KUMARAGURU COLLEGE OF TECHNOLOGY, COIMBATORE – 641 049

B.E., ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATION 2018A

(2023 Batch onwards)

CURRICULUM AND SYLLABI

I-VIII Semesters

Department of Electrical and Electronics Engineering

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VISION

To be a Centre of Excellence in Globalizing Education and Research in the field of Electrical and Electronics Engineering

MISSION

The Mission of the department is to

- Empower the students with state-of-art knowledge to excel as eminent electrical engineers with multi-disciplinary skills.
- Emphasize social values and leadership qualities to meet the industrial needs, societal problems and global challenges.
- Enable the technocrats to accomplish impactful research and innovations

PROGRAMEDUCATIONAL OBJECTIVES (PEOs)

Our graduates will be able to

PEO 1: Pursue a diverse range of careers in engineering, consultancy, and entrepreneurship.

PEO 2: Contribute to continuous professional development through higher studies and life-long learning.

PEO 3: Demonstrate their technical proficiency with ethical values and social responsibility.

PEO 4: Innovate and provide solutions for ever-changing global environments with familiarity in computational platforms in electrical engineering.

PROGRAMOUTCOMES (POs)

Engineering Graduates will be able to:

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Apply the knowledge acquired in Electrical and Electronics Engineering to technological advancements

PSO 2: Identify suitable solutions for design and control of electrical and electronic systems

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KUMARAGURU COLLEGE OF TECHNOLOGY
B.E ELECTRICAL AND ELECTRONICS ENGINEERING
CURRICULUM
REGULATIONS 2018A

SEMESTER I										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U18MAI1201	Linear Algebra and Calculus	Embedded-Theory & Lab	BS	3	0	2	0	4	-
2	U18PHI1201	Engineering Physics	Embedded-Theory & Lab	BS	3	0	2	0	4	-
3	U18CSI1202	Problem solving and Programming using C	Embedded-Theory & Lab	ES	2	0	2	0	3	-
4	U18MEI1201	Engineering Graphics	Embedded-Theory & Lab	ES	2	0	2	0	3	-
5	U18ENI1201	Fundamentals of Communication-I	Embedded-Theory & Lab	HS	2	0	2	0	3	-
6	U18INI1600	Engineering Clinic- I	Embedded-Practical & Project	ES	0	0	4	2	3	-
								Total Credits	**20**	
								Total Contact Hours/week	**28**	

SEMESTER II										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U18MAI2201	Advanced Calculus and Laplace Transforms	Embedded-Theory & Lab	BS	3	0	2	0	4	U18MAI1201
2	U18CHI2201	Engineering Chemistry	Embedded-Theory & Lab	BS	3	0	2	0	4	-
3	U18ENI2201	Fundamentals of Communication-II	Embedded-Theory & Lab	HS	2	0	2	0	3	-
4	U18CSI2201	Python Programming	Embedded-Theory & Lab	ES	2	0	2	0	3	-
5	U18EEI2201	Electric Circuit Analysis	Embedded-Theory & Lab	PC	3	0	2	0	4	-
6	U18INI2600	Engineering Clinic II	Embedded-Practical & Project	ES	0	0	4	2	3	-
								Total Credits	**21**	
								Total Contact Hours/week	**29**	

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SEMESTER III										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U18MAT3101	Partial Differential Equations and Transforms	Theory	BS	3	1	0	0	4	-
2	U18EEI3201	DC Machines and Transformers	Embedded-Theory & Lab	PC	3	0	2	0	4	-
3	U18EET3002	Electromagnetic Fields	Theory	PC	3	0	0	0	3	-
4	U18EEI3203	Analog Electronics and Linear Integrated Circuits	Embedded-Theory & Lab	PC	3	0	2	0	4	-
5	U18EET3004	Measurements and Instrumentation	Theory	PC	3	0	0	0	3	-
6	U18INI3600	Engineering Clinic - III	Embedded-Practical & Project	ES	0	0	4	2	3	-
								Total Credits	**21**	
								Total Contact Hours/week	**26**	

SEMESTER IV										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U18MAT4101	Numerical Methods and Probability	Theory	BS	3	1	0	0	4	-
2	U18EEI4201	Induction and Synchronous Machines	Embedded-Theory & Lab	PC	3	0	2	0	4	U18EEI3201
3	U18EET4002	Generation, Transmission and Distribution	Theory	PC	3	0	0	0	3	U18EET3002
4	U18EEI4203	Digital Electronics	Embedded-Theory & Lab	PC	3	0	2	0	4	U18EEI3203
5	U18EET4004	Network and System	Theory	PC	3	0	0	0	3	U18EEI2200
6	U18EEI4205	PLC Automation	Embedded-Theory & Lab	PC	2	0	2	0	3	U18EEI3203
7	U18INI4600	Engineering Clinic - IV	Embedded-Practical & Project	ES	0	0	4	2	3	U18INI3600
								Total Credits	**24**	
								Total Contact Hours/week	**30**	

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SEMESTER V										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U18EET5001	Power Electronics	Theory	PC	3	0	0	0	3	U18EEI4201
2	U18EEI5202	Microprocessors and Microcontrollers	Embedded-Theory & Lab	PC	3	0	2	0	4	U18EEI4203
3	U18EEI5203	Control Systems	Embedded-Theory & Lab	PC	3	0	2	0	4	U18MAT3101
4	U18EET5004	Electrical Machine Design	Theory	PC	3	0	0	0	3	U18EEI3201 U18EEI4201
5	U18EET5005	Digital Signal Processing	Theory	PC	3	0	0	0	3	U18MAT3101
6	U18EEE****	Professional Elective I	Theory	PE	3	0	0	0	3	-
7	U18EEE****	Professional Elective II	Theory	PE	3	0	0	0	3	-
8	U18*******	Open Elective-I	Theory	OE	3	0	0	0	3	-
Total Credits									**26**	
Total Contact Hours/week									**28**	

SEMESTER VI										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U18EEI6201	Embedded System	Embedded-Theory & Lab	PC	2	0	2	0	3	U18EEI5202
2	U18EET6002	Power system Protection and switch gear	Theory	PC	3	0	0	0	3	U18EET4002
3	U18EEI6203	Power system Analysis	Embedded-Theory & Lab	PC	3	0	2	0	4	U18MAT3101 U18EET4002 U18EEI4201
4	U18EEI6204	Solid state drives	Embedded-Theory & Lab	PC	3	0	2	0	4	U18EET5001
5	U18CSI6211	Data structures and Algorithms	Embedded-Theory & Lab	ES	3	0	2	0	4	-
6	U18EEE****	Professional Elective – III	Theory	PE	3	0	0	0	3	-
7	U18*******	Open Elective-II	Theory	OE	3	0	0	0	3	-
Total Credits									**24**	
Total Contact Hours/week									**28**	

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SEMESTER VII										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U18MBT7000	Engineering Economics and Financial Management	Theory	HS	3	0	0	0	3	-
2	U18EET7001	Special Electrical Machines	Theory	PC	3	0	0	0	3	U18EEI3201 U18EEI4201
3	U18EEE****	Professional Elective IV	Theory	PE	3	0	0	0	3	-
4	U18EEE****	Professional Elective V	Theory	PE	3	0	0	0	3	-
5	U18EEP7702	Project Phase I	Project	PW	0	0	0	6	3	-
6	U18EEP7703	Industrial Training	Project	PW	0	0	0	2	0	-
Total Credits									**15**	
Total Contact Hours/week									**18**	

SEMESTER VIII										
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U18EEP8701	Project Phase II	Project	PW	0	0	0	24	12	-
Total Credits									**12**	
Total Contact Hours/week									**24**	
Total Credits									**163**	

List of Mandatory Non-Credit Courses					
S. No	**Course Code**	**Course Title**	**Course Mode**	**CT**	**Semester**
1	U18CHT3000	Environmental Science and Engineering	Theory	MC	3
2	U18INT6000	Constitution of India	Theory	MC	6

List of Mandatory Courses with credit					
S. No	**Course Code**	**Course Title**	**Course Mode**	**CT**	**Semester**
1	U18VET4101	Universal Human Values 2: Understanding Harmony	Theory	3	4
2	U18TLR1001	Heritage of Tamils	Theory	1	1
3	U18TLR2001	Tamils and Technology	Theory	1	2

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PROFESSIONAL ELECTIVES									
S. No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**
1	U18EEE0001	Power System Operation and Control	Theory	PE	3	0	0	0	3
2	U18EEE0002	Electrical Energy Utilization and conservation	Theory	PE	3	0	0	0	3
3	U18EEE0003	High Voltage Engineering	Theory	PE	3	0	0	0	3
4	U18EEE0004	Restructured Power System	Theory	PE	3	0	0	0	3
5	U18EEE0005	VLSI Design	Theory	PE	3	0	0	0	3
6	U18EEE0006	Modern Control Systems	Theory	PE	3	0	0	0	3
7	U18EEE0007	Smart Grid Engineering	Theory	PE	3	0	0	0	3
8	U18EEE0008	Internet of Things	Embedded-Theory & Lab	PE	2	0	2	0	3
9	U18EEE0009	Automotive Electronics	Theory	PE	3	0	0	0	3
10	U18EEE0010	Energy Storage Technology	Theory	PE	3	0	0	0	3
11	U18EEE0011	Switched Mode Power Converters	Theory	PE	3	0	0	0	3
12	U18EEE0012	Power Electronics for Renewable Energy System	Theory	PE	3	0	0	0	3
13	U18EEE0013	Electric Vehicle Technology	Theory	PE	3	0	0	0	3
14	U18EEE0014	Electrical safety and energy Management	Theory	PE	3	0	0	0	3
15	U18EEE0015	Drives for Electric Vehicle	Theory	PE	3	0	0	0	3
16	U18EEE0016	Sensing Techniques and Sensor Systems	Theory	PE	3	0	0	0	3
17	U18EEE0017	Biomedical Instrumentation	Theory	PE	3	0	0	0	3
18	U18EEE0018	Industry 4.0	Theory	PE	3	0	0	0	3
19	U18EEE0019	Machine Learning	Theory	PE	3	0	0	0	3
20	U18EEE0020	Introduction to R Programming	Embedded-Theory & Lab	PE	2	0	2	0	3

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21	U18EEE0021	Data Communication and Networks	Theory	PE	3	0	0	0	3
22	U18EEE0022	HVDC and FACTS	Theory	PE	3	0	0	0	3
23	U18EEE0023	Python for Data Structures and Data Science	Theory	PE	3	0	0	0	3
24	U18EEE0024	EV Batteries and Battery Management Systems	Embedded	PE	2	0	2	0	3

ONE CREDIT COURSES			
S.No	**Course code**	**Course Title**	**Industry that will offer the course**
1	U18EEC0001	Automotive Embedded Systems	TVS MOTORS, HOSUR
2	U18EEC0002	Embedded System Arm Cortex M3 MCU	UTL TECHNOLOGIES, BANGALORE
3	U18EEC0003	Case Study Using Arm Cortex M3 MCU – Automation Of Linear Weighing Machine	TECHNOPAC AUTOMATION & CONTROLS, COIMBATORE
4	U18EEC0004	Substation Design	BALFOUR BEATY INFRASTRUCTURE, BANGALORE
5	U18EEC0005	Industrial Embedded Systems And Communication Protocols	TECHNOPAC AUTOMATION & CONTROLS, COIMBATORE
6	U18EEC0006	Green Building Design (Energy Focused Tools)	ECOLOGICAL ADVISORS INDIA PVT LTD
7	U18EEC0007	HDL Programming	To be identified

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SEMESTER - I

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U18MAI1201 LINEAR ALGEBRA AND CALCULUS

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Identify eigen values and eigen vectors, apply Cayley Hamilton theorem and convert quadratic form to canonical form.

CO2: Determine the radius, centre, circle of curvature of functions.

CO3: Discover the evolutes of curves and the envelope of a family of curves.

CO4: Solve first order ordinary differential equation and apply in some physical situations.

CO5: Solve higher order ordinary differential equations and apply the knowledge to physical situations.

CO6: Evaluate the total derivative of a function, expand the given function as series and locate the maximum and minimum for multivariate functions.

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S							M	M		M	M	
CO2	S	S							M	M		M	M	
CO3	S	S							M	M		M	M	
CO4	S	S							M	M		M	M	
CO5	S	S							M	M		M	M	
CO6	S	S							M	M		M	M	

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course-end survey

THEORETICAL COMPONENT CONTENTS:

MATRICES **9 + 3 Hours**

Rank of a matrix – Linearly dependent and independent vectors – Eigen values and eigen vectors of a real matrix – Properties of eigen values and eigen vectors – Cayley Hamilton theorem (excluding proof) – Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS **4 + 1 Hours**

Curvature – Radius, Centre and Circle of curvature in Cartesian, Parametric and Polar form

EVOLUTES AND ENVELOPES **5 + 2 Hours**

Evolute – Envelope of family of curves with one and two parameters – Evolute as the envelope of normals – properties of evolute and envelope.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS **9 + 3 Hours**

Leibnitz's equation – Bernoulli's equation – Equations of first order and higher degree - Clairauts form – Applications: Orthogonal trajectories and Newton's law of cooling

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HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS **9 +3 Hours**

Linear equations of second and higher order with constant coefficients – Euler's and Legendre's linear equations – Method of variation of parameters – First order Simultaneous linear equations with constant coefficients - Application - Mass-spring mechanical system. (Differential equations and associated conditions should be given).

FUNCTIONS OF SEVERAL VARIABLES **9 +3 Hours**

Total derivative – Taylor's series expansion – Maxima and minima of functions of two variables – Constrained maxima and minima: Lagrange's multiplier method with single constraints – Jacobians.

REFERENCES

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 41st Edition, 2011.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
3. Kreyzig E., "Advanced Engineering Mathematics", Tenth Edition, John Wiley and sons, 2011.
4. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007
5. Kandasamy P., Thilagavathy K., and Gunavathy K., "Engineering Mathematics", S. Chand & Co., New Delhi, (Reprint) 2008
6. Venkataraman M.K., "Engineering Mathematics", The National Pub. Co., Chennai,2003
7. Weir, MD, Hass J, Giordano FR: Thomas' Calculus, Pearson education 12th Edition, 2015
8. P.Bali., Dr. Manish Goyal., Transforms and partial Differential equations, University Science Press, New Delhi, 2010
9. G.B.Thomas and R.L.Finney, Calculus and analytical geometry, 11th Edition, PearsonEducation, (2006)

PRACTICAL COMPONENT CONTENTS:

LIST OF MATLAB PROGRAMMES:

1. Introduction to MATLAB.
2. Matrix Operations - Addition, Multiplication, Transpose, Inverse
3. Rank of a matrix and solution of a system of linear equations
4. Characteristic equation of a Matrix and Cayley-Hamilton Theorem.
5. Eigen values and Eigenvectors of Higher Order Matrices
6. Curve tracing
7. Solving first order ordinary differential equations.
8. Solving second order ordinary differential equations.
9. Determining Maxima and Minima of a function of one variable.
10. Determining Maxima and Minima of a function of two variables.

Theory: 45 **Tutorial: 0** **Practical: 15** **Project: 0** **Total : 60 Hours**

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U18 PHI1201

ENGINEERING PHYSICS
(Common to all B.E., B.TECH.)

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Understand the principles of motion and rotation of a rigid body in the plane.
CO2: Enhance the fundamental knowledge in properties of matter and its applications relevant to various streams of Engineering and Technology.
CO3: Recognise the nature and role of the thermodynamic parameters.
CO4: Compute electrostatic field and electric potential due to point and distributed charges.
CO5: Use electrostatic & magneto static boundary conditions to relate fields in adjacent media.
CO6: Introduce and provide a broad view of the smart materials and Nano science to undergraduates.

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Cos	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M										M	M	
CO2	S	M			S							M	M	
CO3	S	M			S							M	M	
CO4	S	M			S							M		M
CO5	S	M			S							M		M
CO6	S	M					M					M		M

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II (Theory component)
2. Cooperative learning report, Assignment; Group Presentation, Project report, Poster preparation,
3. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component)
4. Model examination (lab component)
5. End Semester Examination (Theory and lab component)

Indirect

1. Course-end survey

THEORETICAL COMPONENT CONTENTS:

KINEMATICS & RIGID BODY MOTION **9 Hours**

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples.

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PROPERTIES OF MATTER AND MATERIALS TESTING **9 Hours**

Properties of matter: Hooke's Law Stress - Strain Diagram - Elastic moduli - Relation between elastic constants - Poisson's Ratio - Expression for bending moment and depression - Cantilever - Expression for Young's modulus by Non uniform bending and its experimental determination.

Materials testing: Mechanism of plastic deformation, slip and twinning – types of fracture – Vickers Hardness test - fatigue and creep test.

HEAT **9 Hours**

Specific heat capacity, thermal capacity. Temperature rise. Coefficient of linear thermal expansion. Methods of measurement of thermal expansion. Thermal stresses in composite structures due to non-homogeneous thermal expansion. Applications -The bimetallic strip. Expansion gaps and rollers in engineering structures. Thermal conductivity: differential equation of heat flow. Lee's disc apparatus for determination of thermal conductivity. Thermal Insulation. Convection and radiation. Applications to refrigeration and power electronic devices.

ELECTROSTATICS & MAGNETOSTATICS **10 Hours**

ELECTROSTATICS : Maxwell's equation for electrostatics – E due to straight conductors, circular loop, infinite sheet of current -electric field intensity (D) - Electric potential - dielectrics - dielectric polarization - internal field – Clasious- Mosotti equation - dielectric strength - applications.

MAGNETOSTATICS: Maxwell's equation for magnetostatics - B in straight conductors, circular loop, infinite sheet of current - Lorentz force, magnetic field intensity (H) – Biot–Savart's Law – Ampere's Circuit Law –Magnetic flux density (B) – magnetic materials – Magnetization – Applications.

NEW ENGINEERING MATERIALS AND NANOTECHNOLOGY **8 Hours**

New Engineering Materials: Metallic glasses – preparation, properties and applications – Shape memory alloys (SMA) – characteristics, properties of NiTi alloy applications - advantages and disadvantages of SMA.

Nano Materials: synthesis - Ball milling - Sol-gel - Electro deposition — properties of nano particles and applications. – Carbon Nano Tubes – fabrication by Chemical Vapour Deposition - structure, properties & applications.

PRACTICAL COMPONENT CONTENTS:

LIST OF EXPERIMENTS

1. Determination of thermal conductivity of a bad conductor -Lee's disc
2. Determination of Acceleration due to Gravity – Compound Pendulum
3. Determination of wavelength of light, Numerical aperture and acceptance of optical fibre
4. Determination of band gap of a semiconductor
5. Determination of compressibility of a given liquid - Ultrasonic Interferometer
6. Determination of thickness of thin sheet – Air wedge
7. Determination of frequency of an electrically maintained turning fork – Melde's string
8. Determination of wavelength of mercury source using diffraction grating- Spectrometer
9. Determination of solar cell efficiency using Lux Meter
10. Determination of Young's Modulus – Non-uniform bending

Experiments for Demonstration:

1. Hall effect
2. Hardness Test
3. Four probe experiment
4. Hysteresis curve

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REFERENCES

1. Elements of Properties of Matter, Mathur D.S., Shyamlal Charitable Trust, New Delhi, 1993.
2. Properties of matter, brijlal and Subharamaniam, S.Chand and Co, New Delhi, 2004.
3. Fundamentals of General Properties of Matter by Gulati H.R., R. Chand & Co., New Delhi, 1982.
4. Engineering Mechanics (2nd ed.),Harbola M. K., Cengage publications, New Delhi, 2009.
5. Introduction to Mechanics, Verma M. K. (CRC Press), University Press, 2000.
6. Thermodynamics: An Engineering Approach (SI Units), yunus a. cengel&michael a. boles 7th edition, mcgraw-hill companies 2014.
7. Engineering Electromagnetics, W. H. Hayt and John A. Buck, 6th Edition, Tata McGraw Hill, New Delhi, 2014.
8. Electromagnetic Field Theory, 5th Edition, Gangadhar K.A. and Ramanathan P.M., Khanna Publishers, New Delhi, 2013.
9. Problems and Solutions in Electromagnetics, 1st Edition, J.A. Buck and W. H. Hayt, Tata McGraw Hill, New Delhi, 2010.
10. Theory and Problems of Electromagnetic Schaum's Outline Series, 5th Edition, Joseph A. Edminister, Tata McGraw Hill Inc., New Delhi, 2010.
11. Engineering Physics, Rajendran V., Tata McGraw-Hill Education Pvt. Ltd., 2010
12. Nano – the Essentials, Pradeep T., McGraw-Hill Education, Pvt. Ltd., 2007.

REFERENCES

1. Laboratory Manual of Engineering Physics, Dr. Y. Aparna&Dr. K. Venkateswara Rao, V.G.S Publishers.
2. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
3. Great Experiments in Physics, M.H. Shamos, Holt, Rinehart and Winston Inc., 1959.
4. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.

Theory: 45 **Tutorial: 0** **Practical: 30** **Project: 0** **Total : 75 Hours**

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U18CSI1202	PROBLEM SOLVING AND PROGRAMMING USING C	L	T	P	J	C
		3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1 Acquire knowledge on different problem solving techniques.

CO2 Use appropriate data types and control structures for solving a given problem.

CO3 Execute different array and string operations.

CO4 Experiment with the usage of pointers and functions.

CO5 Organize data using structures and unions.

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M							L				M	M
CO2	S	M							L	L				
CO3	S	L			L	L			L	L		L		
CO4	M	L	M	L	L	L			L	L		M		
CO5	M	L	M	L	L	L			L	L		M		

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II (Theory Component)
2. Assignment (Theory Component)
3. Group Presentation (Theory Component)
4. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component)
5. Model examination (lab component)
6. End Semester Examination (Theory and lab component)

Indirect

1. Course End Survey

THEORETICAL COMPONENT CONTENTS:

STRUCTURED PROGRAMMING **6 Hours**

Algorithms, building blocks of algorithms (instructions/statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration). Introduction to C Programming – Operators and Expressions – Data Input and Output – Control Statements.

ARRAYS AND STRINGS **6 Hours**

Defining an array – Processing an array –Multidimensional Arrays Character Arithmetic – Defining a string – Initialization of Strings – Reading and Writing Strings – Processing Strings –Searching and Sorting of Strings

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FUNCTIONS, STORAGE CLASSES **6 Hours**

Defining a function – Accessing a function – Function prototypes – Passing arguments to a function – Passing arrays to functions – Function with string - Recursion – Storage classes

POINTERS **7 Hours**

Pointer Fundamentals – Pointer Declaration – Passing Pointers to a Function – Pointers and one dimensional arrays – operations on pointers– Dynamic memory allocation.

STRUCTURES AND UNIONS **5 Hours**

Structures and Unions: Defining a Structure – Processing a Structure – User defined data types (Typedef) – Unions

REFERENCES

1. Byron S Gottfried and Jitendar Kumar Chhabra, "Programming with C", Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
2. PradipDey and Manas Ghosh, "Programming in C", Second Edition, Oxford University Press, 2011.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
4. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007
5. ReemaThareja, "Programming in C", Second Edition, Oxford University Press, 2011.

PRACTICAL COMPONENT CONTENTS:

LIST OF EXPERIMENTS

1. Writing algorithms, flowcharts and pseudo codes for simple problems.
2. Programs on expressions and conversions
3. Programs using if, if-else, switch and nested if statements
4. Programs using while, do-while, for loops
5. Programs on one dimensional arrays, passing arrays to functions and array operations
6. Programs using two dimensional arrays, passing 2D arrays to functions
7. Programs using String functions
8. Programs using function calls, recursion, call by value
9. Programs on pointer operators, call by reference, pointers with arrays
10. Programs using structures and unions.

REFERENCES

1. Byron S Gottfried and Jitendar Kumar Chhabra, "Programming with C", Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
2. PradipDey and Manas Ghosh, "Programming in C", Second Edition, Oxford University Press, 2011.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
4. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.

Theory: 30 **Tutorial: 0** **Practical: 30** **Project: 0** **Total: 60 Hours**

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U18MEI1201 **ENGINEERING GRAPHICS**

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1 Construct various plane curves.

CO2 Construct projection of points and projection of lines.

CO3 Develop projection of surfaces and solids.

CO4 Solve problems in sections of solids and development of surfaces.

CO5 Apply free hand sketching and concepts of isometric in engineering practice.

CO6 Draw engineering drawing in AutoCAD with dimensions.

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										
CO2	S	S									W	
CO3	S	S									M	
CO4	S	S										
CO5	S	S										
C06	S											

COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Open Book Test, Assignment, Group Presentation 3. Viva, Experimental Report for each Experiment (lab Component) 4. Model Examination (lab component) 5. End Semester Examination (Theory and lab components)
Indirect
1. Course-end survey

PLANE CURVES, PROJECTION OF POINTS, LINES AND PLANES **10 Hours**

Importance of graphics in design process, visualization, communication, documentation and drafting tools, Construction of curves - ellipse, parabola, and hyperbola by eccentricity method only. Orthographic projection of points.

Projections of straight lines located in first quadrant - determination of true length and true inclinations.

Projections of plane surfaces - polygonal lamina and circular lamina, located in first quadrant and inclined to one reference plane.

PROJECTION AND SECTION OF SOLIDS **10 Hours**

Projection of simple solids - prism, pyramid, cylinder and cone. Drawing views when the axis of the solid is inclined to one reference plane.

Sectioning of simple solids - prisms, pyramids, cylinder and cone. Obtaining sectional views and true shape when the axis of the solid is vertical and cutting plane inclined to one reference plane.

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DEVELOPMENT OF SURFACES, ISOMETRIC PROJECTIONS AND FREE-HAND SKETCHING **10 Hours**

Development of lateral surfaces of truncated prisms, pyramids, cylinders and cones.
Isometric projection, Isometric scale, Isometric views of simple solids, truncated prisms, pyramids, cylinders and cones.
Free hand sketching techniques, sketching of orthographic views from given pictorial views of objects, including free-hand dimensioning.

INTRODUCTION TO AUTOCAD **15 Hours**

Introduction to Drafting Software (AutoCAD) & its Basic Commands. Introduction to coordinate systems, object selection methods, selection of units and precession. sketching – line, circle, arc, polygon, rectangle and ellipse. Working with object snaps, layers and object properties. Editing the objects – copy, move, trim, extend, working with arrays, mirror, scale, hatch, fillet and chamfer.

ISOMETRIC VIEWS WITH AUTOCAD **15 Hours**

Building drawings – Single and double bed room house (sectional Top view only). Introduction to Motion path animation. Isometric views of simple solid blocks.

REFERENCES

1. Basant Agrawal and CM Agrawal, Engineering Drawing, McGraw-Hill, New Delhi, First Edition, 2008.
2. Venugopal K. and Prabhu Raja V., Engineering Graphics, New Age International (P) Limited, New Delhi, 2008.
3. Nataraajan K.V., Engineering Drawing and Graphics, Dhanalakshmi Publisher, Chennai, 2005.
4. Warren J. Luzadder and Jon. M. Duff, Fundamentals of Engineering Drawing, Prentice Hall of India Pvt. Ltd., New Delhi, Eleventh Edition, 2005.
5. Gopalakirishna K.R., Engineering Drawing (Vol. I & II), Subhas Publications, 2001.
6. James Leach, AutoCAD 2017 Instructor, SDC Publications, 2016.

Theory: 30 **Tutorial: 0** **Practical: 30** **Project: 0** **Total: 60 Hours**

Signature of the Chairman BOS EEE

U18ENI1201	FUNDAMENTALS OF COMMUNICATION - I	L	T	P	J	C
		2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1 To communicate effectively by using appropriate grammar and technical parlance in a range of academic scenarios.

CO2 To interpret and critically evaluate discourses related to functional English.

CO3 To disseminate professional information through appropriate means of communication.

