/Static/Numerical)
2. Relay Testing -Voltage relay/ Impedance Relay (Electromechanical/Static/Numerical)
3. Insulation Testing - LT & HT Cable
4. Earth Resistance
5. Testing of transformer oil
6. Testing of dielectric strength of solid insulating materials

Instructions:

Both software and hardware experiments are included. **At least 10 experiments (4 hardware experiments are mandatory)**. **Students have to do software simulation or a hardware testing for the End semester examination.**

Reference Books:

1. HadiSaadat, *Power System Analysis*, 2/e, McGraw Hill, 2002.
2. Kothari D. P. and I. J. Nagrath, *Modern Power System Analysis*, 2/e, TMH, 2009
3. M. S. Naidu, V. Kamaraju, *High Voltage Engineering*. Tata McGraw-Hill Education, 2004
4. Wadhwa C. L., *Electrical Power Systems*, 3/e, New Age International, 2009.
5. IEC 61850.
6. IEEE 1547 and 2030 Standards.
7. IS Codes for Testing of Power System components.
8. IEC 61724-1:2017Performance of Solar Power Plants.

CODE	COURSE	CATEGORY	L	T	P	CREDIT
24SJEEL334	POWER ELECTRONICS LAB	PCC	0	0	3	2

Preamble : Impart practical knowledge for the design and setup of different power electronic converters and its application for motor control.

Prerequisite : Power Electronics (24SJEET306)

Course Outcomes : After the completion of the course the student will be able to

CO 1	Analyze the characteristics and triggering requirements of various power semiconductor devices.
CO 2	Design and implement controlled rectifier circuits, DC-DC converters, and AC voltage controllers to regulate power for various load conditions.
CO 3	Simulate and analyze power electronic converters and motor drives using appropriate software tools.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	2	2	-	-	-	3	2	-	3
CO 2	3	3	2	2	2	-	-	-	3	2	-	3
CO 3	3	3	2	2	2	-	-	-	3	2	-	3

ASSESSMENT PATTERN:

Mark distribution:

Total Marks	CIE marks	ESE marks	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation (CIE) Pattern:

Attendance	Regular Lab work	Internal Test	Total
15	30	30	**75**

End Semester Examination (ESE) Pattern:

The following guidelines should be followed regarding award of marks:

a) Preliminary Work : 15Marks

b) Implementing the work/Conducting the experiment : 10Marks

c) Performance, result and inference (usage of equipments and troubleshooting) : 25Marks

d) Viva voce : 20marks

e) Record : 5Marks

General instructions : Practical examination is to be conducted immediately after the second series test after conducting 10 experiments from the list of experiments given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the end semester examination only on submitting the duly certified record. The external examiner shall endorse the record.

LIST OF EXPERIMENTS:

(10 experiments are mandatory)

HARDWARE EXPERIMENTS: (A minimum of 7 experiments are mandatory)

1. Static characteristics of SCR

Aim: To determine the minimum gate current & gate voltage required to trigger the SCR also to measure the latching current, holding current and to plot the static characteristics of SCR

2. R and RC firing scheme for SCR control

Aim: To design and set up a half wave controlled rectifier with R and RC firing circuits and plot voltage waveform across the load and thyristor for different firing angles. Also determine the minimum and maximum firing angles of this circuit.

3. Line Synchronised Triggering Circuits of SCR

Aim: To design and set-up line synchronized Ramp Trigger and Digital Trigger circuits of SCR and observe the waveforms

4. AC Voltage Controller

Aim: To study the single phase AC voltage controller using TRIAC/SCRs. Set-up a single phase AC voltage controller & observe waveforms across load resistance for different firing angles.

5. Gate Driver Circuits for MOSFET/IGBT

Aim: To design and test a gate driver circuit for triggering half bridge inverter using MOSFET / IGBT using industry-standard MOSFET drive ICs/Circuits. To test the driving of floating and ground-referenced configurations.

6. Single Phase fully Controlled SCR bridge rectifier

Aim: To design and set up a single phase full converter with RL/RLE loads and observe the waveforms with and without freewheeling diode.

7. Design of Inductor/Transformer

Aim: To design and fabricate an inductor/transformer to be used in power electronic circuits.

8. Design and set-up buck/ boost / buck-boost converters

Aim: To design and set up the buck/boost/buck-boost converter and analyse the characteristics of the same.

9. Speed control of DC motor using chopper

Aim: To Control the speed of a DC motor using a step-down chopper

10. Speed control of 3-phase induction motor

Aim: To Control the speed of a 3-phase induction motor using V/f control method.

SIMULATION EXPERIMENTS: (A minimum of 3 experiments are mandatory)

11. Simulation of 1-phase fully-controlled and half-controlled rectifier fed separately excited DC motor

Aim: To simulate 1-phase fully-controlled and half-controlled rectifier fed Separately Excited DC motor and observe the speed, torque, armature current, armature voltage, source current waveforms and find the THD in source current and input power factor.

12. Simulation of buck/boost/buck-boost converters

Aim: To simulate a buck, boost and buck boost converter using MATLAB/equivalent or any other simulation platform and analyse the performance under various duty ratio/ switching frequency.

13. Simulation of single phase & three phase sine PWM inverters.

Aim: To simulate a single phase and three phase sine PWM inverter using MATLAB/equivalent

14. Simulation of 3-phase fully-controlled converter with R, RL, RLE loads

Aim: To simulate a 3-phase fully controlled converter with R,RL and RLE loads and observe the waveform in MATLAB simulink/equivalent.

Reference Books:

1. L. Umanand: Power Electronics – Essentials & Applications, Wiley-India
2. Mohan, Undeland, Robbins: Power Electronics, Converters, Applications & Design, Wiley-India
3. Muhammad H. Rashid: Power Electronics Circuits, Devices and Applications, Pearson Education
4. Ned Mohan A: "First course on power electronics and drives", MNPERE, 2003 Edn.