NATIONAL ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai)

K.R.NAGAR, KOVILPATTI

www.nec.edu.in

REGULATIONS – 2023

CURRICULUM & SYLLABUS

B. E. – ELECTRICAL AND ELECTRONICS ENGINEERING

(Outcome Based Education & Choice Based Credit System)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I. VISION

- Promoting active learning, critical thinking coupled with ethical values to meet the global challenges

II. MISSION

- To instill state-of-the-art technical knowledge and research capability that will prepare our graduates for professionalism and life-long learning.
- To update knowledge to meet industrial and real world challenges
- To inculcate social and ethical values.

III. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1 : Excel in industrial or graduate work in Electrical Engineering and allied fields.

PEO 2 : Practice their profession conforming to ethical values and active participation in the affairs of the profession.

PEO 3 : Adapt to evolving technologies and stay current with their profession

IV. PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1 : Apply the basic knowledge of mathematics, science and engineering to identify, formulate, design and investigate complex engineering problems of power electronics and drives, power and energy systems, high voltage engineering, control and instrumentation and applied electronics.

PSO 2 : Apply the modern engineering hardware and software tools in electrical and electronics engineering to adopt in multi disciplinary environments and innovative practices.

V. PROGRAM OUTCOMES (POs)

PO 1 : **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2 : **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3 : **Design/development of solutions:** 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.

PO 4 : **Conduct investigations of complex problems:** 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.

PO 5: **Modern tool usage:** 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.

PO 6: **The engineer and society:** 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

PO 7: **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** 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: **Project management and finance:** 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: **Life-long learning:** 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.

REGULATIONS 2023

B.E. – EEE CURRICULUM AND SYLLABUS

SEMESTER – I

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Induction Programme – 2 weeks									**0**
Theory Courses									
1.	23SH11C	தமிழர்மரபு / Heritage of Tamils	HSMC	1	0	0	0	1	1
2.	23SH12C	Mathematical Foundations for Engineers	BSC	3	1	0	0	4	4
3.	23SH13C	Introduction to Engineering	ESC	1	0	0	0	1	1
Integrated Courses									
4.	23SH14C	Technical English	HSMC	1	0	2	0	3	2
5.	23SH15C	Engineering Physics	BSC	2	0	2	0	4	3
6.	23SH16C	Engineering Chemistry	BSC	2	0	2	0	4	3
7.	23ME11C	Engineering Graphics	ESC	2	0	4	0	6	4
Practical Courses									
8.	23EE14C	Engineering Practice	ESC	0	0	4	0	4	2
			TOTAL	**12**	**1**	**14**	**0**	**27**	**20**

SEMESTER - II

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23SH21C	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	0	0	0	1	1
2.	23GN05C	Professional Ethics and Human Values	HSMC	2	0	0	0	2	2
3.	23GN01C	Aptitude Essentials	EEC	1	0	0	0	1	1
4.	23EE21C	Fourier Series & Transform, Complex Analysis and Calculus	BSC	3	1	0	0	4	4
5.	23EE22C /23EC22C	Materials Science	ESC	2	0	0	0	2	2
6.	23EE23C	Basic Civil and Mechanical Engineering	ESC	3	0	0	0	3	3
Integrated Courses									
7.	23EE24C	Electric Circuit Analysis	PCC	3	1	2	0	6	5
8.	23SH22C	Professional English	HSMC	1	0	2	0	3	2
9.	23CS11C	Problem Solving Techniques	ESC	3	0	2	0	5	4
Practical Courses									
10.	23GN02C	Innovation through Design Thinking	EEC	0	0	0	4	4	2
			TOTAL	**19**	**2**	**6**	**4**	**31**	**26**

SEMESTER – III

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23EE31C	Electromagnetic Theory	ESC	3	1	0	0	4	4
Integrated Courses									
2.	23EE32C	Transforms, Probability and Statistics	BSC	3	0	0	2	5	4
3.	23EE33C	DC Machines and Transformers	PCC	3	0	2	0	5	4
4.	23EE34C	Measurement and Instrumentation	PCC	3	0	2	0	5	4
5.	23EE35C	Electron Devices and Circuits	PCC	3	1	2	0	6	5
Practical Courses									
6.	23GN03C	Intellectual Property Rights Study	EEC	0	0	0	4	4	2
7.	23GN04C	Aptitude Excellence	EEC	0	0	2	0	2	1
			TOTAL	**15**	**2**	**8**	**6**	**31**	**24**

SEMESTER – IV

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23EE41C	Signals and Systems	PCC	3	0	0	0	3	3
2.	23EE42C	Power System-I	PCC	3	1	0	0	4	4
3.	-	Elective Science Stream	BSC	3	0	0	0	3	3
4.	23MC02C	Environmental Science and Engineering	MC	2	0	0	0	2	0
Integrated Courses									
5.	23EE43C	AC Rotating Machines	PCC	3	0	2	0	5	4
6.	23EE44C	Linear Integrated Circuits	PCC	3	1	2	0	6	5
7.	23EE45C	Object Oriented Programming	ESC	2	0	2	2	6	4
Practical Courses									
8.	23EE46C	System Modeling projects	EEC	0	0	2	2	4	2
			TOTAL	**19**	**2**	**8**	**4**	**33**	**25**

SEMESTER – V

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	-	PEC I	PEC	3	0	0	0	3	3
2.	-	OEC I	OEC	3	0	0	0	3	3
3.	23MC01C	Constitution of India	MC	2	0	0	0	2	0
Integrated Courses									
4.	23EE51C	Control Systems	PCC	3	0	2	0	5	4
5.	23EE52C	Power System II	PCC	3	0	2	0	5	4
6.	23EE53C	Digital Electronics	PCC	3	1	2	0	6	5
7.	23EE54C	Power Electronics	PCC	3	0	2	0	5	4
Practical Courses									
8.	23EE55C	Simulation using Modern tool	EEC	0	0	2	2	4	2
			TOTAL	**20**	**1**	**10**	**2**	**33**	**25**

SEMESTER – VI

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23EE61C	Power System Protection and Switchgear	PCC	3	0	0	0	3	3
2.	23EEXXE	PEC II	PEC	3	0	0	0	3	3
3.	23EEXXE	PEC III	PEC	3	0	0	0	3	3
4.	-	OEC II	OEC	3	0	0	0	3	3
5.	23GN06C	Project Management and Finance	HSMC	2	0	0	0	2	2
Integrated Courses									
6.	23EE62C	High Voltage Engineering	PCC	3	0	2	0	5	4
7.	23EE63C	Microprocessor, Microcontroller and its Applications	PCC	3	0	2	0	5	4
Practical Courses									
8.	23EE64C	Product Development Practice	EEC	0	0	0	4	4	2
			TOTAL	**20**	**0**	**4**	**4**	**28**	**24**

SEMESTER – VII

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	-	PEC IV	PEC	3	0	0	0	3	3
2.	-	PEC V	PEC	3	0	0	0	3	3
3.	-	PEC VI	PEC	3	0	0	0	3	3
4.	-	OEC III	OEC	3	0	0	0	3	3
Practical Courses									
5.	23EE71C	Mini Project	EEC	0	0	0	6	6	3
6.	23EE72C	Internship (4 Weeks)	EEC	-	-	-	-	-	2
			TOTAL	**12**	**0**	**0**	**6**	**18**	**17**

SEMESTER – VIII

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Practical Courses									
1.	23EE81C	Capstone Project / Industry Practice	EEC	0	0	0	12	12	6
			TOTAL	**0**	**0**	**0**	**12**	**12**	**6**

Total Number of credits: 167

DISTRIBUTION OF CREDIT – EEE DEPARTMENT

Category	I Sem.	II Sem.	III Sem.	IV Sem.	V Sem.	VI Sem.	VII Sem.	VIII Sem.	Credits	Percentage of credits
HSMC	3	5	-	-	-	2	-	-	**10**	05.99
BSC	10	4	4	3	-	-	-	-	**21**	12.58
ESC	7	9	4	4	-	-	-	-	**24**	14.38
PCC	-	5	13	16	17	11	-	-	**62**	37.12
PEC	-	-	-	-	3	6	9	-	**18**	10.77
OEC	-	-	-	-	3	3	3	-	**9**	05.38
EEC	-	3	3	2	2	2	5	6	**23**	13.78
Total	**20**	**26**	**24**	**25**	**25**	**24**	**17**	**6**	**167**	**100**

ELECTIVE COURSES (SCIENCE STREAM)

S. No	Course Category	Course Code	Course Name	L	T	P	E	C
MATHEMATICS								
1.	OEC	23SH01E	Linear Algebra, Mathematical Logic and Set Theory	2	1	0	0	3
2.	OEC	23SH02E	Linear Structures and Transformations	2	1	0	0	3
3.	OEC	23SH03E	Number Theory	2	1	0	0	3
4.	OEC	23SH04E	Numerical Analysis	2	1	0	0	3
5.	OEC	23SH05E	Optimization Techniques	2	1	0	0	3
6.	OEC	23SH06E	Principles of Discrete Mathematics	2	1	0	0	3
7.	OEC	23SH07E	Random Processes and Queuing Theory	2	1	0	0	3
8.	OEC	23SH08E	Statistical Techniques and Numerical Methods	2	1	0	0	3
9.	OEC	23SH09E	Transforms, Mathematical Logic and Set Theory	2	1	0	0	3
PHYSICS								
10.	OEC	23SH10E	Fundamentals of Laser Technology	3	0	0	0	3
11.	OEC	23SH11E	Nanomaterials for Engineers	3	0	0	0	3
12.	OEC	23SH12E	Photonics	3	0	0	0	3
CHEMISTRY								
13.	OEC	23SH13E	Biology for Computing	3	0	0	0	3
14.	OEC	23SH14E	Biological Systems for Engineers	3	0	0	0	3
15.	OEC	23SH15E	Polymer Science and Technology	3	0	0	0	3
16.	OEC	23SH16E	Sensors for Engineering Applications	3	0	0	0	3

Course Code	**தமிழர் மரபு (HERITAGE OF TAMILS)**	**L**	**T**	**P**	**E**	**C**
23SH11C	(Common to all B.E. / B.Tech. Degree Programmes)	**1**	**0**	**0**	**0**	**1**

COURSE OUTCOMES

இப்பாடம் முடிந்ததும் மாணவர்களிடம் வளரும் திறன்

CO1: தமிழ் மொழியின் இலக்கிய வளம், ஓவிய, சிற்பக் கலையின் பரிணாம வளர்ச்சி நாட்டுப்புறக் கலை மற்றும் வீர விளையாட்டுக்கள் பற்றிய அறிவு மற்றும் விளக்கும் திறன்

CO2: தமிழர்களின் திணை சார் கோட்பாடுகள் மற்றும் இந்திய பண்பாட்டில் தமிழர்களின் பங்கு பற்றிய அறிவு மற்றும் விளக்கும் திறன்

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: know and explain about Tamil literary resources, Dimensional growth of painting and sculpture arts, folk art and martial arts.

CO2: know and explain about Tamils Thinai concepts, contribution of Tamils in Indian National Movements and Indian Culture

CO1: தமிழ் மொழியின் இலக்கிய வளம், ஓவிய, சிற்பக் கலையின் பரிணாம வளர்ச்சி நாட்டுப்புறக்கலை மற்றும் வீர விளையாட்டுக்கள் பற்றிய அறிவு மற்றும் விளக்கும் திறன் **L:9**

இந்திய மொழிக்குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு - நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு - தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

CO1: know and explain about Tamil literary resources, Dimensional growth of painting and sculpture arts, folk art and martial arts.

Language Families in India - Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan - Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils - Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

CO2:தமிழர்களின் திணை சார் கோட்பாடுகள் மற்றும் இந்திய பண்பாட்டில் தமிழர்களின் பங்கு பற்றிய அறிவு மற்றும் விளக்கும் திறன் **L:6**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி - இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப் படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

CO2: know and explain about Tamils Thinai concepts, contribution of Tamils in Indian National Movements and Indian Culture

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas - Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

REFERENCES:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு:தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

L: 15; TOTAL: 15 PERIODS

Course Code	MATHEMATICAL FOUNDATIONS FOR ENGINEERS	L	T	P	E	C
23SH12C	(Common to all B.E. / B.Tech. Degree Programmes)	**3**	**1**	**0**	**0**	**4**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: interpret the nature of quadratic form by orthogonal transformation.
CO2: identify the maxima and minima of functions.
CO3: solve ordinary differential equations.
CO4: find the solution of partial differential equations.
CO5: evaluate integrals of multivariate calculus.

Soft skill Component

CO6 : develop communication, problem solving and interpersonal skills

CO1: interpret the nature of quadratic form by orthogonal transformation. **L:9, T:3**

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors – Diagonalisation of a matrix by orthogonal transformation – Quadratic forms – Reduction of quadratic form to canonical form by orthogonal transformation and its nature; Cayley – Hamilton theorem (excluding proof) - Application: Stretching of a elastic membrane.

CO2: identify the maxima and minima of functions. **L:9, T:3**

Functions of two variables: Limit, continuity and partial derivatives; Total derivative, Jacobian, Taylor series- Application : Linearization of Non Linear systems using Taylor Series - Maxima and minima - Method of Lagrange multipliers.

CO3: solve ordinary differential equations. **L:9, T:3**

Solutions of first order ordinary differential equations - Equations solvable for ‘p’, equations solvable for ‘y’, equations solvable for ‘x’ - Solutions of higher order linear differential equations with constant coefficients – Cauchy’s and Legendre’s linear equations - Method of variation of parameters – Solution of simultaneous linear differential equation. Application RCL – circuit and Mass Spring System.

CO4: find the solution of partial differential equations. **L:9, T:3**

Formation of partial differential equations – Solutions of standard types of first order partial differential equations - Lagrange’s linear equations - Solutions of homogeneous and Non homogeneous linear partial differential equations of second and higher order with constant coefficient – Application - Shallow wave equations of first order PDE.

CO5 : evaluate integrals of multivariate calculus **L:9, T:3**

Double integration – Cartesian and polar coordinates - Change of order of integration - Change of variables - Cartesian to polar coordinates - Area as double integral - Triple integration - Cartesian and polar coordinates – Change of Variables- Cartesian to spherical and cylindrical coordinates. Application – Moments and centers of mass.

TEXT BOOKS:

1. Grewal.B.S., Higher Engineering Mathematics, Khanna Publications, 44th Edition, 2021.
2. James E. Gentle, Matrix Algebra, Springer International Publishing, 2nd Edition, 2017
3. Shanker Rao.G., Linear Albebra, WileyIndia, 1st Edition , 2017

REFERENCES:

1. Bali.N.P. and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications Private Limited, 10th Edition, 2016.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India, 10th Edition, 2017.
3. Kenneth B. Howell, Ordinary Differential Equations, CRC Press, 2020.
4. James Strewart, Daniel Clegg, Saleem Watson, Essential Calculus Early Trancendentals, Cengage Learning, 9th Edition, 2021.
5. Nanda Kumar A.K, P.S.Datti: Raju .K.George , Ordinary Differential Equations, Cambridge University press, 2017.

L: 45; T: 15; TOTAL: 60 PERIODS

Course Code	INTRODUCTION TO ENGINEERING	L	T	P	E	C
23SH13C	(Common to all B.E. / B.Tech. Degree Programmes)	**1**	**0**	**0**	**0**	**1**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: articulate the importance of Engineering and its role in society through OBE framework
CO2: identify and describe academic pathways towards career settlement

CO1: articulate the importance of Engineering and its role in society through OBE framework **L:9**

Engineering – An introduction, Classification of different Engineering Disciplines, Role of Engineers in Society. Graduate Attributes (GA), Program Specific Criteria (PSC)- Program Educational Objectives (PEO), Program Outcomes (PO), Course Outcomes (CO), Choice Based Credit System (CBCS), course categories, teaching and learning process, active and passive learning, project / problem based learning, different assessments process.

CO2: identify and describe academic pathways towards career settlement **L:6**

Curriculum, cafeteria curriculum and self learning big picture of the Program and the significance of each course in the undergraduate Engineering Program, Discuss the different career paths for an engineering graduate. Career objective, competency requirement.

Case study: Each student has to interact with alumni mentors/seniors/faculty members/surf the internet and present a career path that inspires him/her at the end of the course

REFERENCES:

1. Quamrul H. Mazumder Introduction to Engineering, An Assessment and Problem Solving Approach, CRC Press, 1st Edition, 2016.
2. Saeed Moaveni, "Engineering Fundamentals an Introduction to Engineering", Cengage Learning, USA, 4th Edition, 2011.