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									S		S	
CO2	M		W		W			M	S		S	
CO3	M		M		W			M	S		S	

COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment of Skills 2. Assignment 3. Written Test 4. End Semester Examination
Indirect
1. Course-end survey

No	Topic	Hours
	MODULE I - 12 Hrs	
1.1	Parts of Speech	2
1.2	Subject Verb Agreement	2
1.3	Speak up (Self Introduction, JAM)	4
1.4	Writing sentences using 'Be-forms'	3
1.5	Test	1
	MODULE II - 12Hrs	
2.1	Articles, Gerunds, Infinitives	2
2.2	Speak up (Greetings & Polite English)	4
2.3	Dialogue Writing	3
2.4	Skimming & Scanning	2
2.5	Listening Skills - I	1
	MODULE III - 12 Hrs	
3.1	Tenses & Voice	2
3.2	Sentences & its kinds	2
3.3	Speak up (Narration & Description)	4
3.4	Summarizing & Note-making	3
3.5	Listening Skills – II	1
	MODULE IV - 12 Hrs	

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4.1	Framing Questions – 4 types	2
4.2	Speak up (Role play)	4
4.3	Letter writing – Formal and Informal & Email Writing	3
4.4	Reading Comprehension & Cloze test	2
4.5	Listening Skills – III	1

MODULE V - 12 Hrs

5.1	Degrees of Comparison	2
5.2	Clauses	2
5.3	Speak up (Power Point Presentation)	4
5.4	Writing (Picture perception)	3
5.5	Test	1
	Total	**60**

REFERENCES

1. A Modern Approach to Non Verbal Reasoning (English, Paperback, Dr. R S Aggarwal)
2. The Power of Words(Bloomsbury, UK, 2012, Hyacinth Pink)
3. Word Power Made Easy: The Complete Handbook for Building a Superior Vocabulary (By Norman Lewis)
4. Effective Technical Communication Tata McGraw Hills Publications (Ashraf Rizvi)
5. English and Soft skills Orient Black Swan Publishers (S. P. Dhanavel)
6. Know Your Grammar: Trans.in Tamil & Malayalam –A Bilingual Approach (Bloomsbury, UK, 2012, Hyacinth Pink)

Theory: 30 Tutorial: 0 Practical: 30 Project: 0 Total: 60 Hours

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U18INI1600 **ENGINEERING CLINIC 1**

L	T	P	J	C
0	0	4	2	3

COURSE OBJECTIVE:

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Basic understanding of engineering systems

CO2: Teamwork leading to the design of a simple toy to a complex table top model

CO3: Understanding of the realistic constraints of engineering systems

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S	M	M
CO2											S		M	M
CO3										S			M	M

The course will offer the students with an opportunity to gain an basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

Course	Semester	Focus
Engineering Clinic I	1	IOT with C programming using Arduino

Theory: 12 **Tutorial: 0** **Practical: 21** **Project: 12** **Total: 45 Hours**

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SEMESTER - II

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U18MAI2201

ADVANCED CALCULUS AND LAPLACE TRANSFORMS
(Common to All Branches)

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES
After successful completion of this course, the students would be able to

- **CO1** Evaluate double and triple integrals in Cartesian coordinates and apply them to calculate area and volume.
- **CO2** Apply various integral theorems for solving engineering problems involving cubes and rectangular parallelepipeds.
- **CO3** Construct analytic functions of complex variables and transform functions from z-plane to w-plane and vice-versa, using conformal mappings.
- **CO4** Apply the techniques of complex integration to evaluate real and complex integrals over suitable closed paths or contours.
- **CO5** Solve linear differential equations using Laplace transform technique.
- **CO6** Determine multiple integrals, vector differentials, vector integrals and Laplace transforms using MATLAB.

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S			M				M	M		M	M	
CO2	S	S			M				M	M		M	M	
CO3	S	S			M				M	M		M	M	
CO4	S	S			M				M	M		M	M	
CO5	S	S			M				M	M		M	M	
CO6	S	S			M				M	M			M	

COURSE ASSESSMENT METHODS

Direct Tools

1. Continuous Assessment Test I, II (Theory component)
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc (as applicable) (Theory component)
3. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component)
4. Model examination (lab component)
5. End Semester Examination (Theory and lab component)

Indirect Tools

1. Course-end survey

THEORETICAL COMPONENT CONTENTS:

MULTIPLE INTEGRALS **9 Hours**

Double integration – Cartesian coordinates – Change of order of integration - Triple integration in Cartesian coordinates – Applications: Area as double integral and Volume as triple integral.

VECTOR CALCULUS **9 Hours**

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Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Verification of theorem and simple applications.

ANALYTIC FUNCTIONS **9 Hours**

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy- Riemann equations in Cartesian coordinates and sufficient conditions (excluding proofs)– Properties of analytic function – Construction of analytic function by Milne Thomson method – Conformal mapping : $w = z + c$, cz , $1/z$ – Bilinear Transformation

COMPLEX INTEGRATION **9 Hours**

Cauchy's integral theorem – Cauchy's integral formula –Taylor's and Laurent's series –Singularities –Residues –Residue theorem –Application of residue theorem for evaluation of real integrals – Contour Integration (excluding poles on the real axis).

LAPLACE TRANSFORMS **9 Hours**

Definition - Properties: Superposition, Shift in t or Time Delay, Shift in s, Time Derivatives, Time Integral-Initial Value Theorem - Final Value Theorem - Transform of periodic functions - Inverse transforms - Convolution theorem – Applications: Solution of linear ordinary differential equations of second order with constant coefficients.

PRACTICAL COMPONENT CONTENTS:

LIST OF MATLAB PROGRAMMES:

1. Evaluating double integral with constant and variable limits.
2. Area as double integral
3. Evaluating triple integral with constant and variable limits
4. Volume as triple integral
5. Evaluating gradient, divergence and curl
6. Evaluating line integrals and work done
7. Verifying Green's theorem in the plane
8. Evaluating Laplace transforms and inverse Laplace transforms of functions including impulse.
9. Heaviside functions and applying convolution.
10. Applying the technique of Laplace transform to solve differential equations

REFERENCES

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 41st Edition, 2011.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
3. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007.
4. Kandasamy P., Thilagavathy K., and Gunavathy K., "Engineering Mathematics", S. Chand & Co., New Delhi, (Reprint) 2008.
5. Kreyzig E., "Advanced Engineering Mathematics", Tenth Edition, John Wiley and sons, 2011.
6. Venkataraman M.K., "Engineering Mathematics", The National Pub. Co., Chennai, 2003.
7. Weir, MD, Hass J, Giordano FR: Thomas' Calculus Pearson education 12th ED, 2015.

Theory: 45 **Tutorial: 0** **Practical: 30** **Project: 0** **Total: 75 Hours**

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U18CHI2201	ENGINEERING CHEMISTRY (Common to All Branches)	L	T	P	J	C
		3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students will be able to

- **CO1** Apply the basic principles of chemistry at the atomic and molecular level.
- **CO2** Analyze the impact of engineering solutions from the point of view of chemical principles
- **CO3** Apply the chemical properties to categorize the engineering materials and their uses
- **CO4** Integratethe chemical principles in the projects undertaken in field of engineering and technology
- **CO5** Develop analytical proficiency through lab skill sets to demonstrate in professional practice

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M												
CO2	S	M		M										
CO3	S	M		S										
CO4	S	M		S										
CO5	M	S		S										

COURSE ASSESSMENT METHODS

Direct Tools
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group 3. Presentation, Project report, Poster preparation,Prototype or Product Demonstrationetc (as applicable) 4. End Semester Examination
Indirect Tools
1. Course-end survey

THEORETICAL COMPONENT CONTENTS:

CHEMICAL BONDING **7 Hours**

Bonding: Introduction – Ionic bonding - Van der Waal's forces (dipole - dipole, dipole - induced dipole, induced dipole - induced dipole interactions) - hydrophobic interaction. Bonding in organic molecules: covalent and co-ordinate bonds (overview only) - hybridization (sp, sp2, sp3) - hydrogen bonding and its consequences.

THERMODYNAMICS **7 Hours**

Introduction - Thermodynamic process – Internal energy – Enthalpy – limitations of First law of thermodynamics – Second law of thermodynamics - Entropy - Third law of thermodynamics – Free Energy and Work Function – Clausius-Clapeyron equation – Maxwell's relations – Kirchhoff's equation.

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ELECTROCHEMISTRY AND CORROSION **7 Hours**

Electrodes - Electrode Potential – Nernst equation and problems - Galvanic cell - Electrochemical Series.

Corrosion: Classification and mechanism of chemical and electrochemical corrosion - Factors influencing corrosion. Corrosion control: Inhibitors – Cathodic protection (Sacrificial anodic protection, Impressed current cathodic protection) – Protective coating: Electroplating (Au) and Electroless plating (Ni).

WATER TECHNOLOGY **6 Hours**

Introduction - soft/hard water - Disadvantages of hard water in industries– scale, sludge, priming and foaming, caustic embrittlement.Treatment of hard water: External treatment (Ion exchange method) - Internal treatment (colloidal, carbonate, phosphate and calgon conditioning) - Desalination (Reverse osmosis, Electrodialysis)

ENGINEERING MATERIALS **9 Hours**

Polymer: Introduction – Preparation, Properties and Applications of PMMA, PET, PVC.

Composites: Constituents of Composites – Polymer Composites - Metal Matrix Composites - Ceramic Matrix Composites – Applications. Lubricants: Classification - Functions - Properties (viscosity index, flash and fire point, oiliness, carbon residue, aniline point, cloud point and pour point) - Semi solid lubricant (greases with calcium based, sodium based, lithium based) - Solid lubricants (graphite, molybdenum disulphide)

SURFACE CHEMISTRY AND CATALYSIS **9 Hours**

Adsorption: Types of adsorption – Adsorption isotherms: Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Applications of adsorption on pollution abatement.

Catalysis: Catalyst – catalytic poisoning and catalytic promoters - autocatalysis –- acid base catalysis – enzyme catalysis – Michaelis-Menten equation – applications. Chemical kinetics: Introduction – first order, pseudo first order, second order, zero order equations – parallel reactions – opposing reactions.

PRACTICAL COMPONENT CONTENTS:

LIST OF EXPERIMENTS

1. Preparation of Standard solutions
2. Conductometric estimation of mixture of acids vs strong base
3. Estimation of extent of corrosion of Iron pieces by Potentiometry
4. Estimation of the extent of dissolution of Copper / Ferrous ions by spectrophotometry.
5. Estimation of acids by pH metry.
6. Determination of total, temporary and permanent hardness by EDTA method.
7. Estimation of DO by Winkler's method
8. Estimation of Alkalinity by Indicator method.
9. Estimation of Chloride by Argentometric method
10. Estimation of Sodium and Potassium in water by Flame photometry.

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11. Determination of Flash and Fire point of lubricating oil
12. Determination of Cloud and Pour point of lubricating oil
13. Determination of relative and kinematic viscosities of lubricating oil at different temperatures
14. Determination of corrosion rate on mild steel by Weight loss method Morphological studies of corrosion on mild steel by microscopic techniques

REFERENCES

1. Jain P.C. and Jain. M., Engineering Chemistry, 16th Edition, DhanpatRai Publishing Company, New Delhi, Reprint 2017.
2. Puri B.R., Sharma L.R., Pathania, M.S. Principles of physical chemistry, Vishal Publishing Co., 2017
3. Atkins, P. and de Paula, J., Atkin'sPhysical Chemistry, 9th ed., Oxford Univ. Press, 2009.
4. Glasstone S., An introduction to Electrochemistry, 10th Edition, Affiliated to East West Press Private Limited, 2007.
5. Samir Sarkar., Fuels and Combustion, 3rd Edition, Orient Longman, India, 2009.
6. Dara S.S. and Umare S.S., A text book of Engineering Chemistry, S.Chand and Company Limited, New Delhi, 2014.
7. Engineering Chemistry, Wiley India Editorial Team, Wiley, 2018.

Theory: 45 **Tutorial: 0** **Practical:30** **Project: 0** **Total: 75 Hours**

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U18ENI2201

FUNDAMENTALS OF COMMUNICATION - II (Common To All Branches)

L	T	P	J	C
2	0	2	0	3

Course Objectives:

1. To effectively use the basic language skills to imbibe technical language skills.
2. To hone written and spoken competencies leading to effective communication.
3. To comprehend, use and explain technical data and information.

COURSE OUTCOMES
After the course the student will be able to:

CO1 Read, understand, and interpret material on technology.

CO2 Communicate knowledge and information through oral and written medium.

CO3 Compare, collate and present technical information according to the audience and purpose.

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		**W**		**S**					**S**	**S**		**S**		
CO2				**S**					**S**	**S**		**W**		
CO3				**M**					**S**	**S**		**S**		

COURSE ASSESSMENT METHODS

Direct Tools
1.Continuous Assessment of Skills 2.Assignment 3.Written Test 4. End Semester Examination.
Indirect Tools
1. Course-end survey

No	TOPIC	
	MODULE I	**12 Hrs**
1.1	Introduction to Technical Writing Technical Definitions	2
1.2	Writing Instructions / Instruction Manual	2
1.3	Writing Recommendations	2
1.4	Speaking Activity I	6

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	MODULE II	**12 Hrs**
2.1	Process Writing	2
2.2	Review Writing I - Product	2
2.3	Review Writing II – Article	2
2.4	Speaking Activity II	6
	MODULE III	**12 Hrs**
3.1	Interpreting and Transcoding Graphics	2
3.2	Types of Report / Writing a Report	2
3.3	Reading & Responding to texts	2
3.4	Speaking Activity III	6
	MODULE IV	**12 Hrs**
4.1	Drafting a project proposal	2
4.2	Listening to technical talks	2
4.3	Preparing a survey Questionnaire	2
4.4	Speaking Activity IV	6
	MODULE V	**12 Hrs**
5.1	Writing Memos, Circulars, Notices	2
5.2	Writing Agenda and Minutes	2
5.3	Inferential Reading	2
5.4	Speaking Activity V	6
	Total	**60**

TEXT BOOKS

REFERENCES

1. Technical English Workbook, VRB Publishers Pvt. Ltd (Prof. Jewelcy Jawahar, Dr.P.Ratna)
2. Effective Technical Communication, Tata McGraw Hills Publications (Ashraf Rizvi)
3. Technical Communication – English Skills for Engineers, Oxford Higher Education (Meenakshi Raman, Sangeeta Sharma)

Theory:30 Tutorial: 0 Practical:30 Project: 0 Total: 60 Hours

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U18CSI2201 **PYTHON PROGRAMMING**

(Common to All Branches)

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

- **CO1** Classify and make use of python programming elements to solve and debug simple logical problems.(K4,S3)
- **CO2** Experiment with the various control statements in Python.(K3,S2)
- **CO3** Develop Python programs using functions and strings.(K3,S2)
- **CO4** Analyze a problem and use appropriate data structures to solve it.(K4,S3)
- **CO5** Develop python programs to implement various file operations and exception handling.(K3,S2)

CO/PO MAPPING

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Cos	PROGRAMME OUTCOMES (POs)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		S			M					M		M			
CO2			M							M		M			
CO3			M							M		M		M	
CO4	S	S	M		M					M		M		M	
CO5			M							M		M			

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test, Assignment
3. Viva, Experimental Report for each Experiment (lab Component)
4. Model Examination (lab component)
5. End Semester Examination (Theory and lab components)

Indirect

1. Course-end survey

THEORETICAL COMPONENT CONTENTS:

BASICS OF PYTHON PROGRAMMING 6 Hours

Introduction-Python Interpreter-Interactive and script mode -Values and types, operators, expressions, statements, precedence of operators, Multiple assignments, comments.

CONTROL STATEMENTS AND FUNCTIONS IN PYTHON 6 Hours

Conditional (if), alternative (if-else), chained conditional (if-elif-else)-Iteration-while, for, break, continue, pass – Functions - Introduction, inbuilt functions, user defined functions, passing parameters, return values, recursion, Lambda functions.

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DATA STRUCTURES: STRINGS,LISTS and SETS **7 Hours**

Strings-String slices, immutability, string methods and operations -Lists-creating lists, list operations, list methods, mutability, aliasing, cloning lists, list and strings, list and functions-list processing-list comprehension, searching and sorting, Sets-creating sets, set operations.

DATA STRUCTURES: TUPLES, DICTIONARIES **5 Hours**

Tuples-Tuple assignment, Operations on Tuples, lists and tuples, Tuple as return value- Dictionaries-operations and methods, Nested Dictionaries.

FILES, MODULES, PACKAGES **6 Hours**

Files and Exception-Text files, reading and writing files, format Operator-Modules-Python Modules-Creating own Python Modules-packages, Introduction to exception handling.

PRACTICAL COMPONENT CONTENTS:

LIST OF EXPERIMENTS

1. Implement simple python programs using interactive and script mode.
2. Develop python programs using id() and type() functions
3. Implement range() function in python
4. Implement various control statements in python.
5. Develop python programs to perform various string operations like concatenation, slicing, Indexing.
6. Demonstrate string functions using python.
7. Implement user defined functions using python.
8. Develop python programs to perform operations on list
9. Implement dictionary and set in python
10. Develop programs to work with Tuples.
11. Create programs to solve problems using various data structures in python.
12. Implement python program to perform file operations.
13. Implement python programs using modules and packages.

REFERENCES

1. Ashok NamdevKamthane,Amit Ashok Kamthane, “Programming and Problem Solving with Python” , Mc-Graw Hill Education,2018.
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, Second edition, Updated for Python 3, Shroff / O’Reilly Publishers, 2016.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach”, Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd,” Exploring Python”, Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012.
6. Charles Dierbach, “Introduction to Computer Science using Python: A Computational Problem Solving Focus”, Wiley India Edition, 2013.

E BOOKS AND ONLINE LEARNING MATERIALS

1. www.mhhe.com/kamthane/python
2. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, Updated for Python 3, Shroff / O’Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)

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ONLINE COURSES AND VIDEO LECTURES:

http://nptel.ac.in
https://www.edx.org/course/introduction-to-python-fundamentals-1
https://www.edx.org/course/computing-in-python-ii-control-structures-0
https://www.edx.org/course?search_query=Computing+in+Python+III%3A+Data+Structures

Theory: 30 **Tutorial: 0** **Practical: 30** **Project: 0** **Total: 60 Hours**

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U18EEI2201	ELECTRIC CIRCUIT ANALYSIS	L	T	P	J	C
		3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Reduce the complex circuits using reduction techniques and source transformations.	**K3**
CO2	Analyse and measure the response of AC circuits.	**K2**
CO3	Apply network theorem to compute the electrical parameters of circuit and demonstrate in hardware.	**K3**
CO4	Familiarize with the concepts of magnetic circuits and analyze its parameters	**K2**
CO5	Understand the 3-phase circuits with balanced and unbalanced loads.	**K2**

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S		S					M	W			M	M
CO2	S	S		S					M	W			M	M
CO3	S	S		S	M				M	W			M	M
CO4	S	M												W
CO5	S	M												M

COURSE ASSESSMENT METHODS

Direct Tools

1. Continuous Assessment Test I, II
2. Pre-or Post-experiment Test/Viva; Experimental Report for each experiment; Comprehensive report / Model Examination
3. Assignment, Open book test; Cooperative learning report, Group Presentation, Problem based learning, Project based learning, Mini Projects, Project report, Quiz, Role play, Self-Explanatory videos, Prototype or Product Demonstration etc. (as applicable)
4. End Semester Examination

Indirect Tools

1. Course-end survey
2. Programme Exit survey
3. Placement/Higher education record
4. Feedback (Students, Employers, Parents, Professional body members, Alumni)

THEORETICAL COMPONENT CONTENTS:

BASIC CIRCUIT CONCEPTS **9 Hours**

Introduction to Electrical Circuits: Voltage, Current, Power and Energy - Circuit Elements : R,L,C Parameters – Energy Sources – Kirchhoff's Laws –Series and Parallel DC circuits-Voltage Division and Current Division-Power in DCSeries and Parallel Circuits-Network Reduction Techniques – Source Transformation- Star-to-Delta and Delta-to-Star Transformation.

AC CIRCUIT CONCEPTS **9 Hours**

Angular Relation of a Sine Wave- Sine Wave Equation- RMS and Average Values of Voltage and Current - Phase Relation in Pure R, L and C. Complex Impedance: Impedance Diagram– PhasorDiagram- Analysis of Series, Parallel Circuits. Power and Power Factor: Instantaneous Power - Average Power- Apparent Power and Power Factor- Reactive Power- Power Triangle. Resonance: Series Resonance – Bandwidth and Q factor- Introduction to Parallel Resonance.

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CIRCUIT ANALYSIS & NETWORK THEOREMS **9 Hours**

Nodal analysis and Mesh analysis for D.C and A.C circuits, Superposition Theorem, Thevenin'sTheorem, Norton's Theorem, Reciprocity Theorem, Maximum Power Transfer Theorem, Millmann's Theorem, Duality in Networks.

MAGNETIC COUPLED CIRCUITS **9 Hours**

Introduction to Magnetic Circuits & Magnetic Materials- B-H Curve- Magnetic Leakage and Fringing - Comparisons of Magnetic and Electric Circuits - Self and Mutual Inductance-Co-Efficient of Coupling-Dot Convention-Analysis of Simple Coupled Circuits- Single Tuned Circuits

THREE PHASE CIRCUITS **9 Hours**

Phase Sequence-Line and Phase Quantities-Three Phase Star and Delta Connections -Analysis of Three Phase Circuits with Star and Delta Connected Balanced and Unbalanced Loads- Power Measurement in Three Phase Circuits using Two Wattmeter Method

TEXT BOOKS:

1. Sudhakar A. and Shyammohan S.P., Circuits and Networks: Analysis and Synthesis, Tata McGraw-Hill Education (India) Pvt Ltd, New Delhi, 2015.
2. AbhijitChakrabarti, Circuit Theory: Analysis and Synthesis, DhanpatRai& Co, 2014.

REFERENCES

1. William H. HaytJr, Jack E. Kemmberly, and Steven M. Durbin, Engineering circuit analysis, Tata McGraw-Hill Education (India) Pvt Ltd, New Delhi, 2011.
2. Joseph A. Edminister and Mahmood Nahvi, Electric Circuits, Schaum's Series, Tata McGraw-Hill Education (India) Pvt Ltd, New Delhi, 2007.
3. Arumugam M. and Premkumar N., Electric Circuit Theory, Kanna Publishers, 1991.
4. Theraja B. L and Theraja A. K., A Textbook of Electrical Technology, S. Chand Limited, 2005
5. Mehta R. K and Mal A. K, Problems and Solutions in Electric Circuit Analysis, CBS Publishers & Distributors, 2002

PRACTICAL COMPONENT CONTENTS:

LIST OF EXPERIMENTS

1. Experimental Verification of Ohm's Laws & Kirchhoff's Laws.
2. Experimental Verification of Superposition Theorem.
3. Experimental Verification of Thevenin's Theorem.
4. Simulation and Experimental Verification of Reciprocity Theorem.
5. Simulation and Experimental Verification of Maximum Power Transfer Theorem.
6. Simulation and Experimental Verification of Mesh Analysis.
7. Measurement of Voltage, Current, Frequency and Phase Angle using CRO
8. Frequency Response of Series and Parallel Resonance Circuit.
9. Electrical wiring.
10. Electrical Appliances – Demonstration

Theory: 45 **Tutorial: 0** **Practical: 30** **Project:** **Total: 75 Hours**

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U18INI2600 ENGINEERING CLINIC - 2

L	T	P	J	C
0	0	4	2	3

COURSE OBJECTIVES

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Identify a practical problem and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S	M	M
CO2											S		M	M
CO3										S			M	M

COURSE ASSESSMENT METHODS:

Direct	Indirect
1. Project reviews 50%	1. Course Exit Survey
2. Workbook report 10%	
3. Demonstration & Viva-voce 40%	

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

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Course	Semester	Focus
Engineering Clinic II	2	Raspberry pi based controllers with Python programming

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Theory: 0 Tutorial: 0 Practical: 30 Project: 90 Total: 90 Hours

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SEMESTER - III

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U18MAT3101

PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS

(Common to AE/AUE/CE/ME/MCE/EEE)

L	T	P	J	C
3	1	0	0	4

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1 Form partial differential equations and solve certain types of partial differential equations.

CO2 Determine the Fourier Series and half range Fourier Series of a function

CO3 Solve one dimensional wave equation, one dimensional heat equation in steady state using Fourier series.

CO4 Apply Fourier series to solve the steady state two dimensional heat equation in cartesian coordinates.

CO5 Identify Fourier transform, Fourier sine and cosine transform of certain functions and use Parseval's identity to evaluate integrals

CO6 Evaluate Z – transform of sequences and inverse Z – transform of functions and solve difference equations.

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M			M				M	M		S	M	
CO2	S	M		M									M	
CO3	S	S	S		S				M	M		S		
CO4	S	M	M									M		
CO5	S	M	M		S									M
CO6	S	S			S				M	M		S		

COURSE ASSESSMENT METHODS

Direct Tools
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable). 3. End Semester Examination
Indirect Tools
1. Course-end survey

PARTIAL DIFFERENTIAL EQUATIONS **9+3 Hours**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions - Solution of PDE by variable separable method – Solution of standard types of first order partial differential equations (excluding reducible to standard types) – Lagrange's linear equation – Linear homogeneous partial differential equations of second and higher order with constant coefficients.

FOURIER SERIES **9+3 Hours**

Dirichlet's conditions – General Fourier series – Odd and Even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.

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BOUNDARY VALUE PROBLEMS – ONE DIMENSIONAL EQUATIONS **5+2 Hours**

Classification of second order quasi linear partial differential equations –Solution of one dimensional wave equation – One dimensional heat equation (excluding insulated ends) – Fourier series solutions in Cartesian coordinates.

BOUNDARY VALUE PROBLEMS – TWO DIMENSIONAL EQUATIONS **4+1 Hours**

Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

FOURIER TRANSFORM **9+3 Hours**

Statement of Fourier integral theorem – Infinite Fourier transforms – Sine and Cosine Transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

Z –TRANSFORM **9+3 Hours**

Z-transform - Elementary properties – Convolution theorem- Inverse Z – transform

REFERENCES

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44thEdition. 2014.
2. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
3. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Volume III", S.Chand & Company ltd., New Delhi, 2006.
4. Ian Sneddon., "Elements of partial differential equations", McGraw – Hill, New Delhi, 2003.
5. Arunachalam T., "Engineering Mathematics III", Sri Vignesh Publications, Coimbatore 2013.

Theory: 45 **Tutorial: 15** **Practical:0** **Project: 0** **Total: 60 Hours**

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U18EEI3201 DC MACHINES AND TRANSFORMERS

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Apply the principles of magnetic circuits and standards to analyze the constructional features and operation of DC machines.	**K3**
CO2	Analyze the principles of operation, back EMF, and torque equation to compare the characteristics and control methods of DC motors.	**K4**
CO3	Analyze the efficiency and performance of DC machines through various testing methods such as Brake test, Swinburne's test, and Hopkinson's test.	**K4**
CO4	Analyze the construction and operation principles of single-phase transformers to interpret their equivalent circuits and performance under load and no-load conditions.	**K4**
CO5	Evaluate the performance of transformers through polarity test, open circuit and short circuit tests.	**K4**
CO6	Demonstrate the practical operation and performance testing of DC machines and transformers through laboratory experiments	**K5**

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	M	W									S
CO2	S	S	S	M	W								M	
CO3	S	S	M										M	S
CO4	W	M	S									M	M	
CO5	W	M	S									M		S
CO6	S	S	M	M	M				S				S	S

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Model Examination (For Practical Courses & Embedded Courses)
3. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
4. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

THEORETICAL COMPONENT CONTENTS:

DC GENERATORS **10 Hours**

Review of magnetic circuits- - IEC & IEEE Standards - Constructional features of DC machines-Principle of operation of DC generator-EMF equation-Types of field excitations-separately excited, shunt and series-Voltage build up in a shunt generator, critical field resistance and critical speed, Armature reaction and Commutation.

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DC MOTORS **9 Hours**

Principle of operation- Back EMF-Torque equation-Types and characteristics-Need for starters and types-Speed control of DC shunt and series motors- Braking of DC Motors- Introduction to BLDC motors.

TESTING OF DC MACHINES **8 Hours**

Losses and efficiency – Testing of DC machines: Brake test - Swinburne's test – Hopkinson's test.

TRANSFORMERS **12 Hours**

Single Phase Transformer : Construction and Principle of Operation – EMF Equation - Transformer on No Load and Load - Phasor Diagram - Equivalent Circuit – Voltage Regulation - Losses - Efficiency - All Day Efficiency - Parallel Operation - Three Phase Transformer connections –Auto transformers- Construction and applications

TESTING OF TRANSFORMERS **6 Hours**

Polarity test – Open circuit and Short circuit tests – Sumpner's test – Separation of no load losses- Introduction to CAD modelling of transformers using Magnet 7.5

PRACTICAL COMPONENT CONTENTS:
LIST OF EXPERIMENTS

1. Open Circuit and load characteristics of DC shunt generator.
2. Brake test of DC shunt motor
3. Load characteristics of DC series motor
4. Speed control on DC motor
5. Separation of no load losses of DC shunt motor
6. Hopkinson's test on DC motor generator set
7. Load test on single-phase transformer
8. OC and short circuit test on single-phase transformer
9. Sumpner's test
10. SCOTT connection

TEXTBOOKS:

1. D P Kothari, and I J Nagrath, "Electric Machines", McGraw Hill Education (India) Private Limited, New Delhi, 2013.
2. AE Fitzgerald and C Kingsley, "Electric Machinery", New York, McGraw Hill Education 2013

REFERENCES:

1. Ashfaq Husain, "Electric Machines", Dhanpat Rai& Co., New Delhi 2011
2. P.S.Bimbhra, "Electrical Machinery", 7th Edition, Khanna Publishers, 2011, New Delhi.

