COURSE SCHEME AND SYLLABUS

FOR

B.E.

(Electrical and Computer Engineering)

THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
(Deemed to be University)

2023

Approved in 109th meeting of the Senate held on March 16, 2023. Revised in 112th meeting of the Senate held on March 11, 2024.

SEMESTER-I

S. NO.	COURSE CODE	COURSE NAME	CODE	L	T	P	CR
1.	UPH013	PHYSICS	BSC	3	1	2	**4.5**
2.	UES101	ENGINEERING DRAWING	ESC	2	4	0	**4**
3.	UHU003	PROFESSIONAL COMMUNICATION	HSS	2	0	2	**3**
4.	UES102	MANUFACTURING PROCESSES	ESC	2	0	2	**3**
5.	UMA010	MATHEMATICS–I	BSC	3	1	0	**3.5**
		TOTAL		12	6	6	**18**

SEMESTER-II

S. NO.	COURSE CODE	COURSE NAME	CODE	L	T	P	CR
1.	UCB009	CHEMISTRY	BSC	3	0	2	**4**
2.	UES103	PROGRAMMING FOR PROBLEM SOLVING	ESC	3	0	2	**4**
3.	UES013	ELECTRICAL & ELECTRONICS ENGINEERING	ESC	3	1	2	**4.5**
4.	UEN008	ENERGY AND ENVIRONMENT	HSS	2	0	0	**2**
5.	UMA004	MATHEMATICS–II	BSC	3	1	0	**3.5**
		TOTAL		14	2	6	**18**

Credits (end of First Year/ II semester): 36

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SEMESTER-III

S. NO.	COURSE CODE	COURSE NAME	CODE	L	T	P	CR
1.	UMA301	DISCRETE MATHEMATICAL STRUCTURES	BSC	3	1	0	**3.5**
2.	ULC301	DATA STRUCTURES	PCC	3	0	2	4
3.	ULC302	INTRODUCTION TO NETWORK THEORY	PCC	3	1	0	3.5
4.	UES301	ANALOG CIRCUITS	ESC	2	0	2	3
5.	ULC303	COMPUTER ARCHITECTURE AND ORGANIZATION	PCC	3	0	0	3
6.	UTA030	ENGINEERING DESIGN PROJECT (BUGGY)	PRJ	1	0	4	3
7.	UTD002	EMPLOYABILITY DEVELOPMENT SKILLS	HSS	2	0	0	2.0
		TOTAL		17	2	8	**22.0**

Credits (end of III sem): 58

SEMESTER-IV

S. NO.	COURSE CODE	COURSE NAME	CODE	L	T	P	CR
1.	ULC403	DESIGN AND ANALYSIS OF ALGORITHMS	PCC	3	0	2	4
2.	ULC404	OPERATING SYSTEMS	PCC	3	0	2	4
3.	UMA028	MATHEMATICS FOR DATA SCIENCE	BSC	3	0	2	4
4.	UTA018	OBJECT ORIENTED PROGRAMMING	ESC	3	0	2	4
5.	UEE413	ELECTRIC MACHINERY	PCC	3	1	2	4.5
6.	ULC405	PRINCIPLES OF POWER SYSTEM ENGINEERING	PCC	3	1	0	3.5
7.	UHU050	EVOLUTIONARY PSYCHOLOGY (1 SELF EFFORT HOUR)	HSS	1*	0	0	1.0
*****Alternate Week		TOTAL		18 +1*	2	10	**25**

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Credits (end of IVsem): 83

SEMESTER-V

S. No.	Course Code	Course Name	CODE	L	T	P	Cr
1	ULC501	DATA BASE MANAGEMENT SYSTEMS	PCC	3	0	2	4
2	ULC502	COMPUTER NETWORKS	PCC	3	0	2	4
3	UEE508	LINEAR CONTROL SYSTEMS	PCC	3	1	2	4.5
4	UEE512	POWER CONVERTERS AND DRIVES	PCC	3	1	2	4.5
5	UTA025	INNOVATION AND ENTREPRENEURSHIP	OTH	1	0	2	3
6		ELECTIVE-I	PEC	3/2	0	0/2	3
		TOTAL		16/15	2	10/12	**23**

Credits (end of V sem): 106

SEMESTER-VI

S. No.	Course Code	Course Name	CODE	L	T	P	Cr
1	ULC601	MACHINE LEARNING TECHNIQUES	PCC	3	0	2	4
2	UEE511	EMBEDDED SYSTEMS DESIGN AND IOT	PCC	3	0	2	4
3	ULC602	DIGITAL MEASUREMENT AND PROTECTION	PCC	3	0	2	4
4	UMA601	MATHEMATICS FOR SIGNAL PROCESSING	BSC	2	1	2	3.5
5	UHU005	HUMANITIES FOR ENGINEERS	HSS	2	0	2	3
6		ELECTIVE -II	PEC	3/2	0	0/2	3
7	ULC691	CAPSTONE PROJECT (STARTS)	PRJ	0	0	2	0
				16/15	1	12/14	21.5

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Credits (end of VI sem): 127.5

SEMESTER-VII

S. No.	Course Code	Course Name	CODE	L	T	P	Cr
1	ULC703	THEORY OF COMPUTATION	PCC	3	1	0	3.5
2	ULC603	ELECTRIC VEHICLE AND REAL TIME SYSTEMS	PCC	3	0	2	4
3	ULC701	SMART ELECTRIC GRID AND ENERGY MANAGEMENT	PCC	3	0	0	3
4		ELECTIVE -III	PEC	3/2	0	0/2	3
5		GENERIC ELECTIVE	OEC	2	0	0	2
6	ULC691	CAPSTONE PROJECT	PRJ	0	0	2	8
		TOTAL		14/13	1	4/6	**23.5**

Credits (end of VII sem): 151

SEMESTER-VIII

S. No.	Course Code	Course Name	CODE	L	T	P	Cr
1	ULC802	SOCIAL NETWORK ANALYSIS	PCC	2	0	2	3
2	ULC803	ETHICAL HACKING	PCC	3	0	2	4
3	ULC892	DESIGN PROJECT	PRJ	--	--	--	8
OR							
1	ULC891	PROJECT SEMESTER	PRJ	--	--	--	15
OR							
1	ULC893	START-UP SEMESTER	PRJ	--	--	--	15

Total Credits (end of VIII sem): 166

BASKETS OF SPECIALIZATION

S.No	Specialization	Elective-I (Semester-V)	Elective-II (Semester-VI)	Elective-III (Semester-VII)
1	**Mathematics and Computing**	Data Mining and Visualization	Deep Learning	Forecasting Methods and Applications
2	**High End Computing**	Cloud Computing	Deep Learning	GPU computing
3	**Computer Animation and Gaming**	Computer Vision	3D Modelling and Animation	Game Design & Development
4	**Information and grid security**	Cyber and Network security	Block Chain Technology and Applications	Grid Security
5	**Electric Vehicle**	Battery Management System	EV Charging Infrastructure	Autonomous Mobility

LIST OF ELECTIVES

S.No.	Course No.	Course Name	L	T	P	Cr
Elective -I						
1	ULCxxx	Battery Management System	2	0	2	3
2	UCS531	Cloud Computing	2	0	2	3
3	UCS653	Data Mining and Visualization	2	0	2	3
4	UMC622	Matrix Computation	2	0	2	3
5	ULC664	Cyber and Network Security	2	0	2	3
6	ULC702	Industrial Communication Protocols and SCADA	3	0	0	3
7	ULC60x	Software engineering	2	0	2	3
8	UCS532	Computer Vision	2	0	2	3
Elective -II						
1	UCS754	Block Chain Technology and Applications	2	0	2	3
2	ULC665	Deep Learning	2	0	2	3
3	ULC xxx	EV Charging Infrastructure	3	0	0	3
4	ULC663	Cyber Physical Systems	3	0	0	3
5	UEE525	Data Analytics Methods	2	0	2	3
6	ULC742	Digital Control Systems	3	0	0	3
7	UCS636	3D Modelling and Animation	2	0	2	3

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8	ULC744	FACTS and Custom Power	3	0	0	3
Elective -III						
1	ULC741	Advanced Metering Infrastructure	3	0	0	3
2	ULCxxx	Grid Security	2	0	2	3
3	ULC643	Forecasting methods and applications	2	0	2	3
4	ULC745	Modern Propulsion system and Robotics	2	0	2	3
5	UMA038	Optimisation and Heuristics	2	0	2	3
6	UCS751	Simulation and Modelling	2	0	2	3
7	UCS646	Game Design & Development	2	0	2	3
8	UCS635	GPU Computing	2	0	2	3
9	ULC641	Autonomous Mobility	3	0	0	3

List of Generic Electives

S.No.	Course No.	Course Name	L	T	P	Cr
1	UHU016	Introductory Course In French	2	0	0	2.0
2	UHU017	Introduction To Cognitive Science	2	0	0	2.0
3	UHU018	Introduction To Corporate Finance	2	0	0	2.0
4	UCS002	Introduction To Cyber Security	2	0	0	2.0
5	UPH064	Nanoscience And Nanomaterials	2	0	0	2.0
6	UEN006	Technologies For Sustainable Development	2	0	0	2.0
7	UMA069	Graph Theory And Applications	2	0	0	2.0
8	UMA070	Advanced Numerical methods	2	0	0	2.0
9	UBT510	Biology for Engineers	2	0	0	3.0