L: 15; TOTAL: 15 PERIODS

Course Code	TECHNICAL ENGLISH	L	T	P	E	C
23SH14C	(Common to all B.E. / B.Tech. Degree Programmes)	**1**	**0**	**2**	**0**	**2**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: apply the fundamental grammar rules in writing

CO2: utilizing phonetic transcription for pronunciation

Practical Component

CO3: apply the basic language skills in various aspects of communication

CO4: utilize technical terms and phrases in specific contexts

CO5: develop the pronunciation skill through various language components

CO6: distinguish different writing forms and interpret text through divergent thinking

CO7: develop effective reports with grammatical and language components

Soft skill Component

CO8: develop communication, team spirit, creativity and time management

CO1: apply the fundamental grammar rules in writing **L:13, P:26**

Parts of Speech - Word Formation using Prefix and Suffix - Sentence formation (Kinds of Sentences) - Tenses (Present, Past & Future tense) – Concord

CO3: apply the basic language skills in various aspects of communication

Diary Writing - Greeting and Self Introduction

CO4: utilize technical terms and phrases in specific contexts

Technical terms and extended definition - Essay Writing (Argumentative Essay and Analytical Essay) - Situational phrases & Conversation - Formal Letter Writing (Permission & Requisition letters)

CO6: distinguish different writing forms and interpret text through divergent thinking

Picture Description, Introduction to Reading Techniques (Skimming, scanning, inferring, predicting, Reading and Reviewing a book (Sci – Fi), E Mail Writing

CO7: develop effective reports with grammatical and language components
Listening and responding to general information (Business context) - Report Writing (Types, Structure, and Stages of report writing) - Checklist

CO2: utilizing phonetic transcription for pronunciation **L:2, P:4**

Phonetics (Vowels & Consonants)

CO5: develop the pronunciation skill through various language components

Word Transformation from one form to another - Letter Writing (Informal) - Listening and responding to general information (General context)

TEXT BOOKS:

1. Paul V. Anderson, Technical Communication: A Reader - Centered Approach, Cengage Learning, 9th Edition, 2017.
2. Ravindra Nath Tiwari, Technical English-II, Shashwat Publication, 1st Edition, 2020.
3. Stephen D. Krashen, Principles and Practice in Second Language Acquisition. Pergamon, 1987.
4. Lester Kaufman and Jane Straus, The Blue Book of Grammar and Punctuation: An Easy-to Use Guide with Clear Rules, Real-World Examples, and Reproducible Quizzes, Wiley, 2021.
5. Wells H. G., The Time Machine, Penguin Classics, 2012.

REFERENCES:

1. Michael McCarthy, English Grammar: The Basics, Taylor & Francis, 2021.
2. Peter Lucantoni and Lydia Kellas, Cambridge IGCSE(TM) English as a Second Language Workbook, Cambridge University Press, 6th Edition, 2022.

L: 15; P: 30; TOTAL: 45 PERIODS

Course Code	ENGINEERING PHYSICS	L	T	P	E	C
23SH15C	(Common to all B.E. / B.Tech. Degree Programmes)	**2**	**0**	**2**	**0**	**3**

COURSE OUTCOMES:

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

Theory Components:

CO1: identify the structural properties of crystalline materials
CO2: comprehend and apply the concepts of centre of mass and elasticity
CO3: explain thermodynamic parameters and fundamental laws and their application in various processes
CO4: illustrate the applications of different lasers and optical fibers
CO5: interpret the quantum concepts, to illustrate the quantization of energy, and computation

Practical Components:

CO6: compare the mechanical properties of the materials due to bending and torsion
CO7: analyze thermal conductivity of different bad conducting materials
CO8: explore the light-matter interaction by the phenomenon of interference and diffraction and photoelectric effect

Soft skill Component:

CO9: develop the team spirit and communication skill through group activities

CO1: identify the structural properties of crystalline materials **L:10**

Crystalline and amorphous materials - unit cell - primitive cell - crystal systems, Bravais lattices - Miller indices – interplanar distance – Characteristics of SC, BCC, FCC, HCP structures - Bragg's law - X-ray diffraction and its applications - Synthesis of crystalline materials

CO2: comprehend and apply the concepts of centre of mass and elasticity **L:6,**
CO6: compare the mechanical properties of the materials due to bending and torsion **P:10**

Multi-particle dynamics - Introduction - Center of mass (CM) – CM of continuous bodies -

Introduction to rigid bodies - translation - rotation – moment of inertia – theorems of moment of inertia – Torsional pendulum.

Elasticity – Stress - strain diagram and its applications - Moduli of elasticity and its relation - bending of beams - Bending moment – cantilever - theory and experiment - Uniform bending - theory and experiment – Non Uniform bending - I-shaped girders

CO3: explain thermodynamic parameters and fundamental laws and their application in various processes **L:6, P:8**

CO7: analyse thermal conductivity of different bad conducting materials.

Laws of thermodynamics – Thermo dynamical processes – Introduction to heat transfer – conduction - convection and radiation – thermal conductivity of good conductor –Radial flow of heat - Spherical shell method and cylindrical shell method – Thermal conductivity of poor conductor- Lee's disc method– Applications - heat exchangers - refrigerators and ovens

CO4: illustrate the applications of different lasers and optical fibers **L:6, P:6**

CO8: explore the light-matter interaction by the phenomenon of Interference and diffraction and photoelectric effect

Lasers: Interaction of light with matter - Einstein coefficients and their relations – characteristics of laser - components of laser – Lasing action – Pumping methods – Types of Laser - Nd-YAG laser -semiconductor laser- Applications

Fiber optics: principle and classification of optical fibers – propagation of light in optical fiber - Numerical aperture and Acceptance angle – losses associated with optical fibers (Qualitative) – Fiber optic communication system - Applications - Displacement and pressure sensors – Endoscopy

CO5: interpret the quantum concepts, to illustrate the quantization of energy, and computation **L:6, P:2**

CO8: explore the light-matter interaction by the phenomenon of interference and diffraction and photoelectric effect

Planck's radiation law - de-Broglie hypothesis – Matter waves - Heisenberg's uncertainty principle – elementary proof – applications – Schrödinger's time-dependent and time-independent wave equation – physical significance of wave function – Introduction to quantum tunneling - applications - particle in a one-dimensional box – tunneling microscope – quantum confinement in 0D, 1D, 2D systems - quantum computation

TEXT BOOKS:

1. Avadhanulu M. N., Kshirsagar P.G and Arun Murthy T.V.S, A Text book of Engineering Physics, S.Chand & Co, 11th Edition, 2018.
2. Kleppner D and Kolenkow R. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
3. Kenneth S Krane, Modern Physics, Wiley, 4th Edition, 2021.

REFERENCES:

1. Wolfson R., Essential University Physics, Volume 1 & 2, Pearson Education, 2nd Indian Edition, 2009.
2. Hitendra K. Malik, A.K.Singh, Engineering Physics, McGraw Hill Education, 2nd Edition, 2017.
3. Kyungwon An, Fundamentals of Laser Physics, World Scientific Publishing Company, 2023
4. Halliday D, Resnick R and Walker J, Principles of Physics, Wiley, 12th Edition, 2021.

L: 30; P: 30; TOTAL: 60 PERIODS

Course Code	ENGINEERING CHEMISTRY	L	T	P	E	C
23SH16C	(Common to all B.E. / B.Tech. Degree Programmes)	**2**	**0**	**2**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: explain the suitable water treatment technologies for domestic and industrial applications

CO2: apply the knowledge of corrosion to solve the industrial problems

CO3: describe the preparation, properties and their applications of smart materials in various sectors

CO4: describe the basic components and performance analysis of batteries

CO5: predict the mechanical, electrical and electronics properties of materials using various instrumentation techniques

Practical Component

CO6: estimate the amount of Ca^{2+}/ Mg^{2+}, alkalinity and Chloride ion present in the water sample.

CO7: quantify the amount of acid and metal ion in the given samples by different analytical techniques

Soft skill Component

CO8: develop interpersonal, work ethics and communications skills for career settlement

CO1: explain the suitable water treatment technologies for domestic and industrial applications

CO6: estimate the amount of Ca^{2+}/ Mg^{2+}, alkalinity and Chloride ion present in the water sample.

Introduction, sources and impurities in water, potable water specifications (as per WHO and BIS) - hardness-types-estimation of $Ca^{2+}$and Mg^{2+} ion in water by EDTA method. Alkalinity-types-determination of alkalinity of water -chronic daily intake - incremental life time risk - hazard quotient, hazard index, contamination factor - determination of chloride ion in water using Argentometric method-municipal water treatment- physical methods and chemical methods. Disinfection-internal conditioning - calgon and carbonate conditioning. Desalination-types-Reverse Osmosis (RO) process- Forward osmosis (FO) - electro dialysis - demineralization. **L:6, P:12**

CO2: apply the knowledge of corrosion to solve the industrial problems.

CO7: quantify the amount of acid and metal ion in the given samples by different analytical techniques

Corrosion – mechanism of dry and wet corrosion-forms of corrosion– galvanic corrosion and differential aeration corrosion, crevice corrosion, pitting corrosion, microbial corrosion-stress corrosion, intergranular corrosion - determination of rate of corrosion by weight loss method. **L:6, P:6**

Protection: cathodic protection, surface coatings, corrosion inhibitors. Corrosion of industrial components: corrosion and its control in power industries, automotive industries, chemical processing industries and marine industries.

CO3: describe the preparation, properties and their applications of smart materials in various sectors

Polymers: introduction - classification - functional polymers: electroluminescence polymer, biodegradable polymers, fire retardant polymer, thermo responsive polymer - piezo, ferro and pyroelectric polymer - nanocomposites: introduction, synthesis, properties & applications- synthesis of nanocomposites using sol-gel process **L:6**

CO4: describe the basic components and performance analysis of batteries

Introduction - components - operation principle - Lead acid – Nickel metal hydride batteries- Lithium ions batteries: Lithium polymer battery, Lithium sulphur battery - fabrication and performance evaluation- safety issues - battery management system - recycling of lithium batteries. **L:6**

CO5:predict the mechanical, electrical and electronics properties of materials using various instrumentation techniques

CO7: quantify the amount of acid and metal ion in the given samples by different analytical techniques.

Spectroscopy methods: Beer-Lambert's law and its limitations– UV-visible spectroscopy and IR spectroscopy – principle - instrumentation– applications. Estimation of copper. Electro analytical methods: potentiometric titration - Estimation of Fe^{2+} ion by potentiotometric method. Conductometric method- estimation of HCl by conductometric titration- pH metric method-Estimation of HCl by pH metric titration-applications. Thermal analytical methods: Thermal Gravimetric Analysis (TGA) and Differential Thermal Analysis (DTA)- Thermo Mechanical Analysis (TMA) –principle - instrumentation - Thermo gravimetric analysis of $CuSO_4.5H_2O$- applications. **L:6, P:12**

TEXT BOOKS:

1. Jain P.C. and Jain M, Engineering Chemistry, Dhanpat Rai Publishing Company, New Delhi, 17th Edition, 2021.
2. Dara S.S and Umare S.S, A Text Book of Engineering Chemistry, S.Chand & Company Limited, 20th Edition, 2018.
3. Agarwal S, Engineering Chemistry, Cambridge Publishing Company, 2nd Edition, 2019

REFERENCES:

1. Benjamin M. M, Water Chemistry, Waveland Press, 2nd Edition, 2019.
2. Cicek V, Corrosion Engineering, Springer Publishing, 1st Edition, 2021.
3. Shahinpoor. M, Fundamentals of Smart Materials, Publisher: Royal Society of Chemistry, 1st Edition, 2020.
4. Berg H, Bernhardsson S, and Johansson P, Electric Vehicle Batteries: Moving from Research towards Innovation, Publisher: Springer, 1st Edition, 2019.
5. Crouch S, Skoog D, Holler F, Principles of Instrumental Analysis, 2017.

L: 30; P: 30; TOTAL: 60 PERIODS

Course Code	ENGINEERING GRAPHICS	L	T	P	E	C
23ME11C	(Common to MECH, CIVIL, AIDS, EEE, IT)	**2**	**0**	**4**	**0**	**4**

COURSE OUTCOMES:

Upon the successful completion of the course, the student will be able to

CO1: Construct the Engineering Curves and Perform Freehand Sketching.

CO2: Construct the Orthographic Projections of Points, Straight Lines and Lamina

CO3: Draw the Projections of Simple Solids in Different Positions.

CO4: Visualize the Sectional Views and Surface of Various Solids.

CO5: Draw the Isometric and Perspective Projections of Various Solids.

CO1: Construct the Engineering Curves and Perform Freehand Sketching. **L:6, P:12**

Principles of Engineering Graphics – significance. Usage of Drawing Instruments. Lettering and dimensioning exercise Construction of ellipse, parabola and hyperbola using eccentricity method– Construction of cycloids, Epi and Hypo-cycloids. Orthographic views of simple components by Free hand drawing - Transferring measurement from the given object to the free hand sketches.

CO2: Construct the Orthographic Projections of Points, Straight Lines and Lamina **L:6, P:12**

Principle of orthographic projections – Conventions - First angle and third angle projections. Projections of points placed in all quadrants – projections of straight lines – inclined to both reference planes - determination of true length and inclinations. Projections of regular polygonal surfaces and circular lamina inclined to both reference planes.

CO3: Draw the Projections of Simple Solids in Different Positions. **L:6, P:12**

Projections of simple solids like prisms, pyramids, cylinder and cone - axis inclined to one reference plane - change of position method.

CO4: Visualize the Sectional Views and Surface of Various Solids. **L:6, P:12**

Sectioning of simple solids – Axis perpendicular to horizontal plane- Drawing sectional views with true shape of the section. Development of lateral surfaces of truncated solids – Prisms, pyramids, cylinder and cone.

CO5: Draw the Isometric and Perspective Projections of Various Solids. **L:6, P:12**

Principles of isometric projection – Isometric scale – Isometric projections of simple solids like prism, pyramid, cone and cylinder – Combination of solids. Perspective projections of simple solids by visual-ray method

TEXT BOOKS:

1. Bhatt N.D, "Engineering Drawing", 54th Edition, Charotar Publishing House, 2023.
2. Shah M.B and Rana B.C, "Engineering Drawing", Pearson Education, 2nd Edition, 2009.

REFERENCES:

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
2. Agrawal B. & Agrawal C.M., "Engineering Graphics", TMH Publication, 2nd Edition, 2013
3. Narayana K.L. & Kannaiah P, "Text book on Engineering Drawing", Scitech Publishers, 2011.
4. Gopalakrishna K.R, "Engineering Drawing", Subhas Publications, 32nd Edition, 2017.

L: 30; P: 60; TOTAL: 90 PERIODS

Course Code	ENGINEERING PRACTICE LABORATORY	L	T	P	E	C
23EE14C		0	0	4	0	2

PART A - MECHANICAL LABORATORY

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

CO1: prepare a different carpentry joints.

CO2: make a simple component using sheet metal operations.

CO3: make a joints using shield metal arc welding process.
CO4: perform lathe and shaping operations.

LIST OF EXPERIMENTS

1. **CARPENTRY PRACTICES**
   a. Study of carpentry tools
   b. Making T-Joints & Dove tail joints

2. **SHEET METAL PRACTICES**
   a. Study of sheet metal operations
   b. Making of a square tray and conical funnel

3. **METAL JOINING PROCESS PRACTICES**
   a. Study of Shield Metal Arc Welding (SMAW) process
   b. Welding of Butt joints and Lap joints using Shield Metal Arc Welding Process

4. **MACHINING PRACTICES**
   a. Study of lathe machine and shaper machine
   b. Perform lathe and shaping operations

P: 30; TOTAL: 30 PERIODS

TEXT BOOK:

1. Bawa H.S, "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007

REFERENCES:

1. Ramesh Babu V, "Engineering Practices Laboratory Manual", Revised Edition, VRB Publishers Private Limited, Chennai, 2014.
2. Jeyachandran K, Natarajan S. and Balasubramanian S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
3. Jeyapoovan T, Saravanapandian M. and Pranitha S, "Engineering Practices Lab Manual", Vikas Publishing House Private Limited, 2006.
4. Rajendra Prasad A and Sarma PMMS, "Workshop Practice", Sree Sai Publication, 2002
5. Kannaiah P and Narayana K L, "Manual on Workshop Practice", Scitech Publications, 1999.

PART B
ELECTRICAL AND ELECTRONICS ENGINEERING PRACTICES LABORATORY

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

CO1: demonstrate simple residential wiring circuits
CO2: identify faults in any electrical appliances
CO3: measure energy and resistance to earth of electrical equipment
CO4: demonstrate basic electronic components based on their physical parameters and dimensions
CO5: Measure AC signal parameters using CRO and describe the fundamentals and characteristics of electronic components

LIST OF EXPERIMENTS

ELECTRICAL EXPERIMENTS

1. Residential House Wiring using Switches, MCB
2. Stair Case Wiring Connections
3. Study of wiring in different Lamps, Fan and Iron Box
4. Selection of protective devices
5. Coil Rewinding for Transformer and Fan using Rewinding Machine.
6. Measurement of Energy using Energy Meter for Single Phase System
7. Measurement of Earth Resistance using Electrical Equipment
8. Electrical fault detector.

ELECTRONICS EXPERIMENTS

9. Study and testing of Resistor, capacitor and inductor
10. Measurement of AC signal parameter (Peak-Peak, RMS, Period and Frequency) using CRO and DSO.
11. Study and Operation of Digital Multimeter, Function/Signal Generator and Regulated Power Supply
12. Verification of truth table for logic gates.
13. Characteristics of Diode, Transistor.
14. Soldering Practice

P: 30; TOTAL: 30 PERIODS

REFERENCES:

1. Jeyachandran K, Natarajan S and Balasubramanian S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
2. Electrical wiring, estimating and costing", Uppal, S.L. and Laroia, J.M. (1997), 5th Edition. Delhi: Khanna Publishers in Engineering.
3. Jeyapoovan T, Saravanapandian M and Pranitha S, "Engineering Practices Lab Manual", Vikas Publishing House Pvt. Ltd, 2006.
4. Bawa H.S., "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, 2007.
5. Rajendra Prasad A and Sarma P.M.M.S., "Workshop Practice", Sree Sai Publication, 2002.
6. Kannaiah P and Narayana K.L., "Manual on Workshop Practice", Scitech Publications, 1999.

RECOMMENDED ONLINE COURSE(s)

https://nptel.ac.in/courses/108105053
https://onlinecourses.nptel.ac.in/noc22_ee109/preview

Course Code	**தமிழரும் தொழில்நுட்பமும் (TAMILS AND TECHNOLOGY)**	**L**	**T**	**P**	**E**	**C**
23SH21C	(Common to all B.E. / B.Tech. Degree Programmes)	**1**	**0**	**0**	**0**	**1**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

CO1: தமிழர்களின் நெசவு மற்றும் பானைத் தொழில் நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில் நுட்பம், உற்பத்தித் தொழில்நுட்பம் பற்றிய அறிவு மற்றும் விளக்கும் திறன்.