Theory: 45 **Tutorial: 0** **Practical: 30** **Project: 0** **Total: 75 Hours**

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U18EET3002 ELECTROMAGNETIC FIELDS

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1 Apply vector algebra to analyze and solve problems related to position and displacement vectors. **K3**

CO2 Evaluate the electric field intensity and potential gradient using Gauss's law and apply them to solve related problems. **K3**

CO3 Apply basic laws of electrostatics and magnetostatics to determine capacitance, magnetic field intensity and calculate magnetic flux density. **K3**

CO4 Apply knowledge of magnetic fields and inductance to design and analyze practical electrical circuits and devices, including the calculation of inductances for solenoids and toroidal cores. **K4**

CO5 Examine electromagnetic wave equations and analyze the propagation of waves in different mediums using Maxwell's equations. **K3**

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	W											M	
CO2	S	S											M	
CO3	S	S											M	W
CO4	S	M			W								S	M
CO5	S	M			W								S	W

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

REVIEW OF VECTOR CALCULUS 9 Hours

Vector Algebra, Position and Displacement Vectors, Introduction to Orthogonal Coordinate Systems – Conversion of a point from one system to other.

Vector Calculus – Differential Length, Area and Volume, Line, Surface and Volume Integrals, Del Operator, Gradient of a Scalar, Divergence and Curl – its theorem, Types of Vector Fields.

ELECTROSTATIC FIELDS 9 Hours

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Coulomb's law, Electric Field Intensity, Electrical Field due to point charges, line, surface and volume charge distributions, Gauss's law and its applications, Absolute Electric Potential, Potential Gradient, Electric Dipole, Electrostatic Energy and Energy density.

CONDUCTORS, DIELECTRICS AND CAPACITANCE **7 Hours**

Current and current density, Ohm's Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials, Permittivity of dielectric materials, Capacitance - Determination of Capacitance for cylindrical and parallel plate configurations

MAGNETOSTATIC FIELDS **5 Hours**

Biot-Savart Law, Magnetic Field Intensity due to long straight conductor, Ampere's Circuit Law and its applications, Magnetic Flux and Magnetic Flux Density.

MAGNETIC FORCES AND INDUCTANCE **7 Hours**

Steady magnetic fields produced by current carrying conductors, Lorentz' Law of Force, Magnetic Force and Torque, Magnetization and permeability, Magnetic boundary conditions, Inductances and Mutual inductances – Inductance due to solenoid and toroidal core, Magnetic Energy

MAXWELL'S EQUATIONS AND ELECTROMAGNETIC WAVES **8 Hours**

Faraday's Law – Stationary and Motional EMFs - Maxwell's Equations in Differential and Integral forms, Electromagnetic Wave Equation – Propagation of Waves in free space, lossy and lossless dielectrics, good conductor, Skin Effect, Poynting theorem, Introduction to Electromagnetic Simulation Software tool.

TEXT BOOKS

1. W. H. Hayt and John A. Buck, "Engineering Electromagnetics", 7th Edition, Tata McGraw Hill, New Delhi, 2012.
2. Matthew N.O. Sadiku, "Elements of Electromagnetics", 7th Edition, Oxford University Press, 2018.
3. Gangadhar K.A. and Ramanathan P.M., "Electromagnetic Field Theory", 5th Edition, Khanna Publishers, New Delhi, 2013.

REFERENCES

1. A. Pramanik, "Electromagnetism – Theory and applications", PHI Learning Pvt. Ltd., New Delhi, 2009.
2. A. Pramanik, "Electromagnetism – Problems with solution", Prentice Hall India, 2012.
3. J.A. Buck and W. H. Hayt, "Problems and Solutions in Electromagnetics", 1st Edition, Tata McGraw Hill, New Delhi, 2010.
4. John D. Kraus and Daniel A. Fleisch, "Electromagnetics: With Applications", 5th Edition, Tata McGraw Hill, New Delhi, 2010.
5. Joseph A. Edminister, "Schaum's Outline of Theory and Problems of Electromagnetics", 5th Edition, Tata McGraw Hill, New Delhi, 2010.
6. N.N. Rao, "Elements of Engineering Electromagnetics", 6th Edition, Pearson Education, 2009.

Theory: 45 **Tutorial:0** **Practical: 0** **Project: 0** **Total: 45 Hours**

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U18EEI3203 ANALOG ELECTRONICS AND LINEAR INTEGRATED CIRCUITS

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Apply the basics principles of PN junction Diode and Zener Diode for suitable applications	**K3**
CO2	Illustrate the operation and characteristics of BJT JFET and MOSFET for different applications.	**K3**
CO3	Demonstrate the frequency response of amplifier circuits	**K3**
CO4	Analyze the performance of operational amplifier circuits	**K3**
CO5	Infer various ICs and signal conversion techniques for specific functions.	**K4**
CO6	Demonstrate operational amplifier-based circuits and IC applications in laboratory experiments.	**K5**

PRE-REQUISITE

Physics/ Material science

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M	M						M				M	
CO2	S	M	M						M				M	
CO3	M	M	M						M				M	M
CO4	S	M	M						M				M	M
CO5	S		S										S	M
CO6	S	M	M		M				M				M	S

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Model Examination (For Practical Courses & Embedded Courses)
3. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
4. End Semester Examination

Indirect

1. Course End Survey,
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

THEORETICAL COMPONENT CONTENTS:

SEMICONDUCTOR DEVICES **9 Hours**

PN junction Diode – Zener Diode – BJT –JFET- MOSFET- Structure, Operation and VI Characteristics - Applications of Diode: Half Wave & Full Wave Rectifier – Zener voltage regulator.

SMALL SIGNAL AMPLIFIERS USING BJT AND FET **9 Hours**

Need for Biasing, Q point, DC and AC Load line, Biasing Circuits – Base bias, Voltage divider bias, emitter bias, CE, CB Amplifiers –Frequency response and hybrid model of CE amplifier– FET amplifier: CS Amplifier, Multistage Amplifier: RC coupled amplifier, Darlington Amplifier, Differential Amplifier using BJT.

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LARGE SIGNAL, FEEDBACK AMPLIFIERS AND OSCILLATORS **9 Hours**

Classification of Amplifiers - Push-pull Amplifiers: A, B & AB Amplifiers — Tuned Amplifiers: Single Tuned Amplifiers-Advantages of Negative Feedback – Topologies of Voltage/Current: Series & Shunt Feedback Amplifiers – Positive Feedback – Barkhausen Criteria – Operation of RC phase shift, Wien Bridge, Crystal Oscillators.

OPERATIONAL AMPLIFIER CIRCUITS **9 Hours**

Introduction– internal circuit- Basic operations of Op-Amp-Inverting, Non inverting, Differentiator, Integrator- Differential Amplifier: Common mode and Differential mode Analysis - Op-Amp Based Instrumentation Amplifier – Comparator – Multi vibrators – Schmitt trigger

SPECIAL ICs AND SIGNAL CONVERSION CIRCUITS **9 Hours**

V/I and I/V conversion – V/F and F/V conversion – IC 555 Timer circuit: Functional block, characteristics & applications, Astable and monostable operation, IC 566 - voltage controlled oscillator, IC565-phase locked loop circuit, IC voltage regulators - LM317, IC723- Simple applications using simulation software tool.

PRACTICAL COMPONENT CONTENTS:

LIST OF EXPERIMENTS

1. Characteristics of BJT - CE configurations.
2. Characteristics of JFET.
3. Voltage regulator using Zener diode
4. Frequency response of common emitter amplifier.
5. Half wave and full wave rectifiers with filter.
6. Inverting &Non inverting amplifiers using op-amp
7. Integrator and differentiator circuits using op-amp
8. Wien bridge oscillator using op-amp.
9. Astable operation using IC 555.
10. Simulation of op-amp circuits using simulation software tools

TEXT BOOKS

1. S. Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", 4thEdition, McGraw-Hill Education, 2016.
2. Thomas L. Floyd, "Electronic Devices (Conventional Current Version)", 10th Edition, Pearson education, 2017.
3. D. Roy Choudhary, Sheil B. Jani, "Linear Integrated Circuits", 4th Edition, New Age International, New Delhi, 2010.

REFERENCES

1. JacobMillman, Christos C. Halkias, SatyabrataJit, "Electronic Devices and Circuits", Tata McGraw Hill Publishing Limited, New Delhi, 2015.
2. B. P. Singh, Rekha Singh, "Electronic Devices and Circuits", 2nd Edition, Pearson Education, 2013.
3. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.
4. J. B. Gupta, "Electronic Devices and Circuits", 2nd Edition, JPA Publications, 2009.
5. Adel S. Sedra, Kenneth C. Smith&Arun N. Chandorkar, "Microelectronic Circuits", 6th Edition, Oxford University Press, 2013.
6. Donald A Neamen, "Microelectronics Circuit Analysis and Design", 4th Edition, Tata McGraw Hill Publishing Limited, 2009.
7. Ramakant A. Gayakward, "Op-amps and Linear Integrated Circuits", 4th Edition, Pearson Education, New Delhi, 2009.

Theory: 45 Tutorial: 0 Practical: 30 Project: 0 Total: 75 Hours

Signature of the Chairman BOS EEE

U18EET3004	MEASUREMENTS AND INSTRUMENTATION	L	T	P	J	C
		3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Illustrate the concepts of measurement systems to identify and rectify errors in various instruments.	**K2**
CO2	Determine the resistance, inductance, and capacitance accurately using bridges.	**K3**
CO3	Apply various digital measurement techniques to assess electrical quantities effectively.	**K3**
CO4	Differentiate the characteristics and applications of various electronic transducers for specific measurements.	**K4**
CO5	Analyze data acquisition systems incorporating intelligent sensors for efficient data collection and analysis.	**K4**

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M				W								
CO2	S	M	W											W
CO3	S	W			M	W						W	M	M
CO4	S	S				W	M					W	M	M
CO5	S	S			M	W	M					W	M	M

COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II 2. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination
Indirect
1. Course End Survey 2. Programme Exit Survey 3. Placement/Higher Education Record 4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

CONCEPT OF MEASUREMENT SYSTEMS **9 Hours**

Functional elements of an instrument – Static and dynamic characteristic – Errors in measurement – Standards and calibration – Construction, Principle of operation of MC & MI meters - Electro Dynamic moving type Wattmeter – Induction type Energy meter- Potentiometer-CRO-Time, Frequency & Phase angle Measurement

RESISTANCE, INDUCTANCE AND CAPACITANCE MEASUREMENT **9 Hours**

DC bridges – Kelvin double bridge, Wheat stone bridge, Mega Ohm Bridge, Megger – AC bridges - Schering bridge - Maxwell's inductance bridge - capacitance bridge – Anderson bridge - Wein bridge

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DIGITAL MEASUREMENT **9 Hours**

Digital Measurement of Electrical Quantities – Concept of digital measurement- - Concepts and types of Digital voltmeter - Digital MultiMeter -True RMS meter - DSO & MSO (Block Diagram)- frequency meter – Power Quality Analyzer -Energy meter.

ELECTRONIC TRANSDUCER AND APPLICATIONS **9 Hours**

Transducer: Characteristics, Classification and selection - Displacement Transducer: LVDT- Temperature Transducer: Resistance Temperature Detector, Thermocouples, Thermistor, and Pyrometer- Pressure Transducer: Piezo Electric Transducer - Liquid level Transducer: Ultrasonic Transducer – Liquid Flow transducer: Ultra sound type, Differential pressure type -Speed measurement using Encoder and hall effect sensor.

DATA ACQUISITION SYSTEM AND INTELLIGENT SENSORS **9 Hours**

Digital to Analog Converters: R-2R Ladder D/A Converter, Analog to Digital Converters: Successive Approximation A/D Converter, Data Acquisition System: Introduction, Types, Block diagram of single channel and multi-channel DAS– compact data logger, Microcomputer based data acquisition system- Intelligent Sensors: MEMS sensors, Nano sensors.

TEXT BOOKS

1. A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", DhanpatRai& Sons Publications, New Delhi, 2012.
2. H.S.Kalsi, "Electronic Instrumentation", 3rd Edition, Tata McGraw Hill, New Delhi, 2010.

REFERENCES

1. Ernest O.Doeblin, "Measurement Systems – Applications and Design", 5th Edition, McGraw Hill, New Delhi, 2007.
2. A.D.Cooper and A.D.Helfrik, "Modern Electronic Instrumentation and Measurement Techniques", 2nd Edition, Prentice Hall of India, New Delhi, 2008.
3. S.Ramabhadran, "Electrical Measurements and Instruments", Khanna Publishers, New Delhi, 2009.
4. S.K.Singh, "Industrial Instrumentation and Control", 3rd Edition, Tata McGraw Hill Publishers, New Delhi, 2008.
5. E. W. Golding & F. C. Widdis, "Electrical Measurement & Measuring Instrument", 5th Edition, A.H.Wheeler& co., India, 2011.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

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U18INI3600 **ENGINEERING CLINIC - 3**

L	T	P	J	C
0	0	4	2	3

COURSE OBJECTIVES

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Identify a practical problem and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S	M	M
CO2											S		M	M
CO3										S			M	M

COURSE ASSESSMENT METHODS:

Direct	Indirect
1. Project reviews 50%	1. Course Exit Survey
2. Workbook report 10%	
3. Demonstration & Viva-voce 40%	

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

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Course	Semester	Focus
Engineering Clinic III	3	Design project combining concepts learnt in Engineering clinics I and II

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Theory: 0 Tutorial: 0 Practical: 0 Project: 90 Total: 90 Hours

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SEMESTER - IV

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U18MAT4101

NUMERICAL METHODS AND PROBABILITY

(Common to AE/AUE/CE/ME/MCE/EEE)

L	T	P	J	C
3	1	0	0	4

COURSE OUTCOMES

After successful completion of this course, the students will be able to

- **CO1:** Apply various numerical techniques for solving non-linear equations and systems of linear equations.
- **CO2:** Analyze and apply the knowledge of interpolation and determine the integration and differentiation of the functions by using the numerical data.
- **CO3:** Predict the dynamic behaviour of the system through solution of ordinary differential equations by using numerical methods.
- **CO4:** Solve PDE models representing spatial and temporal variations in physical systems through numerical methods
- **CO5:** Apply the concepts of probability to random variables
- **CO6:** Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S											M	
CO2	S	S											M	
CO3	S	S							M				M	M
CO4	S	S												
CO5	S	S							M					
CO6	S	S												M

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Model Examination (For Practical Courses & Embedded Courses)
3. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
4. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS **9+3 Hours**

Linear interpolation method – Iteration method – Newton's method – Solution of linear system by Gaussian elimination and Gauss-Jordan methods - Iterative methods: Gauss Jacobi and Gauss - Seidel methods – Inverse of matrix by Gauss – Jordan method – Eigenvalues of a matrix by Power method.

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INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION **9+3 Hours**

Lagrange's and Newton's divided difference interpolation – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's rules.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3 Hours

Single step methods: Taylor's series method – Euler and Improved Euler methods for solving a first order equations – Fourth order Runge - Kutta method for solving first and second order equations – Multistep method: Milne's predictor and corrector method.

BOUNDARY VALUE PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS **9+3 Hours**

Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain–Solution of one dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes –Solution of one dimensional wave equation by explicit scheme.

PROBABILITY AND RANDOM VARIABLES **9+3 Hours**

Axioms of probability - Conditional probability – Total probability – Bayes' theorem – Random variable – Distribution function – properties – Probability mass function-Probability density function – moments -Binomial, Poisson and Normal distributions – Properties.

REFERENCES

1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.
2. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", 7th Edition, Pearson Education Asia, New Delhi, 2007.
3. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 7th Edition, Tata McGraw-Hill, New Delhi, 2016.
4. R.A. Johnson and C.B. Gupta, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
5. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th edition, 2017.
6. Gupta S.C, and KapurV.K "Fundamentals of Applied Statistics", Sultan Chand, New Delhi, 4th Edition, 2014.

Theory: 45 Tutorial: 15 Practical: 0 Project: 0 Total: 60 Hours

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U18EEI4201 **INDUCTION AND SYNCHRONOUS MACHINES**

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Apply the principles of operation of three-phase induction motors to solve problems related to torque and power output.	**K3**
CO2	Analyze various starting and speed control methods of three-phase induction motors to determine their efficiency.	**K4**
CO3	Evaluate the performance of single-phase induction motors by examining their equivalent circuits and starting methods.	**K4**
CO4	Design the equivalent circuit and phasor diagram of synchronous generators to predict their regulation and performance.	**K4**
CO5	Examine the operation and power factor improvement methods of synchronous motors to assess their efficiency in power systems.	**K4**
CO6	Conduct tests on induction and synchronous machines to demonstrate their performance characteristics and efficiency.	**K5**

PRE-REQUISITE

1. DC Machines and Transformers

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		W	M					M				M	S
CO2	S	M	M	M					M				M	
CO3	S	M	M	M					M				M	S
CO4	S	W	M	M					M				M	
CO5	M		M							M		M	M	S
CO6	S	M	M		M				S				S	

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Model Examination (For Practical Courses & Embedded Courses)
3. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
4. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

THEORETICAL COMPONENT CONTENTS:

THREE PHASE INDUCTION MOTORS **9 Hours**

Constructional details – Types– Principle of operation – Rotating Magnetic Field- Slip – Equivalent circuit – Torque and power output - Slip-torque characteristics - Condition for maximum torque – Losses and efficiency – No load and blocked rotor test - Circle diagram – Linear induction motors.

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STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTORS 9 Hours

Need for starters – Types of starters – Cogging and crawling - Speed control – Change of voltage, torque, number of poles – Cascaded connection – Slip power recovery scheme-Separation of No load losses - Braking of Induction motors

SINGLE PHASE INDUCTION MOTORS 9 Hours

Constructional details of single phase induction motor – Double revolving field theory — Starting methods of single-phase induction motors – Split phase motors - Shaded pole motors- Equivalent circuit – No load and blocked rotor test – Universal motors – Repulsion motors.

SYNCHRONOUS GENERATORS 10 Hours

Constructional details – Types of rotors – EMF equation – Synchronous reactance-Synchronous Impedance-Equivalent circuit and phasor diagram – Armature reaction – Predetermination of regulation by synchronous impedance, MMF and Potier methods-Power and torque- Load division – Synchronizing to Infinite Busbar– Salient pole machine - Two reaction theory – Determination of direct and quadrature axis synchronous reactance using slip test .

SYNCHRONOUS MOTORS 8 Hours

Principle of operation – Hunting – Methods of starting - Torque and Power - Effect of change in excitation-V and Inverted V curves - Power factor improvement using Synchronous condenser

PRACTICAL COMPONENT CONTENTS:

LIST OF EXPERIMENTS

1. Load test on three-phase induction motor
2. Construction of circle diagram of a 3 phase induction motor by no load and blocked rotor test
3. Load test on single-phase induction motor
4. No load and blocked rotor tests on single-phase induction motor
5. Separation of no load losses in 3 phase Induction motor
6. Predetermination of performance characteristics of 3 phase induction motor by no load and blocked rotor test
7. Regulation of 3 phase alternator by EMF and MMF method
8. Regulation of 3 phase alternator by ZPF method
9. Regulation of 3 phase salient pole alternator by slip test
10. V and inverted V curves of 3 phase synchronous motor

TEXTBOOKS

1. D P Kothari, and I J Nagrath, “Electric Machines”, McGraw Hill Education (India) Private Limited, New Delhi, 2013.
2. A.E.Fitzgerald, Charles Kingsley, Stephen.D.Umans, “Electric Machinery”, 7th Edition, Tata Mcgraw Hill, New Delhi, 2013.

REFERENCES

1. Langsdorf, “AC Machines”, McGraw Hill Education, 1984
2. M G Say, “Performance and design of AC Machines”, CBS Publishers, 2002
3. P C Sen, “Principles of Electric Machines and Power Electronics”, John Wiley and sons, 2007

Theory: 45 Tutorial: 0 Practical: 30 Project: 0 Total: 75 Hours

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U18EET4002 **GENERATION, TRANSMISSION AND DISTRIBUTION**

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Analyze the principles of conventional and non-conventional power generation methods.	**K4**
CO2	Evaluate the environmental impact of different renewable energy resources.	**K4**
CO3	Analyze the performance of transmission lines and their parameters.	**K4**
CO4	Illustrate the features and select the configurations of various line insulators and cables.	**K3**
CO5	Analyze distribution system designs for various load schemes.	**K4**

PRE-REQUISITE

1. Network Theory
2. Electro Magnetic Fields

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S						M						S	M
CO2	S	S	M	W	W		M	M					M	
CO3	S	M					S						S	
CO4	S	M					M	M					M	
CO5	S	M					M						S	

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

CONVENTIONAL POWER GENERATION **9 Hours**

Introduction – Basic idea of generation (Changeover from D.C to A.C, A.C generator)- Classification of Power Plants – Working principles of thermal (coal, gas and diesel), Hydro-electric and Nuclear Power plants – Merits and Demerits.

NON-CONVENTIONAL POWER GENERATION **9 Hours**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment - Qualitative study of different renewable energy resources: Solar, wind (using Modern software tools), Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

MODELING AND PERFORMANCE OF TRANSMISSION LINES **12 Hours**

Structure of electrical power system Calculation of parameters of transmission lines: Resistance, inductance and capacitance- Classification of lines: Short line, medium line and long line - equivalent

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circuits, attenuation constant, phase constant, surge impedance, transmission efficiency and voltage regulation - Skin and Proximity effects- Ferranti effect, Phenomena of corona and its losses.

INSULATORS AND CABLES (QUALITATIVE STUDY ONLY) 7 Hours

Insulators: Types - voltage distribution in insulator string and grading, improvement of string efficiency - Underground cables: Constructional features of LT and HT cables- capacitance, dielectric stress and grading - thermal characteristics.

DISTRIBUTION SYSTEM 8 Hours

Classification of Distribution systems - AC distribution and DC Distribution - Connection Scheme of Distribution System - Radial system, Ring-main and Interconnected System. AC distribution - AC distributor with concentrated load - three-phase, four-wire distribution system. Sub-mains - Stepped and tapered mains.

TEXTBOOK

1. S. N. Singh, "Electric Power Generation, Transmission and Distribution", 2nd Edition, Prentice Hall of India, New Delhi, 2008.
2. B. R. Gupta, "Power System Analysis and Design", 5th Edition, S. Chand, New Delhi, 2001.

REFERENCES

1. C.L. Wadhwa, "Electrical Power Systems", 6th Edition, New Age International (P) Ltd., New Delhi, 2010.
2. D. P Kothari and I J Nagrath, "Modern Power System Analysis", 4th Edition, Tata McGraw Hill, New Delhi, 2011.
3. El-Wakil M.M., "Power Plant Technology", 2nd Edition, Tata McGraw Hill, New Delhi, 2010.
4. G.D. Rai, "Introduction to Power Plant Technology", 3rd Edition, Khanna Publishers, New Delhi, 2013.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

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U18EEI4203 DIGITAL ELECTRONICS

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Apply the principles of digital circuits to solve basic problems.	**K3**
CO2	Analyze logical expressions and simplify using K-Maps and Quine-McCluskey Method.	**K4**
CO3	Analyze, design and implement various combinational logic circuits.	**K4**
CO4	Design and implement sequential circuits using flip-flops and counters.	**K4**
CO5	Classify different semiconductor memories and identify suitable PLD for the applications.	**K3**
CO6	Design, Simulate and implement various digital logic circuits.	**K4**

PRE-REQUISITE

1. Analog Electronics

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S												M	
CO2	S	S	S										S	S
CO3	S	S	S										S	M
CO4	S	M	M		M								M	M
CO5	S	M	M										S	M
CO6	S	S	M	M	M				S				M	S

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Model Examination (For Practical Courses & Embedded Courses)
3. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
4. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

THEORETICAL COMPONENT CONTENTS

FUNDAMENTALS OF DIGITAL SYSTEMS **9 HOURS**

Introduction to Digital Circuits, Logic Gates, Boolean Algebra, Number Systems: Binary, Signed Binary, Octal, Hexadecimal Number, Binary Arithmetic, One's and Two's Complements, Binary Codes: 8421, 2421, Gray Code, Excess 3 Code, Error detecting and Correcting Codes.

Standard representation for logic functions: SOP, POS, Canonical Form, Simplification of Logical functions using K-Map, Quine-McCluskey Method – Don't Care Conditions (upto 4 variables)

DESIGN OF COMBINATIONAL LOGIC CIRCUITS **9 HOURS**

Design of Combinational Circuits - Adders, Subtractors, Parallel Adder, Carry Look Ahead Adder, Digital Comparator, Parity Generator/Checker, Code Converters, Encoders, Decoders, Multiplexer, De-Multiplexer, Implementation of Boolean function using Multiplexer.

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SEQUENTIAL LOGIC CIRCUITS **11 HOURS**

Latch, Flip Flops: SR, JK, T and D types – Characteristic Equation, Excitation Table, Types of Triggering, Master Slave JK Flip Flop, Applications of Flip Flops, Conversion of one flip flop into other flip flop, Counters: Synchronous & Ripple Counter - Modulo-N Counter, Counter Design using Flip Flops, Shift Registers: Types and Applications, Ring Counter.

SEQUENTIAL CIRCUIT DESIGN **7 HOURS**

Classification of Sequential Circuits: Moore and Mealy Model, Design of Synchronous Sequential Circuit: State Diagram, State Table, State Reduction, State Assignment, Hazards in sequential circuits.

SEMICONDUCTOR MEMORIES AND DIGITAL INTEGRATED CIRCUITS 9 HOURS

Introduction to Memories: RAM, ROM, PROM, EEPROM, PLA, PAL, FPGA, Implementation of Combinational Logic using PLA and PAL.

Basic IC Terminologies, Characteristics of Digital Logic families: TTL and CMOS logic, Introduction to circuit design using Simulation Software tool.

PRACTICAL COMPONENT CONTENTS

LIST OF EXPERIMENTS

Verification of truth table for Logic Gates and Flip Flops.

2. Implementation of Boolean Function using Gates.
3. Design and implementation of Adder / Subtractor circuits.
4. Design of Code converters: Gray to Binary, Binary to Gray.
5. Design and implementation of Encoder and Decoder using Logic Gates.
6. Design of combinational circuit using MUX/DEMUX.
7. Design and implementation of 4 – bit Synchronous Counter.
8. Design and implementation of 4 – bit Asynchronous Counter.
9. Design and implementation of 4 – bit Shift Registers.
10. Design of simple combinational circuits using Simulation Software Tool.

TEXT BOOKS

1. M. Morris Mano, “Digital Logic and Computer Design”, Pearson India Education Services Pvt. Ltd., New Delhi, 2016.
2. R. P. Jain, “Modern Digital Electronics”, 4th Edition, Tata McGraw Hill Education Pvt Ltd., 2010.
3. A. Anand Kumar, “Fundamentals of Digital Circuits”, 4th Edition, Prentice Hall India, 2016.

REFERENCES

1. Soumitra Kumar Mandal, “Digital Electronics: Principles and Applications”, Tata McGraw Hill Education Pvt Ltd, 2010.
2. Thomas L. Floyd, “Digital Fundamentals”, 11th Edition, Pearson Education Limited, 2014.
3. Raj Kamal, “Digital Systems: Principles and Design”, 3rd Edition, Pearson Education Limited, 2009.
4. John M. Yarbrough, “Digital Logic: Applications and Design”, West Publishing Company, 2002.
5. David J. Comer, “Digital Logic & State Machine Design”, Oxford University Press, 2012.

Theory: 45 Tutorial: 0 Practical: 30 Project: 0 Total: 75 Hours

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U18EET4004 NETWORK AND SYSTEM

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Apply the basic concepts of graph theory to solve electrical networks	K3
CO2	Analyze the transient behavior of DC and AC circuits	K4
CO3	Model the networks in S-domain and determine their equivalent two port network parameters	K3
CO4	Design various types of filters, attenuators and observe their frequency response	K3
CO5	Categorize the different types of signals and systems	K3

PRE-REQUISITE

1. Laplace transform technique, matrix operations

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M											M	S
CO2	S	S	W		M								M	M
CO3	S	M											M	M
CO4	S	M	W				W						M	M
CO5	S	W												M

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

NETWORK TOPOLOGY **9 Hours**

Basic definitions of a network graph - planar graph and non-planar graph – tree and co-tree properties – Twigs and links – incidence matrix – Tie- set matrix and branch currents – cut-set and tree branch voltages - fundamental cut – sets – Formation of network equations: Node voltage equations – loop current equations -solving networks using Graph theory.