Table 1: Nature of course and code

Nature of the course	CODE**
Basic Science Courses	BSC
Engineering Science Courses	ESC
Humanities and Social Science Courses	HSS
Professional Core Courses	PCC
Professional Elective Courses	PEC
Open Elective Courses	OEC
Project	PRJ
Others {not available/specified in the categories mentioned here}	*OTH*

Table 3: Total Credit Score for specific Nature of course/s

Nature of the course	CODE	Total Credits	Semester and Course Name
Basic Science Courses	BSC	*29.5*	<1, Applied Physics> <1, Mathematics–I> <II, Applied Chemistry> <II, Mathematics–II> <III, Discrete Mathematical Structures> <IV, Mathematics for Data Science> <VI, Mathematics for Signal Processing> <VII, Optimisation and Heuristics, Elective>
Engineering Science Courses	ESC	*23.5*	<I, Engineering Drawing> <I, Manufacturing Processes> <II, Programming for Problem Solving> <II, Electrical & Electronics Engineering> <III, Object Oriented Programming> <III, Analog Circuits>
Humanities and Social Science Co	HSS	*11*	<I, Professional Communication> <II, Energy and Environment> <VI, Humanities For Engineers> <Semester III, Employability Development Skills> <Semester IV, Evolutionary Psychology>
Professional Core Courses	PCC	*66*	<III, [Data Structures, Introduction to Network Theory, Computer Architecture And Organization] > <IV, [Design and Analysis of Algorithms, Operating Systems, Electric Machinery, Principles of Power System Engineering]> <V, [Data Base Management Systems**, Computer Networks, Linear Control Systems, Power Converters and Drives]> <VI,[Machine Learning Techniques, Embedded Systems Design and IoT, Digital Measurement and Protection]> <VII,[Theory of Computation, Electric Vehicle and Real Time Systems, Smart Electric Grid and Energy Management]>
Open Elective Courses	OEC	*2*	<VII, Generic Elective>
Project	PRJ	*26*	<IV, Engineering Design Project(BUGGY) > <VI-VII, Capstone Project> <VIII, Project Semester>

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UPH013: Physics

L	T	P	Cr
3	1	2	4.5

Course Objectives: To introduce the student to the basic physical laws of oscillators, acoustics of buildings, ultrasonics, electromagnetic waves, wave optics, lasers, and quantum mechanics and demonstrate their applications in technology. To introduce the student to measurement principles and their application to investigate physical phenomena.

Syllabus

Oscillations and Waves: Oscillatory motion and damping, Applications - Electromagnetic damping – eddy current; Acoustics: Reverberation time, absorption coefficient, Sabine's and Eyring's formulae (Qualitative idea), Applications - Designing of hall for speech, concert, and opera; Ultrasonics: Production and Detection of Ultrasonic waves, Applications - green energy, sound signaling, dispersion of fog, remote sensing, Car's airbag sensor.

Electromagnetic Waves: Scalar and vector fields; Gradient, divergence, and curl; Stokes' and Green's theorems; Concept of Displacement current; Maxwell's equations; Electromagnetic wave equations in free space and conducting media, Application - skin depth.

Optics: Interference: Parallel and wedge-shaped thin films, Newton rings, Applications as Non-reflecting coatings, Measurement of wavelength and refractive index. **Diffraction:** Single and Double slit diffraction, and Diffraction grating, Applications - Dispersive and Resolving Powers. **Polarization:** Production, detection, Applications – Anti-glare automobile headlights, Adjustable tint windows. **Lasers:** Basic concepts, Laser properties, Ruby, HeNe, and Semiconductor lasers, Applications – Optical communication and Optical alignment.

Quantum Mechanics: Wave function, Steady State Schrodinger wave equation, Expectation value, Infinite potential well, Tunneling effect (Qualitative idea), Application - Quantum computing.

Laboratory Work :

1. Determination of damping effect on oscillatory motion due to various media.
2. Determination of velocity of ultrasonic waves in liquids by stationary wave method.
3. Determination of wavelength of sodium light using Newton's rings method.
4. Determination of dispersive power of sodium-D lines using diffraction grating.
5. Determination of specific rotation of cane sugar solution.
6. Study and proof of Malus' law in polarization.
7. Determination of beam divergence and beam intensity of a given laser.
8. Determination of displacement and conducting currents through a dielectric.
9. Determination of Planck's constant.

Micro Project: Students will be given physics-based projects/assignments using computer simulations, etc.

Course Learning Outcomes (CLOs) /Course Objectives (COs):
On completion of this course, the students will be able to:

1. Understand damped and simple harmonic motion, the role of reverberation in designing a hall and generation and detection of ultrasonic waves.
2. use Maxwell's equations to describe propagation of EM waves in a medium.
3. demonstrate interference, diffraction and polarization of light.
4. explain the working principle of Lasers.
5. use the concept of wave function to find probability of a particle confined in a box.
6. perform an experiment, collect data, tabulate and report them and interpret the results with error analysis.

Text Books:

1. Beiser, A., Concept of Modern Physics, Tata McGraw Hill (2007) 6th ed.
2. Griffiths, D.J., Introduction to Electrodynamics, Prentice Hall of India (1999) 3rd ed.
3. Jenkins, F.A. and White, H.E., Fundamentals of Optics, McGraw Hill (2001) 4th ed.

Reference Books:

1. Wehr, M.R, Richards, J.A., Adair, T.W., Physics of The Atom, Narosa Publishing House (1990) 4th ed.
2. Verma, N.K., Physics for Engineers, Prentice Hall of India (2014)1st ed.
3. Pedrotti, Frank L., Pedrotti, Leno S., and Pedrotti, Leno M., Introduction to Optics, Pearson Prentice HallTM (2008) 3rd ed.

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

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UES101: Engineering Drawing

L	T	P	Cr
2	4	0	4.0

Course Objectives: This module is dedicated to graphics and includes two sections: 2D drafting and 3D modelling of solid objects. This course is aimed at making the student understand the concepts of projection systems, learn how to create projections of solid objects using first and third angle orthographic projection as well as isometric and auxiliary projection, concept of sectioning, to interpret the meaning and intent of toleranced dimensions and to create/edit drawings using drafting software. In addition, this course shall give an insight on the basic 3D modelling concepts like extrude, revolve, sweep, construction of complex solids.

Syllabus

Engineering Drawing Concepts

1. Introduction to Engineering Drawing
2. Projection systems: First angle and third angle projection system
3. Orthographic Projection: Points, Lines, Solid objects
4. Isometric Projections
5. Auxiliary Projections
6. Development of surfaces
7. Section of solids
8. Limits, fits and tolerances

2D Drafting

1. Management of screen menus commands
2. Creating basic drawing entities
3. Co-ordinate systems: Cartesian, polar and relative coordinates
4. Drawing limits, units of measurement and scale
5. Layering: organizing and maintaining the integrity of drawings
6. Design of prototype drawings as templates.
7. Editing/modifying drawing entities: selection of objects, object snap modes, editing commands,
8. Dimensioning: use of annotations, dimension types, properties and placement, adding text to drawing

3D Modelling

1. Management of screen menus commands
2. Introduction to basic 3D modelling commands such as extrude, revolve, sweep etc.
3. Creation of 2D drawings from a 3D model

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Micro Projects /Assignments:

1. Completing the views - Identification and drawing of missing lines and views in the projection of objects
2. Projects related to orthographic and isometric projections Using wax blocks/soap bars/any soft material to develop three dimensional object from given orthographic projections
3. a. 3D modelling of complex machine components
   b. Development of production drawings of individual components from the model

Course Learning Outcomes (CLOs) /Course Objectives (COs):

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

1. Creatively comprehend the geometrical details of common engineering objects
2. Draw dimensioned orthographic and isometric projections of simple engineering objects
3. Interpret the meaning and intent of limits, fits and tolerances in the drawing
4. create/edit the engineering drawings for simple engineering objects using 2D drafting software
5. create/edit 3D models of engineering components using 3D modelling software

Text Books:

1. Jolhe, D.A., Engineering Drawing, Tata McGraw Hill, 2008
2. Davies, B. L., Yarwood, A., Engineering Drawing and Computer Graphics, Van Nostrand Reinhold (UK), 1986

Reference Books:

1. Gill, P.S., Geometrical Drawings, S.K. Kataria & Sons, Delhi (2008).
2. Gill, P.S., Machine Drawings, S.K. Kataria & Sons, Delhi (2013).
3. Mohan, K.R., Engineering Graphics, Dhanpat Rai Publishing Company (P) Ltd, Delhi (2002).
4. French, T. E., Vierck, C. J. and Foster, R. J., Fundamental of Engineering Drawing & Graphics Technology, McGraw Hill Book Company, New Delhi (1986).
5. Rowan, J. and Sidwell , E. H., Graphics for Engineers, Edward Arnold, London (1968).
6. Mastering AutoCAD 2021 and AutoCAD LT 2021, Brian C. Benton, George Omura, Sybex - John Wiley and Sons, Indiana (2021).

Evaluation Scheme

Evaluation Elements	**Weightage %**
MST (1.5 hours-CAD based) (MST)	**20**
EST (2 hours-CAD based) (ESE)**	**45**
AutoCAD tutorials/SolidWorks/Project work*	**35**

* Students are required to bring their personal computers for the tutorial work.

* Availability of institute server resources for sharing the software licenses with the student community.

**Institute computational resources in collaboration with other academic units / departments for conducting the mid semester and end semester test.

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UHU003: Professional Communication

L	T	P	Cr
2	0	2	3.0

Course Objectives: The course is designed to develop the interpersonal, written, and oral as well as the non- verbal communication skills of the students. The course begins by building up on the theoretical concepts and then practicing on the applicability of the various elements. Since the course has very high applicability content, the students are advised to practice in class as well as off class. A very high level of interaction is expected of the students in the class.