CO2: தமிழர்களின் வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம், அறிவியல் தமிழ் மற்றும் கணினித் தொழில்நுட்பம் பற்றிய அறிவு மற்றும் விளக்கும் திறன்.

Upon the successful completion of the course, the student will be able to

CO1: Know and explain about Tamils weaving and Pottery technology, Design and construction Technology and Manufacturing Technology.

CO2: Know and explain about Tamils Agriculture and irrigation technology, Scientific Tamil and Tamil computing

CO1:தமிழர்களின் நெசவு மற்றும் பானைத் தொழில் நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில் நுட்பம் மற்றும் உற்பத்தித் தொழில் நுட்பம் பற்றிய அறிவு மற்றும் விளக்கும் திறன் L:9

சங்ககாலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிகப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்- சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்ககாலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு - சங்ககாலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும் கோவில்களும் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாடு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக்கலை- கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத்தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்கநாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்குமணிகள் - எலும்புத்துண்டுகள் - தொல்லியல்சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

CO1:KNOW AND EXPLAIN ABOUT WEAVING AND CERAMIC TECHNOLOGY, DESIGN AND CONSTRUCTION TECHNOLOGY, MANUFACTURING TECHNOLOGY

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW)– Graffiti on Potteries- Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age — Details of Stage Constructions in Silappathikaram- Sculptures and Temples of Mamallapuram- Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo –Saracenic architecture at Madras during British Period- Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold Coins as source of history - Minting of Coins — Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences – Gemstone types described in Silappathikaram.

CO2: தமிழர்களின் வேளாண்மை, நீர்ப்பாசனத் தொழில்நுட்பம், அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் பற்றிய அறிவு மற்றும் விளக்கும் திறன். **L:6**

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக்குமுழித்தூம் பின் முக்கியத்துவம் -கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்- அறிவியல் தமிழின் வளர்ச்சி - கணினித் தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக்கல்விக்கழகம் - தமிழ் மின்நூலகம் - இணையத்தில் தமிழ்அகராதிகள் - சொற்குவைத் திட்டம்.

CO2: KNOW AND EXPLAIN ABOUT AGRICULTURE TECHNOLOGY, IRRIGATION TECHNOLOGY, SCIENTIFIC TAMIL & TAMIL COMPUTING

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing – Knowledge of Sea - Fisheries — Pearl - Conche diving - Ancient Knowledge of Ocean – Knowledge Specific Society- Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books –Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries– Sorkuvai Project.

REFERENCE BOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் - கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி–வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை–ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறைவெளியீடு)
5. Social Life of Tamils(Dr.K.K.Pillay)A joint publication of TNTB & ESC and RMRL
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International InstituteofTamilStudies.)
9. Keeladi-Sangam City Civilization on the banks of river Vaigai (Jointly Published by: Department of Archaeology &Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

L: 15; TOTAL: 15 PERIODS

23GN05C	**PROFESSIONAL ETHICS AND HUMAN VALUES**	**L**	**T**	**P**	**E**	**C**
	(Common to all B.E. / B.Tech. Degree Programmes)	**2**	**0**	**0**	**0**	**2**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

CO1: Recognize and practice the core human values and theories related to ethical behavior.

CO2: Analyze the engineering ethical breach from past study.
CO3: Distinguish and apply safety, responsibility and rights in workplaces.

CO1: Recognize and practice the core human values and theories related to ethical behavior **L: 10**

Moral dilemmas and moral autonomy - Kohlberg's theory - Gilligan's theory - Consensus and controversy –Case studies: Vigil mechanism, Whistle blowing - Protected disclosures - Personal ethics, work ethics and human values - Governing Regulation.

CO2 : Analyze the engineering ethical breach from past study **L: 10**

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - Case study: The challenger disaster

CO3 : Distinguish and apply safety, responsibility and rights in workplaces **L: 10**

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - Collegiality and loyalty - respect for authority – confidentiality; Collective bargaining, Conflicts of interest - Case study; Occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination. Case studies: The Three mile island and Chernobyl disaster

TEXT BOOK

1. Mike W Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 5th Edition, 2022

REFERENCES

1. BehnamTaebi, "Ethics and Engineering: An Introduction", Cambridge University Press, 2021
2. Ajesh Faizal, Aswathy S U, Roy V I, "Professional Ethics in Engineering: an Industry Perspective", Noor Publishing, 2021
3. R.S.Naagarazan, "A Textbook on Professional Ethics and Human Values", New age International Pvt. Ltd; 3rd Edition, 2022
4. Dr. P. Elamurugan, "Professional Ethics in Engineering", Notion Press, 2021

L:30; TOTAL:30 PERIODS

Course Code	APTITUDE ESSENTIALS	L	T	P	E	C
23GN01C	(Common to all B.E. / B.Tech. Degree Programmes)	1	0	0	0	1

COURSE OUTCOMES:

Upon the completion of the course the students will be able to
CO1: Recall the fundamentals in quantitative techniques and solve Number series problems quickly
CO2: Develop problem solving skills on Numbers and enhance arithmetic ability
CO3: Infer appropriate comparison and distribution methods using ratio and to form equations
CO4: Improve quantitative skills and solve problems on percentages and profit loss
CO5: Calculate data interpretation and data sufficiency in quantitative aptitude

CO1: Recall the fundamentals in quantitative techniques and solve Number series problems quickly **L : 3**

Numeric series – Finding missing numbers – Odd number out series - Letter series – Symbol series - Alphanumeric series

CO2: Develop problem solving skills on Numbers and enhance arithmetic ability **L : 3**

Number Types - HCF & LCM – Square root- Cubic root - divisibility criteria- Unit digit calculation- Prime factors

CO3: Infer appropriate comparison and distribution methods using ratio and to form equations **L : 3**

Ratio & Proportion: Comparison of Ratios - Variations: Direct and indirect proportion Ages: Present Age, Past Age & Future calculation

CO4: Improve quantitative skills and solve problems on percentage and profit loss **L : 3**

Concept of Percentage – Percentage calculation - Calculation of Percentage on Population Results on Depreciation .Profit and Loss –Percentage of Profit and Loss – Discount

CO5: Calculate data interpretation and data sufficiency in quantitative aptitude **L : 3**

Data Interpretation – Pie Chart – Bar Chart – Table Chart .Data Sufficiency in Logical Reasoning : Numbers, Ratio, Ages, Percentage and Profit Loss

REFERENCES:

1. Dr.R.Aggarwal, " Quantitative Aptitude", S Chand Publishing, Revised Edition 2017
2. R.V.Praveen, "Quantitative Aptitude and Reasoning" , 3rd Edition , Eastern Economy Edition, PHI Learning 2016

Video Materials

Profit Loss

https://youtu.be/PpVO7I8dx6U

https://youtu.be/_cW7_BUDYcw

Number series

https://youtu.be/_4ZJFkFE2XU

https://youtu.be/83nJmniFmNk

Numbers

https://youtu.be/81pwuMJ8OIU

https://youtu.be/VT_N9cacgl4

Square root and Cube root

https://youtu.be/nJSqsaT0AgU

https://youtu.be/_HyhwS8P9KY

Problems on Ages

https://youtu.be/6PCTRVmu-ek

https://youtu.be/eAl3BvO_Ipw

Data Interpretation

https://youtu.be/s99rda8e0vc

Course Code	FOURIER SERIES & TRANSFORM, COMPLEX ANALYSIS AND CALCULUS	L	T	P	E	C
23EE21C		3	1	0	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO 1: perform Fourier series expansion of the functions.

CO 2: compute the Fourier transforms of various functions.
CO3: interpret analytic function in transformations.
CO4: evaluate complex integration over contour.
CO5: analyze the concepts related to vector field.

CO 1 : perform Fourier series expansion of the functions

Dirichlet's conditions–General Fourier series –Half range series–Complex form of Fourier series– Parseval's identity–Harmonic analysis- Identification of frequencies. **L:9,T:3**

CO2 : compute the Fourier transforms of various functions

Fourier Integral theorem (without proof)–Fourier transform pair–Fourier Sine and Cosine transforms–Properties–Transforms of simple functions–Convolution theorem –Parseval's theorem. **L:9,T:3**

CO3 : interpret analytic function in transformations

Analytic functions - Necessary and Sufficient conditions (excluding proofs) - Harmonic and orthogonal properties of analytic functions - Harmonic conjugate - Construction of analytic functions- fluid flow problems - Conformal mapping: w= z+c, cz, 1/z and bilinear transformation. **L:9,T:3**

CO 4 : evaluate complex integration over contour

Statement and applications of Cauchy's integral theorem and Cauchy's integral formula (excluding proof) – Taylor's and Laurent's expansions - Singular points - Residues - Cauchy's Residue theorem (excluding proof) - Application of residue theorem to evaluate real integrals - Unit circle and semi - circular contour (excluding poles on boundaries). **L:9,T:3**

CO5: analyze the concepts related to vector calculus

Differentiation of vectors : Gradient, Divergence, Curl and Directional derivatives – Line, Surface and Volume Integrals - Statement of Green's, Gauss divergence and Stokes' theorem - Simple applications involving rectangular parallelepiped and cubes. **L:9,T:3**

TEXT BOOKS:

1. Grewal.B.S, Higher Engineering Mathematics, 44th Edition, Khanna Publications, Delhi, 2021.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley India, 2017.

REFERENCES:

1. Bali.N.P. and Manish Goyal, A Textbook of Engineering Mathematics, 9th Edition, Laxmi Publications Private Limited., 2018.
2. Ramana B.V, Higher Engineering Mathematics, Tata Mc-Graw Hill Education, New Delhi, 2017.
3. Jain.R.K. and Iyengar.S.R.K., Advanced Engineering Mathematics, 5th Edition, Narosa Publishing House Private Limited, 2016.
4. Michael D .Greenberg, Advanced Engineering Mathematics, 2nd Edition, Pearson Education, 2021.

L: 45; T: 15; TOTAL: 60 PERIODS

23EC22C /	**MATERIALS SCIENCE**	**L**	**T**	**P**	**E**	**C**
23EE22C	(Common to ECE & EEE Branches)	**2**	**0**	**0**	**0**	**2**

COURSE OUTCOMES:

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

Theory Components:

CO1: explain the conductivity in metals using free electron theory.
CO2: describe the fundamental properties ofsemiconductors.
CO3: apply the magnetic and dielectric properties for relevant electrical and electronics engineering applications.
CO4: illustrate the optical properties and their applications to optical devices.
CO5: apply the concepts of nanomaterials for nano devices.

CO1: explain the conductivity in metals using free electron theory.

Conduction in metals - Classical free electron theory of metals – Mobility and electrical conductivity - Thermal conductivity of metals - Wiedemann – Franz law – Quantum free electron theory – merits and limitations of free electron theory (FET) - Fermi-Dirac Statistics - Density of States. **L:6**

CO2: describe the fundamental properties of semiconductors.

Energy band diagram - Direct and indirect band gap - Carrier concentration and Fermi level in anintrinsic semiconductor- Carrier concentration and Fermi level in N-type and P-type semiconductors - Carrier transport in Semiconductors: Drift, mobility, diffusion and carrier lifetime - Hall effect **L:6**

CO3: apply the magnetic and dielectric properties for relevant electrical and electronics engineering applications.

Magnetic materials – Classification – Hysteresis – Ferrites - $BaTiO_3$ – Application of Nd-Fe-B magnets. Electric polarization – Different types of polarization – Temperature and frequency dependence – Dielectric loss and dielectric breakdown – dielectric materials applications - capacitors and transformers. **L:6**

CO4: illustrate the optical properties and their applications to optical devices.

Light waves in a homogeneous medium – Refractive index – Dispersion – Classification of Optical materials – Luminescence - Fluorescence– Phosphors – Photoconductivity – Display devices - Principle and working of LED, OLED, LCD - Laser diode – Photodiode (CdS and CdSe)- Optical Amplifiers. **L:6**

CO5: apply the concepts of nanomaterials for nano devices.

Nanomaterials - synthesis - properties - Band gap of nanomaterials – Quantum Tunneling – Quantum cascade lasers -Nano magnets - GMR - Conductivity of metallic nanowires – Carbonnanotubes: Properties and applications - QLED – Spintronics and its device application. **L:6**

TEXTBOOKS:

1. Dr. M. Arumugam, Materials Science, Anuradha Publications, 2018
2. S. M. Sze and M. K. Lee, Semiconductor Physics and Devices, Wiley, 2021.
3. T. Pradeep, Nano: The Essentials: Understanding Nanoscience and Nanotechnology, McGraw-Hill Education, 2017.

4. Hilmi Unlu and Norman J. M. Horing, Progress in Nanoscale and Low-Dimensional Materials and Devices, Springer Link, 2022.

REFERENCES:

1. S.O Pillai, Solid State Physics, 10th edition, NEW AGE International Publishers, 2022
2. W.D.Callitser and D.G. Rethwish. Materials Science and Engineering, John Wiley & Sons, 2014.
3. Juan Martinez-Vega, Dielectric Materials for Electrical Engineering, Wiley, 2013
4. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson Education, 2009.
5. J. Wilson and J.F.B. Hawkes, Optoelectronics, Pearson Education, 2018.

L : 30; TOTAL : 30 PERIODS

Course Code 23EE23C	**BASIC CIVIL AND MECHANICAL ENGINEERING**	**L**	**T**	**P**	**E**	**C**
		3	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon the completion of this course, the students will be able to
CO1: discuss the materials and measurement techniques used in civil engineering.
CO2: describe the fundamental elements of civil engineering structures.
CO3: explain the basic manufacturing processes
CO4: demonstrate the components and working principle of IC engines and power plants
CO5: describe the working principle of refrigeration and air conditioning system

CO1: discuss the materials and measurement techniques used in civil engineering **L:9**

Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas – Contours. Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel - timber – modern materials, Thermal and acoustic insulating materials, Decorative panels, water proofing materials, Modern uses of Gypsum, Prefabricated Building component (brief discussion only).

CO2: describe the fundamental elements of civil engineering structure **L:9**

Building Plans – Setting out of a building – Foundations – Types of foundations - Bearing capacity and settlement - Brick masonry – stonemasonry – beams – columns – lintels – roofing – flooring – plastering –- Types of Bridges and Dams - water supply network - Rain water harvesting – Solid waste management- Introduction to Highways and Railways – Introduction to Green Buildings.

CO3: explain the basic manufacturing processes **L:9**

Overview of manufacturing processes - Introduction to metal casting process – Welding Processes- Bulk deformation processes - Powder metallurgy and plastic processing.

CO4: demonstrate the components and working principle of IC engines and power plants **L:9**

Internal combustion engines-Classification – Construction - Working principle- Four stroke and two stroke cycles - Comparison of four stroke and two stroke engines. Power Plants – Classification – Construction and working principle - steam, Gas,

Diesel, Hydroelectric, Nuclear, Wind Energy and Solar Power plants.

CO5: describe the working principle of refrigeration and air conditioning system **L:9**

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression -Window and Split type room Air conditioner.

TEXT BOOKS:

1. Shanmugam G and Palanichamy M.S, "Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi, 2016.
2. Shanmuga Sundaram S and Mylsamy K, "Basic Civil and Mechanical Engineering", Cengage Learning, 2011.
3. Ramamrutham S, 'Basic Civil Engineering', DhanpatRai Publishing Co.(P)Ltd, 2013
4. Venugopal K, Prabhu Raja V and SreeKanjana G "Basic Mechanical Engineering", Anuradha Publications., Chennai, 2014

REFERENCES:

1. Punmia, B.C, Ashok Kumar Jain, Arun Kumar Jain, 'Basic Civil Engineering', Lakshmi Publishers, 2012.
2. Seetharaman S., 'Basic Civil Engineering', Anuradha Agencies, 2005.
3. Rangwala, S.C, 'Building materials', Charotar Publishing House, Pvt. Limited, 27th Edition, 2009.
4. S.K. Garg, "Water Supply Engineering", Khanna publishers, Delhi, 2005
5. Khanna and Justo, "Highway Engineering", New Chand and Bros, Roorkee, 2000
6. Shantha Kumar S R J, "Basic Mechanical Engineering", Hi-tech Publications, 2013.
7. Kalpakjian.S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2013

L: 45; TOTAL: 45 PERIODS

Course Code	**ELECTRIC CIRCUIT ANALYSIS**	**L**	**T**	**P**	**E**	**C**
23EE24C		**3**	**1**	**2**	**0**	**5**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: describe the basic concepts of circuit analysis and basic laws

CO2: apply the network theorems and reduction techniques to estimate the steady state response for a given excitation

CO3: examine the application of series, parallel resonance and coupled circuits

CO4: infer and Evaluate the transient response of electric circuit and characteristics of two port networks.

CO5: analyse three-phase balanced and unbalanced systems in star and delta configurations.

Practical Component

CO6: examine the electric circuits using mesh and nodal analysis

CO7: make use of network theorems to simplify the circuits.

CO8: compute the frequency response of resonant and tuned circuits
CO9: analyze the dynamic behavior of electric circuits using simulation tool.
CO10: infer the behaviors of balanced and unbalanced systems in star and delta configurations using simulation tool.

Soft Skill Component

CO11: Develop effective communication skills, and build team work in analyzing the electric circuits with ethics

CO1: describe the basic concepts of circuit analysis and basic laws **L:9, T:3**
CO6: examine the electric circuits using mesh and nodal analysis **P:6**

Resistive, Inductive and Capacitive elements - Power, Power Factor and Energy - Ohm's Law– Kirchoffs laws and its verification – voltage and current division - source transformation – star delta conversion- Mesh current and node voltage analysis in D.C and A.C. circuits – Experimental verification of mesh and nodal analysis - Phasor diagram - Average and RMS value.