CIRCUIT TRANSIENTS **9 Hours**

Steady state and Transient response in ‘S’ domain – DC response of RL, RC and RLC circuits and sinusoidal response of RL, RC and RLC circuits.

NETWORK FUNCTIONS AND TWO PORT NETWORKS **9 Hours**

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Transform impedance and transform circuits - network functions for one port and two port networks — poles and zeros and their significance – time domain response from pole – zero plot-Two port networks - Z, Y, ABCD and h parameters – analysis of T and π networks.

FILTERS AND ATTENUATORS **9 Hours**

Introduction – classification of filters – filter networks – equations of filter networks - LPF and HPF – limitations of constant k filters – m-derived filters- LPF and HPF. Attenuators: T network, π network, Lattice network and bridged T networks.

SIGNALS AND SYSTEMS **9 Hours**

Classification of signals: continuous – discrete – periodic - energy and power signals;

Classification of systems: Continuous – discrete – linear – causal – stable – dynamic - recursive and time variance.

TEXT BOOKS

1. Sudhakar A. and Shyammohan S.P., "Circuits and Networks: Analysis and Synthesis", 3rd Edition, Tata McGraw-Hill, New Delhi, 2006.
2. Ramesh Babu, "Digital Signal Processing", 4th Edition, SciTech Publications (India) Pvt. Ltd., 2012.

REFERENCES

1. D. Roy Choudhury, "Networks and Systems", 1st Edition, New Age Publications (Academic), New Delhi, 2005.
2. Gupta, B.R., "Network Analysis and Synthesis", 4th Revised Edition, S.Chand& Company (Pvt) Ltd., New Delhi, 2013.
3. Jagan N.C., and Lakshminarayana C., "Network Theory", 2nd Edition, BS Publications, Hyderabad, 2005.
4. Joseph A. Edminister and MahmoodNahvi, "Electric Circuits Schaum's Outline Series", 6th Edition, Tata McGraw-Hill, New Delhi, 2014.
5. Umesh Sinha, "Network Analysis and Synthesis", 3rd Edition, SathyaPrakashan Publishers, New Delhi, 2013.
6. D.H. Hayes, "Digital Signal Processing Schaum's Outline Series", 2nd Edition, Tata McGraw Hill, New Delhi, 2011.

Theory: 45 Tutorial:0 Practical: 0 Project: 0 Total: 45 Hours

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U18EEI4205 PLC AUTOMATION

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Analyze the components of PLC systems and evaluate their advantages and disadvantages.	**K3**
CO2	Demonstrate the construction of PLC ladder diagrams incorporating Boolean and relay logic and analyze their functionality.	**K4**
CO3	Evaluate the application of programming techniques involving timers and counters in PLC systems	**K4**
CO4	Apply program control and sequencing instructions to solve various scenarios using PLC	**K4**
CO5	Design and implement PLC-based control systems in laboratory experiments.	**K5**

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													
CO2	S	M	S		S								M	M
CO3	S	M			S						M		M	M
CO4	S	M	M	S	M								M	M
CO5	S	M	W	M	M				S				M	S

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Model Examination (For Practical Courses & Embedded Courses)
3. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
4. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

THEORETICAL COMPONENT CONTENTS

INTRODUCTION TO PLC **10 hours**

Definition and history of PLC, Overall PLC system, PLC Input and output modules, central processing unit, processor, input modules (Interfaces), power supplies , PLC advantages and disadvantages, selection criteria for PLC, Input ON/OFF switching devices, Input analog devices, Output ON/OFF devices, output analog devices.

PROGRAMMING OF PLC **10 hours**

Methods of Programming - construction of PLC ladder diagram, Basic components & their symbols in ladder diagram, Fundamental of ladder diagram, Boolean logic &relay logic, and analysis of rungs. Timers and counters, programming with timers and counters.

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APPLICATION OF PLC **10 hours**

Instructions in PLC , program control instruction ,math instruction, sequencer instruction , use of PC as PLC , application of PLC, case studies of bottle filling system.

LABORATORY COMPONENT CONTENTS:

LIST OF EXPERIMENTS

1. Develop a Boolean logic to flash Lamp
2. Implementation of simple combination logic using PLC
3. Sequential Logic using PLC
4. Timer – On Delay and Off Delay
5. Counter – Up and Down
6. Design of Alarms and Interlocks
7. Water Level Control System
8. Temperature control system
9. Implementation of motor control forward and Reverse control using PLC
10. Automatic Liquid filling system using PLC
11. Stepper Motor Control using PLC

REFERENCES

1. Frank D. Petruzella, “Programmable Logic Controllers”, McGraw-Hill Companies, 3rdEdition, March 2013.
2. Ian G.Warnock, “Programmable Controllers Operation and Application”, Prentice Hall International, UK, 1992.
3. John W. Webb and Ronald A.Reis, “Programmable Logic Controllers – Principles and Applications”, Prentice Hall Inc., New Jersey, 3rdEdition, 1995.
4. Krishnakant , “Computer Based Industrial Control”, Prentice Hall of India, 1997.

Theory: 30 **Tutorial: 0** **Practical:30** **Project: 0** **Total: 60 Hours**

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U18INI4600 ENGINEERING CLINIC - 4

L	T	P	J	C
0	0	4	2	3

Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Identify a practical problem and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:

1. Engineering Clinic 3

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	M	W		S			S	M	M
CO2											S		M	M
CO3										S			M	M

Course Assessment methods:

Direct	Indirect
1. Project reviews 50%	1. Course Exit Survey
2. Workbook report 10%	
3. Demonstration & Viva-voce 40%	

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the _____ semester, students will focus primarily on ____(insert focus from below table)____

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Course	Semester	Focus
Engineering Clinic IV	4	Reverse engineering project to improve performance of a product

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Theory: 0 Tutorial: 0 Practical: 0 Project: 90 Total: 90 Hours

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U18VET0101 **UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY**

L	T	P	J	C
2	1	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1 Develop a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.

CO2 Understand (or develop clarity) of the harmony in the human being, family, society and nature/existence.

CO3 Strengthen their self-reflection.

CO4 Develop commitment and courage to act.

PRE-REQUISITE

None. Universal Human Values 1 (Desirable)

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M	M	M	S			M	-	-
CO2						S	M		S	S		S	-	-
CO3								M	M		W	S	-	-
CO4								S	M		M	M	-	-

COURSE ASSESSMENT METHODS

Direct
1. Assessment by faculty mentor 2. Self-assessment 3. Socially relevant project/Group Activities/Assignments 4. End Semester Examination
Indirect
Assessment by peers (Survey form)

COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION

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

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

UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF!

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

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

UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP

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

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

UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE

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

IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

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4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:

   a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
   b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

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

COURSE DURATION:

No	MODULE	HOURS
1	Module 1	[7 Theory+ 3 Tutorial] 10 Hrs
2	Module 2	[6 Theory+ 3 Tutorial] 9 Hrs
3	Module 3	[7 Theory+ 3 Tutorial] 10 Hrs
4	Module 4	[5 Theory+ 3 Tutorial] 8 Hrs
5	Module 5	[5 Theory+ 3 Tutorial] 8 Hrs
	Total	**45**

Theory: 30 Hours	**Tutorial:15**	**Practical: 0**	**Project: 0**	**Total: 45 Hours**

TEXT BOOK:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

REFERENCE BOOKS:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)
14. https://www.youtube.com/watch?v=E1STJoXCXUU&list=PLWDeKF97v9SP_Kt6jqzA3pZ3yA7g_OAQz
15. https://www.youtube.com/channel/UCo8MpJB_aaVwB4LWLAx6AhQ
16. https://www.uhv.org.in/uhv-ii

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SEMESTER - V

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U18EET5001 POWER ELECTRONICS

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Distinguish the operation, capabilities, characteristics of various power semiconductor devices and driver circuits.	**K4**
CO2	Analyze the performance of AC-DC converter for different loads	**K4**
CO3	Design and analyze step-down and step-up choppers in DC to DC converters.	**K4**
CO4	Apply the Voltage and frequency control of inverters and AC-AC converters	**K3**
CO5	Design simulation model for power electronic converters	**K5**

PRE-REQUISITE

1. Analog Electronics
2. Circuit Theory

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													M
CO2	S	M	M	M	M								W	M
CO3	S	M	M		M								M	M
CO4	S	M	W										M	M
CO5	M	W			M								M	W

COURSE ASSESSMENT METHODS

Direct Tools

1. Continuous Assessment Test I, II
2. Assignment, Open book test, Group Presentation, Mini Projects, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect Tools

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

POWER SEMI-CONDUCTOR DEVICES **9 Hours**

Power diode, power BJT, SCR, Power MOSFET and IGBT – Structure and operation, Static and switching characteristics- Structure and V-I characteristics of GTO and TRIAC- Driver and snubber circuits.

AC TO DC CONVERTERS **9 Hours**

Single phase and three phase half and fully controlled converters – Effect of source inductance – Analysis of converters with R and RL loads - Performance parameters - Dual converters.

DC TO DC CONVERTERS **9 Hours**

Step-down chopper - Time ratio control and current limit control – Step-up chopper- Two quadrant and four quadrant choppers - Switching mode regulator - Buck, boost, buck-boost converters- Isolated converter: forward and flyback topology-DC-DC Converters for PV systems.

DC TO AC CONVERTERS **9 Hours**

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Single phase and three phase bridge voltage source inverters –Voltage control and harmonic reduction (waveform improvement) - Current source inverter- Inverters application for Induction Heating and UPS.

AC TO AC CONVERTERS **9 Hours**

Single phase and Three phase AC voltage controllers – Phase control – PWM control- single and three phase cyclo converters – On load Transformer Tap Changers-Simulation of Power Electronic Circuits (Quantitative)

TEXT BOOKS

1. M.H. Rashid, "Power Electronics: Circuits, Devices and Applications", 3rd Edition, Pearson Education, 2014, New Delhi.
2. M.D. Singh, K. B. Khanchandani, "Power Electronics", 2nd Edition, Tata McGraw Hill, 2006, New Delhi.John B Peatman, "Designing with PIC Micro Controller", McGraw-Hill, 2013.

REFERENCES

1. Ned Mohan, Tore. M. Undeland, William. P. Robbins, "Power Electronics: Converters, Applications and Design", 3rd Edition, Wiley, 2010, India.
2. Vidhyathil Joseph, "Power Electronics Principles and Applications",McGraw Hill Education (India), 2010.
3. Williams, B. W., "Power Electronics: Devices, Drivers, Applications, and Passive Components" 3rd Edition, McGraw Hill, 2006.
4. Andrzej M. Trzynadlowski, "Introduction to Modern Power Electronics", 2nd Edition, Wiley India Pvt. Ltd., 2011.
5. P.S. Bimbra, "Power Electronics", Khanna Publishers, 2012, New Delhi.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

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U18EEI5202 **MICROPROCESSORS AND MICROCONTROLLERS**

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Apply the fundamentals of 8-bit and 16-bit microprocessors architectures and analyze their role in embedded systems.	**K3**
CO2	Program 8051 microcontroller in assembly language using its addressing modes, and instruction set.	**K3**
CO3	Apply data serialization techniques and interface programming methods to demonstrate the working of various peripherals with 8051 microcontrollers.	**K3**
CO4	Illustrate the architecture and memory organization of PIC 16F8xx and categorize addressing modes.	**K3**
CO5	Analyze I/O port interface using embedded 'C' programs for PIC microcontroller	**K4**
CO6	Demonstrate proficiency in interfacing various peripherals with microcontrollers through laboratory experiments.	**K5**

PRE-REQUISITE

1. Digital Electronics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M											M	M
CO2	S	M	M		M								M	M
CO3	S	S	M	M									M	S
CO4			S	S	S								M	M
CO5			S	S	S				M				M	S
CO6				M					M				M	S

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Model Examination (For Practical Courses & Embedded Courses)
3. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
4. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

THEORETICAL COMPONENT CONTENTS:

INTRODUCTION **9 Hours**

Overview and comparison of microprocessors and microcontrollers - vendors in microprocessors and microcontrollers - Fundamentals of 8-bit and 16-bit microprocessors: Architectures – Pin diagrams – Pipelining concepts - Role of microprocessors and microcontrollers in embedded systems.

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8051 MICROCONTROLLER **9 Hours**

8051 architecture – I/O pins – ports – addressing modes – instruction set– timers and counters – serial data communication – interrupts – memory organization – assembly language programming.

8051 PROGRAMMING USING EMBEDDED 'C' **9 Hours**

Port initialization – data types – time delay – logic operations – data conversion – data serialization – Interface Programming: relay – timer – serial communication – LED – LCD – Programming Tools: KEIL IDE.

PIC MICROCONTROLLER **9 Hours**

Architecture of PIC 16F8xx – FSR – Oscillator Circuit – Program Memory organization- Register File Structure - Addressing Modes – Interrupts.

PICPROGRAMMING USING EMBEDDED 'C' **9 Hours**

Port initialization – data types – time delay – logic operations - Internal structure and Programming: I/O ports —Timers – capture/compare/PWM module – ADC - 7segment display – SPI. Programming Tools: MPLABORATORY IDE.

PRACTICAL COMPONENT CONTENTS:
LIST OF EXPERIMENTS

8051 Program using Assembly Language

1. Programs for 8-bit arithmetic, control instructions using 8051 microcontroller
2. Stepper motor interfacing with 8051 microcontroller

8051 Program using Embedded C

3. LED and Timer programming
4. Serial communication to PC

PIC Program using Embedded C

5. LED and Timer programming
6. Interfacing with LCD
7. Interfacing with Seven segment display
8. Analog to Digital conversion
9. Generation of PWM pulse
10. Interfacing with communication modules

TEXTBOOKS

1. Ramesh S Gaonkar, "Microprocessor architecture programming and application with 8085", 6th Edition, Penram International publication, New Delhi, 2011.
2. Muhammad Ali Mazidi, Janice GillispieMazidi, RolinD.Mckinlay, "The 8051 microcontroller and embedded systems using assembly and C", 2nd Edition, Pearson Education, 2011.
3. John B Peatman, "Designing with PIC Micro Controller", McGraw-Hill, 2013.

REFERENCES

1. Kenneth J Ayala, "The 8051-microcontroller architecture programming and application", Penram International publication, New Delhi, 2004.
2. MykePredko, "Programming and Customizing the PIC Microcontroller", McGraw-Hill, New York, 2007.
3. PIC16F87XA Data Sheet [Online] Available: http://www.wvshare.com/datasheet/Microchip_PDF/ PIC16F877A.PDF.

Theory: 45 **Tutorial: 0** **Practical: 30** **Project: 0** **Total: 75 Hours**

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U18EEI5203 CONTROL SYSTEMS

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Analyze the basics of control systems theory and apply mathematical modeling techniques.	**K4**
CO2	Analyze the system response in time domain	**K4**
CO3	Apply frequency response analysis and understand their significance.	**K3**
CO4	Analyze stability concepts in control systems and apply root locus techniques for stability analysis.	**K4**
CO5	Apply state variable analysis techniques and assess system controllability and observability.	**K3**
CO6	Demonstrate the application of various control techniques in laboratory experiments.	**K3**

PRE-REQUISITES

1. Partial Differential Equations and Transforms

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M											W	S
CO2	S	M			M								W	M
CO3	S	M	W		M								W	M
CO4	S	M	W										S	M
CO5	M	M			W				S			M	M	S
CO6	S	S	W		S				S				M	S

COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II 2. Model Examination (For Practical Courses & Embedded Courses) 3. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable) 4. End Semester Examination
Indirect
1. Course End Survey 2. Programme Exit Survey 3. Placement/Higher Education Record 4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

THEORETICAL COMPONENT CONTENTS:

SYSTEMS AND THEIR REPRESENTATION **9 Hours**

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Basic elements in control systems – Open and closed loop systems -Mathematical modelling of physical systems: Transfer function model of Mechanical and Electrical systems Electrical analogue of mechanical systems - Transfer function of DC Servo motor and AC Servomotor-Block diagram reduction techniques – Signal flow graphs.

TIME RESPONSE ANALYSIS **9 Hours**

Time response – Types of test input-step, ramp, impulse and parabolic inputs – I order system response for step, ramp and impulse input and II order system Response for step input– Time domain specifications -Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

FREQUENCY RESPONSE ANALYSIS **9 Hours**

Frequency response – Frequency domain specifications- Correlation between frequency domain and time domain specifications– Polar plot – Bode plot- Introduction to Constant M and N circles.

STABILITY OF CONTROL SYSTEM **9 Hours**

Definition of Stability - Location of roots of Characteristics equation in S plane for stability – Routh Hurwitz criterion – Root locus Techniques – Effect of pole, zero addition – Gain margin and phase margin –Concepts of Nyquist stability criterion.

STATE VARIABLE ANALYSIS **9 Hours**

State space formulation-state model of linear system-state diagram-state space representation using physical variable- state space representation using phase variable - state space representation using canonical variable-Solution of state equations using Laplace transform-Concepts of Controllability and Observability.

PRACTICAL COMPONENT CONTENTS:
LIST OF EXPERIMENTS

1. Transfer function of DC and AC servo motors.
2. Analyse the different types of Controllers (PI, PD, PID) using simulation and experiment.
3. Time Response of First order and second order system using simulation and experiment.
4. Stability analysis of linear systems.
5. Measurement of R, L and C using different bridges.
6. Calibration of
    a. Single phase Energy Meter.
    b. Wattmeter using CT and PT.
7. A/D and D/A Converters.
8. Measurement of Non Electrical Quantities using Transducers.
9. Data Acquisition System using LabView
10. Measurement of high resistance using Megger.

TEXT BOOKS

1. I.J. Nagrath& M. Gopal, "Control Systems Engineering", 5th Edition, New Age International Publishers, New Delhi, 2007.
2. M. Gopal, "Control Systems, Principles & Design", 4th Edition, Tata McGraw Hill, New Delhi, 2012.

REFERENCES

1. K. Ogata, "Modern Control Engineering", 5th Edition, Pearson Education, New Delhi, 2010.
2. B.C. Kuo, "Automatic Control Systems", 7th Edition, Prentice Hall of India Ltd., New Delhi, 2003.
3. R. Anandha Natarajan and B. Ramesh Babu, "Control System Engineering", 3rd Edition, Scitech Publication, 2009.
4. Norman S. Nise, "Control Systems Engineering", 4th Edition, John Wiley & Sons, Inc., 2007.
5. M.N. Bandyopadhyay, "Control Engineering Theory & Practice", Prentice Hall of India, 2004.

Theory: 45 Tutorial:0 Practical: 30 Project: 0 Total: 75 Hours

Signature of the Chairman BOS EEE

U18EET5004 ELECTRICAL MACHINE DESIGN

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

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

CO1	Understand the major considerations and constraints in electrical machine design to evaluate their impact on performance and functionality.	**K2**
CO2	Design DC Machines with the key components for the given specifications.	**K4**
CO3	Design the components Single phase and Three phase Transformers along with cooling methodologies.	**K4**
CO4	Apply design principles to analyze the output equations and main dimensions of induction and synchronous machines.	**K3**
CO5	Apply the principles of computer-aided design (CAD) , C Programming to analyze and design DC Machines and Transformers.	**K4**

PRE-REQUISITE

1. DC Machines and Transformers
2. Induction and Synchronous machines

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M												
CO2	M	S	S										S	
CO3	M	S	S										S	
CO4	M	S	S										S	
CO5	S	S	S		S								M	M

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Model Examination (For Practical Courses & Embedded Courses)
3. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
4. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

DESIGN CONSIDERATIONS AND MAGNETIC CIRCUIT CALCULATIONS 9 HOURS

Major Considerations and Constraints in Electrical Machine Design, Electrical and Magnetic Materials, Insulating Materials for rotating electrical machines and transformers, Thermal Design Aspects, Types of Enclosures and Cooling Methods.

B-at Curves, MMF calculation for Air gap and Teeth, Real and Apparent Flux Densities, General Concepts in the Design of Rotating Machines-Main Dimensions, Magnetic and Electric Loadings, Choice of Loadings.

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DC MACHINES **9 HOURS**

Output Equation of DC Machines, Main Dimensions, Choice of Poles, Design of Armature – Choice of Windings, slots, core depth, Design of Commutator and Brushes, Losses and Efficiency Calculations.

TRANSFORMERS **9 HOURS**

kVA rating of Single Phase and Three Phase Transformers, Volt per turn, Design of Core, Yoke and Windings for Core and Shell Type Transformers, Overall Dimensions, Design of Cooling Tanks with tubes.

INDUCTION AND SYNCHRONOUS MACHINES **13 HOURS**

Output Equation of Poly-phase AC Machines, Main Dimensions, Induction Machine - Stator design, Design of Squirrel Cage Rotor (Bars, Slots, End Rings), Design of Wound Rotor.
Synchronous Machine – Design of Salient Pole Machines, Short Circuit Ratio, Effect of SCR on Machine Performance, Design of Stator and Rotor, Design of Field Coil.

COMPUTER APPLICATION IN MACHINE DESIGN **5 HOURS**

Computer Aided Design (CAD)-Analysis, Synthesis and Hybrid Approaches, Design of DC Machine and Transformer using C Programming Language, Introduction to Machine Design Software.

TEXTBOOKS

1. K.M.V. Murthy, "Computer Aided Design of Electrical Machines", B S Publications, 2008.
2. S.K. Sen, "Principles of Electrical Machine Design with Computer Programmes", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2nd Edition, 2006.
3. R.K. Agarwal, "Principles of Electrical Machine Design", S.K. Kataria and Sons, Delhi, 5th Edition, 2014.
4. A Shanmugasundaram, G. Gangadharan, R. Palani, "Electrical Machine Design Data Book", New Age Pvt. Ltd., Reprint of 1st Edition, 2007.

REFERENCES

1. A.K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, New Delhii, 5th Edition, 1997.
2. V.N. Mittle and A. Mittle, "Design of Electrical Machines", Standard Publications and Distributors, Delhi, 5th Edition, 2014.

Theory: 45 Tutorial:0 Practical: 0 Project: 0 Total: 45 Hours

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U18EET5005	DIGITAL SIGNAL PROCESSING	L	T	P	J	C
		3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Analyze and categorize the various types of signals and systems	**K3**
CO2	Analyze stability of discrete-time systems using Z-transform and difference equation methods.	**K4**
CO3	Compute, simulate and analyze the DFT using FFT algorithms.	**K3**
CO4	Design and realize digital filters using windowing techniques and frequency transformations.	**K4**
CO5	Illustrate the architecture of DSP processor and speed control of PMSM motor using TMS 320F281 Processor.	**K3**

PRE-REQUISITE

1. Partial Differential Equations and Transforms

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S												
CO2	S	S											M	M
CO3	S	S			M								M	S
CO4	S	S	M										M	S
CO5	M	M	M		M						M		S	M

COURSE ASSESSMENT METHODS

Direct Tools
1. Continuous Assessment Test I, II 2. Assignment, Open book test; Cooperative learning report, Group Presentation, Problem based learning, Project based learning, Mini Projects, Project report, Quiz, Role play, Self-Explanatory videos, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination
Indirect Tools
1. Course-end survey 2. Programme Exit survey 3. Placement/Higher education record 4. Feedback (Students, Employers, Parents, Professional body members, Alumni)

SIGNALS AND REPRESENTATION **7 Hours**

Classification of signals: One Dimensional, Two-Dimensional, Three Dimensional Signal. Various Classification of Systems and signals - Basic Elements of DSP, Sampling Theorem - Applications of Digital Signal Processing - ECG.

DISCRETE TIME SYSTEM ANALYSIS **9 Hours**

Z-transform and its properties, ROC, Inverse z-transforms; difference equation – Solution by z-transform, Stability analysis, Linear and Circular Convolution.

DISCRETE FOURIER TRANSFORM & COMPUTATION **9 Hours**

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DFT, magnitude and phase representation - Computation of DFT using FFT algorithm radix 2 – DIT and DIF –MATLAB Programming for FFT Computation.

DESIGN OF DIGITAL FILTERS **11 Hours**

FIR Filter – Linear phase characteristics - Windowing Techniques. IIR design - Analog filter design - Butterworth approximations - digital design using impulse invariant and bilinear transformation - Warping, pre-warping, Frequency transformation. FIR & IIR filter realization.

DSP PROCESSOR **9 Hours**

Introduction to DSP processors - Architecture and features of TMS 320F281 Processor – General purpose timer - PWM generation unit - capture control units- Introduction to code composer studio - DSP based speed control of PMSM motor.

REFERENCES

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, 2003 / PHI.
2. D.H. Hayes, "Digital Signal Processing", Schaum's Outline Series, Tata McGraw Hill, New Delhi, 2007.
3. B. Venkataramani, M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications", Tata McGraw Hill, New Delhi, 2003.
4. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, "Discrete – Time Signal Processing", Pearson Education, New Delhi, 2003.
5. Ramesh Babu, "Digital Signal Processing", 4th Edition, SciTech Publications (India) Pvt.Ltd.,2012.
6. "TMS320F281 data sheet and application notes", www.ti.com.

Theory:45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

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SEMESTER - VI

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U18EEI6201	EMBEDDED SYSTEM	L	T	P	J	C
		2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	apply fundamental concepts of embedded systems to understand their architecture and functioning.	**K3**
CO2	analyze various communication protocols used in embedded systems to distinguish their applications.	**K4**
CO3	evaluate the role of Real-Time Operating Systems (RTOS) in enhancing the performance of embedded systems.	**K3**
CO4	demonstrate proficiency in ARM architecture, including its programmer's model, registers, and processor modes.	**K3**
CO5	Apply and optimize embedded C code for ARM LPC2148 to achieve efficient resource utilization.	**K3**
CO6	design and implement embedded systems solutions using practical programming techniques and protocols learned in the laboratory sessions.	**K4**

PRE-REQUISITE

Microprocessors and Microcontrollers

O/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M											S	M
CO2	S	M											M	M
CO3	S	S	S	M	M				M		M	M	M	
CO4			S	S	S				S		M	M	S	S
CO5	S		M		M						M		S	M
CO6	S	M	S		S	M			M			M	M	S

COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II 2. Model Examination (For Practical Courses & Embedded Courses) 3. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable) 4. End Semester Examination
Indirect
1. Course End Survey 2. Programme Exit Survey 3. Placement/Higher Education Record 4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

THEORETICAL COMPONENT CONTENTS:

INTRODUCTION TO EMBEDDED SYSTEMS AND RTOS **10 Hours**

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Embedded Systems: Fundamentals, I/O Devices and Classification – Embedded product life cycle – Communication Devices and Ports – Serial Communication Protocols: SPI, I^2C, CAN, USB – Wireless and Mobile System Protocols – RTOS for Embedded Systems – Task Scheduling and Policies.

ARM ARCHITECTURE **10 Hours**

ARM Programmer's model – Registers – Processor modes – Pipeline – Interrupts – ARM organization – ARM processor families – Overview of ARM and Thumb instructions – Instruction Scheduling – ARM Memory Management Unit – Register Allocation.

ARM LPC2148 PROGRAMMING **10 Hours**

Writing and optimizing the embedded C Code – Profiling and Cycle Counting – Conditional Execution – Looping Constructs – Timers and counters – Watchdog timer – UART – ADC – DAC – PWM. Programming Tool: KEIL IDE.

PRACTICAL COMPONENT CONTENTS:

LIST OF EXPERIMENTS ARM LPC2148

1. Program using Arithmetic operations
2. Program using logic operations
3. LED programming
4. Analog to digital conversion
5. PWM control
6. Timer programming
7. Interrupt programming
8. Interfacing with LCD
9. Interfacing with Seven segment display
10. Study on communication protocols

TEXTBOOKS

1. Raj Kamal, "Embedded Systems – Architecture, Programming and Design", 2nd Edition, Tata McGraw Hill, New Delhi, 2013.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Ray field 'ARM System Developer's Guide Designing and Optimizing System Software', Morgan Kaufmann Publishers, 2009.