Syllabus

Fundamentals of Communication: Meaning, Types and Characteristics of communication, Applicability of Transactional Analysis and Johari Window for enhancing interpersonal communication skills. Seven Cs of Effective Communication, Barriers to Effective Communication.

Effective Oral Communication: Understanding Principles of Oral communication, Formal and Informal Oral Communication, Oral Communication and Behavioral Patterns, Advantages and Disadvantages of Oral Communication.

Effective Listening: Listening vs Hearing, Active Listening techniques, Barriers to Listening.

Effective non-verbal communication: Meaning and Importance of Non-Verbal Communication, Different Types of Non-verbal Communication, Interpretation of Non-verbal Cues.

Effective written Communication: Characteristics of Good Writing, Choice of Words, Sentence Construction, Paragraph development, Forms of writing.

Business Communication: Technical Report Writing, Designing Resumes and Cover Letters for effective job application, E-mail writing and e-mail etiquette.

Organizational Communication: Directional communication: Downward, Upward and Horizontal Communication, Grapevine.

Reading: The following texts (one from each of the two categories listed below) are required to be read by the students in the semester:

Category 1: Animal Farm by George Orwell, Lord of the Flies by William Golding, Life of Pi by Yann Martel

Category 2: The Namesake by Jhumpa Lahiri, The God of Small Things by Arundhati Roy, Q&A by Vikas Swarup

Laboratory Work :

1. Needs-assessment of spoken and written communication with feedback.
2. Training for Group Discussions through simulations and role plays.
3. Technical report writing on survey-based projects.
4. Project-based team presentations.

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Course Learning Outcomes (CLOs) /Course Objectives (COs):
On completion of this course, the students will be able to:

1. Apply communication concepts for effective interpersonal communication.
2. Speak assertively and effectively.
3. Interpret non-verbal cues in professional communication.
4. Write objectively, purposefully and effectively.
5. Design effective resumes and reports.

Text Books:

1. Mukherjee H.S..Business Communication: Connecting at Work. Oxford University Press.(2013)
2. Lesikar R.V, and Flately M.E., Basic Business Communication Skills for empowering the internet generation.(2006)
3. Raman, M.,and Singh ,P, Business Communication . Oxford . University Press (2008).

Reference Books:

1. Riordan, G.R. Technical Communication. Cengage Learning India Private Ltd. (2012)
2. Butterfield, Jeff., Soft Skills for everyone, Cengage Learning New Delhi, (2013).
3. Robbins, S.P., & Hunsaker, P.L., Training in Interpersonal Skills, Prentice Hall of India, New Delhi, (2008).
4. Orwell, G., Animal Farm, Fingerprint Publishing, New Delhi, (2017).
5. Golding, W, Lord of the Flies, Faber & Faber; Export edition (1999)
6. Martel,Y., Life of Pi, RHC, New Delhi, (2012).
7. Lahiri,J., The Namesake, Harpercollins (2007)
8. Arundhati Roy,A., The God of Small Things, Penguin India, (2002).
9. Swarup,V., Q&A, Black Swan,(2009).

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

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UMA010: Mathematics-I

L	T	P	Cr
3	1	0	3.5

Course Objectives: To provide students with skills and knowledge in sequence and series, advanced calculus, calculus of several variables and complex analysis which would enable them to devise solutions for given situations they may encounter in their engineering profession.

Syllabus

Sequences and Series: Introduction to sequences and infinite series, Tests for convergence/divergence, Limit comparison test, Ratio test, Root test, Cauchy integral test, Alternating series, Absolute convergence, and conditional convergence.

Series Expansions: Power series, Taylor series, Convergence of Taylor series, Error estimates, Term by term differentiation and integration.

Partial Differentiation: Functions of several variables, Limits and continuity, Chain rule, Change of variables, Partial differentiation of implicit functions, Directional derivatives and its properties, Maxima and minima by using second order derivatives.

Multiple Integrals: Double integral (Cartesian), Change of order of integration in double integral, Polar coordinates, Graphing of polar curves, Change of variables (Cartesian to polar), Applications of double integrals to areas and volumes, Evaluation of triple integral (Cartesian).

Complex analysis: Introduction to complex numbers, Geometrical interpretation, Functions of complex variables, Examples of elementary functions like exponential, trigonometric and hyperbolic functions, Elementary calculus on the complex plane (limits, continuity, differentiability), Cauchy – Riemann equations, Analytic functions, Harmonic functions.

Course Learning Outcomes (CLOs) /Course Objectives (COs):
On completion of this course, the students will be able to:

1. determine the convergence/divergence of infinite series, approximation of functions using power and Taylor's series expansion and error estimation.

2. examine functions of several variables, define and compute partial derivatives, directional derivatives, and their use in finding maxima and minima in some engineering problems.

3. evaluate multiple integrals in Cartesian and Polar coordinates, and their applications to engineering problems.

4. represent complex numbers in Cartesian and Polar forms and test the analyticity of complex functions by using Cauchy – Riemann equations.

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Text Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic Geometry, Pearson Education (2007), 9th ed.
2. Stewart James, Essential Calculus; Thomson Publishers (2007), 6th ed.
3. Kasana, H.S., Complex Variables: Theory and Applications, Prentice Hall India, 2005 (2nd edition).

Reference Books:

1. Wider David V, Advanced Calculus: Early Transcendentals, Cengage Learning (2007).
2. Apostol Tom M, Calculus, Vol I and II, John Wiley (2003).
3. Brown J.W and Churchill R.V, Complex variables and applications, McGraw Hill, (7th edition)

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

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UES102: Manufacturing Processes

L	T	P	Cr
2	0	2	3.0

Course Objectives: This course introduces the basic concepts of manufacturing via machining, forming, casting and joining, enabling the students to develop a basic knowledge of the mechanics, operation and limitations of basic machining tools along with metrology and measurement of parts. The course also introduces the concept of smart manufacturing.

Syllabus

Machining Processes: Principles of metal cutting, Cutting tools, Cutting tool materials and applications, Geometry of single point cutting tool, Introduction to computerized numerical control (CNC) machines, G and M code programming for simple turning and milling operations, introduction of canned cycles.

Metal Casting: Introduction & Principles of sand casting, Requisites of a sound casting, Permanent mold casting processes, casting defects

Metal Forming: Hot & cold metal working, Forging, Rolling, Sheet Metal operations.

Joining Processes: Method of joining, type of electric arc welding processes, Methods of shielding, Power source characteristics, Resistance welding, Soldering, Brazing.

Smart Manufacturing: IoT and ML in manufacturing, Introduction to Additive Manufacturing, Robotics and Automation in manufacturing.

Laboratory Work :

Relevant shop floor exercises involving practices in Sand casting, Machining, Welding, Sheet metal fabrication techniques, CNC turning and milling exercises, Experiments on basic engineering metrology and measurements to include measurements for circularity, ovality, linear dimensions, profiles, radius, angular measurements, measurement of threads, surface roughness.

Basic knowledge and derivations related to above measurements, uncertainties, statistical approaches to estimate uncertainties, Line fitting, static and dynamic characteristics of instruments will be discussed in laboratory classes.

Assignments: Assignments for this course will include the topics: Manufacturing of micro-chips used in IT and electronics industry and use of touch screens. Another assignment will be given to practice numerical exercises on topics listed in the syllabus. Case study related to smart manufacturing.

Micro Project: Fabrication of multi-operational jobs using the above processes as per requirement by teams consisting of 4 -6 members. Quality check should be using the equipment available in metrology lab.

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Course Learning Outcomes (CLOs) /Course Objectives (COs):
On completion of this course, the students will be able to:

1. identify & analyse various machining processes/operations for manufacturing of industrial components
2. apply the basic principle of bulk and sheet metal forming operations
3. apply the knowledge of metal casting for different requirements.
4. identify and analyse the requirements to for achieving a sound welded joint apply the concept of smart manufacturing

Text Books:

1. Degarmo, E. P., Kohser, Ronald A. and Black, J. T., Materials and Processes in Manufacturing, Prentice Hall of India (2008) 8th ed.
2. Kalpakjian, S. and Schmid, S. R., Manufacturing Processes for Engineering Materials, Dorling Kingsley (2006) 4th ed.

Reference Books:

1. Martin, S.I., Chapman, W.A.J., Workshop Technology, Vol.1 & II, Viva Books (2006) 4th ed.
2. Zimmer, E.W. and Groover, M.P., CAD/CAM - Computer Aided Designing and Manufacturing, Dorling Kingsley (2008).
3. Pandey, P.C. and Shan, H. S., Modern Machining Processes, Tata McGraw Hill (2008).
4. Mishra, P. K., Non-Conventional Machining, Narosa Publications (2006).
5. Campbell, J.S., Principles of Manufacturing, Materials and Processes, Tata McGraw Hill Company (1999).
6. Lindberg, Roy A., Processes and Materials of Manufacture, Prentice Hall of India (2008) 4th ed.

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

UCB009: Chemistry

L	T	P	Cr
3	0	2	4.0

Course Objectives: The course aims at elucidating principles of applied chemistry in industrial systems, water treatment, engineering materials, computational and analytical techniques.

Syllabus

Atomic and Molecular spectroscopy: Introduction to spectroscopy, principles of atomic absorption, flame emission spectrophotometry and ICP-AES (Inductively Coupled Plasma- Atomic Emission Spectroscopy), Quantification by calibration method, Jablonski diagram, fluorescence and phosphorescence, Beer-Lambert's Law, principle and applications of UV-Vis and IR spectroscopy.