CO2: apply the network theorems and reduction techniques to estimate the steady state response for a given excitation **L:9, T:3**
CO7: make use of network theorems to simplify the circuits **P:6**

Thevenin and Norton Theorems and its Experimental verification – Superposition Theorem and its Experimental verification – Maximum power transfer theorem and its Experimental verification – Reciprocity Theorem and its Experimental verification – Millman's theorem.

CO3: examine the application of series, parallel resonance and coupled circuits **L:9, T:3**
CO8: compute the frequency response of resonant and tuned circuits **P:6**

Series, parallel resonance and its Experimental verification on Frequency response – Quality factor and Bandwidth – Self and mutual inductance – Coefficient of coupling – Single tuned circuits and experimental verification –Measurement of self inductance of a coil

CO4: infer and Evaluate the transient response of electric circuit and characteristics of two port networks. **L:9, T:3**
CO9: analyze the dynamic behavior of electric circuits using simulation tool. **P:6**

Review of Laplace transformation; Laplace transform of network and time domain solution for RL, RC and RLC networks for AC and DC excitations; Transient behaviour of circuit elements under switching conditions and their representations, evaluation of initial and final conditions in RL, RC and RLC circuits with AC and DC excitations- experimental verification of transient response of RL, RC circuits for DC input

CO5: analyse three-phase balanced and unbalanced systems in star and delta configurations **L:9, T:3**
CO10: infer the behaviors of balanced and unbalanced systems in star and delta configurations using simulation tool. **P:6**

Review of balanced system; Unbalanced systems: Delta-connected, three-wire star connected, four-wire star-connected loads; Analysis of unbalanced 3-wire star load: Kirchhoff's law, loop current method, star/delta conversion method using millman's theorem- Simulation of three phase balanced and unbalanced star, delta networks circuits

using Simulation package.

TEXT BOOKS:

1. Charles K Alexander, Matthew Sadiku, Fundamentals of Electric Circuits, 2022, 7th Edition, McGraw Hill Education.
2. William H. HaytJr, Jack E. Kemmerly, and Steven M. Durbin, Engineering Circuits Analysis, McGraw Hill publishers, New Delhi, 2019.

REFERENCES:

1. John Bird, "Electrical Circuit Theory and Technology", 6th Edition, Newnes Publication, 2017.
2. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", McGraw. Hill Education, 5th Edition, New Delhi, 2015.
3. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, McGraw Hill, New Delhi, 2017.

L: 45; T:15; P: 30; TOTAL: 90 PERIODS

Course Code	**PROFESSIONAL ENGLISH**	**L**	**T**	**P**	**E**	**C**
23SH22C	(Common to all B.E. / B.Tech. Degree Programmes)	**2**	**0**	**2**	**0**	**2**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: extend the primary language skills to develop critical thinking

CO2: build the secondary language skillsfor professional competence

Practical Component

CO3: apply the vital sub-functions of listening in particular context

CO4: take part in propagating ideas through effective oral communication

CO5: inferring information using various reading techniques

CO6: construct professional content via distinct methods of writing

Soft skill Component

CO7: develop interpersonal, communicational and behavioral attributes

CO1:extend the primary language skills to develop critical thinking

CO3: apply the vital sub-functions of listening in particular context

L:6,P:16

CO4: take part in propagating ideas through effective oral communication

If Conditionals – Standard Abbreviations –Types of Listening (Comprehensive, Informational, Critical Listening) – One Word Substitution, Components of Speaking

Listening for Specific Information –Listening to Speech (Oxford Union Society) – Listening to Science Talks or Theories

Product Description – Chart Description – Process Description – Group Discussion (Uses – Structure – Strategies – Team Work – Positive & Negative Body Languages – Samples – Demo)

CO2:build the secondary language skills for professional competence **L:5,P:18**
CO5: inferring information using various reading techniques
CO6: construct professional content via distinct methods of writing

Synonyms – Intensive and Extensive Reading –Error Spotting (Based on Concord, Pronoun, Articles & Adverb Placement)– Writing Style (Persuasive, Expository & Descriptive)

Newspaper Reading – Reading Comprehension (Fiction & NonFiction)

Business Letters for Quotations and Clarification, Placing Orders and Making Complaints – Proposal Writing – Job Application Letter & Resume Preparation – Paragraph Writing – Content Writing

TEXT BOOKS

1. Lucantoni, Peter & Lydia Kellas. "English as a Second Language Workbook", 6th Edition, Cambridge University Press, 2022.
2. Twain, Mark. "The Adventures of Tom Sawyer", 1st Edition, Pegasus, 2012.
3. Clear, James. "Atomic Habits", 1st Edition, Dreamliners, 2022.
4. Garcia, Hector & Francesc Miralles. Ikigai: The Japanese Secret to a long and Happy Life. 1st Edition, Tuttle Publishing, 2021.
5. Elbow, Peter, "Writing with Power" 2nd Edition, Oxford University Press, 1998.

REFERENCES

1. Butterfield, Jeff. "Soft Skills for Everyone". 2nd Edition, Cengage, 2020
2. Raman, Meenashi & Sangeetha Sharma. Professional English. 1st Edition, Oxford University Press, 2018

L: 11; P: 34; TOTAL: 45 PERIODS

Course Code	PROBLEM SOLVING TECHNIQUES	L	T	P	E	C
23CS11C	(Common to all B.E. / B.Tech. Degree Programmes)	**3**	**0**	**2**	**0**	**4**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theroy Component

CO1:apply fundamentals of problem solving techniques to develop simple algorithms for arithmetic and logical problems

CO2:apply fundamental, sequential, conditional logic statements and arrays for solving basic problems

CO3: implement modular programming concept using user defined functions

CO4: inscribe programs using pointers and to allocate memory for user defined data types using dynamic memory management functions

CO5: develop file processing application programs

Practical Component

CO6: develop programs for simple algorithms using sequential and Control structures

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

CO8: develop application programs using structures and files concept.

CO1: apply fundamentals of problem solving techniques to develop simple algorithms for arithmetic and logical problems **L:6**

Overview of programming: Problem Solving in Everyday Life, Types of Problem, Computer-based problem solving, Algorithms - Building blocks of algorithms (statements, control flow, functions) - Notation (pseudo code, flow chart) – Problem solving aspect – Top down design – Implementation of algorithms – Program Verification – Efficiency of algorithms – Analysis of algorithm.

CO2: apply fundamental, sequential, conditional logic statements and arrays for solving basic problems **L:12, P:10**

Data Types - Constants – Variables - Keywords – Operators– Problem Solving using fundamental algorithms. Control Statements: Branching and Looping - Algorithms Using Selection and Repetition - Summation of a set of numbers, Reversing Digits of an Integer - Implementation of fundamental algorithms and factoring methods - Array Techniques - Array order reversal, Array Counting, Finding maximum and the minimum value in a set

CO6: develop programs for simple algorithms using sequential and Control structures

Solve problems using control statements (Decision making and Looping)

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

Problem solving based on Array Handling(1D and 2D, Multi-dimensional arrays, traversal, rotation) - Solve problems to handle strings

CO3: implement modular programming concept using user defined functions **L:10, P:8**

Modular Programming approach: Modularization and recursion - Bubble Sort, Selection Sort, Linear Search, Binary Search, Implementation of sorting and searching

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

Solve problems by using modular approach (Functions and Recursion)

CO4: inscribe programs using pointers and to allocate memory for user defined data types using dynamic memory management functions **L:12, P:10**

Pointer Concept – add numbers using call by reference – finding maximum number from list of numbers - permutations of a given string using pointers – Implementation of function returns a pointer;

Structures & Union - finding the largest element of an array using Dynamic Memory Allocation – Implementation of Student database in structure using Dynamic Memory Allocation;

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

Build efficient solutions to manage memory efficiently through Pointers.

CO8: develop application programs using structures and files concept.

Develop applications using Structures

CO5: Develop file processing application programs **L:5, P:2**

File Handling: Files - Introduction, Types of file processing: Sequential access, Random access – Implementation of word count, copy file, Voter's age validation, Marks range validation

CO8: Develop application programs using structures and files concept.

Develop appliactions using Files

TEXT BOOKS:

1. Maureen Sprankle and Jim Hubbard, Problem Solving and Programming Concepts, Prentice Hall, 9th Edition, 2012.
2. R.G Dromey, How to solve it by Compute, Pearson education, Delhi, 2nd Edition, 2021.

REFERENCES:

1. Behrouz A. Forouzan, Richard F.Gilberg, P.Golda Jeyasheeli, G.Priyanka, S.T.Veena , Problem solving Using C A Structured Programming Approach, Volume I & II, 1st Edition, Cengage Publication, 2022
2. Karl Beecher, Computational Thinking: A Beginner's Guide to Problem Solving and Programming, BCS Learning & Development Limited, 1st Edition, 2017.
3. Byron S. Gottfried, Jitendar Kumar Chhabra, Programming with C, Tata McGraw Hill Publishing Company, New Delhi, 4th Edition, 2018.
4. Kernighan B.W., Ritchie D.M., C Programming Language (ANSI C), Prentice Hall of India Private Limited., New Delhi, 2nd Edition, 2010.
5. Pradip Dey and Manas Ghosh, Programming in C, Oxford University Press, New Delhi, 2018.
6. Yashavant P. Kanetkar, Let Us C, BPB Publications,16th Edition, 2020
7. H. M.Deitel, P. J. Deitel, C How to Program, Pearson Education., New Delhi, 7th Edition, 2016.

L: 45; P: 30; TOTAL: 75 PERIODS

Course Code	**INNOVATION THROUGH DESIGN THINKING**	**L**	**T**	**P**	**E**	**C**
23GN02C	**(Common to all B.E. / B.Tech. Degree Programmes)**	**0**	**0**	**0**	**4**	**2**

COURSE OUTCOMES

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

Experiential Component

CO1: Analyse the impact of design thinking process.

CO2: Practice design thinking process through real world problems.

Soft skill Component

CO3: Present survey conclusions on selected real-world problems.

CO1: Analyse the impact of design thinking process **30**

Design thinking process: history and phases -Ideation tools: brainstorming, mind mapping, scrambler method, six thinking hats -case studies.

CO2: Practice design thinking process through real world problems **30**

Real world problem selection-Practicing the preliminary stages of design thinking process - work presentation.

TEXT BOOKS:

1. Falk Uebernickel, Li Jiang, Walter Brenner, Britta Pukall, Therese Naef, "Design Thinking: The Handbook", WS Professional, 2020
2. PavanSoni, "Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem solving", Penguin Random House, 2020

REFERENCES:

8. Michael Lewrick, "The Design Thinking Playbook", Wiley, 2019
9. Kathryn Christopher, "Design Thinking in Engineering", Kendall Hunt Publishing Company, 2019
10. Robert Curedale, "Design Thinking Process & Methods" Design Community College Inc, 5th Edition, 2019
11. David Lee, "Design Thinking in the Classroom", Ulysses Press, 2018
12. Jimmy Jain, "Design Thinking for Startups", Notion Press, 2018
13. Monika Hestad Silvia Rigoni Anders Grnli, "The Little Booklet on Design Thinking: An Introduction", Zaccheus Entertainment, 2nd Edition, 2017
14. Scott Swan, Michael G.Luchs and Abbie Griffin, "Design Thinking: New Product Development Essentials", Wiley-Blackwell, 2016
15. D.M. Arvind Mallik, "Design Thinking for Educators", Notion Press, 2019

E:60; TOTAL:60 PERIODS

Course Code	**ELECTROMAGNETIC THEORY**	**L**	**T**	**P**	**E**	**C**
23EE31C		**3**	**1**	**0**	**0**	**4**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: apply vector calculus on electromagnetic fields in different coordinate system
CO2: analyze the electrostatic field distribution in different medium along with their applications
CO3: evaluate the magneto static field distribution in different medium along with their applications
CO4: illustrate different methods of emf generation and Maxwell's equations
CO5:examine the concept of electromagnetic waves in different spaces and characterizing parameters

CO1: Apply vector calculus on electromagnetic fields in different coordinate system **L:9, T:3**

Sources and effects of electromagnetic fields- review of scalar and vector fields- Coordinate systems (rectangular, cylindrical and spherical) – coordinate transformation- Vector calculus- vector operator del, gradient, divergence and curl- integral theorems of vectors.

CO2: Analyze the electrostatic field distribution in different medium along with their applications **L:9, T:3**

Coulomb's law, Electric field intensity- point charges, Line, Surface and Volume charge

distributions - Gauss law and its applications - Electric field in free space, conductors, dielectrics -Electric potential - different configurations- potential due to electric dipole - Electrostatic Energy and Energy density–Electric Boundary conditions - Capacitance - Electric field in multiple dielectrics and configuration - Laplace, Poisson's equations and solutions

CO3: Evaluate the magnetostatic field distribution in different medium along with their applications **L:9, T:3**

Lorentz force – Biot-Savart's Law – Ampere's Law - magnetic fields by differential current element – Magnetic force due to current carrying conductors - Magnetic flux and magnetic flux density – different configuration - Scalar and Vector Magnetic potentials -- Magnetostatic Energy and Energy density – Magnetic circuits - Magnetization and permeability - Magnetic boundary conditions – Torque - Inductance calculations.

CO4: Explain different methods of emf generation and Maxwell's equations **L:9, T:3**

Faraday's law for Electromagnetic induction - Transformer and motional EMF – Faraday Disc generator - Displacement current - Maxwell's equation (differential & Integral form) - Relation between field theory and circuit theory

CO5: examine the concept of electromagnetic waves in different spaces and characterizing parameters **L:9, T:3**

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

TEXT BOOKS:

1. Sadiku Matthew N.O., "Principles of Electromagnetics", 6th Edition, Oxford University Press, New Delhi, 2021.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.

REFERENCES:

1. Hayt W.H., Buck J.A and JaleelAkhtar M., "Engineering Electromagnetics" 9th Edition McGraw Hill Education, India, 2020.
2. Henry W.Ott, "Electromagnetic Compatibility Engineering", Wiley-Blackwell; Revised Edition (11 September 2009).
3. J. Edminister and Vishnu Priye, "Electromagnetics", 2nd Edition, Schaum's Series, 2017.
4. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.

L: 45; T: 15; TOTAL: 60 PERIODS

Course Code	TRANSFORMS, PROBABILITY AND STATISTICS	L	T	P	E	C
23EE32C		3	1	0	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO 1: apply Laplace transform to solve ordinary differential equations.

CO 2: solve difference equations using Z-Transform.
CO3: perform basic probability concepts and standard distributions.
CO4: find the correlation and regression of two dimensional random variables.
CO5: calculate the various measures of central tendencies.

CO 1 : apply Laplace transform to solve ordinary differential equations

Definition of Laplace transform and its inverse – Transforms of elementary functions – Properties – Transforms of periodic functions – Initial and final value theorems – Convolution theorem.- solutions of linear ordinary differential equations with constant coefficients - Solutions of simultaneous differential equations of first order with constant coefficients - *Determine the solution of ordinary differential equations in Laplace transform – Activity through software.* **L:9,T:3**

CO2 : solve difference equations using Z-Transform

Z– transform –Elementary properties – Inverse Z–transform – Convolution theorem- Initial and final value theorem – Formation of difference equations –Solutions of difference equations using Z–transform **L:9,T:3**

CO3 : perform basic probability concepts and standard distributions

Discrete and continuous random variables - Moments - Moment generating functions and their properties. Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, and Normal distributions.. **L:9,T:3**

CO 4 : find the correlation and regression of two dimensional random variables

Joint distributions - Marginal and conditional distributions – Covariance - Correlation and regression - Transformation of random variables – Central Limit Theorem. **L:9,T:3**

CO5: calculate the various measures of dispersion

Central tendencies -Mean, median, mode - Measures of Dispersion –Mean deviation, and Quartile deviation–Moments– Skewness –Kurtosis - Correlation and Regression - *Carry out performance study on measures of central tendencies – Case Study through software***.** **L:9,T:3**

TEXT BOOKS:

1. Grewal.B.S. Higher Engineering Mathematics, 44th Edition, Khanna Publications, Delhi, 2021.
2. Richard A. Johnson, Irwin Miller, John Freund, Miller & Freund's, Probability and Statistics for Engineers, 9th Edition, Pearson Education Limited, Global Edition, 2017.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley India, 2017

REFERENCES:

1. Ramana B.V, Higher Engineering Mathematics , Tata Mc-Graw Hill Education, New Delhi, 2017.
2. Jain.R.K. and Iyengar.S.R.K., Advanced Engineering Mathematics, 5th Edition, Narosa Publishing House Private Limited, 2016.
3. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, Probability and Statistics for Engineers and Scientists, Pearson Education, Asia, 9th Edition, 2016

L: 45; T:15; TOTAL: 60 PERIODS

Course Code	DC MACHINES AND TRANSFORMERS	L	T	P	E	C
23EE33C		3	0	2	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: illustrate the fundamentals of magnetic circuits and electromechanical energy conversion.

CO2: recognize the different types of transformer and evaluate the performance of transformer.

CO3: identify the DC generator for suitable applications and familiarize the performance of DC generator

CO4: select and draft specifications of DC motors for various applications along with speed control methods.