REFERENCES

1. Steve Furber, "ARM System-on-Chip Architecture", Pearson Education, 2013.
2. Trevor Martin, 'The Insider's Guide to the Philips ARM7-Based Microcontrollers, An Engineer's Introduction To The LPC2100 Series' Hitex (UK) Ltd.,
3. David E Simon, "An Embedded Software Primer", Pearson Education India, New Delhi, 2013.
4. https://www.nxp.com/docs/en/data-sheet/LPC2141_42_44_46_48.pdf.

Theory: 30 **Tutorial: 0** **Practical: 30** **Project: 0** **Total: 60 Hours**

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U18EET6002 POWER SYSTEM PROTECTION AND SWITCHGEAR

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand the principles of protection schemes and relays against faults	**K3**
CO2	Classify the various types of circuit breakers and their working	**K3**
CO3	Analyze the protection schemes for different power system components	**K4**
CO4	Demonstrate the basic principles of digital protection	**K3**
CO5	Analyze protection schemes and wide-area measurements for improving protection systems	**K4**

PRE-REQUISITE

1. Transmission and Distribution
2. Electrical Machines

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M					M							S	M
CO2	S												S	M
CO3	M	M											M	M
CO4	M	M			M								M	M
CO5	M	M			M	M							M	M

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

PROTECTION SCHEMES **9 Hours**

Principles and need for protective schemes – Methods of Neutral grounding – Zones of protection and essential qualities of protection – Protection schemes-Operating principles of relays–Classification of relays- Electromagnetic Relays –Directional, Differential relays.

CIRCUIT BREAKERS **9 Hours**

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching - current chopping - interruption of capacitive current - Types of circuit breakers –air break, oil, SF6 and vacuum circuit breakers –Rating and selection of Circuit breakers- Types of MCB curves (B,C,D).

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APPARATUS PROTECTION **9 Hours**

Current transformers and Potential transformers and their applications in protection schemes- Transformer and Generator protection. Bus Bar arrangement schemes and its Protection.

DIGITAL PROTECTION **9 Hours**

Computer-aided protection- Block diagram of Numerical relays –distant protection of transmission lines-Demonstration of time based over-current Relays, Overload Relays.

SYSTEM PROTECTION **9 Hours**

System Protection Schemes. Under-frequency, under- voltage and df/dt relays, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

TEXTBOOK

1. Sunil S. Rao, "Switchgear and Protection and Power System", 13th Edition, Khanna publishers, New Delhi, 2008.
2. M.L. Soni, P.V. Gupta, V.S. Bhatnagar, A. Chakrabarti, "A Text Book on Power System Engineering", 2nd Edition, DhanpatRai& Co., 2009.

REFERENCES

1. Y.G. Paithankar and S.R. Bhide, "Fundamentals of Power System Protection", 2nd Edition, Prentice Hall of India, New Delhi, 2010.
2. Badri Ram, Vishwakarma, "Power System Protection and Switchgear", 2nd Edition, Tata McGraw Hill, New Delhi, 2012.
3. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.
4. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.

Theory: 45 **Tutorial: 0** **Practical:0** **Project: 0** **Total: 45 Hours**

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U18EEI6203 POWER SYSTEM ANALYSIS

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Apply techniques to represent power system components in per unit quantities.	**K3**
CO2	Apply techniques to solve power flow equations using Gauss Seidel, Newton Raphson, and Fast Decoupled methods.	**K3**
CO3	Analyze symmetrical faults in power systems using sequence impedances and networks.	**K4**
CO4	Analyze unsymmetrical faults including single line to ground, line-to-line, and double line to ground faults.	**K4**
CO5	Evaluate power system stability through steady state and transient stability analysis using swing equation and equal area criterion.	**K4**
CO6	Simulate software-based solutions for power system analysis experiments including bus admittance matrix formulation, load flow analysis, and stability analysis.	**K4**

PRE-REQUISITE

1. Partial Differential Equations and Transforms
2. Transmission and Distribution
3. AC Machines

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S		M									S	M
CO2	S	M	M	M	M								S	M
CO3	S	M		M	M								S	M
CO4	S	M	M	W	M								S	
CO5	S	M			M				W				M	
CO6	S	M			S				M				S	M

COURSE ASSESSMENT METHODS

Direct Tools

1. Continuous Assessment Test I, II
2. Model Examination(For Practical courses & Embedded courses)
3. Assignment, Open book test; Cooperative learning report, Group Presentation, Problem based learning, Project based learning, Mini Projects, Project report, Quiz, Role play, Self-Explanatory videos, Prototype or Product Demonstration etc. (as applicable)
4. End Semester Examination

Indirect Tools

1. Course-end survey
2. Programme Exit survey
3. Placement/Higher education record
4. Feedback (Students, Employers, Parents, Professional body members, Alumni)

THEORETICAL COMPONENT CONTENTS:

PER UNIT REPRESENTATION OF POWER SYSTEM **9 Hours**

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Basic components of a power system – Representation of Power System Components: Synchronous machines, Transformers, Transmission lines - Single line diagram- impedance and reactance diagrams, per unit quantities, changing the base of per unit quantities, advantages of per unit system.

POWER FLOW ANALYSIS **11 Hours**

Introduction – Bus Classification – Bus admittance matrix – Solution of load flow equations: Gauss Seidel method – Newton Raphson method – Fast decoupled Method – Introduction to (Electromagnetic Transient Analyser Programme) ETAP software for power system analysis.

SYMMETRICAL FAULT ANALYSIS **9 Hours**

Types of faults- Formation of Z_{bus} using building algorithm - Symmetrical faults -Transient in R-L series circuit, calculation of 3-phase short circuit current and reactance of synchronous machine, internal voltage of loaded machines under transient conditions.

UNSYMMETRICAL FAULT ANALYSIS **9 Hours**

Unsymmetrical faults- Symmetrical components- Sequence impedances and sequence networks - Analysis of single line to ground fault, line-to-line fault and double Line to ground fault.

POWER SYSTEM STABILITY **7 Hours**

Steady state and Transient stability–stability limits - swing equation – Equal area criterion-critical clearing angle and time – Multimachine stability analysis.

PRACTICAL COMPONENT CONTENTS:

LIST OF EXPERIMENTS

1. Bus admittance matrix formulation using MATLAB.
2. Load Flow Analysis – Gauss Seidel Method using MATLAB.
3. Load Flow Analysis – Newton-Raphson Method using ETAP.
4. Economic dispatch with and without losses using MATLAB.
5. Z-bus Formation using MATLAB.
6. Short circuit analysis on a power system using power world simulator.
7. Unsymmetrical Fault Analysis using ETAP.
8. Solution of swing equation using MATLAB.
9. Stability analysis using MATLAB.

TEXT BOOKS

1. HadiSaadat “Power system analysis”, Tata McGraw Hill, New Delhi, 2010
2. D P Kothari, I J Nagrath ‘Modern Power System Analysis’, 3rd Edition, 2011.

REFERENCES

1. John .J. Grainger &Stevenson.W.D., 'Power System Analysis', McGraw Hill, 1 st Edition, 2003
2. P. Kundur, “Power System Stability and Control”, 1st Edition, McGraw Hill Publishing, 2006.
3. B. R. Gupta “Power System Analysis and Design”, 5th Edition, S.Chand& Company, 2005.
4. M.A. Pai, “Computer Techniques in power system Analysis”, 3rd Edition, McGraw Hill, New Delhi, 2014.

Theory: 30 **Tutorial: 15** **Practical: 30** **Project: 0** **Total: 75 Hours**

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U18EEI6204 SOLID STATE DRIVES

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Apply the basics of drive characteristics to analyze motor behavior in different operating conditions.	**K3**
CO2	Apply analytical methods to assess the performance parameters of converter-fed DC motor drives.	**K3**
CO3	Analyze the operation of chopper-fed DC drives to differentiate between single quadrant and four quadrant control.	**K4**
CO4	Evaluate the suitability of induction motor drive techniques for various applications such as steel rolling mills and traction systems.	**K4**
CO5	Analyze the operation of synchronous motor drives and propose improvements for specific applications.	**K4**
CO6	Design and implement laboratory experiments to simulate and analyze the performance of power converters and motor drives.	**K4**

PRE-REQUISITE

1. Power Electronics
2. DC machines and Transformers
3. AC Machines

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M											M	
CO2	S	M	M										M	
CO3	S	M	M										W	M
CO4	S	M	M										W	M
CO5	S		S		M				W				M	M
CO6	S	M	M		S				M				M	M

COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II 2. Model Examination (For Practical Courses & Embedded Courses) 3. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable) 4. End Semester Examination
Indirect
1. Course End Survey 2. Programme Exit Survey 3. Placement/Higher Education Record 4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

THEORETICAL COMPONENT CONTENTS:

DRIVE CHARACTERISTICS **9 Hours**

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Elements of electric drive system- dynamic equations-speed torque characteristics of various types of loads – multi quadrant operation- Selection of power rating for drive motors: classes of duty, heating and cooling – constant torque and constant power operations - Electrical Braking.

CONVERTER FED DC DRIVES **9 Hours**

Single phase half controlled and fully controlled converter fed DC motor drive - Three phase half controlled and fully controlled converter fed DC motor drive - Performance parameters -Dual converter fed separately excited DC motor drive.

CHOPPER FED DC DRIVES **9 Hours**

Single quadrant chopper fed DC motor drive - Analysis of performance parameters of step-down chopper fed separately excited DC motor drive – Two quadrant and four quadrant chopper fed DC drive.

INDUCTION MOTOR DRIVES **9 Hours**

Stator voltage controller fed induction motor drive – VSI and CSI fed induction motor drive - static rotor resistance control - Slip power recovery scheme - Introduction to vector control of induction motor drive.

SYNCHRONOUS MOTOR DRIVE AND DRIVE APPLICATIONS **9 Hours**

Synchronous motor drive: V/F control- self-control – Permanent Magnet Synchronous motor drive- Drive applications: steel rolling mill– paper mill – traction – cranes and lifts- BLDC motor drive- Electric Vehicle Drive - Simulation of simple DC and AC drive circuits using software tools.

PRACTICAL COMPONENT CONTENTS:
LIST OF EXPERIMENTS

1. Single phase AC-DC Converters with R and RL load.
2. MOSFET based step up and step-down choppers.
3. Single phase PWM inverter.
4. TRIAC based single phase voltage controller
5. Single phase Cyclo-converter.
6. Speed control of DC motor using three phase AC-DC converter.
7. Four quadrant chopper-based DC motor drive.
8. Speed control of Induction motor by V/F control method.
9. Simulation of single phase fully controlled converter with RLE load.
10. Simulation of Solar PV based DC drive.
11. Study of drive circuit for MOSFET/ IGBT
12. Harmonic Analysis in power converters

TEXTBOOKS

1. Gopal K. Dubey, “Fundamentals of Electric Drives”, 2nd Edition, Narosa Publishing House, New Delhi, 2015.
2. M.D. Singh, K.B. Khanchandani, “Power Electronics”, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.

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REFERENCES

1. S.K. Pillai, “A First Course on Electrical Drives”, 3rd Edition, New Age International Publishers, New Delhi, 2014.
2. Bimal K. Bose. “Modern Power Electronics and AC Drives”, 2nd Edition, Prentice Hall of India, 2005.
3. R. Krishnan, “Electric Motor & Drives Modeling, Analysis and Control”, 1st Edition, Prentice Hall of India, 2001.
4. VedamSubramanium, “Electric Drives Concepts and Applications”, 2nd Edition, Tata McGraw Hill, New Delhi, 2011.
5. P. C. Sen, “Thyristor DC Drives”, John Wiley & sons, New York, 2008.

Theory: 45 Tutorial: 0 Practical: 30 Project: 0 Total: 75 Hours

Signature of the Chairman BOS EEE

U18CSI6211 **DATA STRUCTURES AND ALGORITHMS**

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1 Develop simple algorithms for solving problems
CO2 Explain the basic data structures and its operations.
CO3 Explain basics of hashing and solve problems using trees
CO4 Summarize various searching and sorting algorithms.
CO5 Make use of graph based algorithms to solve problems.
CO6 Explain the concept of time complexity and space complexity.

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M	W											
CO2	M									W				M
CO3		M	W							W				M
CO4		M												M
CO5	S	M	W							W				M
CO6		M												W

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Model Examination (For Practical Courses & Embedded Courses)
3. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
4. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

THEORETICAL COMPONENT CONTENTS:

PROBLEM SOLVING **9 Hours**

Problem solving – Top-down Design – Implementation – Verification – Efficiency – Analysis – Sample algorithms.

LISTS, STACKS AND QUEUES **9 Hours**

Abstract Data Type (ADT) – The List ADT – The Stack ADT – The Queue ADT

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TREES **9 Hours**

Preliminaries – Binary Trees – The Search Tree ADT – Binary Search Trees – AVL Trees – Tree Traversals – Hashing – General Idea – Hash Function – Separate Chaining – Open Addressing – Linear Probing – Priority Queues (Heaps) – Model – Simple implementations – Binary Heap

SORTING **9 Hours**

Preliminaries – Insertion Sort – Shell sort – Heap sort – Merge sort – Quick sort – External Sorting

GRAPHS **9 Hours**

Definitions – Topological Sort – Shortest-Path Algorithms – Unweighted Shortest Paths – Dijkstra's Algorithm – Minimum Spanning Tree – Prim's Algorithm – Applications of Depth-First Search – Undirected Graphs – Biconnectivity – Introduction to NP-Completeness

PRACTICAL COMPONENT CONTENTS:

LIST OF EXPERIMENTS

1. Array implementation of stack
2. Linked implementation stack
3. Implementation of singly linked List
4. Implementation of doubly linked List
5. Implementation of circular Queue
6. Implement the application for checking 'Balanced Parenthesis' using array implementation of Stack ADT.
7. Implement the application for 'Evaluating Postfix Expressions' using linked list implementations of Stack ADT.
8. Implement Search Tree - Binary Search Tree
9. Implement Heap Sort
10. Implement Quick Sort

TEXT BOOK

1. R. G. Dromey, "How to Solve it by Computer" (Chaps 1-2), Prentice-Hall of India, 2002.

REFERENCES

1. M. A. Weiss, "Data Structures and Algorithm Analysis in C", 3rd edition, Pearson Education Asia, 2007. (chaps 3, 4.1-4.4 (except 4.3.6), 5.1-5.4.1, 6.1-6.3.3, 7.1-7.7 (except 7.2.2, 7.4.1, 7.5.1, 7.6.1, 7.7.5, 7.7.6), 7.11, 9.1-9.3.2, 9.5-9.5.1, 9.6-9.6.2, 9.7)

Theory: 45 Tutorial:0 Practical: 30 Project: 0 Total: 75 Hours

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U18INT6000 CONSTITUTION OF INDIA

L	T	P	J	C
2	0	0	0	0

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1 Gain Knowledge about the Constitutional Law of India
CO2 Understand the Fundamental Rights and Duties of a citizen
CO3 Apply the concept of Federal structure of Indian Government
CO4 Analyze the Amendments and Emergency provisions in the Constitution
CO5 Develop a holistic approach in their life as a Citizen of India

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						M			W			S
CO2						S		S				M
CO3									M	S		W
CO4								W	M			M
CO5						M		M				S

COURSE ASSESSMENT METHODS

Direct
1. Group Activity / Quiz/ Debate / Case studies 2. Class test / Assignment
Indirect
Surveys

Introduction to Indian Constitution **4 Hours**

Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution - Salient features and characteristics of the Constitution of India

Fundamental Rights **8 Hours**

Scheme of the fundamental rights - Right to Equality - Fundamental Right under Article 19 - Scope of the Right to Life and Liberty - Fundamental Duties and its legal status - Directive Principles of State Policy – Its importance and implementation

Federal Structure **8 Hours**

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India - The constitutional powers and status of the President of India

Amendment to Constitution **6 Hours**

Amendment of the Constitutional Powers and Procedure - The historical perspectives of the constitutional amendments in India

Emergency Provisions **4 Hours**

National Emergency, President Rule, Financial Emergency Local Self Government – Constitutional Scheme in India

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REFERENCES

1. Constitution of India - Ministry of Law & Justice – PDF format awmin.nic.in/coi/coiason29july08.pdf
2. Introduction to the Constitution of India by DurgadasBasu
3. The Constitution of India – Google free material - www.constitution.org/cons/india/const.html
4. Parliament of India – PDF format *download.nos.org/srsec317newE/317EL11.pdf*
5. The Role of the President of India – By Prof.Balkrishna
6. Local Government in India – E Book - Pradeep Sachdeva https://books.google.com/books/.../Local_Government_in_In...

Theory: 30 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 30 Hours**

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SEMESTER - VII

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U18MBT7000	ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT	L	T	P	J	C
		3	0	0	0	3

COURSE OUTCOMES

CO1	Evaluate the economic theories, Cost concepts and pricing policies	**K2**
CO2	Analyze the market structures and integration concepts	**K2**
CO3	Apply the concepts of national income and understand the functions of banks and concepts of globalization	**K2**
CO4	Apply the concepts of financial management for project appraisal and working capital management	**K2**
CO5	Understand accounting systems	**K2**
CO6	Analyze financial statements using ratio analysis	**K2**

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		M				M					M		M	
CO2				M		M					M		M	
CO3						M					M			
CO4				M							S			M
CO5											S			
CO6		M		M							S			M

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

ECONOMICS, COST AND PRICING CONCEPTS 9 Hours

Economic theories – Demand analysis – Determinants of demand – Demand forecasting – Supply – Actual Cost and opportunity Cost – Incremental Cost and sunk Cost – Fixed and variable Cost – Marginal Costing – Total Cost – Elements of Cost – Cost curves – Breakeven point and breakeven chart – Limitations of break even chart – Interpretation of break even chart – Contribution – P/V-ratio, profit-volume ratio or relationship – Price fixation – Pricing Policies – Pricing methods.

CONCEPTS ON FIRMS AND MANUFACTURING PRACTICES 9 Hours

Firm – Industry – Market – Market structure – Diversification – Vertical integration – Merger – Horizontal integration.

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NATIONAL INCOME, MONEY AND BANKING, ECONOMIC ENVIRONMENT — 9 Hours

National income concepts – GNP – NNP – Methods of measuring national income – Inflation – Deflation – Kinds of money – Value of money – Functions of bank – Types of bank – Economic liberalization – Privatization – Globalization

CONCEPTS OF FINANCIAL MANAGEMENT — 9 Hours

Financial management – Scope – Objectives – Time value of money – Methods of appraising project profitability – Sources of finance – Working capital and management of working capital

ACCOUNTING SYSTEM, STATEMENT AND FINANCIAL ANALYSIS — 9 Hours

Accounting system – Systems of book-keeping – Journal – Ledger – Trail balance – Financial statements – Ratio analysis – Types of ratios – Significance – Limitations

TEXT BOOKS

1. Prasanna Chandra, "Financial Management (Theory & Practice) 7th Edition, TMH, New Delhi, 2008.
2. J. Fred Weston, E.F. Brigham, "Essentials of Managerial Finance" 10th Edition, Dryden Press Series in Finance, 1996.

REFERENCES

1. Pandey, I. M., "Financial Management",12th Edition, Pearson India Publisher.
2. Fundamentals of Financial Management- James C. Van Horne.
3. Bhaskar S. "Engineering Economics and Financial Accounting",Anuradha Agencies, Chennai, 2003.
4. Financial Management & Policy -*J*ames C. Van Horne.
5. Management Accounting & Financial Management- M. Y. Khan & P. K. Jain.
6. Management Accounting Principles & Practice -P. Saravanavel.
7. Ramachandra Aryasri.A., and Ramana Murthy V.V., "Engineering Economics & Financial Accounting"-Tata McGraw Hill, New Delhi, 2006.
8. Varshney R.L., and Maheswari K.L., "Managerial Economics" – Sultan Chand & Sons, New Delhi, 2001.
9. Samvelson and Nordhaus, "Economics"-Tata McGraw Hill, New Delhi, 2002.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

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U18EET7001 SPECIAL ELECTRICAL MACHINES

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

CO1	Apply the operating principle and characteristics of synchronous reluctance motors to solve practical problems.	**K3**
CO2	Analyze the various modes of excitation and drive circuits in stepper motors to evaluate their performance.	**K4**
CO3	Evaluate the torque equation and power controllers of switched reluctance motors to justify their application in different scenarios.	**K4**
CO4	Analyze microprocessor-based control system for permanent magnet brushless DC motors to optimize their performance.	**K4**
CO5	Design a control strategy for permanent magnet synchronous motors considering speed-torque characteristics and converter requirements.	**K4**

PRE-REQUISITE

1. DC Machines and Transformers
2. Induction and Synchronous Machines
3. Power Electronics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S												M
CO2	S	M												M
CO3	S	S	M										M	M
CO4	S	M	W										M	M
CO5	S	M											M	S

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Assignment, Open book test; Cooperative learning report, Group Presentation, Problem based learning, Project based learning, Mini Projects, Project report, Quiz, Role play, Self-Explanatory videos, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course-end survey
2. Programme Exit survey
3. Placement/Higher education record
4. Feedback (Students, Employers, Parents, Professional body members, Alumni)

SYNCHRONOUS RELUCTANCE MOTORS **9 Hours**

Constructional features – Axial and radial air gap motors – Operating principle – Reluctance Torque – Phasor diagram - Characteristics – Vernier motor.

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STEPPER MOTORS **9 Hours**

Constructional features – Principle of operation – Modes of excitation- Torque production in Variable reluctance stepper motor – PM stepper- Hybrid motor – Single and multi stack configurations – Linear and non- linear analysis – Characteristics – Drive circuits- open loop and closed loop control.

SWITCHED RELUCTANCE MOTORS **9 Hours**

Constructional features – Principle of operation – Torque equation – Power controllers – Characteristics – Microprocessor based control - Computer control.

PERMANENT MAGNET BRUSHLESS DC MOTORS **9 Hours**

Commutation in DC motors – Difference between mechanical and electronic commutators – Hall sensors- Optical sensors- square wave PMBLDC drives - EMF and torque equations – Speed Torque characteristics - Power controllers - Microprocessor based control.

PERMANENT MAGNET SYNCHRONOUS MOTORS **9 Hours**

Principle of operation – EMF, power input and torque expressions – Phasor diagram – Power controllers – Converter Volt-ampere requirements – Torque speed characteristics - Microprocessor based control-Introduction to magnetic levitation.

TEXT BOOKS

1. K. V. Ratnam "Special Electrical Machines" Orient Blackswan/ University press, 2008.
2. T. Kenjo and S. Nagamori, "Permanent Magnet and Brushless DC Motors", Clarendon Press, Oxford University, London, 1990.

REFERENCES

1. T.J.E. Miller, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.
2. T. Kenjo, "Stepping Motors and Their Microprocessor Controls", Clarendon Press, Oxford University, London, 1994
3. V. V. Athani, "Stepper Motors – Fundamentals, Applications and Design", New Age International Publications, India, 2013.
4. R. Krishnan "Switched Reluctance Motor and Drives" CRC Press, Washington, 2001.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

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U18EEP7702 **PROJECT PHASE I**

L	T	P	J	C
0	0	0	6	3

COURSE OUTCOMES

CO1	Apply the knowledge of Electrical and Electronics Engineering to analyze technical issues and develop solution	**K4**
CO2	Design and develop system or prototypes by utilizing modern software tools and equipment	**K5**
CO3	Identify societal issues and provide environmental friendly and sustainable solution	**K4**
CO4	Develop professionalism, self-confidence, ethical responsibilities and team work	**K4**
CO5	Communicate effectively and report the findings in systematic manner	**K4**

PRE-REQUISITE

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	M	M	M	S	S		M	S	S	S
CO2	S	S	S	M	M	M	M	S	S		M	S	M	M
CO3	M	M	M			S	S	S	S	M	M	S	M	M
CO4						S	S	S	S	M	S	S	M	M
CO5	M	M								S	M	S	M	M

COURSE ASSESSMENT METHODS

Direct
1. Project Review 2. End Semester Viva Voce
Indirect
1. Course-end survey 2. Programme Exit survey 3. Placement/Higher education record 4. Feedback (Students, Employers, Parents, Professional body members, Alumni)

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U18EEP7703 **INDUSTRIAL TRAINING**

L	T	P	J	C
0	0	0	2	0

COURSE OUTCOMES

CO1	Develop technical , communication and interpersonal skills to meet the requirements of industrial needs.	**K4**
CO2	Apply ethical principles and norms of engineering practice in the Industrial Environment	**K5**
CO3	Communicate and collaborate effectively with the team and society	**K4**
CO4	Solve real life challenges in the workplace by analyzing work environment and scenarios.	**K4**
CO5	Develop work habits and attitudes necessary for job success	**K4**

PRE-REQUISITE

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S				S	S	S	S	S	S
CO2	M	S	S	S	S	S	S	S				S	S	S
CO3		M	M						S	S		S	S	S
CO4		S	S	S	S	S	S	M	M	M	S	S	S	S
CO5						S		S	S	S	S	S	S	S

2-4 weeks of Industrial Training during Summer/Winter vacation at the end of semesters 1-6 from 2021 Batch onwards. Evaluated during VII semester by assessing the report and conducting seminar presentation. Assessment is done by the panel composed of members nominated by the Head of the Department with the approval of CoE. In case a student score Letter “RA” grade in Internship course then he/she must repeat the internship.

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SEMESTER – VIII

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U18EEP8701 **PROJECT PHASE II**

L	T	P	J	C
0	0	0	24	12

COURSE OUTCOMES

CO1	Apply the knowledge of Electrical and Electronics Engineering to analyze technical issues and develop solution	**K4**
CO2	Design and develop system or prototypes by utilizing modern software tools and equipment	**K5**
CO3	Identify societal issues and provide environmental friendly and sustainable solution	**K4**
CO4	Develop professionalism, self-confidence, ethical responsibilities and team work	**K4**
CO5	Communicate effectively and report the findings in systematic manner	**K4**

PRE-REQUISITE

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	M	M	M	W	S		M	S	S	S
CO2	S	S	S	S	S	M	M	M	S		M	S	S	S
CO3	M	M	M			S	S	S	S	M	M	S	S	S
CO4						S	S	S	S	M	S	S	M	M
CO5	M	M								S	M	S	M	M

COURSE ASSESSMENT METHODS

Direct
1. Project Review 2. End Semester Viva Voce
Indirect
1. Course-end survey 2. Programme Exit survey 3. Placement/Higher education record 4. Feedback (Students, Employers, Parents, Professional body members, Alumni)

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ELECTIVES

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U18EEE0001	POWER SYSTEM OPERATION AND CONTROL	L	T	P	J	C
		3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Apply the basics of forecasting and control techniques in power systems.	**K3**
CO2	Analyze system load characteristics and formulate reserve requirements for efficient system operation.	**K4**
CO3	Evaluate the real and reactive power control mechanisms in power systems for stability and efficiency.	**K5**
CO4	Examine solutions for unit commitment problems considering various constraints.	**K4**
CO5	Evaluate the implementation of computational intelligence methods in economic dispatch for optimal power system operation.	**K5**

PRE-REQUISITE

1. Control Systems
2. Power System Analysis

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		M			M	W							M
CO2	S	M		M		W							M	
CO3		S		M									S	M
CO4	M	M		S		M							S	M
CO5	M	M		M		M							S	S

COURSE ASSESSMENT METHODS

Direct Tools
1. Continuous Assessment Test I, II 2. Assignment, Open book test; Cooperative learning report, Group Presentation, Problem based learning, Project based learning, Mini Projects, Project report, Quiz, Role play, Self-Explanatory videos, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination
Indirect Tools
1. Course-end survey 2. Programme Exit survey 3. Placement/Higher education record 4. Feedback (Students, Employers, Parents, Professional body members, Alumni)

FORECASTING AND CONTROL — 9 Hours

System load variation: System load characteristics, load curves-daily, weekly and annual, load-duration curve, load factor, diversity factor. Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves. Overview of system operation: Load forecasting, unit commitment, load dispatching. Overview of system control: Governor Control, LFC, EDC, AVR, system voltage control, security control.

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REAL AND REACTIVE POWER CONTROL **10 Hours**

REAL POWER CONTROL: Speed governing mechanism and modeling: Speed-loadcharacteristics– Loadsharingbetweentwosynchronousmachinesinparallel; LFC control of a single-area system: Static and dynamic analysis.

REACTIVE POWER CONTROL: Typical excitation system, modeling, static and dynamic analysis, stability compensation; generation and absorption of reactive power: Relation between voltage, power and reactive power at anode; method of voltage control: Injection of reactive power. Tap-changing transformer- MVAR injection of switched capacitors

UNIT COMMITMENT **8 Hours**

Statement of Unit Commitment (UC); constraints in UC: spinning reserve thermal unit constraints, hydro constraints, fuel constraints and other constraints; UC solution methods: Priority-list methods, numerical problems.