Electrochemistry: Background of electrochemistry, Ionic mobility, Conductometric titrations, Modern Batteries: Pb-acid and Li ion battery, Corrosion and its protection.

Water Treatment and Analysis: Physiochemical parameters of water quality, External and internal methods of Softening of water: carbonate, phosphate, calgon and colloidal conditioning, Zeolite process, Ion exchange process, treatment of water for domestic use, Desalination of brackish water: Reverse osmosis & Electrodialysis.

Fuels: Classification of fuels, Calorific value, Cetane and Octane number, alternative fuels: biodiesel, Power alcohol, synthetic petrol, Fuel cells: H2 production and storage, Water splitting, Rocket propellant.

Chemistry of Polymers: Classification of polymers, tacticity of polymers, molecular weight calculations, Polymers in daily life, conducting, inorganic and biodegradable polymers.

Computers in Chemistry: Introduction to SMILES (Simplified Molecular Input Line-Entry System): Methodology and encoding rules, SMILES notation-chemical structure interconversions and its applications.

Laboratory Work : Electrochemical measurements: Experiments involving use of pH meter, conductivity meter, potentiometer, Spectroscopic technique, Volumetric titrations: Determination of mixture of bases, hardness, alkalinity, chloride and iron content, Application of polymers and SMILES Language. onducting currents through a dielectric.

Course Learning Outcomes (CLOs) /Course Objectives (COs): On completion of this course, the students will be able to:

1. recognize principles and applications of atomic and molecular spectroscopy.
2. explain the concepts of conductometric titrations, modern batteries and corrosion.
3. apply and execute water quality parameter and treatment methods.
4. discuss the concept of alternative fuels, application of polymers and SMILES.
5. execute laboratory techniques like pH metry, potentiometry, spectrophotometry, conductometry and volumetry.

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Text Books:

1. Engineering Chemistry, S. Vairam and S. Ramesh, Wiley India 1st ed, 2014.
2. Engineering Chemistry, K. S. Maheswaramma, and M. Chugh. Pearson, 2016.

Reference Books:

1. Engineering Chemistry, B. Sivasankar, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 2008.
2. Engineering Chemistry, M.J. Shulz, Cengage Learnings, 2007.
3. J. Chem. Inf. Comput. Sci., D. Weininger, Vol. 28, 1988, 31-36.

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

UES103: PROGRAMMING FOR PROBLEM SOLVING

L	T	P	Cr
3	0	2	4.0

Course Objectives: This course is designed to solve and explore the problems using the art of computer programming with the help of C Language. Students will be able to apply these problem solving concepts in real life applications.

Syllabus

Introduction to Computer Fundamentals: Computer Memory Hierarchy, Types of Software Binary number system, Algorithm, Flowchart, Formulate simple algorithms for logical and arithmetic problems.

Basics of C Programming: Structure and Life cycle of a C Program, Data types, Identifiers, Variables, Keywords, Constants, input/output statements, Operators, Type conversion and type casting. Translate the algorithms to code snippets.

Decision Making and Iterative Statements: Decision making- if, if-else, Nested ifelse, Multiple if, else if, switch, Ternary Operator, Loops- (while, do-while, for), Nesting of Loops, break, continue and goto. Implement the switch () to solve the basic functions of scientific calculator.

Functions: Function prototype, Definition and Call, Type of Functions, Scope of variables in (Block, Function, Program, File), Storage classes (Auto, Register, Static and Extern), Recursion (with the introduction of Stack), Implementation of recursion to solve the problem of Tower of Hanoi.

Arrays and Strings: One-dimensional array its operations (Traversal, Linear Search, Insertion, Deletion, Bubble Sort), Two-dimensional and its operations (Addition, Transpose and Multiplication), Passing of array into a function (row and entire array), Input and output of a string, string inbuilt functions, 2-D Character array.

Pointers: Introduction to Pointers, Pointer arithmetic, Passing arguments to a function using pointer (understanding of call by value and call by reference), Accessing arrays using pointers Dynamic memory allocation (malloc(), calloc(), realloc() and free()), Pointer and Functions.

Structures and Union: Structure declaration, Initialization of structures, Structure variables, Accessing structure elements using (.) operator, Array of structure variables, Passing structure variable to a function (individual and entire structure), Structure pointer, Comparison of Structure and Union.

File Handling: Introduction of Files (streams in C), using File (Declaring, Opening and Closing), Operations on File (Reading, Writing and appending), and Random Access of a file, command line argument

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Laboratory Work

To implement programs for various kinds of real life applications in C Language.

Course Learning Outcomes (CLOs) /Course Objectives (COs):

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

1. Comprehend and analyze the concepts of number system, memory, compilation and debugging of the programs in C language.
2. Analyze the control & iterative statements to solve the problems with C language source codes.
3. Design and create programs for problem solving involving arrays, strings and pointers.
4. Evaluate and analyze the programming concepts based on user define data types and file handling using C language.

Text Books:

1. C Programming Language, Brian W. Kernighan Dennis M. Ritchie, 2nd ed, 2012.
2. Programming in ANSI C, Balagurusamy G., 8th ed., 2019

Reference Books:

1. Let Us C, Kanetkar Y., 16th ed., 2017
2. Programming with C, Byron S Gottfried, McGraw Hill Education, Forth edition, 2018

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

UES013:ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P	Cr
3	1	2	4.5

Course Objectives: To introduce the basic concepts of electrical and electronics engineering.

Syllabus

DC Circuits: Introduction to circuit elements; rms and average values for different wave shapes, independent and dependent current and voltage sources; Kirchhoff's laws; mesh and node analysis; source transformations; network theorems: Superposition theorem, Thevenin's and Norton's theorem, Maximum power transfer theorem; star-delta transformation; steady state and transient response of R-L and R-C and R-L-C circuits.

AC Circuits: Concept of phasor, phasor representation of circuit elements; analysis of series and parallel AC circuits; concept of real, reactive and apparent powers; resonance in RLC series and parallel circuits; balanced three phase circuits: voltage, current and power relations for star and delta arrangement; analysis of balanced and unbalanced circuits; three phase power measurement using two-wattmeter and one-wattmeter methods.

Magnetic circuits: analogy between electric and magnetic circuits; series and parallel magnetic circuits; operating principles of electrical appliances: single-phase transformer and rotating machines; tests and performance of single-phase transformer.

Digital Logic Design: Digital signals, Number systems, Positive and negative representation of numbers, Signed-number representation, Binary arithmetic, Postulates and theorems of Boolean Algebra, Algebraic simplification, Sum of products and product of sums formulations (SOP and POS), Gate primitives, Logic Gates and Universal Gates, Minimization of logic functions, Karnaugh Maps, Logic implementation using Gates, Decoder, MUX, Flip-Flops, Asynchronous up/down counters.

Electronic Devices: p- n junction diode: V-I characteristics of diode, Operation of Bipolar Junction Transistor, CB and CE configuration, Transistor as a switch, Operation of SCR, DIAC and TRIAC.

Operational Amplifier Circuits: The ideal operational amplifier, the inverting, non- inverting amplifiers, Op-Amp Characteristics, Applications of Op-amp: summing amplifier, differentiator and integrator.

Laboratory Work

Kirchhoff's laws, network theorems, ac series and parallel circuit, three phase power measurement, magnetic circuit, tests on transformer, resonance in AC circuit, combinational circuits, flip flops, shift register and binary counters, asynchronous and synchronous up/down counters, BJT characteristics.

Course Learning Outcomes (CLOs) /Course Objectives (COs):

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

1. Apply various networks laws and theorems to solve dc circuits
2. Compute different ac quantities with phasor representation
3. Comprehend the operation in magnetic circuits, single phase transformer and rotating machines.
4. Recognize and apply the number systems and Boolean algebra.
5. Reduce and simplify Boolean expressions and implement them with logic gates.
6. Discuss and explain the working of diode, transistor and operational amplifier, their configurations and applications.

Text Books:

1. Hughes, E., Smith, I.M., Hiley, J. and Brown, K., Electrical and Electronic Technology, Prentice Hall (2008) 10th ed.
2. Nagrath, I.J. and Kothari, D.P., Basic Electrical Engineering, Tata McGraw Hill (2002).
3. Boylestad, R.L. and Nashelsky, L., Electronic Devices & Circuit Theory, Perason (2009).
4. Mano M. M. and Ciletti, M.D., Digital Design, Pearson, Prentice Hall, (2013).

Reference Books:

1. Chakraborti, A., Basic Electrical Engineering, Tata McGraw-Hill (2008).
2. Del Toro, V., Electrical Engineering Fundamentals, Prentice-Hall of India Private Limited (2004).
3. David Bell, Electronics Devices and Circuits, Oxford Publications (2009).

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

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UEN008: Energy and Environment

L	T	P	Cr
2	0	0	2.0

Course Objectives: The exposure to this course would facilitate the students in understanding the terms, definitions and scope of environmental and energy issues pertaining to current global scenario; understanding the need of sustainability in addressing the current environmental & energy challenges.

Syllabus

Introduction: Concept of sustainability and sustainable use of natural resources, Climate Change & its related aspects.

Air Pollution: Origin, Sources and effects of air pollution; Primary and secondary meteorological parameters; wind roses; Atmospheric stability; Source reduction and Air Pollution Control Devices for particulates and gaseous pollutants in stationary sources.

Water Pollution: Origin, Sources of water pollution, Category of water pollutants, Physicochemical characteristics, Components of wastewater treatment systems.