CO5: analyze the performance parameters/characteristics of the DC machines & transformer under various operating conditions through proper testing

Practical Component

CO6: estimate the magnetic losses in magnetic circuits

CO7: investigate the performance characteristics, efficiency, regulation & significance of various transformer connection

CO8: demonstrate the DC Generator Characteristics for various loading parameters

CO9: demonstrate the DC Motor Characteristics for various loading parameters

CO10: explore the performance of DC Machines and Transformers testing

Soft Skill Component

CO11: Develop effective communication skills, and build team work in characterizing DC machines and transformers with ethics

CO1: describe the fundamentals of Magnetic Circuits and Electromechanical Energy Conversion **L:9, P:6**

CO6: estimate the magnetic losses in magnetic circuits

Magnetic Circuits : MMF, Reluctance & Permeability - Magnetic Materials - B-H Curve, Magnetic Losses - Experimental Verification of Separation of magnetic losses in magnetic circuit – Faraday's law – Energy Stored in the magnetic field – Electromechanical Energy Conversion – Singly Excited System – Multiple Excited System – Rotating Magnetic Field

CO2: Recognize the different types of transformer and evaluate the performance of transformer **L:9, P:6**

CO7: investigate the performance characteristics, efficiency, regulation and significance of various transformer connections.

Construction and Working Principle –EMF Equation- Equivalent circuit Parameters – Phasor Diagram – Auto transformer -Three Phase transformer- Experimental Verification of Load Test on Single and three Phase transformer - Study of Three Phase transformer Connections – Transformer materials, Applications of transformers, Special purpose Instrument transformers (CT and PT), Emerging technologies - Earthing Transformer, Pulse Transformer, High frequency Transformer Solid-State Transformer, Dry-type transformers, Smart transformer, Green transformer

CO3: identify the DC Generator for suitable applications and familiarize the performance of DC Generator **L:9, P:6**

CO8: demonstrate the DC Machines Characteristics for various loading parameters

Construction - Principle of Operation – Lap and Wave windings – EMF Equation – Armature Reaction – Method of Excitation – Commutation – Interpoles and Compensating Winding – Characteristics of DC Generator – Experimental Verification of Open Circuit and Load Characteristics of DC Shunt Generator- Load Characteristics of DC series Generator- Load Characteristics of DC Cumulative and Differential Compound Generator Applications (Qualitative Case Study).

CO4: select and draft specifications of DC motors for various applications along with speed control methods. **L:9, P:6**

CO9: demonstrate the DC Motor Characteristics for various loading parameters

Principle of Operation – Back EMF – Torque Equation – Types of Motors – Experimental verification of Load test on DC Shunt Motor, DC Series Motor- Load Test on Cumulative and Differential DC Compound Motor- Speed Control of DC Shunt Motor - Starters and Speed Control – Speed Torque Characteristics – Braking— selection of motor - Applications (Qualitative Case Study).

CO5: Analyze the performance parameters/characteristics of the DC machines & Transformer under various operating conditions through proper testing **L:9, P:6**

CO10: explore the performance of DC Machines and Transformers testing

DC Machines: Losses & Efficiency – Condition for Maximum Efficiency - Retardation test – Swinburne's Test – Hopkinson's Test, Transformer: Losses & Efficiency, Condition for Maximum Efficiency –Experimental verification of Swinburne's Test- Hopkinson's test- Sumpner's test- Open circuit and Short Circuit Test on Single Phase Transformer All day efficiency and Voltage Regulation – OC & SC Test - Sumpner's test – Polarity Test.

TEXT BOOKS:

1. Nagrath I. J and Kothari D. P. "Electric Machines", 5th Edition, Tata Mc Graw Hill Publishing Company Limited, 2017.
2. S.K.Bhattacharya "Electrical Machines", 4th Edition, McGraw Hill Education, 2017.

REFERENCES:

1. M.N.Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning Private Limited, New Delhi, 2011.
2. Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, "Electric Machinery", 7th Edition, Tata Mc-Graw Hill Books Company, 2013.
3. P.S. Bimbhra, "Electrical Machinery", Khanna Publishes, 7th Edition, 2011.
4. B.L.Theraja, and A.K.Theraja, A text book of Electrical Technology, Shree Hari Publications, 2021.
5. V.K.Metha and Rohit Metha "Principles of Electrical Machines" S.Chand Publications, 2014.
6. "Transformers", 2nd Edition, BHEL, 2003.
7. IEC60076 -Transformer standards, IEC 60034 rotating machines.

L: 45; P: 30; TOTAL: 75 PERIODS

Course Code	MEASUREMENT AND INSTRUMENTATION	L	T	P	E	C
23EE34C		3	0	2	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: analyze the performance characteristics of instruments

CO2: describe the construction and operation of various measuring instruments.

CO3: select appropriate AC and DC bridges for the measurement of electrical parameters

CO4: illustrate the operation of transducer suitable for measurement of non electrical quantities

CO5: outline the significance of computer-based data acquisition and digital display devices.

Practical Component

CO6: perform statistical error analysis for instrument data to describe its characteristics.

CO7: calibrate the instruments with standards and design the components for extending its range.

CO8: design the DC and AC bridges for measuring electrical parameters

CO9: build signal conditioning circuit for transducer and analyze its transient and steady state behaviors.

CO10: utilize smart system for parameter measurement and monitoring using digital technology.

Soft Skill Component

CO11: Develop monitoring system with ethics, teamwork and effective communication skills.

CO1: analyze the performance characteristics of instruments **L:8, P:2**

CO6: perform statistical error analysis for instrument data to describe its characteristics.

Methods of Measurement – Fundamental and derived units – Elements of instrument – Static and Dynamic characteristics of instruments – Error types– Propagation of error - Statistical error analysis – Performance measures –Experimental measurement and analysis of Error for a set of data from a batch of resistance – Standard and Calibration

CO2: describe the construction and operation of various measuring instruments. **L:9, P:8**

CO7: calibrate the instruments with standards and design the components for extending its range

Types of analog meters –Principle of Moving coil instruments –Moving iron instruments –Extension of meter range –Design and validate multipliers for extending the range of voltmeter and ammeter- Induction type wattmeter and energy meters – Calibration of three phase energy meter by two wattmeter method and validate using multifunction meter Instrument transformer -Calibrate fixed and variable ratio CT in current measurement- Optical CT-CVT-IVT.

CO3:select appropriate AC and DC bridges for the measurement of electrical parameters **L:10, P:10**

CO8: design the DC and AC bridges for measuring electrical parameters

Balance condition – Source & Detectors – Wheatstone bridge, Kelvin's double bridge – Experimental validation - Maxwell's bridge – Anderson bridge – Experimental design of Maxwell's bridge and Anderson bridge – De-Sauty bridge – Schering bridge – Experimental design of Schering bridge and De-Sauty bridge– Wein bridge – Megger– Earth resistance –Localization of cable fault – Experimental verification of Megger.

CO4: illustrate the operation of transducer suitable for measuring a physical parameter **L:9, P:6**

CO9: build signal conditioning circuit for transducer and analyze its transient and steady state behaviors.

Transducers selection criteria – Types of transducers – Potentiometer – Strain gauge– Encoders – LVDT – Pressure transducer – Calibration experiment for Resistive, inductive and capacitive transducers – Temperature transducers – Build signal conditioning circuit for thermocouple– Transient and steady state analysis for RLC circuit design – Flow meters – Pyrometers–Piezo-electric transducers – hall effect transducer.

CO5: outline the significance of computer-based data acquisition and digital display devices. **L:9, P:4**

CO10: utilize smart system for parameter measurement and monitoring using digital technology

Quantization – Digital voltmeters – Ramp and integrating –Digital multimeter –Digital storage Oscilloscope –Digital printers –Data acquisition system – Display devices: LCD, LED, OLED –Smart monitoring: Multifunction meter, Virtual instrumentation - ELVIS Data acquisition experiment in LabVIEW platform - Introduction to IoT technology - Remote monitoring experiment using IoT technology.

TEXT BOOKS:

1. Ernest O. Doebelin , Dhanesh N. Manik, “Measurement Systems”, 7th Edition, McGraw Hill Education, 2019.
2. Prithwiraj Purkait, Budhaditya Biswasm Santanu Das, Chiranjib Koley, “Electrical and Electronic Measurements and Instrumentation, McGraw Hill Education, 2017.

REFERENCES:

1. Arthur Whitmore Smith, “Principles of Electrical measurements”, Legare Street Press, 2022.
2. A.K.Sawhney, “A Course in Electrical and Electronic Measurements and Instrumentation”, Shree Hari Publications, 2021.
3. Kalsi. H.S, “Electronic Instrumentation”, Tata McGraw Hill, 4th Edition 2019.
4. Alan S.Morris, Reza Langari, “Measurement and Instrumentation Theory and Application”, Elsevier, 2012.
5. Helfrick, Albert. D and Copper. W.D, “Electronics Instrumentation and Measurement Techniques”, Prentice Hall of India Ltd. & Co, New Delhi, 2010.

NPTEL MATERIAL: https://archive.nptel.ac.in/courses/108/105/108105153/#

L: 45; P: 30; TOTAL: 75 PERIODS

Course Code	ELECTRON DEVICES AND CIRCUITS	L	T	P	E	C
23EE35C		3	1	2	0	5

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: explain the characteristics and applications of PN junction diode.
CO2: describe the working principle of transistor and design of biasing circuits
CO3: summarize the characteristics of amplifier using BJT and MOSFET
CO4: illustrate the operation of differential and feedback amplifiers circuits
CO5: demonstrate the pulse and power supply circuits using IC's

Practical Component

CO6: demonstrate the characteristics and applications of PN junction diode.
CO7: realize the characteristics BJT and MOSFET under various bias
CO8: develop an amplifier circuit using BJT and MOSFET
CO9: construct the differential and feedback amplifiers.
CO10: build and verify the power supply circuits

Soft Skill Component

CO11: Develop communication skills and team work during the design of electronic circuit components

CO1: explain the characteristics and applications of PN junction diode.
CO6: demonstrate the characteristics and applications of PN junction diode.
L:9, T:3, P:6

PN Junction diode – Structure, Operation , Experimental verification of V-I characteristics–Equivalent Circuit – Ideal and Practical Diode – Reverse Recovery Time –Logic Gates using Diode – Rectifiers – Half Wave and Full Wave Rectifier with experimental verification – Filters – Zener diode, characteristics– LED –Schottky diode – Photo Diode – Laser diodes–optocouplers – Analysis of data sheet parameters.

CO2: describe the working principle of transistor and design of biasing circuits
CO7: realize the characteristics BJT and MOSFET under various bias
L:9, T:3, P:6

BJT Structure, - Characteristics of BJT under CB and CE Configuration - Operation – experimental verification of CE, CB, CC Characteristics – Needs of Biasing – Load Line – JFET, MOSFET Structure, - Characteristics of MOSFET and JFET- Operation and Characteristics– Biasing Circuits BJT and MOSFET– experimental verification of Design of Transistor Biasing - Analysis of data sheet parameters – UJT Structure and characteristics.

CO3: summarize the characteristics of amplifier using BJT and MOSFET
CO8: develop an amplifier circuit using BJT and MOSFET
L:9, T:3, P:6

BJT small signal model – Analysis of CE, CC amplifiers – Frequency response analysis – MOSFET Small signal model– Experimental Verification of Frequency Response of Common Emitter Amplifier - Frequency Response of Common Source MOSFET Amplifier - Analysis of CS and Source follower –Power amplifiers, Class A, B, AB – Cascaded Amplifier – Design and implementation of Power amplifiers - Darlington

CO4: illustrate the operation of differential and feedback amplifiers circuits
CO9: construct the differential and feedback amplifiers.
L:9, T:3, P:6

Differential amplifier and its experimental verification – Common mode and Difference mode analysis – Advantages of negative feedback – voltage / current, series, Shunt feedback – Positive feedback – Condition for Oscillations, RC phase shift oscillators and experimental verification – Wien bridge, Hartley, Colpitts and Crystal oscillators.

CO5: demonstrate the pulse and power supply circuits using IC's
CO10: build and verify the power supply circuits

L:9, T:3, P:6

Pulse circuits – RC integrator and differentiator – Diode Clipping & Clamping circuits – Zener Diodes as Regulators – experimental verification of Design of Zener Voltage regulator - IC voltage regulators – LM78XX, 79XX – Variable voltage regulators switching regulators LM317, LM723 – experimental verification of Design of switching regulators - Linear Mode Power Supply – Switched Mode Power Supply

TEXT BOOKS:

1. Donald.A. Neamen, "Electronic Circuit Analysis and Design", 2nd Edition, Tata McGraw Hill, 2009.
2. Millman.J and Halkias.C, "Electronic Devices and Circuits", 4th Edition, McGraw HillEducation, 2017.

REFERENCES:

1. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", 11th Edition, Prentice Hall, 2015.
2. Thomas L. Floyd and David M.Buchla, "Electronics Fundamentals: Circuits, Devices and Applications", 8th Edition, Pearson College Div, 2010.
3. David A. Bell, "Fundamentals of Electronic Devices and Circuits", Oxford University Press, 2009.
3. Schilling and Belove, "Electronic Circuits", TMH, 3rd Edition, 2002.
4. Chenming Hu, "Modern Semiconductor Devices for Integrated Circuits", Prentice Hall, 2009

L: 45; T:15; P: 30; TOTAL: 90 PERIODS

23GN03C	INTELLECTUAL PROPERTY RIGHTS STUDY	L	T	P	E	C
	(Common to all B.E. / B.Tech. Degree Programmes)	**0**	**0**	**0**	**4**	**2**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Experiential Component

CO1: Survey and practice the basic elements of existing patents.

CO2: Investigate and present the state of art technologies through effectual IP search.

Soft Skill Component

CO3: Present patent survey conclusions

CO1 Survey and practice basic elements of existing patents **30**

Basic elements of IPR – claims – infringements – Patent examination and Report - Case studies: patent survey.

CO2 Investigate and present the state of art technologies through effectual IP search **30**

Importance of IP search-factors to be considered for effective IP search-Hands-on Practice

REFERENCES

1. D.P. Mittal, "Indian Patents Law and Procedure", Taxman Publication, 2002
2. B.L. Wadera, "Patents, trademarks, copyright, Designs and Geographical Judications", 2010
3. P. Narayanan, "Intellectual Property Law", Eastern Law House, 2022
4. N.S. Gopalakrishnan & T.G.Agitha, "Principles of Intellectual Property", Eastern Book Company, Lucknow, 2009.

E:60 TOTAL:60 PERIODS

Course Code	**APTITUDE EXCELLENCE**	**L**	**T**	**P**	**E**	**C**
23GN04C		**0**	**0**	**2**	**0**	**1**

COURSE OUTCOMES

Upon the completion of the course the students will be able to

CO1: Infer appropriate methods to simplify computation

CO2: Develop problem solving skills on Time and Work and enhance arithmetic ability

CO3: Interpret fundamentals in quantitative techniques and solve problems quickly

CO4: Improve quantitative skills and solve problems on permutation and Combination

CO5: Acquire the knowledge of Cognitive ability and solve puzzles effectively

CO1: Infer appropriate methods to simplify computation

Simplification: Nested Series simplification(fraction) -BODMAS rule – Viraculum (or Bar) rule – Modulus of a real number –Multiplication shortcuts -Comparing Fractions-Data Sufficiency **P:6**

CO2: Develop problem solving skills on Time and Work and enhance arithmetic ability

Time and Work: Work Done - Days from Work:- Ratio – Efficiency –Work and wages - Data Sufficiency **P:6**

CO3: Interpret fundamentals in quantitative techniques and solve problems quickly

Time Speed Distance: Body moving in the same direction- Body moving in the opposite direction-Average speed- Meeting point - Data Sufficiency **P:6**

CO4: Improve quantitative skills and solve problems on permutation and Combination

Probability Permutation Combination: Fundamental Counting Principle – Computing Permutation – Circular Permutation – Computing Combinations - Data Sufficiency **P:6**

CO5: Acquire the knowledge of Cognitive ability and solve puzzles effectively

Abstract reasoning: Mirror and water image – Figure Matrix –Pattern Completion – Logical puzzles – Dot situation - Ranking ordering. **Cognitive ability:** Blood Relation - Direction Sense Test-Data Sufficiency **P:6**

REFERENCE BOOKS

1. R.V.Praveen, "Quantitative Aptitude and Reasoning", 3rd Edition , Eastern Economy Edition, PHI Learning 2016
2. Arun Sharma," Quantitative Aptitude for CAT", McGraw Hill Edge, 10th Edition 2022
3. Dr.R.Aggarwal, " Quantitative Aptitude", S Chand Publishing, Revised Edition 2017

P:30; TOTAL: 30 PERIODS

Course Code	SIGNALS AND SYSTEMS	L	T	P	E	C
23EE41C		3	0	0	0	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

CO1: analyze the types and properties of different signals and systems
CO2: utilize the different mathematical approaches for the behavior of CT and DT LTI systems
CO3: demonstrate the behavior of CT signals and systems in complex frequency domain
CO4: demonstrate the behavior of DT signals and systems in complex frequency domain
CO5: describe the concept of sampling and applications of signals and systems

CO1: analyze the types and properties of different signals and systems **L:9**

Signals: Types – Properties: periodicity, absolute integrability, determinism and stochastic character – Basic Signals: unit impulse, unit step, sinusoid, complex exponential and time-limited signals - continuous and discrete time signals.
Systems: continuous and discrete time systems – Properties: additively and homogeneity, shift-invariance, causality, stability, realisability – Simulation of basic signals and basic operation on signals.

CO2: utilize the different mathematical approaches for the behavior of CT and DT LTI systems **L:9**

Impulse response and step response – convolution - input-output behavior – cascade interconnections - Characterization of causality and stability of LTI systems – correlation - System representation through differential equations and difference equations – the notion of a frequency response and its relation to the impulse response - block diagram representation - State-space Representation of systems - State-Space Analysis – Simulation of time response of system.