ECONOMIC DISPATCH **9 Hours**

Incremental cost curve, co-ordination equations without loss and with loss, solution by λ-iteration method, Computational intelligent method (Algorithm and Flowchart only). Base point and participation factors, Numerical problems.

COMPUTER CONTROL OF POWER SYSTEMS **9 Hours**

Energy control centre: Functions – Monitoring, data acquisition and control. System hard ware Configuration–SCADA and EMS functions: Network topology determination, state estimation, security analysis and control. Various operating states: Normal, alert, emergency, in extreme and restorative. State transition diagram showing various state transitions and control strategies.

TEXTBOOKS

1. Olle.I.Elgerd,"ElectricEnergySystemsTheory–AnIntroduction",2nd Edition, Tata McGraw Hill, 2008, New Delhi.
2. Allen. J. Wood and Bruce F. Wollenberg, "Power Generation, Operation and Control", Edition, John Wiley & Sons, Inc., 2014.

REFERENCES

1. I.J.NagrathandD.P.Kothari,"ModernPowerSystemAnalysis",4th Edition, Tata McGraw Hill, 2011, New Delhi.
2. P. Kundur, "Power System Stability & Control", 1st Edition, McGraw Hill, 2006, USA. PSR Murthy, "Operation & Control in Power System", 1st Edition, CRC Press, 2011.
3. S Sivanagaraju, G Sreenivasan, "Power System Operation and Control", Edition, Pearson Education, 2010.
4. Robert H. Miller, James H. Malinowski, "Power System Operation",3rd Edition, McGraw Hill, 2009.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

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U18EEE0002 ELECTRICAL ENERGY UTILIZATION AND CONSERVATION

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Apply principles to design illumination systems and Heating Elements according to specific requirements.	**K3**
CO2	Understand the concepts of electric heating, welding, electric traction, and braking systems.	**K1**
CO3	Illustrate the concepts and operation of electrochemical processes.	**K1**
CO4	Analyze different types of tariff structures, assess the impact of tariffs, and employ methods to optimize tariffs through energy conservation.	**K2**
CO5	Interpret the concepts of energy management and audit techniques.	**K1**

PRE-REQUISITE

1. Electric Circuits Analysis.
2. DC and AC Machines.

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	S	S	M		M								M
CO2	M					M							S	M
CO3	M						M						S	
CO4	S	M				S							S	M
CO5	S	M				S			M				S	M

COURSE ASSESSMENT METHODS

Direct Tools

1. Continuous Assessment Test I, II
2. Assignment, Open book test; Cooperative learning report, Group Presentation, Problem based learning, Project based learning, Mini Projects, Project report, Quiz, Role play, Self-Explanatory videos, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect Tools

1. Course-end survey
2. Programme Exit survey
3. Placement/Higher education record
4. Feedback (Students, Employers, Parents, Professional body members, Alumni)

ILLUMINATION,HEATING AND WELDING **9 Hours**

Natureofradiation-definition-laws-photometry-lightingcalculations-designofillumination- systems (for residential, industrial, commercial, health care, Street lightings, sports, administrative complexes) –types of lamps – energy efficient lamps. Methods of heating, requirement of heating material –design of heating element – furnaces – welding generator – welding transformer and its characteristics.

ELECTRIC TRACTION **9 Hours**

Introduction–requirements of an ideal traction system – supply systems – mechanics of train

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movement –traction motors and control –multiple units –braking –current collection system– recent trends in electric traction.

ELECTRO CHEMICAL PROCESS **9 Hours**

Introduction to electrolysis –electro plating–electrode position–extraction of metals–current – efficiency– batteries types –charging methods.

CONSERVATION **9 Hours**

LT and HT tariff structure–impact of tariff –power factor improvement methods–impact ofpowerqualityonHTbilling-introductiontoelectricalenergyconservation–Greenbuilding concept.

ENERGY MANAGEMENT ANDAUDIT **9 Hours**

Types of energy audit-Energy audit approach-understanding energy costs-Bench marking-Energy performance- Matching energy use to requirement-Maximizing system efficiencies-optimizing the input energy requirements- Fuel and energy substitution- Energy Audit instruments.

TEXTBOOKS

1. E. Openshaw Taylor, "Utilization of Electrical Energy in SI Units",1st Edition, Orient Longman Pvt. Ltd., New Delhi,2006.
2. GeneralAspectofEnergyManagementandEnergyAudit,2nd Edition, By Bureau of Energy Efficiency, Ministry of Power, India, 2005.

REFERENCES

1. H.Partab,"Art and Science of Utilization of Electrical Energy",1stEdition, DhanpatRai and Co., New Delhi, 2015.
2. Gopal. K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosa Publishing House, New Delhi, 2014.
3. C.L.Wadhwa,"Generation, Distribution and Utilization of Electrical Energy",Edition, New Age International, 2006.
4. J.B.Gupta,"Utilization of Electric Power and ElectricTraction",Kattaria and Sons, 2014.
5. M.L.Soni,P.V.Gupta,V.S.Bhatnagar,A.Chakrabarti,"ATextBookonPowerSystem Engineering", 2ndEdition, Dhanpat Rai & Co., 2014
6. Donald R Wulfinghoff, "Energy Efficiency Manual", Energy Institute Press, USA,1999.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

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U18EEE0003 HIGH VOLTAGE ENGINEERING

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Analyze the causes and effects of over voltages in electrical power systems.	**K4**
CO2	Evaluate methods of protection against over voltages in electrical power systems.	**K4**
CO3	Analyze the breakdown mechanisms in gases, solids, and liquids under high voltage conditions.	**K4**
CO4	Illustrate the various techniques for the generation and measurement of high voltages and high currents.	**K3**
CO5	Examine high voltage testing procedures for electrical power apparatus.	**K4**

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S												S	
CO2	S	M											S	
CO3	S	M											S	M
CO4	S	M											S	W
CO5	S			W									S	W

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

OVER VOLTAGES IN ELECTRICAL POWER SYSTEM 9 Hours

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages– protection against over voltages.

ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS 9 Hours

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids – Breakdown mechanisms in composite dielectrics.

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GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS **9 Hours**

Generation of high voltages- testing transformers in cascade- series resonant circuits and their advantages- half and full wave rectifier circuits- voltage doubler and cascade circuits- electrostatic generator- characteristics parameters of impulse voltages- single stage impulse generator circuits, multistage impulse generation circuits.

MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS **9 Hours**

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers – Peak Voltmeter, Generating Voltmeters – Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps – High current shunts- Digital techniques in high voltage measurement.

HIGH VOLTAGE TESTING OF ELECTRICAL POWER APPARATUS **9 Hours**

Testing of Insulator - Bushings - Isolators, Circuit breakers – Cables – Transformers.

TEXTBOOKS

1. M. S. Naidu and V. Kamaraju, “High Voltage Engineering”, 5th Edition, Tata McGraw Hill, New Delhi, 2013.
2. E. Kuffel and M. Abdullah, “High Voltage Engineering”, 2nd Edition, Pergamon Press, 2000.

REFERENCES

1. C.L Wadwa, “High Voltage Engineering”, 3rd Edition, New Age International, New Delhi, 2012.
2. T.J.Gallagher and A.J Pearmain, “High Voltage Measurement, Testing and Design”, 2nd Edition, Wiley, New York, 2007.
3. R.D. Begamudre, “High Voltage Engineering (Problems and Solution)”, 1st Edition, New Age International, New Delhi, 2010.

Theory: 45 **Tutorial: 0** **Practical:0** **Project: 0** **Total: 45 Hours**

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U18EEE0004 RESTRUCTURED POWER SYSTEM

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Analyze the reasons for restructuring of the power industry and its implications.	**K3**
CO2	Evaluate the importance of congestion management in a deregulated environment.	**K4**
CO3	Analyze different methods of transmission pricing and their implications.	**K4**
CO4	Evaluate the impact of market power on electricity markets and methods to mitigate it.	**K5**
CO5	Examine a framework for understanding reforms in the Indian power sector.	**K4**

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M												M	
CO2	M	M											M	M
CO3	M	M				W							S	
CO4	M					M							M	M
CO5	M					M							S	

COURSE ASSESSMENT METHODS

Direct Tools

1. Continuous Assessment Test I, II
2. Assignment, Open book test; Cooperative learning report, Group Presentation, Problem based learning, Project based learning, Mini Projects, Project report, Quiz, Role play, Self-Explanatory videos, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect Tools

1. Course-end survey
2. Programme Exit survey
3. Placement/Higher education record
4. Feedback (Students, Employers, Parents, Professional body members, Alumni)

INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY 9 Hours

IE Act 2003 - Reasons for restructuring / deregulation of power industry - Understanding the restructuring process - –Market equilibrium -Market clearing price- Electricity markets around the world.

TRANSMISSIONCONGESTIONMANAGEMENT 9 Hours

Definition of congestion - Reasons for transfer capability limitation - Importance of congestion management in deregulated environment - Effects of congestion - Desired features of congestion management schemes - Classification of congestion management methods - Calculation of ATC using PTDF and LODF based on DC model.

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PRICING OF TRANSMISSION NETWORK USAGE AND LOSS ALLOCATION 9 Hours

Power wheeling - Issues involved- Principles of transmission pricing - Classification of transmission pricing methods - Rolled-in transmission pricing methods: Postage stamp method, Incremental postage stamp method, Contract path method.

MARKET POWER AND GENERATORS BIDDING 9 Hours

Attributes of a perfectly competitive market -The firm's supply decision under perfect competition - Imperfect competition: Monopoly, Oligopoly - Electricity markets under imperfect competition - Market power: Sources of market power, Effect of market power, Identifying market power, Market power mitigation.

REFORMS IN INDIAN POWER SECTOR 9 Hours

Framework of Indian power sector : Historical Developments - The Institutional Framework- The Electricity Act 2003 - Provisions in the generation sector - the transmission sector - the distribution sector - Power trading - Open Access issues - Power exchange.

TEXTBOOKS

1. Kankar Bhattacharya, Jaap E. Daadler, Math H.J Bollen, "Operation of restructured power systems", 1st Edition, Kluwer Academic Publisher,2001.
2. Mohammad Shahidehpour, MuwaffaqAlomoush, Restructured Electrical Power Systems: Operation, Trading and Volatility.

REFERENCES

1. S. A. Khaparde, A.R. Abhyankar, "Restructured Power Systems", 1st Edition, Alpha Science International Publications,2006.
2. Indian Energy Exchange :http://www.iexindia.com
3. Power Exchange India Limited: http://www.powerexindia.com/
4. Indian Electricity Regulations :http://www.cercind.gov.in

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

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U18EEE0005 **VLSI DESIGN**

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Apply principles of MOS transistor to analyze CMOS circuits.	**K3**
CO2	Analyze different techniques for low power design in combinational logic circuits.	**K4**
CO3	Evaluate timing issues and clock strategies in sequential logic circuits.	**K3**
CO4	Apply arithmetic building blocks to design high-speed adders and multipliers.	**K4**
CO5	Assess implementation strategies for FPGA architectures.	**K4**

PRE-REQUISITE:

1. Digital electronics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		W										M	
CO2	S		W	M		M	M	M				M		S
CO3	S		M			M	M	M				M	M	S
CO4	S		S			M	M	M				M	M	S
CO5	S	S	W	M										

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

MOS TRANSISTOR PRINCIPLE **9 Hours**

NMOS and PMOS transistors - Process parameters for MOS and CMOS - Electrical properties of CMOS circuits and device modeling - Scaling principles and fundamental limits - CMOS inverter scaling - propagation delays - Stick diagram - Layout diagrams.

COMBINATIONAL LOGIC CIRCUITS **9 Hours**

Examples of Combinational Logic Design - Elmore's constant - Pass transistor Logic -Transmission gates -static and dynamic CMOS design - Power dissipation – Low power design principles

SEQUENTIAL LOGIC CIRCUITS **9 Hours**

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Static and Dynamic Latches and Registers - Timing issues – pipelines - clock strategies - Memory architecture and memory control circuits - Low power memory circuits - Synchronous and Asynchronous design

DESIGNING ARITHMETIC BUILDING BLOCKS **9 Hours**

Data path circuits - Architectures for ripple carry adders - carry look ahead adders - High speed adders – accumulators – Multipliers – dividers - Barrel shifters - speed and area trade-off.

IMPLEMENTATION STRATEGIES **9 Hours**

Full custom and Semi custom design - Standard cell design and cell libraries - FPGA building block architectures - FPGA interconnect routing procedures.

TEXT BOOKS

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", 2nd Edition, Prentice Hall of India, 2003.
2. M.J. Smith, "Application Specific Integrated Circuits", Addison Wesley, 1997

REFERENCES

1. N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", 2nd Edition, Addision Wesley, 1993
2. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005
3. A.Pucknell, Kamran Eshraghian, "Basic VLSI Design", 3rd Edition, Prentice Hall of India, 2007.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

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U18EEE0006 MODERN CONTROL SYSTEMS

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Analyze state space systems and apply controllability and observability concepts.	**K4**
CO2	Evaluate common types of non-linear phenomena and their linearization techniques.	**K4**
CO3	Analyze stability of non-linear systems using describing function and Liapunov's methods.	**K4**
CO4	Apply pole placement technique for state feedback and design state observers.	**K3**
CO5	Evaluate advances in control systems including optimal, adaptive, robust, and intelligent methods.	**K4**

PRE-REQUISITES

1. Control System

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M											W	
CO2	M		W										W	M
CO3	M	M											W	M
CO4	M	M											S	M
CO5	M	W			M								M	

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

STATE SPACE ANALYSIS **9 Hours**

State variable systems - controllability and Observability - State variable feedback and its effect on controllability and Observability-elements of observer theory

NON LINEAR SYSTEMS **9 Hours**

Common types of non- linear phenomena – linearization -singular points- phase plane method - construction of phase trajectories- describing functions.

STABILITY ANALYSIS **9 Hours**

Basic concepts-derivation of describing functions-stability of non- linear systems by describing function method- Liapunov's method of stability studies- Popov's criterion.

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STATE SPACE DESIGN **9 Hours**

Pole placement technique by state feedback for linear SISO time invariant system–Design of state observers and servo system.

ADVANCES IN CONTROL SYSTEMS **9 Hours**

Optimal control - adaptive control - robust control and intelligent control methods-Introduction to distributed control systems.

TEXT BOOKS

1. Chi-Tsong Chen, "Linear System Theory and Design", Oxford University Press, 4th Edition, 2012.
2. Khalil H.D., "Nonlinear Systems", Prentice Hall Publications, 3rd Edition, 2003.

REFERENCES

1. Stanley M. Shiners, "Modern Control System theory and Design", John Wiley and Sons Publications, 2nd Edition, 1998.
2. Ogata K.,"Modern Control Engineering", Prentice Hall Publications, 5th Edition, 2010.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

Signature of the Chairman BOS EEE

U18EEE0007 SMART GRID ENGINEERING

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Analyze the architectural designs of smart grids and their components.	**K4**
CO2	Analyze the role of information and communication technologies in smart grid systems.	**K4**
CO3	Demonstrate the application of sensing and measurement technologies in smart grid operations.	**K3**
CO4	Illustrate the use of control and automation techniques for efficient smart grid management.	**K3**
CO5	Prepare strategies for integrating power electronics and energy storage systems into smart grid infrastructure.	**K3**

PRE-REQUISITE

1. Power System Analysis

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													M
CO2	S	M								S			S	S
CO3	S	M			S					M			S	S
CO4	S	M			S								S	S
CO5	S				S								S	S

COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II 2. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination
Indirect
1. Course End Survey 2. Programme Exit Survey 3. Placement/Higher Education Record 4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

SMART GRID ARCHITECTURAL DESIGNS 9 hours

Need for implementation of Smart grid - Smart Grid initiatives - Overview of the technologies required for the Smart Grid -Working Definition of the Smart Grid Based on Performance Measures - Representative Architecture - Functions of Smart Grid Components: Smart Devices Interface Component-Storage Component. Transmission Subsystem Component- Monitoring and Control Technology Component- Intelligent Grid Distribution Subsystem Component - Demand Side Management Component.

INFORMATION AND COMMUNICATION TECHNOLOGIES 9 Hours

Data Communication, Dedicated and shared communication channels, Layered architecture and protocols, Communication technology for smart grids, Information security for the smart grid.

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SENSING AND MEASUREMENT TECHNOLOGIES 9 Hours

Synchrophasor Technology – Phasor Measurement Unit, Smart metering and demand side integration - Communication infrastructure and protocol for smart metering – Data Concentrator, Meter Data Management System. Demand side Integration – Services, Implementation and Hardware Support of DSI.

CONTROL AND AUTOMATION TECHNIQUES 9 Hours

Distribution automation equipment – Substation automation equipments: current transformer - potential transformer - Intelligent Electronic Devices - Bay controller - Remote Terminal Unit. Distribution management systems – SCADA: Modelling and analysis tools, applications.

POWER ELECTRONICS AND ENERGY STORAGE SYSTEMS 9 Hours

Power Electronics in smart grid application – Role of FACTS in smart grid by Shunt and series compensation techniques - Role of HVDC in smart grid for bulk power transfer and offshore wind connections. Energy Storage Technologies – Batteries - Flow Battery - Fuel Cell and Hydrogen Electrolyser – Flywheel - Super-Conducting magnetic energy storage system - Super Capacitor.

REFERENCES

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid Technologies and applications", John Wiley Publishers Ltd., 2012.
2. James Momoh, "Smart Grid Fundamentals of Design and Analysis", IEEE Press, 2012.
3. Lars T. Berger, Krzysztof Iniewski, "Smart Grid applications, Communications and Security", John Wiley Publishers Ltd., 2012.
4. Yang Xiao, "Communication and Networking in Smart Grids", CRC Press, Taylor and Francis Group, 2012.
5. Caitlin G. Elsworth, "The Smart Grid and Electric Power Transmission", Nova Science Publishers, 2010.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

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U18EEE0008	INTERNET OF THINGS	L	T	P	J	C
		2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Analyze the architectural overview, design principles, and capabilities required for IoT.	**K4**
CO2	Evaluate the hardware and software components essential for building IoT systems.	**K3**
CO3	Evaluate the associated technologies such as SDN, cloud computing, and fog computing in IoT applications.	**K4**
CO4	Apply IoT concepts to real-world applications like smart cities, smart homes, healthcare, and industrial IoT.	**K3**
CO5	Demonstrate proficiency in programming and interfacing IoT devices using Arduino and Raspberry Pi.	**K3**
CO6	Implement IoT solutions through various experiments involving sensors, actuators, and communication protocols in a laboratory setting.	**K5**

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S				W									M
CO2	S	M			W									M
CO3	S	M			M								M	S
CO4	S	M			S	M							M	S
CO5	S	M			S								S	S
CO6	S	M			S	M			M				S	S

COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II 2. Model Examination (For Practical Courses & Embedded Courses) 3. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable) 4. End Semester Examination
Indirect
1. Course End Survey 2. Programme Exit Survey 3. Placement/Higher Education Record 4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

THEORETICAL COMPONENT CONTENTS:

Introduction to IoT **8 hours**

Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways,

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Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT.

Elements of IoT **9 Hours**

Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces.

Software Components- Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, BLE, CoAP, UDP, TCP, LoRa WAN.

Associated Technologies **8 Hours**

Introduction to SDN-SDN for IoT, Data Handling and Analytics, Cloud Computing-Cloud Computing, Fog Computing-Edge Computing, Li-Fi.

APPLICATIONS **5 Hours**

Smart Cities and Smart Homes-Connected Vehicles, Smart Grid, Industrial IoT, Precision Agriculture, Healthcare.

PRACTICAL COMPONENT CONTENTS:
LIST OF EXPERIMENTS

Arduino I/O programming

1. LED and DIP Switch
2. Interfacing with Sensor and Actuators
3. Interfacing with LCD Display
4. Communication over Bluetooth-MIT APP Inventor
5. Cloud Interfacing (Azure/Amazon web services/Think speak)

Raspberry Pi Programming using Python

6. LED and DIP Switch
7. Interfacing with Sensor and Actuators
8. To install MySQL database on Raspberry Pi and perform basic SQL queries.
9. Write a program to create TCP/UDP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.
10. Cloud Interfacing (Azure/Amazon web services/Think speak)

Study on Industrial IoT Gateway and LoRa Communication

REFERENCES

1. Vijay Madisetti, Arshdeep Bahga, İnternet of Things, "A Hands on Approach", University Press
2. David Hanes, "IoT Fundamentals Networking Technologies, Protocols, and Use Cases for Internet of Things", CISCO Press, 2017
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017
4. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill
5. NPTEL Reference: https://nptel.ac.in/courses/106/105/106105166/

Theory: 30 **Tutorial: 0** **Practical: 30** **Project: 0** **Total: 60 Hours**

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U18EEE0009 AUTOMOTIVE ELECTRONICS

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Analyze the construction and working principles of automotive starting, charging, and ignition systems.	**K4**
CO2	Evaluate the role of electronic engine control systems in vehicle performance and emissions control.	**K3**
CO3	Apply integrated development environments for embedded systems in automotive applications, including booting, debugging, and reconfiguration.	**K3**
CO4	Analyze the implementation of embedded systems in modern automobiles, focusing on engine management, distributed systems, and on-board diagnostics.	**K4**
CO5	Evaluate various communication protocols used in automotive embedded systems, including SPI, I2C, and CAN.	**K4**

PRE-REQUISITE

1. Basics of Electrical and Electronics Engineering
2. Microprocessor and Microcontrollers

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M												
CO2	S	M											S	S
CO3	M	S		M	M								S	S
CO4	S	M											S	M
CO5	S	M											S	M

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Model Examination (For Practical Courses & Embedded Courses)
3. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
4. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

INTRODUCTION **9 Hours**

Construction and working: Starting system - Charging system - Ignition system – Overview of Battery: Parameters, Types and characteristics, charging techniques, testing and maintenance - Basic electrical and electronic wiring, switching and lighting system in an automobile.

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ELECTRONIC ENGINE CONTROL SYSTEM **9 Hours**

Overview of Vehicle Electronic system - Electronic engine control and Ignition system - Power train and Chassis subsystem – Cruise control – Automobile sensors and actuators - Electronic control of braking and traction - Environmental legislation (Pollution Norms - Euro / Bharat standards).

INTEGRATED DEVELOPMENT ENVIRONMENT IN EMBEDDED SYSTEMS **9 hours**

Integrated Development Environment (Introduction to IDE, Getting Started, Hardware / Software Configuration (Boot Service, Host – Target Interaction) - Booting (IDE-Interaction, target-Agent) – Reconfiguration - Managing IDE - Target Servers – Agents - Cross – Development, debugging - Introduction to an IDE for the Laboratory board – RTOS – PC based debugger.

EMBEDDED SYSTEMS IN AUTOMOTIVE CONTEXT **9 Hours**

Embedded systems in typical modern automobile - Engine Management system - Diesel / Gasoline system – Distributed systems: Vehicle safety, Body electronics, Infotainment and Navigation systems – On board diagnosis - System level tests.

COMMUNICATION PROTOCOLS **9 Hours**

Introduction to control networking – Communication protocols in embedded systems – SPI, I2C, USB – Vehicle communication protocols – Introduction to CAN, LIN, FLEXRAY, MOST, KWP2000.

REFERENCES

1. Robert Bosch, “Bosch Automotive Handbook”, 9th Edition, Bentley Publishers, 2014.
2. Joerg Schaeuffele, Thomas Zurawka, “Automotive Software Engineering – Principles, Processes, Methods and Tools”, 1st Edition, SAE International, 2005
3. Jean J. Labrosse, “µC/OS-II Real Time Kernel”, 2nd Edition, CMP Books, 2002.
4. Denton. T, “Automobile Electrical and Electronic Systems”, 4th edition,2012.
5. Nicholas Navit, “Automotive Embedded System Handbook”, CRC Press, Taylor and Francis Group, 2009.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

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U18EEE0010 **ENERGY STORAGE TECHNOLOGY**

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1 Analyze the energy demand supply, and associated issues in energy storage technology. **K4**

CO2 Evaluate the materials used in modern storage devices for their suitability and effectiveness. **K4**

CO3 Apply the factors controlling battery operational characteristics and primary mechanisms to practical scenarios. **K3**

CO4 Assess the significance of fuel cells, their application, and the necessity for hybrid energy storage. **K4**

CO5 Illustrate the working of supercapacitors and their design parameters in energy storage technology. **K3**

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M					S						W	
CO2	S		M				M						M	
CO3	M	M			S		M						S	S
CO4	M	M					M						M	M
CO5	S	M					M						M	M

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course End Survey
2. Programme Exit Survey
3. Placement/Higher Education Record
4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

STORAGE: HISTORICAL PERSPECTIVE, INTRODUCTION AND CHANGES 9 hours

Storage Needs-Variations in Energy Demand-Variations in Energy Supply-Interruptions in Energy Supply-Transmission Congestion -Demand for Portable Energy -Demand and scale - requirements - Environmental and sustainability issues.

TECHNICAL METHODS OF STORAGE 9 hours

Introduction: Energy and Energy Transformations - Potential energy (pumped hydro, compressed air, springs) - Kinetic energy (mechanical flywheels) -Thermal energy without phase change passive (adobe) and active (water)-Thermal energy with phase change (ice, molten salts, steam) - Chemical energy (hydrogen, methane, gasoline, coal, oil)- Electrochemical energy (batteries, fuel cells) - Electrostatic energy (capacitors), Electromagnetic energy (superconducting magnets) - Different Types of Energy Storage Systems.

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PERFORMANCE FACTORS OF ENERGY STORAGE SYSTEMS **9 hours**

Energy capture rate and efficiency -discharge rate and efficiency-dispatch ability and load flow characteristics -Scale flexibility, durability-cycle lifetime, mass and safety – risks of fire, explosion, toxicity-ease of materials recycling and recovery -Environmental consideration and recycling-Merits and demerits of different types of Storage.

HYDROGEN FUEL CELLS AND HYBRID ENERGY **9 hours**

Hydrogen Economy - Generation Techniques - Storage of Hydrogen - Hybrid Energy generation. Applications: Storage for Hybrid Electric Vehicles -Regenerative Power and capturing methods

FLOW BATTERIES AND SUPER CAPACITORS **9 hours**

Flow battery operation -Super Capacitors: power calculation -operation and design.

TEXTBOOK

1. Detlef Stolten, "Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications", Wiley, 2010.
2. Jiujun Zhang, LeiZhang, Hansan Liu, Andy Sun, Ru-Shi Liu, "Electrochemical Technologies for Energy Storage and Conversion", John Wiley and Sons, 2010.

REFERENCES

1. Francois Beguin and Elzbieta Frackowiak, "Super capacitors", Wiley, 2013.
2. Doughty Liaw, Narayan and Srinivasan, "Batteries for Renewable Energy Storage", The Electrochemical Society, New Jersy,2010.
3. Robert Huggins ,Energy Storage: Fundamentals, Materials and Applications 2nd ed. Springer, 2016 Edition

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

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U18EEE0011

SWITCHED MODE POWER CONVERTERS

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Analyze and evaluate the performance characteristics of different DC/DC converter topologies, including efficiency, voltage regulation	**K3**
CO2	Analyze the various control strategies for voltage and current fed converter topologies	**K4**
CO3	Examine the various control strategies for resonant converters	**K3**
CO4	Apply state-space averaging to derive converter transfer functions	**K3**
CO5	Design filter inductor, capacitor and analyze the ratings of power devices in power converters	**K3**

PRE-REQUISITE

1. Power Electronics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M											M	
CO2	M	M	S		W								M	S
CO3	S	M		M								W		S
CO4	S	M	M		M								W	
CO5	S	M	S	M								W		M

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Assignment, Open book test; Cooperative learning report, Group Presentation, Problem based learning, Project based learning, Mini Projects, Project report, Quiz, Role play, Self-Explanatory videos, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course-end survey
2. Programme Exit survey
3. Placement/Higher education record
4. Feedback (Students, Employers, Parents, Professional body members, Alumni)

DC/DC CONVERTERS **9 Hours**

Basic topologies of buck, boost converters, buck-boost converters and cuk converter - isolated DC/DC converter topologies—forward and fly-back converters - half and full bridge topologies - modeling of switching converters.

CURRENT MODE AND CURRENT FED TOPOLOGIES **9 Hours**

Voltage mode and current mode control of converters - peak and average current mode control - its advantages and limitations - voltage and current fed converters

RESONANT CONVERTERS **9 Hours**

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Need for resonant converters - types of resonant converters - methods of control – phase modulation technique with ZVS in full-bridge topology - series resonant converter and resonant transition converter.