Solid waste management: Introduction to solid waste management, Sources, characteristics of municipal solid waste, Solid waste management methods: Incineration, composting, landfilling.

Energy Resources: Classification of Energy Resources; Non-conventional energy resources- Biomass energy, Thermo-chemical conversion and biochemical conversion route; Solar energy-active and passive solar energy absorption systems; Type of collectors; Thermal and photo conversion applications.

Course Learning Outcomes (CLOs) /Course Objectives (COs): On completion of this course, the students will be able to:

1. comprehend the interdisciplinary context of environmental issues with reference to sustainability
2. assess the impact of anthropogenic activities on the various elements of environment and apply suitable techniques to mitigate their impact.
3. demonstrate the application of technology in real time assessment and control of pollutants.
4. correlate environmental concerns with the conventional energy sources associated and assess the uses and limitations of non-conventional energy technologies

Text Books:

1. Moaveni, S., Energy, Environment and Sustainability, Cengage (2018)
2. Rajagopalan, R., Environmental Studies, Oxford University Press (2018)
3. O'Callagan, P.W., Energy Management, McGraw Hill Book Co. Ltd. (1993).

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Reference Books:

1. Peavy H.S., Rowe D.S., and Tchobanoglous, G. (2013) Environmental Engineering, McGraw Hill.
2. Rao, M.N. and Rao, H.V.N. (2014) Air Pollution, McGraw Hill.
3. Metcalf and Eddy. (2003) Wastewater Engineering: Treatment and Reuse, Fourth Edition, McGraw Hill.
4. Rai, G.D. (2014) Non-conventional Energy Resources, Khanna Publishers.

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

UMA004: Mathematics - II

L	T	P	Cr
3	1	0	3.5

Course Objectives: To introduce students the theory and concepts of differential equations, linear algebra, Laplace transformations and Fourier series which will equip them with adequate knowledge of mathematics to formulate and solve problems analytically.

Syllabus

Ordinary Differential Equations: Review of first order differential equations, Exact differential equations, Second and higher order differential equations, Solution techniques using one known solution, Cauchy - Euler equation, Method of undetermined coefficients, Variation of parameters method, Engineering applications of differential equations.

Laplace Transform: Definition and existence of Laplace transforms and its inverse, Properties of the Laplace transforms, Unit step function, Impulse function, Applications to solve initial and boundary value problems.

Fourier Series: Introduction, Fourier series on arbitrary intervals, Half range expansions, Applications of Fourier series to solve wave equation and heat equation.

Linear Algebra: Row reduced echelon form, Solution of system of linear equations, Matrix inversion, Linear spaces, Subspaces, Basis and dimension, Linear transformation and its matrix representation, Eigen-values, Eigen-vectors and Diagonalisation, Inner product spaces and Gram-Schmidt orthogonalisation process.

Course Learning Outcomes (CLOs) /Course Objectives (COs):

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

1. solve the differential equations of first and 2nd order and basic application problems described by these equations.
2. find the Laplace transformations and inverse Laplace transformations for various functions. Using the concept of Laplace transform students will be able to solve the initial value and boundary value problems.
3. find the Fourier series expansions of periodic functions and subsequently will be able to solve heat and wave equations.
4. solve systems of linear equations by using elementary row operations.
5. identify the vector spaces/subspaces and to compute their bases/orthonormal bases. Further, students will be able to express linear transformation in terms of matrix and find the eigenvalues and eigenvectors.

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

Text Books:

1. Simmons, G.F., Differential Equations (With Applications and Historical Notes), Tata McGraw Hill (2009).
2. Krishnamurthy, V.K., Mainra, V.P. and Arora, J.L., An introduction to Linear Algebra, Affiliated East West Press (1976).

Reference Books:

1. Kreyszig Erwin, Advanced Engineering Mathematics, John Wiley (2006), 8th edition.
2. Jain, R.K. and Iyenger, S.R.K., Advanced Engineering Mathematics, Narosa Publishing House (2011), 4th edition.

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

UMA301: DISCRETE MATHEMATICAL STRUCTURES

L	T	P	Cr
3	1	0	3.5

Course Objectives: The course objective is to provide students with an overview of Discrete Mathematical Structures. Students will learn about topics such as logic and proofs, sets and functions, graph theory, boolean algebra, number theory and other important discrete math concepts.

Syllabus

Sets, Relations, and Functions: Sets: Operations on set, Inclusion-exclusion principle, Representation of Discrete Structures, Fuzzy set, Multi-set, bijective function, Inverse and Composition of functions, Floor and Ceiling functions, Growth of functions: Big-O notation, Big-Omega and Big-Theta Notations, Determining complexity of a program, Hash functions.

Relations: Different types of relation and their representation, Equivalence and partialordered relations, Partition and Covering of a set, N-ary relations and database, Closure of relations, Warshall's algorithm, Lexicographic ordering, Hasse diagram, Lattices, Boolean algebra.

Graphs Theory: Representation, Type of Graphs, Paths and Circuits: Euler Graphs, Hamiltonian Paths & Circuits; Cut-sets, Connectivity and Separability, Planar Graphs, Isomorphism, Graph Coloring, Covering and Partitioning, Application of Graph theory in real-life applications.

Basic Logic: Propositional logic, Logical connectives, Truth tables, Normal forms (conjunctive and disjunctive), Validity of well-formed formula, Propositional inference rules (concepts of modus ponens and modus tollens), Predicate logic, Universal and existential quantification, Proof Techniques.

Recurrence Relation: Solving linear recurrence relations, divide and conquer algorithms and recurrence relations.

Algebraic Structures: Group, Semi group, Monoids, Ring, Field, Homomorphism.

Number Theory: Divisibility and Modular Arithmetic, Solving Congruences, Applications of Congruences, Cryptographic applications.

Course Learning Outcomes (CLOs) /Course Objectives (COs):
On completion of this course, the students will be able to:

1. Perform operations on various discrete structures such as set, function, and relation.
2. Apply basic concepts of asymptotic notation in the analysis of the algorithm.
3. Illustrate the basic properties and algorithms of graphs and apply them in modelling and solving real-world problems.

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4. Comprehend formal logical arguments and translate statements from a natural language into their symbolic structures in logic.
5. Identify and prove various properties of rings, fields, and groups.
6. Illustrate and apply the division algorithm, mod function, and Congruence.

Text Books:

1. Discrete Mathematics and its Applications, Rosen H. K., McGraw Hill, 7th ed., 2011
2. Discrete Mathematical Structures with Applications to Computer Science, Tremblay P. J. and Manohar, R., Tata McGraw Hill, 2008.

Reference Books:

1. Contemporary Abstract Algebra, Gallian A. J., Cengage Learning, 9th ed., 2017
2. Discrete Mathematics, Lipschutz S., Lipson M., McGraw-Hill, 3rd ed., 2007

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

ULC301: DATA STRUCTURES

L	T	P	Cr
3	0	2	4.0

Course Objectives: To become familiar with different types of data structures and their applications.

Syllabus

Analyzing algorithms: Basics of algorithm and its analysis, Complexity classes, order arithmetic, Time and space trade-off in algorithms.

Linear Data Structures: Arrays, Strings and string processing, Linked lists (Singly, Doubly, Circular), Abstract data types, their implementation and applications: Stacks (using Arrays and Linked-list), Queues (using Arrays and Linked-list), Hash tables: Hash functions, collision resolution techniques, Strategies for choosing the appropriate data structure.

Searching and Sorting: Linear Search, Binary Search. Introduction to internal and external sort, Bubble Sort, Selection Sort, Insertion Sort, Shell Sort, Quick Sort, Merge Sort, Counting Sort, Radix Sort.

Trees and their applications: Introduction to binary tree, tree traversal algorithms, Binary search tree, AVL Tree, B Tree etc. and common operations on these trees. Heap, Heap Sort, Priority Queue using Heap.

Graphs and their applications: Graph Terminology and its representation, Depth and breadth first traversals, Shortest-path algorithms (Dijkstra and Floyd), Data Structures for Disjoint Sets, Minimum spanning tree (Prim and Kruskal).

Laboratory Work

Implementation of various data structures such as Arrays, Stacks, Queues, Lists, Binary tree traversals, BST, AVL trees, Graphs traversals, Sorting and Searching techniques.

Course Learning Outcomes (CLOs) /Course Objectives (COs):

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

1. Understand the fundamental data structures, their implementation and some of their standard applications.
2. Select and implement appropriate searching and sorting techniques for solving a problem based on their characteristics.
3. Apply tree and graph data structures for specific applications.
4. Design and analyse algorithms using appropriate data structures for real-world problems.

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Text Books:

1. Introduction to Algorithms, Cormen H. T., Leiserson E. C., Rivest L. R., and Stein C, MIT Press,3rd ed., 2009
2. Data Structures, Algorithms and Applications in C++, Sahni S., Universities Press 2nd ed. 2005

Reference Books:

1. Data Structures and Algorithms Made Easy, Karumanchi N., Career Monk Publications, 5th ed., 2017
2. Data structures and algorithms in C++, Adam Drozdek, 4th edition

Evaluation Scheme	
Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

ULC302 : INTRODUCTION TO NETWORK THEORY

L	T	P	Cr
3	1	0	3.5

Course Objectives: To make the students understand the concepts of graph theory, two port networks, filter design, attenuators, oscillator and network synthesis.

Syllabus

Graph Theory: Graph, Tree and link branches, Network matrices and their relations, Choice of linearly independent network variables, Topological equations for loop current and for nodal voltage, Duality.