CO3: demonstrate the behavior of CT signals and systems in complex frequency domain **L:9**

Fourier series representation of periodic signals - Waveform Symmetries - Calculation of Fourier Coefficients. Fourier Transform - convolution/multiplication and their effect in the frequency domain - magnitude and phase response - Fourier domain duality. Laplace Transform for continuous time signals and systems - system functions - poles and zeros of system functions and signals - Laplace domain analysis -solution to differential equations and system behavior – Simulation using CT signals in complex frequency domain

CO4: demonstrate the behavior of DT signals and systems in complex frequency domain **L:9**

Discrete-Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT) - Parseval's Theorem. Z-transform for discrete time signals and systems - system functions - poles and zeros of systems and sequences – z domain analysis - solution to difference equations and system behavior- Simulation using DT signals in complex frequency domain

CO5: describe the concept of sampling and applications of signals and systems **L:9**

Analog to Digital Conversion - Sampling Theorem and its implications - Spectra of sampled signals – Aliasing and its effects - Digital to Analog Conversion – Reconstruction with ideal interpolator, zero-order hold, first-order hold – power spectral density - modulation for communication, filtering, feedback control systems.

TEXT BOOKS:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “Signals and systems”, Prentice Hall India, 2nd Edition, 2015.
2. J.G.Proakis and D.G.Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson Education, 4th Edition, 2014.

REFERENCES:

1. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 3rd Edition, 2013.
2. S. Haykin and B. V. Veen, “Signals and Systems”, Wiley India Pvt.Ltd, 2nd Edition, 2021.
3. A. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Pearson Education India, 3rd Edition, 2014.
4. M. J. Robert and Govind Sharma “Fundamentals of Signals and Systems”, McGraw Hill Education, 2nd Edition, 2017.
5. B. P. Lathi, “Principles of Linear Systems and Signals”, Oxford University Press, 2nd Edition, 2009.

L: 45; TOTAL: 45 PERIODS

Course Code	POWER SYSTEM-I	L	T	P	E	C
23EE42C		3	1	0	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

CO1: demonstrate the fundamental concept of Power system
CO2: evaluate the electrical parameters of the transmission line
CO3: analyze the performance of Transmission line
CO4: analyze the performance of the insulators and cables
CO5: employ the concept of mechanical design of overhead line and substation

CO1: demonstrate the fundamental concept of Power system **L:9,T:3**

Evolution of Power system- Structure of Power system - Generation: Conventional and Non-Conventional Energy Sources (Qualitative Treatment only)-Transmission and Distribution Systems: Types - AC and DC distribution System- Recent Trends in Power System- Synchronized Grid- Smart Grid - Distributed Generation-Pooling station.

CO2: evaluate the electrical parameters of the transmission line **L:9,T:3**

Overhead Transmission Lines : Types of Circuits-Single and Double circuit lines-Electrical and Magnetic Fields in and around the conductors – Lumped and distributed Parameters of single and three phase transmission lines with single and double circuits - stranded and bundled conductors – Symmetrical and Unsymmetrical Spacing-Self and Mutual GMD-Skin Effect and Proximity effects

CO3: analyze the performance of Transmission line **L:9,T:3**

Classification of lines – Short, medium and long transmission line :Equivalent circuits, attenuation constant – Phase constant – Transmission efficiency and voltage regulation-Surge impedance loading– Ferranti effect and corona loss-Tuning of transmission line : Introduction to FACTS devices.

CO4: analyze the performance of the insulators and cables **L:9,T:3**

Insulators-Types of Insulators-voltage distribution in insulator string-improvement of string efficiency-Underground cables: Types of cables, Parameters of cables-Dielectric stress-Grading of cables-Methods of laying-Capacitance of 3-core belted cable.

CO5: employ the concept of mechanical design of overhead line and substation **L:9,T:3**

Mechanical design of transmission line -sag and tension calculations for different weather conditions – Tower spotting – Types of towers

Sub-station Layout (AIS and GIS) - Equipment of Substation-– Bus-bar arrangements-Methods of Grounding- Key diagram of 220 kV/11kV and 11kV/415V Substation - Substation Automation (Qualitative Treatment only).

TEXT BOOKS:

1. Wadhwa C.L., “Electric Power Systems”, New Age International (P) Ltd., 6th Edition, 2018.
2. Kothari D.P. and Nagrath I.J., “Power System Engineering”, Tata McGraw Hill Private Limited, New Delhi, 3rd Edition, 2019.

REFERENCES:

1. Mehta V. K. and Rohit Mehta, “Principles of Power System”, S.Chand Company & Ltd, New Delhi, 2018.
2. Singh S.N., “Electric Power Generation, Transmission and Distribution”, Prentice Hall Private Limited, New Delhi, 2008.
3. S Rama Subbanna and B Loveswara Rao, “Electric Power Transmission and Distribution”, Notion Press, 2019.
4. J.Grainger and W.D.Stevenson, “Power System Analysis”, McGraw Hill Education, 1st Edition, 2017.
5. Hadi Saadat, “Power System Analysis”, Tata McGraw Hill Private Limited, 3rd Edition, 2011.

6. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power systems", 5th Edition, Wiley, 2013.

L: 45; T:15; TOTAL: 60 PERIODS

Course code	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	E	C
23MC02C		2	0	0	0	0

COURSE OUTCOMES:

Upon the successful completion of the course, the student will be able to

CO1: explain the structure and functions of an ecosystem and the importance of biodiversity.

CO2: interpret the causes, effects of air and water pollution.

CO3: comprehend the causes, impacts and management of e-waste and municipal waste.

CO4: apply the knowledge of sustainability practices in the environment.

CO1: explain the structure and functions of an ecosystem and the importance of biodiversity. **L-6**

Introduction to Environment**,** scope and importance of environment – need for public awareness. Eco-system: structure and function. Biodiversity: Introduction - types – values of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India. Conservation of biodiversity: In-situ and ex-situ - Biodiversity index calculation (Simpson and Shannon diversity Index, Sorenson coefficient)

CO2: interpret the causes, effects of air and water pollution. **L-6**

Air pollution - Classification of air pollutants – sources – Effects - Measurements: dust monitor – gas analyzer, particle size analyzer. Water pollution – Classification – health hazards – sampling and analysis of water. Waste water treatment – different industrial effluents and their treatment – Measurement: BOD and COD – atomic absorption spectrometer. Case study (Okhla sewage water treatment plant)

CO3: comprehend the causes, impacts and management of e-waste and municipal waste. **L-12**

Integrated Waste Management: Introduction – Generation and types of solid waste – Swachh Bharat Mission – Solid waste management: collection, transportation, segregation and processing – Disposal: landfill – biochemical processes and energy recovery - Municipal solid waste management rules 2016.

e-Waste Management: Introduction – Composition - Types – Generation – Environmental and health hazards of e-waste – Recycling - Recovery of metals: pyrometallurgical, hydrometallurgical, and biometallurgical process – e-waste management and handling rules 2016 – e-waste management companies in India.

CO4: apply the knowledge of sustainability practices in the environment. **L-6**

Sustainability and Management**:** Introduction - concept, needs and challenges –economic and social aspects of sustainability – unsustainability to sustainability –millennium development goals and protocols – Sustainable Development Goals-targets, indicators and

intervention areas – Climate change – Global, Regional and local environmental issues and possible solutions – case studies. Concept of Carbon Credit – Carbon Footprint – Environmental management in industry – A case study – Zero waste and R concept – Circular economy – ISO 14000 Series – Material Life cycle assessment.

TEXT BOOKS:

1. Miller. G.T and Spoolman. S, 'Environmental Science', 16th Edition, Brooks/Cole Publishing Co., 2018.
2. Peavy. H.S, Rowe. D.R and Tchobanoglous. G, "Environmental Engineering", 2nd Edition, McGraw Hill Education, 2020.
3. Benny Joseph, 'Environmental Engineering', Tata-Mc-Graw Hill, New Delhi, 2016.
4. Gilbert M. Masters, 'Introduction to Environmental Science and Engineering', 2nd Edition, Pearson Education, 2016.

REFERENCES:

1. Kaushik. A and Kaushik. C.P, 'Environmental Science and Engineering', 6th Edition, New Age International Publishers, 2018.
2. Weller. K, 'Environmental Science and Biological Engineering', 1st Edition, WIT Press, 2015.

L:30; TOTAL : 30 PERIODS

Course Code	AC ROTATING MACHINES	L	T	P	E	C
23EE43C		3	0	2	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: demonstrate the performance characteristics of synchronous generators.
CO2: employ different starting methods and explain the performance characteristics of synchronous motors.
CO3: relate the performance of the Induction Machines using phasor diagrams
CO4: use the induction motors for suitable applications and pre-determine the performance of AC motors
CO5: show the principle of operation and performance of single-phase induction motors.

Practical Component

CO6: validate the performance and regulation of alternators using of various direct and indirect method.
CO7: estimate the performance of synchronous motors for different power factors.
CO8: perform the load test of induction motors
CO9: predict the performance characteristics of three phase induction motors
CO10: demonstrate the performance of single phase induction motors.

CO1:demonstrate the performance of synchronous generators **L:9,P:8**

CO6: validate the performance and regulation of alternators using of various direct and indirect methods.

Construction - types - Slots, Coils, concentrated and distributed winding - Winding Factors - EMF Equation - Armature Reaction –experimental verification of Voltage Regulation methods EMF, MMF, ZPF and ASA Methods - Regulation of Three Phase Alternator for resistive, inductive and capacitive loads. - Synchronization of Alternator with bus bars by dark lamp method - Synchronizing power - Parallel Operation - Salient pole machine: Two reaction theory – experimental verification of Slip test - Phasor Diagrams & Voltage Regulation.

CO2: employ different starting methods and explain the performance characteristics of synchronous motors. **L:9,P:2**

CO7: estimate the performance of synchronous motors for different power factors

Principle of Operation - Methods of Starting - Phasor Diagrams - Current loci for constant power input, constant excitation and constant power developed - Power Flow Equations - Effect of Varying load angle and excitation - V and Inverted V Curves with experimental verification - Synchronous Condenser - Hunting and Suppression Techniques.

CO3: relate the performance of the Induction Machines using phasor diagrams **L:9,P:6**

CO8: perform the load test of induction motors

Types - Construction - MMF in Distributed AC Windings - Rotating Magnetic Field - Principle of Operation - Torque equation - Slip-Torque Characteristics –Load test with experimental verification- Phasor Diagram – Losses and efficiency –Separation of No load Losses with experimental verification - Starters - Induction Generators - Doubly-Fed Induction Machines - Generators in Wind turbine – Selection of drives for Induction Motor (Qualitative treatment).

CO4: use the induction motors for suitable applications and pre-determine the performance of AC motors **L:9,P:8**

CO9: predict the performance characteristics of three phase induction motors

No-Load and Blocked Rotor Tests - Circle Diagram, Equivalent Circuit with experimental verification - Cogging and Crawling - Speed Control - Braking – Selection of motors – Applications for electric locomotives and conveyors (Qualitative Case Study).

CO5: show the principle of operation and performance of single-phase induction motors. **L:9,P:6**

CO10: demonstrate the performance of single phase induction motors.

Construction - Principle of operation - Double Revolving Field Theory - Equivalent Circuit, load test with experimental verification - Methods of Starting - Types: Split phase, Capacitor type, Shaded pole, AC series motor and Universal Motor.

TEXT BOOKS:

1. J. Nagrath and D. P. Kothari, "Electric Machines", Mc-Graw Hill Education, 5th Edition, 2017.
2. Theraja. B.L, Theraja. A.K, "A text book on Electrical Technology", Volume–II, S. Chand Company and Ltd, 2014.

REFERENCES:

1. A.E.Fitzgerald, Charles Kingsley, Jr, Stephen D Umans, "Electric Machinery'", Tata McGraw Hill Education, 5th Edition, 2017.
2. Chapman, Stephen J, "Electric machinery fundamentals", Tata McGraw Hill Education, 5th Edition, 2012.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
4. P. S. Bimbhra, "Electric Machines", Khanna Publishers, 2nd Edition, 2017.
5. P.C.Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.
6. Mehta. V.K and Rohit Mehta, "Principle of Electrical Machines", S. Chand Publishers, 2014.
7. Sudipta Chakraborty, Marcelo G. Simes, and William E. Kramer, "Power Electronics for Renewable and Distributed Energy Systems: A Sourcebook of Topologies, Control and Integration", Springer Science & Business, 2013.
8. Rashid.M.H "Power electronics Hand book", Academic press, 2001.
9. Gopal K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, 2nd Edition, 2001.
10. Gray, L. Johnson, "Wind Energy System", Prentice Hall INC, 1995.
11. Haitham Abu-Rub, Mariusz Malinowski, Kamal Al-Haddad. Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications, 2014, A co-publication of IEEE Press and John Wiley & Sons Ltd.

L: 45; P:30; TOTAL: 75 PERIODS

Course Code	LINEAR INTEGRATED CIRCUITS	L	T	P	E	C
23EE44C		3	1	2	0	5

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: Explain the monolithic IC fabrication process
CO2: Apply the characteristics of operational amplifier
CO3: Adapt operational amplifier for various applications
CO4: Summarize the applications of op-amp in analog/digital conversions
CO5: Implement the functions of special ICs and Timer

Practical Component

CO6: Realize the characteristics and applications of an op-amp
CO7: Construct the various application circuits of an op-amp
CO8: Build the the applications of op-amp in analog/digital conversions
CO9: Demonstrate the working of special ICs and Timer

CO1: Explain the monolithic IC fabrication process **L:9**

Advantages of IC over discrete components - Classification, manufacturing process of monolithic IC- Wafer preparation, epitaxial growth, masking and etching - Study of monolithic IC Fabrication Process and types- Fabrication of diodes, Monolithic Resistors and capacitor – Complementary MOSFET – Recent trends in IC packaging - Chip testing (qualitative treatment only)

CO2: Apply the characteristics of operational amplifier
CO6: Realize the characteristics and applications of an op-amp **L:9, T:4, P:8**

Operational amplifier stages - Current mirror and current sources - Current sources as active loads - Ideal op-amp characteristics, DC characteristics, AC characteristics – Experimental verification of op-amp characteristics - Measurement of input impedance and loading effect - Inverting and non-inverting amplifiers, voltage follower, Adder, Subtractor with experimental verification.

CO3: : **Adapt operational amplifier for various applications**
CO7: Construct the various application circuits of an op-amp **L:9, T:4, P:8**

Integrator and differentiator with experimental verification - Sign Changer, scale shanger - V-to-I and I-to-V converters - Differential amplifier, instrumentation amplifier, comparators with experimental verification - Schmitt trigger and triangular wave generator – Astable, monostable, and bistable multivibrator - Precision rectifier.

CO4: Summarize the applications of op-amp in analog/digital conversions
CO8: Build the the applications of op-amp in analog, digital conversions. **L:9, T:4, P:8**

Active filters, oscillators (Wein bridge and phase shift) with experimental verification - Peak detector, S/H circuit - Analog and Digital Conversions with experimental verification - D/A converter, specifications, weighted resistor type, R-2R Ladder types - A/D Converters, specifications, Flash type, counter type, servo tracking type, successive approximation type, dual slope type

CO5: Implement the functions of special ICs and Timer
CO9: Demonstrate the working of special ICs and Timer **L:9, T:3, P:6**

Timer IC 555 - Description and functional diagram - Monostable, astable and bistable operation with experimental verification – Schmitt trigger - Monolithic PLL IC 565 - Voltage controlled oscillator IC566 – Audio power amplifier (LM380) circuit with experimental verification – Opto coupler circuits.

TEXT BOOKS:

1. Sergio Franco, “Design with operational amplifiers and analog integrated circuits”, 3rd Edition, McGraw Hill Education, 2017.
2. D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Private Limited, 4th Edition, 2017.

REFERENCES:

1. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis and Robert G. Meyer, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons Inc, 5th Edition, 2009.
2. S.Salivahanan & V.S.Kanchana Bhaskaran, “Linear Integrated Circuits”, McGraw Hill Education, 2nd Edition, 2017.

3. Ramakant A. Gayakwad, "Op-amps and Linear Integrated Circuits", Pearson Publication, 4th Edition, 2016.
4. K.R. Botkar, "Integrated Circuits", Khanna Publishers, 5th Edition, 2010.

L: 45; T:15; P: 30; TOTAL: 90 PERIODS

Course Code	OBJECT ORIENTED PROGRAMMING	L	T	P	E	C
23EE45C		2	0	2	2	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: apply the object oriented programming constructs to solve known applications
CO2: design and implement effective access specifications with function overloading for application development
CO3: adopt critical thinking to implement inheritance, dynamic binding and generic nature for code reusability
CO4: develop and solve real-world applications by handling files, streams, and exceptions
CO5: build well-defined, efficient data handling strategies using templates and STL

Practical Component

CO6: demonstrate the basic OO principles such as, class, objects, and overloading
CO7: analyze and solve problems using inheritance, polymorphism and files

Experiential Component

CO8: create contemporary solutions for solving real-world OOP applications

CO1: apply the object oriented programming constructs to solve known applications

Object-Oriented Programming Concepts: Introduction, Comparison between procedural programming paradigm and object-oriented programming paradigm, Features of object-oriented programming: Encapsulation, Class, Object, Abstraction, Data hiding, polymorphism, and Inheritance. Functions and Arrays: Function components, Default arguments, passing parameters, Function prototyping, Call by value, Call by reference, Return by reference, Inline functions, Friend functions. Array of objects. Pointer: Pointer and Function pointer. Memory management : New and Delete, pointers to objects **6+4+3**

CO6: demonstrate the basic OO principles such as class, objects, and overloading

programs using data types, control structures, arrays, string, functions and pointers

CO2: design and implement effective access specifications with function overloading for application development **5+6+6**

Classes and Objects: Implementation of a class, Creating class objects, Operations on objects, Relationship among objects, Accessing class members, Access specifiers, Constructor and destructor, Types of constructor, Static members, Empty classes, Nested classes, Local classes, Abstract classes, Container classes. Function Overloading,

Overloading Constructors, Copy Constructors, Finding the Address of Overloaded Functions, Default Function Arguments, Function Overloading and Ambiguity. Operator overloading: Creating a member Operator Function, Operator Overloading Using Friend Function, Overloading New and Delete, Overloading Special Operators

CO6: demonstrate the basic OO principles such as class, objects, and overloading
programs using class, objects, constructors, destructors and overloading

CO3: adopt critical thinking to implement inheritance, dynamic binding and generic nature for code reusability **8+6+6**

Inheritance: Concept of inheritance. Derived class and based class. Derived class constructors, member function, inheritance in the class, class hierarchies, public and private inheritance, aggregation: Classes within classes, inheritance and program development. Polymorphism: Virtual Functions – Virtual Attribute and Inheritance – Virtual Functions and Hierarchy – Pure Virtual Functions – Using Virtual Functions – Early vs. Late Binding. Run-Time Type ID and Casting Operators: RTTI – Casting Operators – Dynamic Cast.