CONVERTER TRANSFER FUNCTIONS **9 Hours**

Application of state-space averaging to switching converters - derivation of converter transfer functions for buck, boost and fly-back topologies.

POWER CONVERTER DESIGN **9 Hours**

Design of filter inductor & capacitor - and power transformer - Ratings for switching devices, current transformer for current sensing - design of drive circuits for switching devices considerations for PCB layout.

TEXTBOOKS

1. Ned Mohan Tore M. Undeland, "Power Electronics: Converters, Applications, and Design", 3rd Edition, John Wiley & Sons, 2007.
2. Abraham I. Pressman, "Switching Power Supply Design", 2nd Edition, McGraw Hill International, 1999.David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.

REFERENCES

1. Erickson, Robert W., "Fundamentals of Power Electronics", Second Edition, Kluwer Academic Publishers, New York, 2004
2. P.C. Sen, "Modern Power Electronics", 2nd Revised Edition, S. Chand-Company, 2005.
3. Andrzej M. Trzynadlowski, "Introduction to Modern Power Electronics", 2nd Edition, Wiley India Pvt Ltd, 2011.
4. Muhammad H. Rashid, "Power Electronics hand book", ISBN: 81 8147 367 1.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

Signature of the Chairman BOS EEE

U18EEE0012	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEM	L	T	P	J	C
		3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Analyze the environmental impacts of renewable energy conversion and differentiate various renewable energy resources.	**K4**
CO2	Analyze the influence of solar radiation and temperature on PV systems and organize the components of a solar PV system.	**K3**
CO3	Analyze the power conditioning schemes for wind energy conversion systems and prioritize grid-related problems in grid-connected WECS.	**K4**
CO4	Generalize the need for hybrid renewable energy systems and evaluate different types of hybrid systems.	**K3, K4**
CO5	Design a power electronics system using hybrid renewable energy systems.	**K5**

PRE-REQUISITE

1. Power Electronics

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	W	M				S						S	M
CO2	S	M	M				M						S	M
CO3	M	W	M				M						M	M
CO4	M	W	M		M		M						S	M
CO5	M	M	M		M		M						M	M

COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II 2. Model Examination (For Practical Courses & Embedded Courses) 3. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable) 4. End Semester Examination
Indirect
1. Course End Survey 2. Programme Exit Survey 3. Placement/Higher Education Record 4. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

INTRODUCTION **9 Hours**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

Signature of the Chairman BOS EEE

PHOTOVOLTAIC ENERGY CONVERSION **9 Hours**

Solar radiation and measurements - Solar cells – Panels and their characteristics – Influence of insolation and temperature – PV arrays – DC-DC converters for solar PV systems-Maximum power point tracking – Applications – Water pumping – Street lighting.

WIND ENERGY SYSTEMS **9 Hours**

Nature of Wind - Components of Wind Energy Conversion System- Basic principle of Wind Energy Conversion System – Classifications of WECS-Generators for WECS – Self excited induction generator - synchronous generator - Power conditioning schemes.

GRID CONNECTED WECS AND SECS **9 Hours**

Grid connectors – Wind farm and its accessories – Grid related problems – Generator control – Performance improvements - Different schemes – Matrix converters -Line commutated inverters-Multilevel inverters-Power converters for Grid connected WECS-Grid connected solar energy converter systems.

HYBRID RENEWABLE ENERGY SYSTEMS **9 Hours**

Need for Hybrid Systems- Range and types of Hybrid systems- Solar PV-fuel Cell, Wind-PV, Wind-Diesel, Wind -Mini-hydro Systems. PE System for on-board charging.

TEXT BOOKS

1. Mukund R. Patel, "Wind and Solar Power Systems: Design, Analysis, and Operation", 2nd Edition, CRC Press, London, 2005.
2. G.D.Rai, "Non - Conventional Energy Sources", 5th Edition, Khanna publishers, 2010.

REFERENCES

1. Ned Mohan Tore. M. Undeland, William. P. Robbins, "Power Electronics converters, Applications and design", 3rd Edition, John Wiley and Sons, 2006.
2. M.H. Rashid, "Power Electronics Circuits, Devices and Applications", 3rd Edition, Prentice Hall of India, New Delhi, 2004.
3. D. P. Kothari, K.C. Singal and Rakesh Ranjan, "Renewable Energy Sources And Emerging Technologies", 2nd Edition, Prentice Hall of India, New Delhi, 2011.
4. Haitham Abu-Rub, Mariusz Malinowski, Kamal Al-Haddad, "Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications",IEEE, Wiley,2014.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

Signature of the Chairman BOS EEE

U18EEE0013	ELECTRIC VEHICLE TECHNOLOGY	L	T	P	J	C
		3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Apply the principles of electric vehicle components and compare them with internal combustion engines and other power sources.	**K3**
CO2	Analyze the dynamics and resistance factors affecting electric vehicles to assess the performance of various powertrain components.	**K4**
CO3	Evaluate different electric motor drive technologies and power converter control strategies to recommend the most efficient propulsion systems for EVs.	**K4**
CO4	Compare various battery technologies and charging methods to determine the optimal energy storage solutions for electric vehicles.	**K3**
CO5	Illustrate integrated vehicle-to-grid systems incorporating charging standards and components to enhance the interaction between electric vehicles and utility grids.	**K3**

PRE-REQUISITE

1. Electrical Machines
2. Power Electronics

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S			S								S	
CO2	S	S	M						M				S	
CO3	S			M			M						M	S
CO4	S	S	M		S								S	M
CO5	S		M								M		M	M

COURSE ASSESSMENT METHODS

Direct
4. Continuous Assessment Test I, II 5. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable) 6. End Semester Examination
Indirect
5. Course End Survey 6. Programme Exit Survey 7. Placement/Higher Education Record 8. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

INTRODUCTION TO ELECTRIC VEHICLES **9 Hours**

Overview of Electric Vehicles-Scenario of EV in India-Components of Electric Vehicle-Electric Vehicle Classification- Comparison with Internal Combustion Engine- Comparison of fuel, electric and solar powered electric vehicles.

VEHICLE DYNAMICS AND SUBSYSTEMS **9 Hours**

Signature of the Chairman BOS EEE

Vehicle resistance-Rolling resistance, Aerodynamic drag, Grading resistance, Acceleration resistance, Tractive effort, Wheel torque, Dynamic Equation-- Introduction to Electric Vehicle subsystems- Power train components.

ELECTRIC PROPULSION SYSTEMS **9 Hours**

Introduction to Electric motor drive technologies for Electric Vehicles –Permanent Magnet machines, Switched Reluctance motor drive– Overview of Power Converters and its control Strategies.

ENERGY STORAGE SOLUTIONS **9 Hours**

Electric Vehicle Batteries-Lead Acid Battery-Battery parameters - Comparison of Batteries-Electric Vehicle Battery charging Technologies-Battery Management System-Need and monitoring parameters-Regenerative Braking.

VEHICLE TO GRID TECHNOLOGIES **9 Hours**

Integration of Electric vehicle in the electric utility systems - Electric vehicle charging station-Types, selection and components-Electric vehicle charging standards-V2G, G2V, V2B, V2H- Case Studies: Electric Bicycle, Electric Bike, Electric Car.

REFERENCES

1. Iqbal Husain ,“Electric and Hybrid Electric Vehicles-Design Fundamentals”,CRC Press,2005.
2. AntoniSzumanowski, “Hybrid Electric Power Train Engineering and Technology: Modelling, Control, and Simulation”, IGI Global, 2013.
3. Larminie, James, and John Lowry, “Electric Vehicle Technology Explained” ,John Wiley and Sons, 2012.
4. Tariq Muneer and Irene IllescasGarcía, “The automobile, In Electric Vehicles: Prospects and Challenges”, Elsevier, 2017.
5. Seth Leitman, Bob Brant, “Build your own Electric Vehicle”,McGraw Hill,2009.

Theory: 45 **Tutorial:0** **Practical: 0** **Project: 0** **Total: 45 Hours**

Signature of the Chairman BOS EEE

U18EEE0014	ELECTRICAL SAFETY AND ENERGY MANAGEMENT	L	T	P	J	C
		3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Analyze safety regulations and their application in electrical installations and operations.	**K4**
CO2	Evaluate the effectiveness of safety measures in electrical equipment installation and grounding techniques.	**K4**
CO3	Apply safety protocols and first aid procedures in response to electrical accidents and emergencies.	**K3**
CO4	Illustrate fire prevention strategies and implement appropriate fire extinguishing techniques in electrical environments.	**K3**
CO5	Prepare energy management plans to identify areas for improvement in electrical energy efficiency.	**K3**

PRE-REQUISITE

1. Generation, Transmission and Distribution
2. Power System Protection and Switch Gear

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		S	M			S	S	M					M	
CO2	M	S				M	M					M	M	M
CO3						M	M	M				M	M	
CO4	S	S				M	M	M				M	M	
CO5	S	W						W					S	

COURSE ASSESSMENT METHODS

Direct

5. Continuous Assessment Test I, II
6. Model Examination (For Practical Courses & Embedded Courses)
7. Assignment, Open Book Test, Cooperative Learning Report, Group Presentation, Problem based Learning, Project based Learning, Mini Projects, Project Report, Quiz, Role Play, Self-Explanatory Videos, Prototype or Product Demonstration etc. (as applicable)
8. End Semester Examination

Indirect

5. Course End Survey
6. Programme Exit Survey
7. Placement/Higher Education Record
8. Feedback (Students, Employers, Parents, Professional Body members, Alumni)

RULES & REGULATIONS **9 Hours**

Power sector organization and their roles – significance of IE rules & IE acts – general safety requirements: span, conductor configuration, spacing and clearing, sag, erection, hazards of electricity.

INSTALLATION AND EARTHING OF EQUIPMENTS **9 Hours**

Signature of the Chairman BOS EEE

Classification of electrical installation - earthing of equipment bodies – electrical layout of switching devices and SC protection – safety in use of domestic appliances – safety documentation and work permit system – flash hazard calculations – tools and test equipments.

SAFETY MANAGEMENT AND FIRST AID **9 hours**

Safety aspects during commissioning – safety clearance notice before energizing – safety during maintenance – maintenance schedule – special tools – security grand– check list for plant security – effects of electric and electromagnetic fields - in HV lines and substations – safety policy in management & organizations – economic aspects – safety program structure – elements of good training program – first aid – basic principles – action taken after electrical shock – artificial respiration and methods – chocking – poisoning.

FIRE EXTINGUISHERS **9 Hours**

Fundamentals of fire – initiation of fires – types – extinguishing – techniques – prevention of fire – types of fire extinguishers- fire detection and alarm system – Co_2 and Halon gas schemes, foam schemes.

ENERGY MANAGEMENT & ENERGY AUDITING **9 Hours**

Objectives of energy management – energy efficient electrical systems – energy conservation and energy policy – renewable source of energy – energy auditing – types and tips for improvement in industry.

REFERENCES

1. Electrical safety handbook – John Codick, McGraw Hill Inc, New Delhi – 2000.
2. Fundamentals of electrical safety – V. Manoilov, Mir Publishers, MOSCOW –1975
3. A Practical Book on domestic safety – C.S. Raju, Sri Sai Publisher, Chennai – 2003.
4. Power Engg. Handbook, TNEB Engineers officers, Chennai – 2002
5. Electrical safety , Fire safety engineering and safety management – S. Rao – R.C, Khanna – Khanna Publisher , Delhi – 1998.
6. The Indian electricity rules, 1956 – authority regulations (1979) – Commercial Law Publication, Delhi - 1999.
7. Electrical safety Engineering-W.F.Cooper, Newnes-Butterworth company-1978.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

Signature of the Chairman BOS EEE

U18EEE0015 DRIVES FOR ELECTRIC VEHICLE

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Understand the characteristics and requirements of Electric Vehicles	**K4**
CO2	Analyze the selection of motor drives for Electric Vehicles	**K4**
CO3	Analyze the performance of Permanent Magnet Brushless DC Motor Drives in EV	**K4**
CO4	Analyze the structure and operation of Induction and Synchronous Motor Drives in EV	**K4**
CO5	Apply the concepts of different energy sources and charging systems for Electric Vehicles	**K3**

PRE-REQUISITE

1. U18EEI3201 DC Machines and Transformers
2. U18EEI4201 Induction and Synchronous Machines
3. U18EET5001 Power Electronics
4. U18EEI5203 Control Systems

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		M		S			M				W		M
CO2	S	M	M		S									M
CO3	S	M	M		M								M	M
CO4	S	M	M		M								M	M
CO5	S		M		M			M				W	M	M

COURSE ASSESSMENT METHODS

Direct
1.Continuous Assessment Test I, II 2.Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3.End Semester Examination
Indirect
1.Course-end survey 2. Programme Exit survey 3.Placement/Higher education record 4.Feedback (Students, Employers, Parents, Professional body members, Alumni)

ELECTRIC VEHICLE FUNDAMENTALS **9 Hours**

Classification of EV- Subsystems and components of EV- Drive Cycles- Characteristics and requirements of EV- Selection of motor drives for EV.

PERMANENT MAGNET BRUSHLESS DC MOTOR DRIVE **9 Hours**

PM Materials- Construction of BLDC motor- EMF and torque equations- Power Controllers: Unipolar and Bipolar drives- Position sensors- Sensor less control- Outer-Rotor PM Brushless DC Motor Drive- Magnetic Gears (MG)- MG PM Brushless DC In-Wheel Motor Drive.

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PERMANENT MAGNET SYNCHRONOUS MOTOR DRIVE **9 Hours**

Structure and operation of PMSM- EMF Equation- Phasor diagram- Torque equation- Self-control- V/f Control- Vector control- PM Synchronous reluctance motor drive- Inverter Requirements- Design Criteria of PM Brushless Motor Drives for EVs- MG PM Brushless AC In-Wheel Motor Drive.

INDUCTION MOTOR DRIVE **9 Hours**

Construction and operation of three phase induction motor- PWM Switching Inverters - Soft Switching Inverters- Field-Oriented Control- Direct Torque Control - Design Criteria of Induction Motor Drives for EVs.

ENERGY SOURCE AND CHARGING OF EV **9 Hours**

Batteries for EV- Fuel Cells- Ultra capacitors- Charging systems for EV batteries- Onboard charging- Smart Charging- Vehicle to grid system (V2G).

TEXT BOOKS

1. K. T. Chau**,** "Electric Vehicle Machines and Drives: Design, Analysis and Application", ISBN: 978-1-118-75252-4 August 2015 Wiley-IEEE Press.
2. Bimal K. Bose. "Modern Power Electronics and AC Drives", 2nd Edition, Prentice Hall of India, 2007.

REFERENCES

1. R. Krishnan, "Electric Motor & Drives Modeling, Analysis and Control", 1st Edition, Prentice Hall of India, 2001.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
3. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
4. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
5. https://www.bosch-mobility-solutions.com/en/solutions/powertrain/battery-electric/electric-drive/

Theory: 45 Hrs **Tutorial: 0 Hrs** **Practical: 0 Hrs** **Project: 0 Hrs** **Total: 45Hrs**

Signature of the Chairman BOS EEE

U18EEE0016	SENSING TECHNIQUES AND SENSOR SYSTEMS	L	T	P	J	C
		3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Analyze the parameters and errors associated with sensor systems to optimize their design and performance.	**K4**
CO2	Evaluate the dynamic response and functionality of resonator sensors in various applications.	**K3**
CO3	Apply knowledge of semiconductor-based sensors to select mechanical, chemical, and optical sensors for suitable applications.	**K3**
CO4	Analyze the principles and applications of optical fiber sensors, including intrinsic and extrinsic sensing techniques.	**K4**
CO5	Illustrate the integration of intelligent sensing techniques, including smart sensors and artificial intelligence, in instrumentation systems.	**K3**

PRE-REQUISITE

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M		M									M	
CO2	S		M	M										M
CO3	M		M	S										M
CO4	M	M	W										W	M
CO5	M	M	M	M	M									M

COURSE ASSESSMENT METHODS

Direct
1.Continuous Assessment Test I, II 2.Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3.End Semester Examination
Indirect
1.Course-end survey 2. Programme Exit survey 3.Placement/Higher education record 4.Feedback (Students, Employers, Parents, Professional body members, Alumni)

INSTRUMENTATION SYSTEM **9 Hours**

Sensor parameters - Random errors - Systematic errors - Environmental disturbances - System design and the contribution of errors - overall transfer function - Dynamic response of the sensor - measurement system as a series of networks

RESONATOR SENSORS **9 Hours**

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Damped harmonic oscillator - Vibrating wire sensors - Torsionally vibrating rod - Longitudinally vibrating plate - Flexural resonators - Vibrating cylinder - Tuning fork - Double tuning fork structure - Bulk acoustic wave resonator sensors - thick films

SEMICONDUCTOR BASED SENSORS **9 Hours**

Mechanical microsensors - Surface acoustic wave sensors - Chemical microsensors - Optical sensors - Temperature sensors - Detectors of ionizing radiation - Magnetic sensors – Magnetodiode - Magnetotransistor

OPTICAL FIBRE SENSORS **9 Hours**

Optical waveguide - Extrinsic optical fibre sensors - Intrinsic optical fibre sensors - Distributed sensing - Referencing techniques

INTELLIGENT SENSING **9 Hours**

Discontinuous-time sampling Scoping - Discrete sampling of the measurand - PC-based data acquisition boards - Smart sensors - Artificial intelligence in instrumentation - Data signal characterization and recovery -Novel developments in flow measurement systems

TEXT BOOKS

1. Roger G. Jackson, “Novel Sensors and Sensing”, CRC Press, 2019.
2. Gerard C.M. Meijer, “Smart Sensor Systems Emerging Technologies and Applications”, Wiley, 2014.
3. Subhas C. Mukhopadhyay, “Advanced Interfacing Techniques for Sensors”, Springer International Publishing, 2017.

REFERENCES

1. Hiroto Yasuura, “Smart Sensors and Systems”, Springer International Publishing, 2020.
2. Clarence W. de Silva, “Sensor Systems Fundamentals and Applications”, CRC Press, 2016.

Theory: 45 Hrs **Tutorial: 0 Hrs** **Practical: 0 Hrs** **Project: 0 Hrs** **Total: 45Hrs**

Signature of the Chairman BOS EEE

U18EEE0017 BIOMEDICAL INSTRUMENTATION L T P J C
3 0 0 0 3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Analyze the fundamentals of biomedical engineering including cell structure, nervous system, and cardiovascular systems.	**K4**
CO2	Evaluate the measurement techniques for non-electrical parameters in biomedical instrumentation such as blood pressure, cardiac output, and pulmonary function.	**K3**
CO3	Analyze the components and electrical parameters of biomedical instrumentation, including ECG, EEG, and EMG.	**K4**
CO4	Compare different imaging modalities used in biomedical imaging and their applications in diagnostics.	**K3**
CO5	Assess the functionality of life-assisting, therapeutic, and robotic devices in biomedical engineering.	**K3**

PRE-REQUISITE

1. U18EET3004 Measurements and Instrumentation

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	W											M	
CO2	S	M	M			M								M
CO3	S		M			M						W	W	M
CO4	S	M	W			M	M					W	W	
CO5	S	M	M		M	M	M							M

COURSE ASSESSMENT METHODS

Direct
1.Continuous Assessment Test I, II 2.Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3.End Semester Examination
Indirect
1.Course-end survey 2. Programme Exit survey 3.Placement/Higher education record 4.Feedback (Students, Employers, Parents, Professional body members, Alumni)

FUNDAMENTALS OF BIOMEDICAL ENGINEERING **9 Hours**

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors

NON - ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9 Hours

Signature of the Chairman BOS EEE

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS **9 Hours**

Electrodes – Limb electrodes –floating electrodes – pregelled disposability electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment

IMAGING MODALITIES AND ANALYSIS **9 Hours**

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems

LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES **9 Hours**

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery –Orthopedic prostheses fixation.

TEXT BOOKS

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2007.
2. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi,2nd edition, 2003
3. Joseph J Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th edition, 2012

REFERENCES

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5. M.Arumugam, ‘Bio-Medical Instrumentation’, Anuradha Agencies, 2003.

Theory: 45 Hrs **Tutorial: 0 Hrs** **Practical: 0 Hrs** **Project: 0 Hrs** **Total: 45Hrs**

Signature of the Chairman BOS EEE

U18EEE0018	INDUSTRY 4.0	L	T	P	J	C
		3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Analyze the fundamental concepts and principles of Industry 4.0, including cyber-physical systems and next-generation sensors.	**K4**
CO2	Evaluate the role of cybersecurity in Industry 4.0 and its implications for industrial IoT systems.	**K5**
CO3	Apply various technologies such as big data analytics, machine learning, and fog computing in the context of Industry 4.0.	**K3**
CO4	Analyze real-world case studies of Industry 4.0 applications in domains like healthcare, power plants, and inventory management.	**K4**
CO5	Examine the technology roadmaps for Industry 4.0, including talent development and new product/process development phases.	**K5**

PRE-REQUISITE

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		S											S
CO2	S	M												S
CO3	S	S	S										S	S
CO4	S	S	S										M	S
CO5	S	S	W	M		S								S

COURSE ASSESSMENT METHODS

Direct
1.Continuous Assessment Test I, II 2.Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3.End Semester Examination
Indirect
1.Course-end survey 2. Programme Exit survey 3.Placement/Higher education record 4.Feedback (Students, Employers, Parents, Professional body members, Alumni)

INTRODUCTION **9 Hours**

Industry 4.0: Globalization-The Fourth Revolution- LEAN Production Systems-Cyber Physical Systems and Next Generation Sensors, Collaborative Platform-and Product Lifecycle Management

INDUSTRIAL IOT **9 Hours**

Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Industrial Sensing & Actuation-Industrial IoT: Business Model and Reference Architecture- Layers: Sensing, Processing, Communication, Networking.

TECHNOLOGIES **9 Hours**

Signature of the Chairman BOS EEE

Big Data Analytics-Software Defined Networks- IIoT Analytics-Machine Learning-Data Science-Data Center Networks-Fog Computing-Application Domains

CASE STUDIES **9 Hours**

Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management-Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies

TECHNOLOGY ROADMAP **9 Hours**

Technology Roadmap for Industry 4.0-Strategy Phase-New Product and Process Development Phase - Talent Development-Skill Requirements-New Product and Process Development Phase

TEXTBOOKS

1. "Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress)
2. Alp, U., & Emre, C. (2018). Industry 4.0: Managing the Digital Transformation.

REFERENCES

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry4.0. CRC Press.
3. Industrial Internet of Things: Cyber manufacturing Systems" by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer)

Theory: 45 Hrs **Tutorial: 0 Hrs** **Practical: 0 Hrs** **Project: 0 Hrs** **Total: 45Hrs**

Signature of the Chairman BOS EEE

U18EEE0019	MACHINE LEARNING	L	T	P	J	C
		3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Analyze the terminologies and evolution of Artificial Intelligence and Machine Learning.	**K3**
CO2	Apply the different types of Machine Learning algorithms, including supervised, unsupervised, and reinforcement learning.	**K3**
CO3	Apply Python programming fundamentals for Machine Learning tasks, including data manipulation and basic operations.	**K4**
CO4	Analyze Machine Learning libraries and perform case studies using key algorithms and operations.	**K4**
CO5	Evaluate the concepts and implementation of Deep Learning, including neural networks and TensorFlow.	**K5**

PRE-REQUISITE

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													W
CO2	S	S	M										W	
CO3	S	M	M										M	M
CO4	S	M	W										M	M
CO5	M	M			M								M	W

COURSE ASSESSMENT METHODS

Direct
1.Continuous Assessment Test I, II 2.Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3.End Semester Examination
Indirect
1.Course-end survey 2. Programme Exit survey 3.Placement/Higher education record 4.Feedback (Students, Employers, Parents, Professional body members, Alumni)

INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING BASICS **9 Hours**

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Terminologies: Artificial Intelligence, Machine Learning, Deep Learning. Data Analytics, Data Science & AI – The Connection, Evolution of AI , Applications of AI.
Types of Machine Learning – Supervised, Unsupervised and Reinforcement, Basic ML process, Cost functions, Bias and Variance, Regularization

SUPERVISED AND UNSUPERVISED LEARNING **9 Hours**

Supervised Learning : Linear Regression, Classification : Support Vector Machines, K-Nearest Neighbors, Decision Tree, Random Forest, Unsupervised Learning - K-means Clustering

PYTHON FOR ML **9 Hours**

Introduction to python, Variables, Data types, List and Tuple operations, Import, Conditional statements, Functions.

ML LIBRARIES AND CASE STUDIES **9 Hours**

Numpy (key operations), Pandas (Series, Data Frame, key operations), Matplotlib (basic plotting), Seaborn (key plots), Scikit-learn(key algorithms and operations). Case study - Regression problem, Classification problem

DEEP LEARNING **9 Hours**

Introduction, Forward propagation, Back propagation, Optimizers, Types - Dense Neural Networks (DNN), Convolutional Neural Networks (CNN), Introduction to Tensor flow, Building a basic DNN using Tensorflow.

TEXT BOOKS

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2009.
2. Bratko, ―Prolog: Programming for Artificial Intelligence, Fourth edition, Addison- Wesley Educational Publishers Inc., 2011.

REFERENCES

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education (India) Private Limited,2013.
2. Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

Theory: 45 Hrs **Tutorial: 0 Hrs** **Practical: 0 Hrs** **Project: 0 Hrs** **Total: 45Hrs**

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U18EEE0020 **INTRODUCTION TO R PROGRAMMING**

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Apply programming fundamentals in R for data manipulation, basic plotting, and file handling.	**K3**
CO2	Analyze statistical concepts such as mean, median, variance, and probability distributions using R programming.	**K4**
CO3	Evaluate statistical testing techniques, linear regression models, and advanced graphics customization using R.	**K5**
CO4	Apply R programming to implement numeric and arithmetic operations, conditions, loops, and functions.	**K3**
CO5	Analyze and interpret statistical data visualization techniques, including pie charts, histograms, and scatter plots using R.	**K4**
CO6	Apply hypothesis testing, ANOVA, multiple linear regression, and model selection algorithms using R in laboratory experiments.	**K4**

PRE-REQUISITE

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S		S		S									M
CO2	S				S									M
CO3	S		M		M								S	M
CO4	S	M			S									M
CO5	S	M			S								S	M
CO6	S	M			M				M				M	M

COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test I, II 2. Model Examination (For Practical Courses & Embedded Courses) 3. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 4. End Semester Examination
Indirect
1. Course-end survey 2. Programme Exit survey 3. Placement/Higher education record 4. Feedback (Students, Employers, Parents, Professional body members, Alumni)

THEORETICAL COMPONENT CONTENTS:

PROGRAMMING FUNDAMENTALS **10 Hours**

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Obtaining and installing R from CRAN – Numeric, arithmetic, assignment, and vectors – Matrices and arrays – non-numeric values – lists, data frames, special values, classes, and coercion – basic plotting – reading and writing files – calling functions – conditions and loops – writing functions – exceptions, timings, and visibility

STATISTICS AND PROBABILITY **10 Hours**

Describing Raw Data – Mean, Median, Mode, Counts, Percentages, Proportions, Quantiles, Percentiles, Variance, Standard Deviation, Interquartile Range, Covariance and Correlation – basic data visualization – probability distributions

STATISTICAL TESTING, MODELING AND ADVANCED GRAPHICS **10 Hours**

Sampling distributions and confidence – hypothesis testing – analysis of variance – simple linear regression – multiple linear regression – linear model selection and diagnostics – advanced plot customization

PRACTICAL COMPONENT CONTENTS:

LIST OF EXPERIMENTS

1. Implement simple R program to perform numeric and arithmetic operations using vectors, matrices, and arrays.
2. Create R program to perform basic functions operation with lists, data frames, special values, classes, plotting, conditions, and loops.
3. Identify elementary statistics parameters from R program coding.
4. Visualizing the raw data using R program from pie charts, histograms, bar, box, and scatter plots.
5. Implement simple R program to realize random variables and probability distributions.
6. Create R program to perform probability mass functions and density functions.
7. Implement simple R program to perform hypothesis testing and ANOVA.
8. Create R program to perform multiple line regression.
9. Implement simple R program to realize model selection algorithms.
10. Visualizing statisitical data using R program in three dimensional with advanced customization.

TEXT BOOKS

1. Sandip Rakshit, “Statistics with R Programming”. McGraw-Hill Education, 2018.
2. Trejo, Omar, and Trejo Navarro, Omar. “R Programming By Example: Practical, Hands-on Projects to Help You Get Started with R”. United Kingdom, Packt Publishing, 2017.