Network Theorems: Superposition Theorem, Thevenin's theorem, Norton's theorem, and Maximum power transfer theorem as applied to A.C. circuits, Tellegen's theorem and their applications.

Two Port Networks: Two port network description in terms of open circuits impedance, Short circuit admittance, Hybrid and inverse hybrid, ABCD and inverse ABCD parameters, Inter-connection of two port network, Indefinites admittance matrix and its applications.

Network Functions: Concepts of complex frequency, Transform impedance, Networks function of one port and two port network, concepts of poles and zeros, property of driving point and transfer function.

Passive Network Synthesis: Introduction, Positive Real Functions: Definition, Necessary and sufficient conditions for a function to be positive real, Synthesis vs. analysis, Elements of circuit synthesis, Foster and Cauer forms of LC Networks, Synthesis of RC and RL networks.

Filters and Attenuators: Classification of filters, Analysis of a prototype low pass, High pass, Band pass, Band stop and Mderived filter, Attenuation, Types of attenuators: symmetrical and asymmetrical.

Active Filters: Introduction to Active filters, first and second order low pass Butterworth filter, First and second order high pass Butterworth filter, Band pass filter.

Course Learning Outcomes (CLOs) /Course Objectives (COs):
On completion of this course, the students will be able to:

1. Apply various laws and theorems to solve electric networks.
2. Analyse the behaviour of two port networks.
3. Apply graph theory concept to solve electrical networks
4. Realize one-port network parameters
5. Design different filter and attenuator configurations.

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Text Books:

1. Hayt, W., Engineering Circuit Analysis, Tata McGraw-Hill (2006).
2. Hussain, A., Networks and Systems, CBS Publications (2004).
3. Valkenberg, Van, Network Analysis, Prentice-Hall of India Private Limited (2007).
4. Gayakwad, A. Op-Amps and Linear Integrated Circuits, Prentice-Hall of India (2006).

Reference Books:

1. Chakarbarti,A., Circuit Theory, Dhanpat Rai and Co. (P) Ltd. (2006).
2. Roy Chowdhuary, D., Networks and Systems, New Age International (P) Limited, Publishers (2007).

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

UES301: ANALOG CIRCUITS

L	T	P	Cr
2	0	2	3.0

Course Objectives: To analyse working of BJT and MOSFET, understand multi-stage and power amplifications, working of operational amplifiers, active filters and oscillators.

Syllabus

Biasing and Thermal Stabilization: Transistor biasing and load line analysis, structure, working and applications of MOSFET, output and transfer characteristics, Thermal Runaway, Thermal Stability, biasing schemes.

Amplifiers: low and high frequency analysis of single stage amplifiers, h-parameter models, variation of parameters, short-circuit current gain, gain-bandwidth product frequency compensation, current mirrors, multistage amplifiers.

Differential and operational amplifiers: Basic operations, negative and positive feedback, distortion and frequency response of an amplifier, applications of amplifiers for multi-stage and power amplifications, CMOS Operational Amplifier: Structure, Analysis and Design, Frequency Response and Compensation Techniques. Switched Capacitor Circuits: Principles of operation, Filter and non-filter applications.

Active filters and Oscillators: Design of Butterworth filters using op amp, condition for sustained oscillation, R-C phase shift, Hartley, Colpitts, Crystal and Wien Bridge Oscillators, Negative Resistance oscillator; Multi-vibrators (Astable, Mono-stable, Bi-Stable).

Laboratory Work

RC coupled amplifier in CE mode, application of bistable, astable and monostable multivibrators, Hartley and Colpitts oscillator.

Minor Project: Automatic intensity control of street lights, auto night lamp with high power LED, water level alarm, panic alarm, dc motor control using L298N motor driver module and Arduino.

Course Learning Outcomes (CLOs) /Course Objectives (COs):

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

1. Design different types of transistor biasing circuits
2. Analyse the applications of amplifiers for multi-stage and power amplifications
3. Design Butterworth active filters and oscillator circuits

Text Books:

1. Boylestad R. L., Electronic Devices and Circuit Theory, Pearson Education(2007).
2. Millman, J. and Halkias, C.C., Integrated Electronics, Tata McGraw Hill(2006).

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

Reference Books:

1. Neamen, Donald A., Electronic Circuit Analysis and Design, McGraw Hill(2006).
2. Sedra A. S. and Smith K. C., Microelectronic Circuits, Oxford University Press(2006).

Evaluation Scheme	
Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

ULC303:COMPUTER ARCHITECTURE AND ORGANIZATION

L	T	P	Cr
3	0	0	3.0

Course Objectives: Focus is on the architecture and organization of the basic computer modules viz. controls unit, central processing unit, input-output organization and memory unit.

Syllabus

Basics of Computer Architecture: Number System and Code Conversion, Logic Gates, Flip Flops, Registers, Counters, Multiplexer, De-multiplexer, Decoder, Encoder etc.

Register Transfer and Micro Operations: Register Transfer Language, Register Transfer, Bus & Memory Transfer, Arithmetic Micro Operations, Logic Micro Operations, Shift Micro Operations, Design of ALU.

Basic Computer Organization: Instruction Codes, Computer Instructions, Design of Timing & Control Unit, Instruction Cycles, Computer Instructions: Memory, Register, and Input-Output Reference Instructions, Interrupts, Complete Computer Description & Design of Basic Computer.

Central Processing Unit: General Register Organization, Stack Organization, Instruction Format, Addressing Modes, Data Transfer & Manipulation, Program Control, RISC, CISC.

Computer Arithmetic: Representation of Numeric Data, Signed and Unsigned Arithmetic, Addition & Subtraction, Multiplication Algorithms: Shift and Add, Booth Multiplier.Floating Point Representation.

Memory Unit: Memory Hierarchy, Processor vs. Memory Speed, High-Speed Memories, Main Memory, Cache Memory and Mapping Schemes, Associative Memory, Interleaving, Virtual Memory, Memory Management Techniques.

Introduction to Parallel Processing: Pipelining, Instruction Pipeline, Arithmetic Pipeline, Performance Metrics and Hazards. Introduction to Advance Processors (Multiprocessors and Multi-cores), Interprocessor Arbitration.

Input Output Organization: Peripheral Devices, I/O Interface Data Transfer Schemes, Program Control, Synchronous and Asynchronous Data Transfer, Priority Interrupt, DMA Transfer, I/O Processor.

Course Learning Outcomes (CLOs) /Course Objectives (COs):
On completion of this course, the students will be able to:

1. Illustrate various elementary concepts of computer architecture including, syntax of register transfer language, micro operations, instruction cycle, and control unit.
2. Describe the design of basic computer with instruction formats & addressing modes.

3. Explore various memory management techniques and algorithms for performing addition, subtraction and division etc.
4. Interpret the concepts of pipelining and advance processors

Text Books:

1. Computer System Architecture, M. Morris Mano, Prentice Hall, 3rd ed., 1991.
2. Computer Architecture and Organization, John P. Hayes, McGraw Hill, 3rd ed., 1998.
3. Computer Organization and Architecture, William Stallings, Pearson, 9th ed., 2013.

Reference Books:

1. Computer Architecture: A Quantitative Approach, John L. Hennessy and David A. Patterson, Elsevier Science,5thed., 2011.
2. System Architecture: software and hardware concepts, William E. Leigh and Dia L. Ali, South Wester Publishing Co., 2nd ed., 2000.

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

UTA030: ENGINEERING DESIGN PROJECT (Buggy)

L	T	P	Cr
1	0	4	3.0

Course Objectives: The project will introduce students to the challenge of electronic systems design & integration. The project is an example of 'hardware and software co-design' and the scale of the task is such that it will require teamwork as a co-ordinated effort.

Syllabus

Hardware overview of Arduino:

- ✤ Introduction to Arduino Board: Technical specifications, accessories and applications.
- ✤ Introduction to Eagle (PCB layout tool) software.

Sensors and selection criterion:

- ✤ Concepts of sensors, their technical specifications, selection criterion, working principle and applications such as IR sensors, ultrasonic sensors.

Active and passive components:

- ✤ Familiarization with hardware components, input and output devices, their technical specifications, selection criterion, working principle and applications such as-
  - Active and passive components: Transistor (MOSFET), diode (LED), LCD, potentiometer, capacitors, DC motor, Breadboard, general PCB etc.
  - Instruments: CRO, multimeter, Logic probe, solder iron, desolder iron
  - Serial communication: Concept of RS232 communication, Xbee
- ✤ Introduction of ATtiny microcontroller based PWM circuit programming.

Programming of Arduino:

- ✤ Introduction to Arduino: Setting up the programming environment and basic introduction to the Arduinomicro-controller.
- ✤ Programming Concepts: Understanding and Using Variables, If-Else Statement, Comparison Operators and Conditions, For Loop Iteration, Arrays, Switch Case Statement and Using a Keyboard for Data Collection, While Statement, Using Buttons, Reading Analog and Digital Pins, Serial Port Communication, Introduction programming of different type of sensors and communication modules, DC Motors controlling.

Basics of C#:

- ✤ Introduction: MS.NET Framework Introduction, Visual Studio Overview and Installation
- ✤ Programming Basics: Console Programming, Variables and Expressions, Arithmetic Operators, Relational Operators, Logical Operators, Bitwise Operators, Assignment Operators,

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Expressions, Control Structures, Characters, Strings, String Input, serial port communication: Read and write data using serial port.

- ✤ Software code optimization, software version control.

Laboratory Work

Schematic circuit drawing and PCB layout design on CAD tools, implementing hardware module of IR sensor, Transmitter and Receiver circuit on PCB.