CO7: analyze and solve problems using inheritance, polymorphism and files.
programs using inheritance and polymorphism.

CO4: develop and solve real-world applications by handling files, streams, and exceptions **5+8+8**

Streams and Files: Streams classes, Stream Errors, Disk File I/O with streams, file pointers, error handling in file I/O with member function, command line arguments. Exception handling: Try, throw, and catch, exceptions and derived classes, function exception declaration, unexpected exceptions, exception when handling exceptions, resource capture and release. Case study with real time applications.

CO7: analyze and solve problems using inheritance, polymorphism and files
programs using files and exception handling

CO5: build well-defined, efficient data handling strategies using templates and STL **6+6+7**

Templates: Parameterized types – Parameterized operations – template mechanisms - Generic programming - variadic templates – template compilation model – Applying Generic Functions – Generic Classes – Type name and Export Keywords – Power of Templates. Standard Template Library: Iterators – Auxiliary Iterator function – Algorithms – Non-modifying sequence operations – mutuating sequence operations – Containers: Sequence and associative containers - Algorithms, string class – explicit, mutable and operator keywords. Namespaces: user defined namespaces, namespaces provided by library.

CO8: create contemporary solutions for solving real-world OOP applications

TEXT BOOKS

1. Bjarne Stroustrup, “A Tour of C++”, 3rd Edition, Pearson Education, April 2023.
2. Ivor Horton, Peter van, “Beginning C++ 20 from novice to professional”, 6th Edition, APRESS media, 2020.

3. Bjorin Andrist, Viktor Sehr, "C++ High Performance: Master the art of optimizing the functioning of your C++ code", 2nd Edition, December 2020.
4. Nicoloai.M Josuttis and Doug Gregor, "C++Templates: Tem complete guide", 1st Edition, 2020.

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REFERENCES

1. Reema Thareja, "Object oriented programming with C++", Revised First Edition, Oxford University Press, 2018.
2. E.Balagurusamy, "Object oriented programming with C++", 8th Edition, September 2020.

RECOMMENDED ONLINE COURSES

1. https://onlinecourses.nptel.ac.in/noc23_cs78/preview
2. https://www.udemy.com/course/oops-and-c-from-basic-to-advanced/?utm_source=adwords&utm_medium=udemyads&utm_campaign=WebDevelopment_v.PROF_la.EN_cc.INDIA_ti.8322_Exp&utm_content=deal4584&utm_term=_._ag_82381207618_._ad_533094292056_._kw__._de_c_._dm__._pl__._ti_dsa-774930032289_._li_9148661_._pd__._&matchtype=&gclid=CjwKCAjws7WkBhBFEiwAIi1686CgFnpeYYHiDNs6T6z6Kx84B35ehfI24i021yFk1aB15zGyVz8_bxoC8QEQAvD_BwE
3. https://www.udemy.com/course/crash-course-on-cpp-stl/
4. https://www.coursera.org/lecture/c-plus-plus-b/1-3-standard-template-library-o3v9K
5. https://www.coursera.org/learn/object-oriented-cpp

L: 30; P: 30; E: 30; TOTAL: 90 PERIODS

Course Code	SYSTEM MODELLING PROJECTS	L	T	P	E	C
23EE46C		0	0	2	2	2

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Practical Component:

CO1: select an electronic project that leads to real world application or requirement of group of customers.

CO2: design the electronic project and system that meet specified performance criteria.

CO3: implement and simulate electronic system using the simulation tools to evaluate performance and functionality.

Experiential Component:

CO4: Develop an electronic project prototype by deep understanding and modeling specific to analog, digital, and mixed-signal systems.

Soft Skill Component

CO5: Work effectively in multidisciplinary teams, demonstrating strong collaboration and communication skills.

CO1: select an electronic project that leads to real world application or requirement of group of customer **E:8**

An electronic project that meets real-world applications and the requirements of a group of

customers. A group of project team members is to select a project using brainstorming session and design thinking process. The project should address the requirement of any group of customers leads to application

- **Task 01: Identify/ Select the project proposed during design thinking process or identify new problem and prepare a one page project proposal**
- **Task 02: Proposal Presentation and review – I**

A written proposal including background information and objectives to be submit. It will be evaluated on content, completeness, and clarity.

CO2: design the electronic project and system that meet specified performance criteria.

System design includes the conceptual design, component selection, software/hardware and requirement of any other resources, feasibility study and time requirements.

- **Task 03: System design should meet the specified user criteria which includes components selection and design.** **P:16**
- **Task 04: Proposal presentation should include selection and design of components as per the requirement and also include feasibility study and time mapping**

CO3: implement and simulate electronic system using the simulation tools to evaluate performance and functionality.

Define the specifications and create a schematic of the electronic system using a CAD tool. Use simulation software to create a model of the system. Run simulations to evaluate the performance and functionality of the system. Analyze the simulation results and optimize the design as needed. **P:14**

- **Task 05: To implement a final project schematic with design and to show expected findings through simulation.**
- **Task 06 : Proposal Presentation and review – II**

CO4: Develop an electronic project prototype by deep understanding and modeling specific to analog, digital, and mixed-signal systems.

Creating an electronic project prototype involves several steps, from understanding the problem to modeling and eventually building the prototype **E:22**

- **Task 07:Prototype implementation and demonstration**
- **Task 08: Review – III (Complete Outcomes)**
- **Task 09**: **Project Document Submission**

P: 30; E: 30; TOTAL: 60 PERIODS

Course Code	LINEAR ALGEBRA, MATHEMATICAL LOGIC AND SET THEORY	L	T	P	E	C
23SH01E		2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: analyze concepts of vector spaces. (CDL 1)

CO2: measure the similarity between different datasets using Inner product spaces. (CDL 1)

CO3: decompose the matrix for computational convenience. (CDL 1)

CO4: illustrate the validity of the arguments. (CDL 1)

CO5**:** analyze the concepts of Sets, Relations and Functions. (CDL 1)

CO1: analyze concepts of vector spaces

Vector spaces – Subspaces – Linear combinations – linear span - Linear independence and linear dependence – Bases and dimensions. **L:6 T:3**

CO2: measure the similarity between different datasets using Inner product spaces

Linear transformation - Null spaces and ranges – Rank Nullity theorem - Matrix representation of a linear transformations - Inner product space - Norms - Orthonormal Vectors - Gram Schmidt orthogonalisation process**.** **L:6 T:3**

CO3: decompose the matrix for computational convenience

Generalized eigenvector - QR decomposition- generalized inverse - Singular value decomposition and applications – Pseudo Inverse . **L:6 T:3**

CO4: illustrate the validity of the arguments.

Propositional Logic – Equivalences and Implications – Normal forms – Predicate Calculus and Quantifiers - Rules of inference – Proof methods and Strategies - Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency. **L:6 T:3**

CO5: analyze the concepts of Sets, Relations and Functions

Basic Definitions - Set operations – Laws of set theory – Relations – Properties of relations - Partial Ordering Relation - Equivalence Relation - Matrices of relations - Closure of relations – Functions – Bijective functions - Inverse and Compositions of functions. **L:6 T:3**

TEXT BOOKS

1. Kenneth H.Rosen, Discrete Mathematics and its Applications (with Combinatory and Graph Theory), Special Indian Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 8th Edition, 2021.
2. Bernard Kolman and David Hill, "Elementary Linear Algebra with Application" Pearson India, 9th Edition, 2019.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2017.

REFERENCE BOOKS

1. Trembly J.P and Manohar.R. Discrete Mathematical Structures with Applications to Computer Science, 1st Edition, Tata McGraw-Hill Pub. Company Limited, New Delhi, 2017.
2. Friedberg, A.H., I nsel,A.J.and Spence, L., Elementary Linear Algebra, a matrix approach, 2nd Edition pearson Publication.
3. Raju.K.George and Abhijith Ajayakumar, A course in Linear Algebra, Springer, 2024.
4. Seymour Lipschutz Marc Lipson., "Linear Algebra" Schaum's Out lines series, 6th Edition, McGraw – Hill Education, 2018.

L : 30; T :15; TOTAL : 45 PERIODS

Course Code	LINEAR STRUCTURES AND	L	T	P	E	C
23SH02E	TRANSFORMATIONS	2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: solve the linear system of equations. (CDL 1)

CO2: determine the dimension of vector spaces. (CDL 1)

CO3: find the orthonormal vectors using Inner product spaces. (CDL 1)

CO4: illustrate Jordan canonical form on a finite dimensional vector space. (CDL 1)

CO5:decompose the matrix using Generalized Eigen vectors for computation.(CDL 1)

CO 1: solve the linear system of equations **L:6 T:3**

General system of linear equations – Matrices– Echelon form of matrix- Solving linear systems- Consistency of a system of linear equations -LU factorization.

CO2: determine the dimension of vector spaces **L:6 T:3**

Vector spaces – Subspaces – Linear combinations – linear span - Linear independence and linear dependence – Bases and dimensions.

CO3: find the orthonormal vectors using Inner product spaces **L:6 T:3**

Linear transformation - Null spaces and ranges – Rank Nullity Theorem - Matrix representation of a lineartransformations - Inner product space - Norms - Orthonormal Vectors - Gram Schmidt orthogonalisation process.

CO4: illustrate Jordan canonical form on a finite dimensional vector space **L:6 T:3**

Generalized eigenvector- Chains- Canonical basis the minimum polynomial- - Algebraic and Geometric multiplicity of Eigen Values - Similar matrices-Modal matrix-Jordan canonical form.

CO5: decompose the matrix using Generalized Eigen vectors for computation **L:6 T:3**

Eigen-values using QR transformations – Generalized Inverse Eigen vectors – Canonical forms – Singular value decomposition and applications – Pseudo inverse

TEXT BOOKS

1. Bernard Kolman and David Hill, "Elementary Linear Algebra with Application" Pearson India, 9th Edition 2019.
2. Seymour Lipschutz Marc Lipson., "Linear Algebra" Schaum's Out lines series, Six edition, McGraw – Hill Education, 2018.

REFERENCE BOOKS

1. Friedberg, A.H., I nsel,A.J.and Spence, L., Elementary Linear Algebra, A Matrix Approach, 2nd Edition, Pearson 2019.
2. Jim Defranza. Daniel Gagiardi "Introduction to Linear Algebra with Applications" Waveland Pr Lnk, 2015.
3. Eggar.Goodaire "Linear Algebra Pure & Applied", World Sceintific, New Delhi, first edition, 2015.
4. Raju.K.George and Abhijith Ajayakumar, A course in Linear Algebra, Springer, 2024.

54.

L : 30; T :15; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH03E	**NUMBER THEORY**	**2**	**1**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: acquire the concepts of theory of numbers. (CDL 1)

CO2: apply the fundamental propositions to interpret solutions of congruence. (CDL 1)

CO3: find the primitive roots for the congruence. (CDL 1)

CO4: analyze the inter-relation between arithmetical functions. (CDL 1)

CO5: determine quadratic residues of congruence. (CDL 1)

CO1 : acquire the concepts of theory of numbers

Introduction – Divisibility- Greatest common divisor - Prime numbers - The fundamental theorem of arithmetic - The series of reciprocals of the primes - The Euclidean algorithm(without Proof) - The greatest common divisor of more than two numbers. **L:6 T:3**

CO2 : apply the fundamental propositions to interpret solutions of congruence

Congruence - Linear congruence - Euler-Fermat theorem - Polynomial congruence modulo p – Wilson's Theorem **L:6 T:3**

CO3: analyze the inter-relation between arithmetical functions.

The Mobius function μ(n) – The Euler Totient function φ(n)– A relation connecting φ and μ – A product formula for φ(n) – properties of φ(n) –Multiplicative functions– completely multiplicative function. **L:6 T:3**

CO4: determine quadratic residues of congruence

Quadratic Residues – Legendre's symbol and its properties – Evaluation of (-1|p) and (2|p) – Gauss lemma – The Quadratic Reciprocity law – Applications – The Jacobi symbol. **L:6 T:3**

CO5: implement the concepts of congruence in cryptography

Chinese remainder theorem - Applications of Chinese remainder theorem - Cryptography and its application – RSA algorithm and Rabin Cryptosystem. **L:6 T:3**

TEXT BOOKS

1. Tom M.Apostol, "Introduction to Analytic Number Theory", Springer International Edition, Narosa Publishing House, New Delhi, 2013.
2. G.A.Jones & J.M.Jones, "Elementary Number Theory", Springer publications, 2012.

REFERENCE BOOKS

1. David M.Burton, "Elementary Number Theory", McGraw Hill, 7th Edition,2023
2. Joseph H.Silverman, "A Friendly Introduction to Number Theory", Pearson Education, 4th Edition, 2019.
3. Titu Andreesu, Gabriel Dospinescu, Oleg MushKarov, Number Theory: concepts and problems, Springer Science & Business Media, 2017.
4. S B Malik , "Basic Number Theory", S Chand publications, 2nd Edition, 2018

L : 30; T :15; TOTAL : 45 PERIODS

Course Code	NUMERICAL ANALYSIS	L	T	P	E	C
23SH04E		2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: solve algebraic and transcendental equations using numerical methods. (CDL 1)

CO2: interpolate and approximate the polynomial of data. (CDL 1)

CO3: perform numerical differentiation and integration. (CDL 1)

CO4: find numerical solution of ordinary differential equation. (CDL 1)

CO5: classify and find numerical solution of partial differential equations. (CDL 1)

CO 1: solve algebraic and transcendental equations using numerical methods

Solutions of Algebraic linear equations Newton - Raphson Method, Fixed Point Iteration method - Solutions of algebraic simultaneous linear equations - Gauss Elimination –Gauss Seidel Methods. **L:6 T:3**

CO 2: interpolate and approximate the polynomial of data

Curve Fitting – Method of Least Squares – Fitting a Straight Line – Fitting a Second Degree Parabola - Finite differences - Newton's Forward & Backward Difference Formulae - Central Differences - Stirling's Formula - Lagrange's Formula. **L:6 T:3**

CO 3: perform numerical differentiation and integration

Derivatives using forward and backward difference Formulae - Trapezoidal rule - Simpson's rules - Double integration using Trapezoidal and Simpson's rules. **L:6 T:3**

CO 4: find numerical solution of ordinary differential equation

Taylor's Series Method - Euler's Method – Runge Kutta fourth order Method – Predictor - corrector Methods - Milne's Method - Finite difference for solving ordinary differential equation. **L:6 T:3**

CO 5: classify and find numerical solution of partial differential equations

Classification of Partial Differential Equations of second order - Finite difference solution of one dimensional heat equation by explicit and implicit methods (Crank Nichelson and Bender Schmidth methods) - One dimensional wave equation and two dimensional Laplace and Poisson equations. **L:6 T:3**

TEXT BOOKS

1. Grewal, B.S., "Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB", 11th Edition, Khanna Publishers, New Delhi, 2014.
2. M.K.Jain, S.R.K.Iyengar, R.K.Jain "Numerical Methods for scientific and Engineering Computation", 6th Edition, New age International Publishers, 2019.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, J. Wiley and Sons, 2023.

REFERENCE BOOKS

1. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 8th Edition, Tata McGrawHill, New Delhi, 2021.
2. Saumyen Guha, Rajesh Srivastava "Numerical Methods: For Engineering and Science", Oxford University Press, New Delhi, 1st Edition with third impression, 2015.
3. K.Sankara Rao , "Numerical Methods For Scientists And Engineers", 5th Edition, New age International Publisher, 2018
4. Dr Chaitanya Kumar, Dr Harinderjit Kaur Chawla, Dr Indarpal Singh "A Textbook on Numerical Methods and Analysis" Sultan Chand and SonsPublisher, 2024

L : 30; T :15; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH05E	**OPTIMIZATION TECHNIQUES**	**2**	**1**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: find optimum solution of linear programming problem. (CDL 1)

CO2: determine the optimum schedule for assignment and transportation problems. (CDL 1)

CO3: acquire decision making in Pure and Mixed Strategies. (CDL 1)

CO4: analyze the network for optimal schedule. (CDL 1)

CO5: compute optimum solution of non-linear programming. (CDL 1)

CO1: find optimum solution of linear programming problem

Linear Programming Problem – Mathematical Formulation of Linear Programming Problems (LPP) – Graphical Solution Method - Canonical and Standard Forms of LPP - Simplex Method - Linear Programming using Artificial Variables - Two Phase Method. **L:6 T:3**

CO2:acquire decision making in Pure and Mixed Strategies

Basic Terms in Game Theory - Two-Person Zero-Sum Games - Maximin-Minimax Principal - Games without Saddle Points - Mixed Strategies-Pure and Mixed Strategies with Saddle Point- Mixed Strategy Problems by Arithmetic Method- Graphic Solution of $2 \times n$ and $m \times 2$ Games. **L:6 T:3**

CO3: analyze the network for optimal schedule

Development of Network Analysis - Network Analysis and Rules of Network Construction - Critical Path Method (CPM) - Programme Evaluation and Review Technique (PERT). **L:6 T:3**

CO4: compute optimum solution of non – linear programming

Formulating a Non-Linear Programming Problem – Constrained Optimization with equality Constraints- Graphical Solution – Kuhn- Tucker Conditions with Non negative constraints- Quadratic Programming – Wolfe's modified Simplex method. **L:6 T:3**

CO5: solve non-linear constrained optimization

Optimization using Gradient Descent – Constrained optimization - Lagrange Multipliers - Convex optimization - Non linear Constrained Optimization. **L:6 T:3**

TEXT BOOKS

1. KantiSwarup, Gupta P.K and Man Mohan, Operations Research: Introduction to management Science, Sultan Chand &Sons, 20th Revised Edition, 2022.
2. Hamdy A Taha, Operations Research - An Introduction, 10th Edition, Pearson Education, 2019.