REFERENCES

1. Lovelace, Robin, and Gillespie, Colin, “Efficient R Programming: A Practical Guide to Smarter Programming”. Japan, O'Reilly Media, Incorporated, 2017.
2. G. Sudhamathy, C. Jothi Venkateswaran, “R Programming: An Approach to Data Analytics”. MJP Publisher, 2019.
3. Pedro J. Aphalo, “Learn R As a Language”. CRC Press, 2020.

Theory: 30 Hrs **Tutorial: 0 Hrs** **Practical: 30 Hrs** **Project: 0 Hrs** **Total: 60Hrs**

Signature of the Chairman BOS EEE

U18EEE0021	DATA COMMUNICATION AND NETWORKS	L	T	P	J	C
		3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Analyze the components and topologies of networks, including WAN/LAN and OSI layered architecture.	**K4**
CO2	Analyze design issues in the data link layer, such as CRC technique and sliding window techniques.	**K4**
CO3	Analyze the design issues of the network layer, including IP addressing, routing, and subnetting.	**K4**
CO4	Apply TCP and UDP protocols, including error handling and congestion control, at the transport layer.	**K3**
CO5	Illustrate the operation of application services like SMTP, HTTP, and DNS, focusing on their security aspects.	**K3**

PRE-REQUISITE

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													W
CO2	S	S	M										W	
CO3	S	M	M										M	M
CO4	S	M	W										M	M
CO5	M	M			M								M	W

COURSE ASSESSMENT METHODS

Direct
1.Continuous Assessment Test I, II 2.Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3.End Semester Examination
Indirect
1.Course-end survey 2. Programme Exit survey 3.Placement/Higher education record 4.Feedback (Students, Employers, Parents, Professional body members, Alumni)

INTRODUCTION TO NETWORK COMPONENTS **9 Hours**

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Components of network – Topologies – WAN / LAN – OSI – ISO layered Architecture – digital Modulation and demodulation techniques – Bit error rates – Line coding – Error correcting codes.

DATA LINK LAYER **9 Hours**

Design issues – CRC technique and sliding window techniques – Performance analysis of sliding window techniques – Framing formats – Case Study – HDLC protocols – Medium access control – CSMA / CD – Token ring and token bus – FDDI – Wireless Networks – Performance analysis of MAC protocols – Bridges.

NETWORK LAYER **9 Hours**

Circuit switching – packet switching – Design issues – IP addressing and IP datagram – Routers and gateways – Routing –Subnetting – CIDR – ICMP – ARP – RARP – basics of Ipv6 – QoS.

TRANSPORT LAYER **9 Hours**

TCP and UDP – Error handling and flow control – Congestion control – TCP Retransmission – Timeout – Socket Abstraction.

APPLICATION SERVICES **9 Hours**

Simple Mail Transfer Protocol (SMTP) – Secure File Transfer Protocols (SFTP), telnet, the World Wide Web (WWW), Hypertext Transfer Protocol (HTTP), Domain name service (DNS), Security, Multimedia applications, DHCP.

TEXT BOOKS

1. Data Communications and Networking, Behrouz A. Forouzan, McGraw Hill Education, 5th Ed., 2012.
2. William Stallings, "Data and Computer Communications", Seventh Edition, Prentice Hall,10th Edition, 2013.

REFERENCES

1. Larry Peterson and Bruce Davie, "Computer Networks: A Systems Approach", The Morgan Kaufmann Series, Elsevier, 5th Ed, 2011.
2. James F Kurose, "Computer Networking: A Top – Down Approach Featuring the Internet", Addison Wesley, 2nd Edition 2002.
3. W.Richard Stevens and Gary R Wright, "TCP / IP Illustrated", Addison Wesley, Volume 1 & 2, 2001.
4. Douglas E Corner, "Internetworking with TCP / IP", Volume 1 & 2, 2000.

Theory: 45 Hrs **Tutorial: 0 Hrs** **Practical: 0 Hrs** **Project: 0 Hrs** **Total: 45Hrs**

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U18EEE0022	HVDC AND FACTS	L	T	P	J	C
		3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Analyze the principles and applications of HVDC transmission systems.	**K4**
CO2	Examine the control characteristics and hierarchy in HVDC converters.	**K3**
CO3	Analyze the impact of harmonics on power systems and the design of filters for mitigation.	**K4**
CO4	Evaluate the objectives and methods of shunt compensation using FACTS devices.	**K3**
CO5	Illustrate the various strategies for series compensation and combined compensators in power systems.	**K3**

PRE-REQUISITE

U18EET4002 Generation, Transmission and Distribution

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													W
CO2	M	M	M										M	S
CO3	S	M	M											M
CO4	M	M											M	M
CO5	M	M	M				S						M	M

COURSE ASSESSMENT METHODS

Direct
1.Continuous Assessment Test I, II 2.Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3.End Semester Examination
Indirect
1.Course-end survey 2. Programme Exit survey 3.Placement/Higher education record 4.Feedback (Students, Employers, Parents, Professional body members, Alumni)

INTRODUCTION TO HVDC TRANSMISSION **9 Hours**

Comparison of AC and DC transmission systems-application of DC transmission-types of DC links, typical layout of a HVDC converter station-HVDC converters-pulse number- analysis of Gratez

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Circuit with and without overlap-converter bridge characteristics - equivalent circuits or rectifier and inverter configurations of twelve pulse converters.

HVDC CONVERTER CONTROL **9 Hours**

Principles of DC Link Control- Converters Control Characteristics- System control hierarchy-firing angle control-current and extinction angle control.

HARMONICS AND FILTERS **9 Hours**

Characteristic and uncharacteristic harmonics –Harmonic ac and dc filters –Interference with communication systems –Ground return.

INTRODUCTION TO FACTS AND SHUNT COMPENSATION **9 Hours**

Flow of power in AC parallel paths and meshed systems-basic types of FACTS controllers- brief description and definitions of FACTS controllers. Static Shunt Compensators: Objectives of shunt compensation-methods of controllable VAR generation: static VAR compensators-SVC and STATCOM, comparison between SVC and STATCOM.

SERIES COMPENSATION **9 Hours**

Objectives of series compensation- variable impedance type-thyristor switched series capacitors (TCSC), and switching converter type series compensators- static series synchronous compensator (SSSC)-power angle characteristics-basic operating control schemes. Combined Compensators: Introduction- Unified Power Flow Controller (UPFC)- basic operating principle- independent real and reactive power flow controller- control structure.

TEXT BOOKS

1. K.R.Padiyar, ―Facts Controllers in Power Transmission and Distribution, New Age International, 1st Edition, 2007, Reprint August 2014, New Delhi.

2. Narain G. Hingorani and Laszlo Gyugyi, Understanding FACTS concepts and Technology of Flexible AC Transmission Systems, Standard Publishers, Delhi 2001.

REFERENCES

1. V.K.Sood, "HVDC and FACTS controllers, Applications of Static converters in power System, Klumer Academic Publishers, 2004

2. Mohan Mathur R, Rajiv K Varma, Thyristor – Based Facts Controllers for Electrical Transmission Systems, IEEE press and John Wiley & Sons, Inc., 2002, Reprint 2009.

Theory: 45 Hrs **Tutorial: 0 Hrs** **Practical: 0 Hrs** **Project: 0 Hrs** **Total: 45Hrs**

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U18EEE0023	PYTHON FOR DATA STRUCTURES AND DATA SCIENCE	L	T	P	J	C
		3	0	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Apply Python programming fundamentals for basic data manipulation, control flow, and functions.	**K3**
CO2	Analyze and implement basic algorithms such as binary search, sorting, and recursive functions using Python.	**K4**
CO3	Evaluate Python's exception handling, file handling, and data structures like stacks, queues, and binary search trees.	**K4**
CO4	Apply Python libraries like NumPy and Pandas for data analysis, exploratory data analysis, and data preprocessing.	**K3**
CO5	Analyze and visualize data using matplotlib and seaborn libraries for scatter plots, line plots, histograms, and box plots.	**K4**

PRE-REQUISITE

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S				M									W
CO2	S	S	M		M								W	
CO3	S	M	M		S								M	M
CO4	M	M	M	S	S								M	M
CO5	M	M	M	S	S								M	W

COURSE ASSESSMENT METHODS

Direct
1.Continuous Assessment Test I, II 2.Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3.End Semester Examination
Indirect
1.Course-end survey 2. Programme Exit survey 3.Placement/Higher education record 4.Feedback (Students, Employers, Parents, Professional body members, Alumni)

INTRODUCTION 9 Hours

Informal introduction to programming - algorithms and data structures via gcd - Downloading and installing Python - gcd in Python: variables, operations, control flow - assignments, conditionals, loops, functions - Python: types, expressions, strings, lists, tuples - Python memory model: names, mutable and immutable

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values - List operations: slices etc - Binary search - Inductive function definitions: numerical and structural induction - Elementary inductive sorting: selection and insertion sort - In-place sorting

ALGORITHMS 9 Hours

Basic algorithmic analysis: input size, asymptotic complexity, - Arrays vs lists - Merge sort – Quicksort - Stable sorting – Dictionaries - More on Python functions: optional arguments, default values - Passing functions as arguments - Higher order functions on lists: map, Filter, list comprehension

EXCEPTION HANDLING AND DATA TYPES 9 Hours

Exception handling - Basic input/output - Handling files - String processing - Backtracking: N Queens, recording all solutions - Scope in Python: local, global, nonlocal names - Nested functions - Data structures: stack, queue - Heaps Abstract datatypes - Classes and objects in Python - "Linked" lists: find, insert, delete - Binary search trees: find, insert, delete - Height-balanced binary search trees-case studies

BASICS OF PYTHON SPYDER (TOOL) AND DATA TYPES 9 Hours

Introduction Spyder - Setting working Directory - Creating and saving a script file - File execution, clearing console, removing variables from environment, clearing environment - Commenting script files – NumPy – NP Array, Pandas data frame and data frame related operations on Toyota Corolla dataset - Reading files - Exploratory data analysis - Data preparation and pre-processing

DATA VISUALIZATION 9 Hours

Data visualization on Toyotas Corolla dataset using matplotlib and seaborn libraries - Scatter plot – Line Plot – Bar Plot – Histogram – Box Plot – Pair Plot - Control structures using Toyota Corolla dataset – if-else family – for loop – for loop with if break –while loop Regression , case study : Predicting price of used cars – Classification – Classifying personal income

TEXT BOOKS

1. Ashok Namdev Kamthane,Amit Ashok Kamthane, Programming and Problem Solving with Python , Mc-Graw Hill Education,2018.
2. Goodrich Michael T, Data Structures and Algorithms in Python John Wiley & Sons Inc,2013
3. Samir Madhavan Mastering python for data science, Packt Publishing Ltd , 2015.

REFERENCES

1. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press , 2013.
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Interdisciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016

Theory: 45 Hrs **Tutorial: 0 Hrs** **Practical: 0 Hrs** **Project: 0 Hrs** **Total: 45Hrs**

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U18EEE0024 **EV BATTERIES AND BATTERY MANAGEMENT SYSTEMS**

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

After the successful completion of this course, the students will be able to

CO1	Analyze and compare the performance, efficiency, and suitability of different types of batteries for various electric vehicle application	**K3**
CO2	Differentiate various battery charging techniques and analyze the impact of C-rate on the charging and discharging processes of batteries	**K3**
CO3	Apply the fundamental principles of battery management systems to real-world scenarios to ensure optimal battery performance and safety	**K4**
CO4	Demonstrate and monitor the performance of battery charging and discharging techniques	**K4**
CO5	Enable students to design and test battery packs for electric vehicles by evaluating battery ratings	**K4**

PRE-REQUISITE

Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	S	M				M						M	
CO2	M	S	S										M	S
CO3	M	S					M						S	S
CO4	S	M			S								M	M
CO5	M		M	S	S		M						M	M

COURSE ASSESSMENT METHODS

Direct
1.Continuous Assessment Test I, II 2.Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3.End Semester Examination
Indirect
1.Course-end survey 2. Programme Exit survey 3.Placement/Higher education record 4.Feedback (Students, Employers, Parents, Professional body members, Alumni)

THEORETICAL COMPONENT CONTENTS:

BATTERIES FOR EV **9 Hours**

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Batteries-Advanced Lithium Batteries (LMO, NMC, LFP and LTO with their comparative study), Lead-acid battery, High temperature batteries for back-up applications, Double layer and Super capacitors for e-mobility application.

BATTERY CHARGING AND PERFORMANCE **11 Hours**

Battery Charging Methods: Constant current and constant voltage methods, fast charging methods, Hybrid methods, Inductive chargers, wireless charging, Battery Performance: Concept of C-rating, Wh and Ah rating, SOH, SOC, DOD ratings, , Effects on capacity, cycle life, and thermal behavior on battery life, optimization of c-rate , Tools and methods to simulate C-rate effects

BATTERY MANAGEMENT SYSTEMS (BMS) **10 Hours**

Battery Management Systems (BMS): Hardware and software components of BMS, integration with EV systems, active and passive cell balancing, , Monitoring, protection, balancing, and thermal management

PRACTICAL COMPONENT CONTENTS:

LIST OF EXPERIMENTS

- Study the basic parameters of battery.
- Demonstrate charging technique of lead acid battery/Lithium-Ion battery.
- Demonstrate the discharging process of battery at various C-rate
- Study of ratings of battery for two wheelers EVs, E-rickshaws, E-CARs
- Study the process of battery testing and measure the parameters of battery.
- Battery Temperature Measurement / thermal safety issues (Thermocouple, Thermistor)
- Battery pack design for given EV application (Testing various series parallel combinations)
- Electric vehicle wiring observation with demo.

Visit to any industry/EV charging station/Research laboratory related to battery and EV.

TEXT BOOKS

1. D.A.J. Rand, R. Woods, and R.M.Dell,"Batteries for Electric Vehicles,"Society of Automotive Engineers, " Warrendale PA, 2003.

2. G-A.Nazriand, G.Pistoa ,Lithium Batteries, Science and Technology, Kluwer Academic Publisher, 2003

REFERENCES

1. G-A.Nazriand, G.Pistoa ,Lithium Batteries, Science and Technology, Kluwer Academic Publisher, 2003

2. H.A.Kiehne, "Battery Technology Handbook", Marcel Dekker,NYC,2003.

3. James Larminie and John Lowry,"Electric Vehicle Technology Explained, "John Wiley,2003.

4. D.Lindenand T.S.Reddy, "Hand book of Batteries,"4th Edition, McGraw-Hill, 2011.

Theory: 30 Hrs **Tutorial: 0 Hrs** **Practical: 30 Hrs** **Project: 0 Hrs** **Total: 60 Hrs**

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ONE CREDIT COURSES

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U18EEC0001 AUTOMOTIVE EMBEDDED SYSTEM

L	T	P	J	C
0	0	1	0	1

3 Hours

History of Automobiles. Major components of an Automobile Systems and its functions - Overview of four stroke I.C.engine , Four Cylinder Engine, Spark firing sequence. Block diagram of Automobile electrical system, Typical wiring diagram, Starter system: General layout and Basic starting circuit

3 Hours

Ignition system: Battery and magneto types, Battery ignition system for four cylinder engine, Ignition system circuit and Distributed ignition coil and ignition advance. Charging system: Typical alternator in common use, cut-out and regulator, Lighting & accessories system. Wiper motor and circuit diagram of wind screen wiper motor and washer.

3 Hours

Physical Variables to be measured in automobiles: Position sensor: Magnetic reluctance and Hall effect sensor and Temperature sensor: Coolant temperature Speed sensor, Fuel level sensor and Acceleration sensor. Actuator: Principle of solenoid and Fuel injector.

3 Hours

Block diagram of Engine control unit -Diagnostics procedure: Introduction, Diagnostics theory: On board and Off-board diagnostics, Diagnostics Link Connector and Vehicle condition monitoring

3 Hours

CAN bus - topology – Data transmission – CAN Protocol – Overview of CAN controller. LIN bus: overview – Data Transmission System – LIN protocol.

Theory: 0 Tutorial: 0 Practical: 15 Project: 0 Total: 15 Hours

Signature of the Chairman BOS EEE

U18EEC0002	EMBEDDED SYSTEMS ARM® CORTEX®-M3 MCUS	L	T	P	J	C
		0	0	1	0	1

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	To understand the architecture and programming of ARM.	**K2**
CO2	To demonstrate the ability to design, troubleshoot, and simulate assembly and C language programs	**K3**
CO3	To demonstrate an understanding of controlling circuits and systems interfaced to a development board.	**K3**
CO4	To implement real time communication protocols in ARM.	**K3**
CO5	To sketch ARM signal processing libraries.	**K3**
CO6	To apply ARM processor concepts on application development.	**K3**

PRE-REQUISITE

1. Microprocessors and Microcontrollers
2. Embedded System

ARM ARCHITECTURE AND PROGRAMMING **3 Hours**

ARM processor family, Application of ARM Processor, The Acorn RISC machine, Architectural inheritance, The ARM programmer's model, ARM development tools-Memory System Architecture-Data processing instructions, Data transfer instructions, Control flow instructions, Conditional execution, ARM Condition codes Understanding of ARM instruction execution, Exceptions in ARM, Thumb programmer's model and instruction set

DESIGN WITH ARM MICROCONTROLLERS **3 Hours**

General purpose I/O - Timers and counters -Watchdog timer - PWM device - Interrupt controllers - A/D and D/A converters - Serial communication devices

ARM COMMUNICATION PROTOCOLS **3 Hours**

UART and SPI communication protocol-I2C communication protocol-I2C Protocol, Programming for I2C Protocol, Real time application using-RTC, Advantages & Disadvantages of I2C Protocols.-USB communication protocol-PCI-bus communication protocol-CAN protocol

DIGITAL SIGNAL IN PROCESSING IN ARM **3 Hours**

Introduction to DSP on ARM –FIR Filter – IIR Filter – Discrete Fourier transform – Exception Handling – Interrupts – Interrupt handling schemes- Firmware and boot loader – Example: Standalone - Embedded Operating Systems – Fundamental Components - Example Simple little Operating System

ARM APPLICATION DEVELOPMENT **3 Hours**

Introduction to Real-Time system, Definitions and examples – Case Studies- CAN, SPI Protocols.

REFERENCES

1. Instructor reference material
2. ARM System Developers Guide, Designing and Optimizing System Software, by Andrew N. SLOSS, Dominic SYMES and Chris WRIGHT, ELSEVIER, 3004
3. ARM System-on-Chip Architecture, Second Edition, by Steve Furber, PEARSON, 2013
4. Operating Systems, 5th Edition, By William Stallings Manuals and Technical Documents from the ARM Inc, web site

Theory: 0 **Tutorial: 0** **Practical: 15** **Project: 0** **Total: 15 Hours**

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U18EEC0003	CASE STUDY USING ARM CORTEX-M3 ® MCU- AUTOMATION OF LINEAR WEIGHING MACHINE	L	T	P	J	C
		0	0	1	0	1

AN INSIGHT INTO LINEAR WEIGHING MACHINE **3 Hours**

Introduction to Embedded Systems - Case Study: Fuel Filling Station, ATM, Linear Weighing Machine - Identification of User Interfaces (Inputs and Outputs) - Identification of System Interfaces (Sensors and Actuators) – Role of Microcontroller – Development of Control Algorithm.

AN INSIGHT INTO ARM CORTEX- M3 ® MCU **3 Hours**

Introduction to ARM7 Microcontroller - ARM7 LPC2138 - Power supply – Program Memory – Data Memory – Clock Circuit – Reset Circuit – Programming Tool Chain – Keil IDE - Simulation using Proteus – List of ARM Peripherals – Pin Configuration.

EMBEDDED C PROGRAMMING **3 Hours**

Embedded C programming – Accessing of Digital Inputs and Outputs – ADC Programming - Timer and their applications - Programming of interrupts - PWM Generation – UART Communication – MODBUS Basics.

HANDS-ON SESSION DC LOAD CONTROL **3 Hours**

On/Off Control – Regulation Control – Application of PWM for DC Control – BJT and MOSFET usage for DC Load – Driver Card - Real time example – PWM Control of Wiper Motor in Automotive Application – ARM Programming.

HANDS-ON SESSION AC LOAD CONTROL **3 Hours**

Control of AC load – Firing Angle control - SCR and TRIAC Applications – Generation of Firing Angle from ARM (using Timer and Interrupt) - Real time example – Control of Heating element / Vibratory Feeder - ARM Programming.

REFERENCES

1. Instructor reference material
2. ARM System Developers Guide, Designing and Optimizing System Software, by Andrew N. SLOSS, Dominic SYMES and Chris WRIGHT, ELSEVIER, 3004
3. ARM System-on-Chip Architecture, Second Edition, by Steve Furber, PEARSON, 2013
4. Operating Systems, 5th Edition, By William Stallings
5. Manuals and Technical Documents from the ARM Inc, web site

Theory: 0 **Tutorial: 0** **Practical: 15** **Project: 0** **Total: 15 Hours**

Signature of the Chairman BOS EEE

U18EEC0004 **SUBSTATION DESIGN**

L	T	P	J	C
0	0	1	0	1

INTRODUCTION TO SUBSTATION DEVICES **4 Hours**

Overview of Electrical substation – Types of substation- Isolater, Circuit breaker, Earthswitch,CT,VT Basic concepts, Single line diagram, Industrial methods and steps for building the substation- Bus bar arrangements.

SUBSTATION INDUSTRIAL TOPICS **4 Hours**

Remote tap changer control – Auto bus transfer scheme – Capacitor bank concepts- Anitpumping relay - trip circuit supervision – Breaker Failure concepts.

RELAY PANEL & INTERNATIONAL STANDARDS **4 Hours**

Single line diagram – Schematic overview –General Arrangements – bill of Materials – AC Distribution panel – DC Distribution panel – ANSI Code & IEC codes.

HANDS ON TRAINING ON SESSION **3 Hours**

Hands on training from Microstation software and AutoCAD software for Doing the Single line diagram, Breaker Tripping logic, AC Distribution, DC Distribution circuits, Relay circuit, Tripping and Closing Circuit for the Circuit breaker. References

REFERENCES

1. John D. McDonald , Electric Power Substations Engineering, Third Edition, CRC press, Jun 2012
2. Network Protection & Automation Guide , published by Alstom Grid Worldwide Contact Centre, May 2011.

Theory: 0 **Tutorial: 0** **Practical: 15** **Project: 0** **Total: 15 Hours**

Signature of the Chairman BOS EEE

U18EEC0005	INDUSTRIAL EMBEDDED SYSTEMS AND COMMUNICATION PROTOCOLS	L	T	P	J	C
		0	0	1	0	1

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1	Understand the various components in Industrial embedded.	**K2**
CO2	Understand the architecture and programming of ARM and ability to design, troubleshoot, and simulate assembly and C language programs	**K3**
CO3	Apply the knowledge on fundamentals of communication protocols	**K3**
CO4	Understanding of controlling circuits and systems interfaced to a development board.	**K3**
CO5	Understand the critical real – time issues involved in end product design with solutions using case studies	**K5**

PRE-REQUISITE

1. Microprocessors and Microcontrollers

2.

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
CO	PROGRAME OUTCOME(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M												
CO2	S	M	M		S									
CO3		S	M		S									
CO4			S		S									
CO5			S	W	S				S	M	M		M	M

OVERVIEW OF INDUSTRIAL EMBEDDED SYSTEMS **3 Hours**

Introduction to Embedded Systems - Case Study: Fuel Filling Station, ATM, Linear Weighing Machine - Identification of User Interfaces (Inputs and Outputs) - Identification of System Interfaces (Sensors and Actuators) – Role of Microcontroller – Development of Control Algorithm.

ARM ARCHITECTURE AND PROGRAMMING **3 Hours**

Introduction to ARM7 Microcontroller - ARM7 LPC2138 - Power supply – Program Memory – Data Memory – Clock Circuit – Reset Circuit – Programming Tool Chain – KEIL IDE - Simulation using Proteus – List of ARM Peripherals – Pin Configuration.

ARM COMMUNICATION PROTOCOLS **3 Hours**

Embedded C programming – Accessing of Digital Inputs and Outputs – ADC, DAC Programming - Timer and their applications - Programming of interrupts - PWM Generation – I2C – SPI Communication - UART Communication – RS232, RS485, MODBUS – CAN Communication.

ARM INTERFACING **3 Hours**

Interfacing with Industrial sensors – Temperature, Pressure, Level, Flow.Interfacing with Industrial actuators – Solenoid Valves, Induction machine using VFD Drive, Stepper motor using Stepper Drive, Heater element.

CASE STUDIES **3 Hours**

Mini Project – Development of PID Temperature control unit with PC Interfacing.

Signature of the Chairman BOS EEE

REFERENCES

1. Instructor reference material
2. ARM System Developers Guide, Designing and Optimizing System Software, by Andrew N. SLOSS, Dominic SYMES and Chris WRIGHT, ELSEVIER, 3004
3. ARM System-on-Chip Architecture, Second Edition, by Steve Furber, PEARSON, 2013
4. Operating Systems, 5th Edition, By William Stallings
5. Manuals and Technical Documents from the ARM Inc, web site

Theory: 0 **Tutorial: 0** **Practical: 15** **Project: 0** **Total: 15 Hours**

Signature of the Chairman BOS EEE

U18EEC0006

GREEN BUILDING DESIGN (ENERGY FOCUSSED TOOLS)

L	T	P	J	C
0	0	1	0	1

COURSE OUTCOMES

After successful completion of this course, the students will be able to

CO1 Communicate the potential of building energy efficiency to impact the nation's energy future, especially as it applies to climate change.

CO2 Understand and apply fundamental concepts of energy and utilities as related to the building environment

CO3 Describe the objectives and general framework of building energy efficiency code and standards.

COS	CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12
CO1	S						M					
CO2			M		M							
CO3	S						M					

INTRODUCTION **2 Hours**

Green Building Concept- Green building rating tools- codes– Standards

INDOOR ENVIRONMENTAL QUALITY MANAGEMENT **1 Hour**

Psychrometry- Comfort conditions- Illumination requirement- Auditory requirement- Air conditioning systems

LIGHTING SYSTEM DESIGN **2 Hours**

Lighting system design- Lighting economics and aesthetics- Impacts of lighting efficiency

ENERGY EFFICIENCYIN BUILDINGS **2 Hours**

Energy conservation in pumps- Fans and blowers- Refrigerating machines- Heat rejection equipment- Energy efficient motors- Insulation. Energy audit and energy targeting- Technological options for energy management.

ENERGY SIMULATION (Practical session) **8 Hours**

Energy Simulation using IESVE software: Building energy analysis methods- Building energy simulation Model- Equipment Sizing- Time based Energy simulation- Sensitivity Analysis- Energy scheduling -Economic Calculations- Energy Efficiency

Theory: 0 **Tutorial: 0** **Practical: 15** **Project: 0** **Total: 15 Hours**

Signature of the Chairman BOS EEE

U18EEC0007	HDL Programming	L	T	P	J	C
		0	0	1	0	1

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO1	Know the need for HDL programming in digital system design.	**K1**
CO2	Understand the basics of Verilog HDL and VHDL programming.	**K2**
CO3	Understand the various design constructs of Verilog HDL and VHDL	**K2**
CO4	Apply the different types of HDL constructs in programming of HDL.	**K3**
CO5	Apply the different types of modelling in design of digital system.	**K3**

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	M													
CO3	M											M		
CO4	M		S		M							M	M	M
CO5	S		S		M							M	M	M

Verilog HDL Programming 7 Hours

Overview of Digital Design with Verilog HDL - Hierarchical Modeling Concepts - Basic Concepts - Modules and Ports - Gate-Level, Dataflow, Behavioral Modeling - Tasks and Functions - Useful Modeling Techniques. Simulation Exercise on Xilinx ISE Design Suite.

VHDL Programming 8 Hours

Introduction - Basic Language Elements – Behavioral, Dataflow, Structural Modelling - Generics and Configurations - Subprograms and Overloading - Packages and Libraries - Hardware Modeling Examples. Simulation Exercise on Xilinx ISE Design Suite.

TEXT BOOKS

1. Samir Palnitkar, Verilog HDL A guide to Digital Design and Synthesis, 2003, SunSoft Press.
2. Jayaram Bhasker, VHDL Primer 3rd Edition, Pearson Education 2015.

REFERENCES

1. www.xilinx.com
2. Brown and Z. Vranesic S, Fundamentals of Digital Logic with Verilog Design', Third edition, McGraw Hill, 2017.

Theory: 15 Hrs **Tutorial: 0 Hrs** **Practical: 0 Hrs** **Project: 0 Hrs** **Total: 15Hrs**

Signature of the Chairman BOS EEE