Bronze Challenge: Single buggy around track twice in clockwise direction, under full supervisory control. Able to detect an obstacle. Parks safely. Able to communicate state of the track and buggy at each gantry stop to the console.

Silver Challenge: Two buggies, both one loop around, track in opposite directions under full supervisory, control. Able to detect an obstacle. Both park safely. Able to communicate state of the track and buggy at each gantry stop with console.

Gold Challenge: Same as silver but user must be able to enter the number of loops around the track beforehand to make the code generalized.

Course Learning Outcomes (CLOs) /Course Objectives (COs):

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

1. Recognize issues to be addressed in a combined hardware and software system design
2. Draw the schematic diagram of an electronic circuit and design its PCB layout using CAD Tools
3. Apply hands-on experience in electronic circuit implementation and its testing
4. Demonstrate programming skills by integrating coding, optimization and debugging for different challenges
5. Develop group working, including task sub-division and integration of individual contributions from the team.

Text Books:

1. Michael McRoberts, Beginning Arduino, Technology in Action Publications, 2 nd Edition.
2. Alan G. Smith, Introduction to Arduino: A piece of cake, Create Space Independent Publishing Platform (2011).

Reference Books:

1. John Boxall, Arduino Workshop - a Hands-On Introduction with 65 Projects, No Starch Press; 1 st edition (2013).

ULC403: DESIGN AND ANALYSIS OF ALGORITHMS

L	T	P	Cr
3	0	2	4.0

Course Objectives: To provide students with the knowledge and skills necessary to design and analyze algorithms for solving computational problems.

Syllabus

Introduction and Complexity Analysis: Analysing algorithms, Complexity classes, Time and space trade-offs in algorithms, Recurrence relations, Analysis of iterative and recursive algorithms, Amortized Analysis.

Algorithm Design Techniques and Analysis

Divide and Conquer: Fundamentals of divide and conquer strategy, Applications such as The maximum subarray problem, Strassen's algorithm for matrix multiplication, merge sort, quick sort etc.

Greedy Algorithms: Elements of greedy strategy, Applications such as activity selection, Huffman Coding, job sequencing, fractional knapsack problem, etc.

Dynamic Programming: Elements of dynamic programming, Memorization and tabulation approaches, Applications such as matrix multiplication, 0/1 knapsack, Longest common subsequence, Optimal binary search tree, etc.

Backtracking: Introduction, Applications such as N queen problem, sum of subsets, graph coloring, etc.

Branch and Bound Algorithm: General method, Applications such as0/1 knapsack problem, Traveling salesperson problem etc.

Graphs & Algorithms: Introduction to graphs, Paths and Circuits, Euler Graphs, Hamiltonian graphs, Cut-sets, Connectivity and Separability, Covering and Partitioning, Strongly connected component, Topological sort, Max flow: Ford Fulkerson algorithm, max flow- min cut.

String Matching Algorithms: Suffix arrays, Rabin-Karp, Knuth-MorrisPratt (KMP), Boyer Moore algorithm.

Problem Classes: P, NP, NP-Hard and NP-complete, deterministic and non-deterministic polynomial time algorithm approximation, Randomized algorithms.

Laboratory Work

Implementation of various algorithmic techniques for solving common computational/engineering problems.

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Course Learning Outcomes (CLOs) /Course Objectives (COs):
On completion of this course, the students will be able to:

1. Analyse the complexity of algorithms and implement it in a specific scenario.
2. Apply common algorithmic techniques such as greedy, dynamic programming etc. to standard computational problems
3. Design solutions by using appropriate data structures or applying algorithms such as string matching, randomized, approximation and graph.
4. Develop efficient algorithms for various computational challenging problems solving in computing

Text Books:

1. Cormen H. T., Leiserson E. C., Rivest L. R., and Stein C., Introduction to Algorithms, MIT Press (2009) 3rd ed.
2. Horwitz E., Sahni S., Rajasekaran S., Fundamentals of Computers Algorithms, Universities Press (2008) 2nd ed.

Reference Books:

1. Levitin A., Introduction to the design and analysis of algorithms, Pearson Education (2008) 2nd ed.
2. Aho A.V., Hopcraft J. E., Dulman J. D., The Design and Analysis of Computer Algorithms, Addsion Wesley (1974) 1st ed.
3. Sedgewick R. and Wayne K., Algorithms, Addison-Wesley Professional (2011), 4th ed.

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

ULC404: OPERATING SYSTEMS

L	T	P	Cr
3	0	2	4.0

Course Objectives: To understand the role, responsibilities, and algorithms involved for achieving various functionalities of an Operating System.

Syllabus

Introduction and Operating System Structures: Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Computing Environments, Operating-System Services, User and Operating-System Interface, System Calls, Types of System Calls, System Programs, Operating-System Structure, System boot.

Process Management: Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication, Overview of Threads, Multi-core Programming, Multithreading Models, CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling.

Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Memory Management: Basic Hardware, Address Binding, Logical and Physical Address, Dynamic linking and loading, Shared Libraries, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table, Virtual Memory Management: Demand Paging, Page Replacement, Allocation of Frames, Thrashing.

Storage Management: Overview of Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, RAID Structure; File Concept, Access Methods, Directory and Disk Structure, File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods.

Protection and Security: Principles of Protection, Domain of Protection, Access Matrix, Implementation of the Access Matrix, The Security Problem, Program Threats.

Process Synchronization: The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Overview of Monitors.

Laboratory Work Learn and practice basic Linux/Unix commands to Create and manipulate files and directories; Explore about Vi Editor environment; Build .C program related to fork (), exec (), wait (), sleep () functions at Linux/Unix platform; Write .C program for message passing and shared memory; Simulate CPU scheduling algorithms using either C or C++

Course Learning Outcomes (CLOs) /Course Objectives (COs):
On completion of this course, the students will be able to:

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1. Describe the basics of an operating system, including the kernel, system calls, and computing environments.
2. Evaluate the effectiveness and trade-offs of different models of multithreading, scheduling algorithms, and methods for handling deadlocks, such as prevention, avoidance, detection, and recovery.
3. Understand components of a memory system, virtual memory and analyze different memory management techniques.
4. Evaluate the effectiveness of different Disk Management strategies, and Critique the design and implementation of File System
5. Explain the basic concepts of Concurrency, Protection and Security issues in an operating system.

Text Books:

1. Operating System Concepts, Silberschatz A., Galvin B. P. and Gagne G., John Wiley & Sons Inc., 9th ed, 2013.
2. Operating Systems Internals and Design Principles, Stallings W., Prentice Hall 9th ed, 2018

Reference Books:

1. Understanding the Linux Kernel, Bovet P. D., Cesati M., O'Reilly Media, 3rd ed, 2006.
2. Introduction to Operating System Design and Implementation: The OSP 2 Approach, Kifer M., Smolka A. S., Springer, 2007

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

UMA028: MATHEMATICS FOR DATA SCIENCE

L	T	P	Cr
3	0	2	4.0

Course Objectives: To introduce the student to the concept of Probability and Statistics that plays a vital role in computing and computational intelligence. Knowledge of these topics is critical to decision making and to the analysis of data. Using concepts of probability and statistics, individuals are able to predict the likelihood of an event occurring, organize and evaluate data.

Syllabus

Mathematical Foundations of Data Sciences: Matrices, Vectors, Vector Spaces, Matrix Decomposition, Singular Value Decomposition, Eigenvalues and vectors, Sets and classes, Limit of a sequence of sets, rings, sigma-rings, sigma fields, monotone classes.

Probability: Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem and independence, Random variable, some common discrete and continuous distributions (Binomial, Poisson, Geometric, Rectangular, Exponential, Normal, Gamma etc.).

Bi-variate Probability Distribution: Probability distribution of functions of a random variable, Joint and marginal distributions, Conditional distributions.

Correlation and Regression: Covariance, Karl-Pearson and rank Correlation coefficients; linear regression between two variables.

Estimation: Unbiasedness, consistency, the method of moments and the method of maximum likelihood estimation, confidence intervals for parameters in one sample and two sample problems of normal populations, confidence intervals for proportions.

Hypothesis tests: Introduction to Sampling Distribution (standard normal, chi-square, T& F distributions), Theory of Estimation, Properties of an estimator, Tests for Goodness of fit: Method of maximum likelihood, Neyman-Pearson lemma (without proofs); Critical regions.
Parametric & Non-parametric tests: One sample and paired sample tests; Sign Test, Signed-rank Test, Kolmogorov Smirnov Test.
Data Processing: Regression, Dimensionality Reduction, Linear Discriminant Analysis Principal Component Analysis.

Laboratory Work

Based on the programming in MATLAB/ Python /R language of various statistical techniques. R for Data Science: Data Wrangling, Data Visualization, Programming, Python for Data Science: Normal Python, NumPy, Pandas, Matplotlib.

Course Learning Outcomes (CLOs) /Course Objectives (COs):
On completion of this course, the students will be able to:

1. Compute probabilities of composite events along with an understanding of random variables and distribution functions.

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2. Explain the convergence of sequence in probabilities.
3. Analyze the correlated data and fit the linear regression models.
4. Interpret the statistical inferences using principles of hypothesis tests.

Text Books:

1. Meyer P. L., Introduction to Probability and Statistical Applications, Oxford & IBH, 2007.
2. Hogg, R. V. and Craig, A.T., Introduction to Mathematical Statistics, Prentice Hall of India, 2004.
3. Ross, S.M., A First Course in Probability, 9th edition, Pearson, 2012.
4. Peng, D., R., R Programming for Data Science, Lulu.com (2012).

Reference Books:

1. Walpole, R. E., Myers, R. H., Myers, S. L. and Ye, K.,. Probability and statistics for engineers and scientists, Pearson, 2010.
2. Hestie Trevor, Tibshirani R., Friedman J., the elements of statistical learning, Springer- Verlag New York Inc., 2nd Ed., 2001.

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

UTA018: OBJECT ORIENTED PROGRAMMING

L	T	P	Cr
3	0	2	4.0

Course Objectives: To become familiar with object oriented programming concepts and be able to apply these concepts in solving diverse range of applications.

Syllabus

Objects and Classes: Structure in C and C++, Class specification, Objects, Namespaces, Overview of pillars of OOPS (Data Encapsulation, Data Abstraction, Inheritance, Polymorphism), Inline functions, Passing objects as arguments, Returning object from a function, Array of objects, Static keyword with data member, member function and object, Friend function, and Friend classes, Pointer to objects, this pointer, Dynamic Initialization, Dynamic memory allocation.

Constructor and Destructor: Constructors and its types, Constructor Overloading, Constructors in array of objects, Constructors with default arguments, Dynamic Constructor, Destructor, 'const' keyword with data member, member function and object.

Inheritance: Introduction to Inheritance, Forms of Inheritance (Single, Multiple, Multilevel, Hierarchical and Hybrid) with various modes (Public, Private and Protected), Inheritance with Constructor and Destructor, Benefits and Limitations of Inheritance.

Polymorphism: Classification of Polymorphism (Compile-time and Run-time), **Compile Time-** Function Overloading, Operator Overloading (Unary operator and Binary operator with member function and friend function), Data Conversion (Basic to user-defined, userdefined to basic, one user-defined to another user-defined). **Run-time**- Pointers to derived class object, Overriding member function, Virtual functions, pure virtual functions, Abstract class.

Exception Handling, Templates and Standard Template Library: Exception handling mechanism, Usage of template, Function templates, Overloading of Function templates, Class templates, Introduction to Standard Template Library and its components. Algorithms, Containers (Array, Vector, Stack, List and Queue) and Iterators.

Laboratory Work

To implement object oriented constructs using C++ programming language.

Course Learning Outcomes (CLOs) /Course Objectives (COs):

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

1. To recall the knowledge of structure and its variables to comprehend the concept of classes, objects, constructors and destructors for implementing the object oriented paradigms.
2. To apply and analyze the inheritance on real life case studies via coding competences.

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3. To design and develop code snippets for polymorphism to proclaim coding potential; and management of run-time exceptions.
4. To assess and interpret the knowledge of templates to appraise the standard template libraries.

Text Books:

1. C++:The Complete Reference , Schildt H., Tata McGraw Hill, 4thed, 2003
2. C++Primer, Lippman B.S., Lajoie J., and MooE.B., , Addison-Wesley Professional, 5th ed, 2013

Reference Books:

1. Object-Oriented Programming in C++, Lafore R., Pearson Education, 4thed, 2002
2. Object Oriented Programming with C++, E Balagurusamy, 8thed, 2017
3. The C++programming language, Stroustrup B., Pearson Education India, 4thed, 2013

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

UEE413 : ELECTRICAL MACHINERY

L	T	P	Cr
3	1	2	4.5

Course Objectives: The course aims to introduce the concept of D.C. Machines, Transformers, Synchronous and Asynchronous AC machines, their construction and performance parameters.

Syllabus

Direct Current Machines: Basic concept and classification of dc machines as per type of excitation, circuit models and related equations of separately and self-excited dc generators and motors, armature reaction, characteristics of dc generators, characteristics of dc motors , speed control of dc motor, DC Motor starters, losses and efficiency in DC machines .

Transformers: Working principle of three phase transformers, construction, basic phasor groups and connections of three phase transformer, V-V and Scott-Connection, Electrical tests and performance metrics, parallel operation of transformers.

Induction (Asynchronous) Motor: Principle of operation and construction, calculation of slip, rotor frequency, rotor emf, current and power, losses and efficiency, induction motor phasor diagram and equivalent circuit, torque-slip and power-slip characteristics, determination of equivalent circuit parameters from no-load test and blocked-rotor test, starting methods of induction motor, methods of speed control.

Synchronous Machines: Operating principle and construction, phasor diagrams of cylindrical and salient pole synchronous generators/alternator, Open circuit and short circuit test of synchronous machine, voltage regulation of an alternator, active and reactive power equations of synchronous machine-power-angle characteristics, synchronizing power and synchronizing torque, Parallel Operation and Synchronisation of generator with infinite bus, operating principle and application of synchronous motor.

Single-phase motors: Basic concept of single-phase induction motor, starting methods, comparison between single and poly-phase induction motors, basic working principle and application of universal motor, single-phase reluctance motor, sub-synchronous motor, hysteresis motor.

Laboratory Work

Open short and short circuit tests on transformer, parallel operation of transformer, measurements of harmonics in inrush current, Scott connection and load sharing, no load, and external characteristics of self and separately excited DC generators, Speed control of DC shunt motor, open circuit and blocked rotor test on induction motor, speed control of induction motor, motor starting methods, voltage regulation of synchronous generator, V and inverted V curves of Synchronous generator, active and reactive power control of synchronous generator.

Course Learning Outcomes (CLOs) /Course Objectives (COs):

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

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

1. Analyse the performance of three phase transformers.
2. Analyse the load sharing with parallel connected single phase/three phase transformers.
3. Analyse the performance characteristics of DC motors and DC generators
4. Use different methods for starting and speed control of DC motors.
5. Analyse tests, characteristics and steady state performance of Three-phase induction motor.
6. Comprehend the performance and test of synchronous machines.
7. Analyse performance of single machine – infinite bus system and number of alternators connected in parallel.

Text Books:

1. D.P. Kothari and I.J. Nagrath, Electric Machines, 4e, Tata McGraw Hill Education Private Limited, New Delhi.
2. P.S. Bimbhra, Electrical Machinery, 7ed., Khanna Publishers, New Delhi.
3. P.S. Bimbhra, Generalized Theory of Electrical Machines, 5e, Khanna Publishers, New Delhi.

Reference Books:

1. Toro, Vincert, Electromechanical Devices for Energy Conversion, Prentice Hall of India.
2. Fitzgerald, A.E., Kingsley, C. Jr., and Umans, Stephen, Electric Machinery, 6e, McGraw Hill, USA.

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**

Approved in 109 th meeting of the Senate held on March 16, 2023. Revised in 112 th meeting of the Senate held on March 11, 2024.

ULC405 : PRINCIPLES OF POWER SYSTEM ENGINEERING

L	T	P	Cr
3	1	0	3.5

Course Objectives: The course aims to impart a critical theoretical and practical introduction to electrical, mechanical design of transmission system and steady state analysis of network.

Syllabus

Introduction to Power System: Structure of power systems, Growth of power systems-Indian overview, Interconnections and their advantages. Power Supply Systems and their comparison, High voltage Transmission Systems.

Electrical Design of Transmission Line: Choice of voltage and frequency, Types of conductor, Size of conductor, Resistance, Inductance and capacitance of single phase and three phase transmission lines. Effect of ground on Capacitance. Parameters of Insulated Cables, Grading of Cables.

Mechanical Design of Transmission line: Tension and sag calculations, Factors affecting Sag, Sag template, Stringing charts, Vibrations and vibration damper.

Insulators: Insulator types, String efficiency and its Improvement.

Performance of Transmission Lines: Characteristics and performance of power transmission lines: Short, Medium, Long lines, Generalized constants, Power flow, regulation, Power circle diagrams, Series and shunt compensation, Corona, Ferranti Effect, Electrostatic and Electromagnetic interference with communication lines.

Transmission network Calculations: Single line diagram of power system, Per Unit System and its advantages, Admittance model, Modelling of regulating transformer, Bus admittance matrix assemble, Bus impedance matrix assembly.

Load Flow Studies: Load flow problem, Power flow equations, Load flow solution using Gauss Seidal and Newton Raphson methods, Decoupling between real and reactive power control, Decoupled and fast decoupled methods, Comparison of load flow methods.

Course Learning Outcomes (CLOs) /Course Objectives (COs):

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

1. Design the electrical parameters of transmission lines and insulated cables under various working conditions.
2. Describe the mechanical design (sag and tension) of transmission line under various environment and geographical conditions .
3. Develop and analyse the transmission line models and evaluate its performance.

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4. Develop an appropriate mathematical model of power system
5. Carry out load flow analysis of practical power system for balanced system.

Text Books:

1. Nagrath, I.J. and Kothari, D.P., Power System Engineering, Tata McGraw Hill (2007).
2. Stevenson, W.D., Power System Analysis, McGraw Hill (2007).
3. Gupta, B.R., Power System Analysis and Design, S. Chand and Company Limited (2009)

Reference Books:

1. M. Pai, Copmuter Techniques in Power System analysis, Tata McGraw Hill, 2nd ed., (2005).
2. Chakraborti, A., Soni, M.L., Gupta, P.V. and Bhatnagar, U.S., A Text Book on Power System Engineering, Dhanpat Rai and Co. (P) Ltd. (2008).
3. Elgard, O.L. , Electric Energy Systems Theory, McGraw Hill Publications , 2nd ed., (2017).

Evaluation Scheme

Evaluation Elements	**Weightage %**
Mid Semester Test (MST)	**25-30**
End Semester Examination (ESE)	**40-45**
Sessional (may include Assignment, Sessional (Includes Regular Lab assessment) and Quizzes Project (Including report, presentation etc.)	**30**