REFERENCE BOOKS

1. Sharma JK., Operations Research, Trinity, New Delhi, 6th Edition, 2017.
2. Sundaresan.V, Ganapathy Subramanian. K.S. and Ganesan.K, Resource Management Techniques, A.R. Publications, 11th Edition, 2017.
3. Gupta P K, Mohan Man, Problems in Operations Research, Sultan Chand & Sons, 2014
4. V K Kapoor, Operations Research , Concept problems & solutions, Sultan Chand & Sons, 2017

L : 30; T :15; TOTAL : 45 PERIODS

Course Code	PRINCIPLES OF DISCRETE MATHEMATICS	L	T	P	E	C
23SH06E		2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: illustrate the validity of the arguments. (CDL 1)
CO2: analyze the concepts of Sets, Relations and Functions. (CDL 1)
CO3: perform the principles of counting and solve recurrence relations. (CDL 1)
CO4: interpret the basic concepts of graphs. (CDL 1)
CO5: compute minimum Spanning Trees and shortest route for the graph. (CDL 1)

CO1: illustrate the validity of the arguments.

Propositional Logic – Equivalences and Implications – Normal forms – Rules of inference – Proof methods and Strategies - Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency. **L:6 T:3**

CO2: analyze the concepts of Sets, Relations and Functions

Basic Definitions - Set operations – Laws of set theory – Relations – Properties of relations - Equivalence Relation - Matrices of relations - Closure of relations – Functions – Bijective functions - Inverse and Compositions of functions. **L:6 T:3**

CO3: perform the principles of counting and solve recurrence relations.

Mathematical induction - Strong induction and well ordering -The basics of counting – The pigeonhole principle - Recurrence relations – Solving linear recurrence relations – Generating functions - Inclusion and exclusion principle. **L:6 T:3**

CO4:interpret the basic concepts of graphs

Graphs and their properties - Special types of graphs – Matrix representation of graphs and graph isomorphism- Euler and Hamiltonian graphs. **L:6 T:3**

CO5: compute minimum Spanning Trees and shortest route for the graph

Trees – Some properties of Trees – Pendant vertices in a Tree – Distance and centers in a Tree – Rooted and Binary Trees - Spanning Trees- minimum spanning tree–Prim's algorithm. **L:6 T:3**

TEXT BOOKS

1. Kenneth H.Rosen, Discrete Mathematics and its Applications (with Combinatory and Graph Theory), Special Indian Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 8th Edition, 2021.
2. Trembly J.P and Manohar.R. Discrete Mathematical Structures with Applications to Computer Science, first Edition, Tata McGraw-Hill Pub. Company Limited, New Delhi, 2020.
3. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, 1st Edition, Dover Publications Inc., 2016.

REFERENCE BOOKS

1. Ralph .P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, 5th Edition, Pearson Education Asia, Delhi, 2019.
2. Bondy, J.A., Murty.U.S.R., Graph Theory with applications, North Holland publication, 2008.
3. K.Balakrishnan, Schaum's Outline of Graph Theory, Tata Mc Graw-Hill Pub, 2020.
4. Richard J.J, Introduction to Graph Theory, 1st Edition, Parker Pub. Company, 2017.

67. **L : 30; T :15; TOTAL : 45 PERIODS**

Course Code	RANDOM PROCESSES AND QUEUEING THEORY	L	T	P	E	C
23SH07E		2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: interpret the basic characteristic features of Random processes. (CDL 1)

CO2: encapsulate the time averages of uncertain events. (CDL 1)

CO3: evaluate spectral densities of functions. (CDL 1)

CO4: analyze the characteristics of Markovian queues. (CDL 1)

CO5**:**apply the concepts of queuing theory in networks.(CDL 1)

CO1: interpret the basic characteristic features of Random processes **L:6 T:3**

Classification - Stationary process - Markov process - Markov chains - Transition probabilities.

CO2 : encapsulate the time averages of uncertain events **L:6 T:3**

Counting Process - Ergodic process - Poisson Process - Renewal Processes - Gaussian process.

CO3 :evaluate spectral densities of functions **L:6 T:3**

Auto correlation - Cross correlation – Power spectral density–Cross spectral density-Properties–Wiener – Khintchine theorem (without proof).

CO4 : analyze the characteristics of Markovian queues

Markovian models – Birth and Death Queuing models- Steady state results: Single and multiple server queuing models- queues with finite waiting rooms- Finite source models- Little's Formula. **L:6 T:3**

CO5: apply the concepts of queuing theory in networks **L:6 T:3**

M/G/1 queue- Pollaczek- Khintchine formula, series queues- open and closed networks.

TEXT BOOKS

1. Oliver C. Ibe, "Fundamentals of Applied Probability and Random processes", Academic Press, 2nd Edition, 2014.
2. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes, Tata McGraw-Hill Education, 3rdEdition, 2017.
3. John F Shortle, James M Thompson, Donald Gross and Carl M Harris, "Fundamentals of Queueing Theory", Wiley and Sons Publication Limited, 5thEdition, 2018.

REFERENCE BOOKS

1. Miller.S.L and Childers, S.L, Probability and Random Processes with applications to Signal Processing and Communications, Elsevier Inc., 2nd Edition, 2012.
2. Peyton. Z. Peebles Jr., Probability Random Variables and Random Signal Principles, 4th Edition, Tata McGraw-Hill Publishers, New Delhi, 2017.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10thEdition, Wiley India, 2017.

L : 30; T :15; TOTAL : 45 PERIODS

Course Code	STATISTICAL TECHNIQUES AND NUMERICAL	L	T	P	E	C
23SH08E	METHODS	2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: calculate the various measures of dispersion. (CDL 1)

CO2: apply the principles of hypothesis testing in small and large samples. (CDL 1)

CO3: analyze the variances in design of experiments. (CDL 1)

CO4: find solution of linear equations and to perform differentiation and integration numerically. (CDL 1)

CO5: compute numerical solution of differential equations. (CDL 1)

CO1: calculate the various measures of dispersion

Central tendencies - Mean, median, mode - Measures of Dispersion –Mean deviation, and Quartile deviation–Moments– Skewness –Kurtosis - Correlation and Regression. **L:6 T:3**

CO2: apply the principles of hypothesis testing in small and large samples

Sampling distributions - Statistical hypothesis - Large sample testsbased on Normal distribution for single mean and difference of means -Tests based on t, and F distributions - Chi-square -Contingency table for independent of attributes – Goodness of fit. **L:6 T:3**

CO3: analyze the variances in design of experiments

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design – 2^2 factorial design. **L:6 T:3**

CO4: find solution of linear equations and to perform differentiation and integration numerically

Solution of algebraic and transcendental linear equations - Newton - Raphson Method- Solution of simultaneous equations – Gauss Elimination method – Gauss Seidel method – Interpolation – Lagrange's Method - Numerical Differentiation – Newton's forward difference and backward difference formula – Numerical integration - Single integration using Trapezoidal and Simpson's 1/3 rd and 3/8 th rules. **L:6 T:3**

CO5: compute numerical solution of differential equations

Taylor's Series Method – Euler's Method – Runge Kutta fourth order Method – Predictor - corrector Methods – Milne's Method - Solution of one dimensional heat equation by explicit and implicit methods(Crank Nichelson and Bender Schmidth methods) - Two dimensional Laplace and Poisson equations. **L:6 T:3**

TEXT BOOKS

1. Richard A. Johnson, "Miller and Freund's Probability and Statistics for Engineers", 9th Edition, Pearson Education Private Ltd., 2018.
2. Grewal, B.S., "Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB", 11th Edition, Khanna Publishers, New Delhi, 2014.

REFERENCE BOOKS

1. Dharmaraja Selvamuthu, Dipayan Das, Introduction to Statistical Methods, Design of Experiments and Statistical Quality Control, Springer Verleg Singapore Pvt. Ltd., 2018.
2. S.C. Gupta and V.K. Kapoor, "Fundamentals of Mathematical Statistics, 12th Edition, Sultan Chand & Sons, Delhi, 2014.
3. M.K.Jain.S.R.K.Iyengar,R.K.Jain "Numerical Methods for scientific and Engineering Computation", 6th Edition, New age International Publishers, 2019.
4. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 8th Edition, Tata McGraw - Hill, New Delhi, 2021.

L : 30; T :15; TOTAL : 45 PERIODS

Course Code	TRANSFORMS, MATHEMATICAL LOGIC AND SET	L	T	P	E	C
23SH09E	THEORY	2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

Theory Components:

CO1: apply Laplace transform to solve ordinary differential equations. (CDL 1)
CO2: compute the Fourier transforms of various functions. (CDL 1)
CO3: solve difference equations using Z-Transform. (CDL 1)
CO4: illustrate the validity of the arguments. (CDL 1)
CO5**:** analyze the concepts of Sets, Relations and Functions. (CDL 1)

CO 1 : apply Laplace transform to solve ordinary differential equations

Definition of Laplace transform and its inverse – Transforms of elementary functions – Properties – Transforms of periodic functions – Initial and final value theorems – Convolution theorem.- solutions of linear ordinary differential equations with constant coefficients. **L:6 T:3**

CO2 : compute the Fourier transforms of various functions

Fourier Integral theorem (without proof)–Fourier transform pair–Fourier Sine and Cosine transforms–Properties–Transforms of simple functions–Convolution theorem –Parseval's theorem. **L:6 T:3**

CO3 : solve difference equations using Z-Transform

Z– transform –Elementary properties – Inverse Z–transform – Convolution theorem- Initial and final value theorem – Formation of difference equations –Solutions of difference equations using Z–transform. **L:6 T:3**

CO4: illustrate the validity of the arguments.

Propositional Logic – Equivalences and Implications – Normal forms – Rules of inference – Proof methods and Strategies - Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency. **L:6 T:3**

CO5: analyze the concepts of Sets, Relations and Functions

Basic Definitions - Set operations – Laws of set theory – Relations – Properties of relations - Equivalence Relation - Matrices of relations - Closure of relations – Functions – Bijective functions - Inverse and Compositions of functions **L:6 T:3**

TEXT BOOKS

1. Grewal.B.S. "Higher Engineering Mathematics", 44th Edition, Khanna Publications, Delhi, 2021.
2. Kenneth H.Rosen, Discrete Mathematics and its Applications, Tata McGraw-Hill Publishing Company Limited, New Delhi, 8th Edition, 2021.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10thEdition, Wiley India, 2017.

REFERENCE BOOKS

1. Ramana B.V, "Higher Engineering Mathematics", Tata Mc-Graw Hill Education, New Delhi, 2017.
2. Trembly J.P and Manohar.R. Discrete Mathematical Structures with Applications to Computer Science, 1st Edition, Tata McGraw-Hill Pub. Company Limited, New Delhi, 2017.
3. J K Goyal, K.P.Gupta, Laplace and Fourier Transforms, Pragati Prakashan, 2016

L : 30; T :15; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH10E	**FUNDAMENTALS OF LASER TECHNOLOGY**	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successfully completing the course , the students will be able to:

CO1: explain the fundamentals of lasers (CDL1)

CO2: demonstrate the laser surface modification process (CDL1)

CO3: describe the laser machining processes (CDL1)

CO4: identify the laser measurement and testing process (CDL1)

CO5: organizethe advanced applications and safety measures of laser (CDL1)

CO1: explain the fundamentals of lasers

Characteristics of laser -laser principle- population inversion-line broadening mechanisms-Q switching - threshold condition for laser-three-level and four-level systems-conditions for continuous wave (CW) and pulsed laser action- pumping schemes-classification of lasers: Er:YAG - carbon dioxide lasers - argon laser - X-Ray lasers - fiber lasers - Raman lasers. **L:9**

CO2: demonstrate the laser surface modification process

Laser surface heat treatment: process parameters - advantages and disadvantages of laser surface treatment; laser surface melting - laser direct metal deposition: processing parameters - methods for applying the coating material- laser alloying and cladding - advantages and disadvantages -laser physical vapor deposition - laser shock peening: analysis - advantages and disadvantages **L:9**

CO3: describe the laser machining processes

Laser welding parameters: beam power, spot diameter and traverse speed; welding efficiency; mechanism of laser welding: conduction mode welding, keyhole welding; laser cutting – process characteristics-fusion cutting, sublimation cutting, photochemical ablation;laser drilling –single pulse drilling-percussion drilling, trepanning applications - laser marking - dot matrix marking, engraving, image micro machining -lasers for marking - application **L:9**

CO4: identify the laser measurement and testing process

Laser for measurement - distance -length-velocity-acceleration-current-voltage-atmospheric effect-laser application in spatial frequency filtering. **L:9**

Holography: basic principle - methods - Holographic interferometry and applications-holography for non – destructive testing – holographic components

CO5: organizethe advanced applications and safety measures of laser

Laser advanced application in defence-laser weapons- industry for material handling: ASRS and AGV- medicine -laser activated therapy - photodynamic therapy, laser angioplasty, lasers in surgery - photocoagulation, photodisruption and photoablation - laser scanning confocal microscopy - Laser safety - danger - safety limits for eye and skin - class four safety arrangements - electric hazards- chemical hazards - fume hazards - explosion hazards - safety guidelines **L:9**

TEXTBOOKS:

1. William M. Steen, “Laser Material Processing”, Springer Verlag, 2010
2. K.Thyagarajan, AjoyK.Ghatak, “Lasers, Theory and Applications”, Springer, 2nd Edition, 2011.
3. Chunlei Guo, Subhash Chandra SinghHandbook of Laser Technology and Applications Lasers Applications: Materials Processing and Spectroscopy, 2nd Edition, (Vol.3), 2021

REFERENCES:

1. Uday Shanker Dixit, Shrikrishna N. Joshi, J. Paulo Davim, "Application of Lasers in Manufacturing" Springer Singapore, 1st Edition, 2019
2. Stephan Wieneke and Christoph Gerhard, "Lasers in Medical Diagnosis and Therapy Basics, applications and future prospects" IOP Publishing Ltd, 2018
3. AK Katiyar, CK Pandey and Manisha Bajpai, "Fundamentals of Laser Systems and Applications", Wiley, 2017.

L : 45; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH11E	**NANOMATERIALS FOR ENGINEERS**	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successfully completing the course , the students will be able to:

CO1: explain the fundamentals of nanomaterials (CDL1)

CO2: interpret the different properties of nanomaterials (CDL1)

CO3: demonstrate the synthesis of nanomaterials (CDL1)

CO4: illustrate the characterization of nanomaterials (CDL1)

CO5: organize the applications of nanomaterials(CDL1)

CO1: explain the fundamentals of nanomaterials

Introduction to nanomaterials - size effect - specific surface area - surface to volume ratio - quantum confinement effects - morphology - density - melting point - wettability - classification based on the dimension - nanoparticles - nanowires - nanoclusters - nanotubes - quantum wells - metal based nanomaterials - nanocomposites - carbon nanotubes - nanosized metals - alloys - semiconductors - ceramics **L:9**

CO2: interpret the different properties of nanomaterials

Mechanical behavior- comparison of bulk and nano materials - elastic and plastic deformation - tensile strength - superplasticity -hardness - nano hardness -influence of porosity - grain size – thermodynamics of nanoparticles- heat capacity – phase transformation of nanoparticles- electrical and optical properties: electrical conductivity in nano tubes, nano rods and nanocomposites - photoconductivity of nanorods - electroluminiscesnce in nanoparticles- magnetic properties: magnetic hysteresis - superparamagnetism **L:9**

CO3: demonstrate the synthesis of nanomaterials

Bottom-up and top-down approach - inert gas condensation - plasma arc technique - ion sputtering - ball milling - molecular beam epitaxy - chemical vapour deposition - method - electrodeposition - ultrasonication - microemulsions method - solvothermal synthesis - microwave assisted synthesis. **L:9**

CO4: illustrate the characterization of nanomaterials

X-ray diffraction - energy dispersive spectrum - atomic force microscopy - high resolution transmission electron microscopy - Raman spectroscopy - x-ray photoelectron spectroscopy - electrochemcial characterization measurements - cyclic voltammetry - linear sweep voltametry - Brunauer-Emmett-Teller - surface area analysis - nanoindentation - determination of nano hardness. **L:9**

CO5: organize the applications of nanomaterials

Functional graphene - carbon nanotube - polymer composite applications in defence and

aerospace - nanomaterials for solar cells - nanoscale catalysts for energy and automobile industries - rechargeable batteries based on nanomaterials - nanomaterials for electrodes and wearable electronics - nano based coating and paints - nanosensors -gas sensors - bio sensors - nano electro mechanical systems **L:9**

TEXTBOOKS:

1. Charles P Poole, Frank J Ownes, Introduction to Nanoscience and Nanotechnology, An Indian Adaption, Wiley, 2020
2. Hornyak, G.Louis, Tibbals, H.F., Dutta, Joydeep, Fundamentals of Nanotechnology, CRC Press, 1st Edition, 2018
3. Dieter Vollath, Nanomaterials an introduction to synthesis, properties and applications, Wiley, 2nd Edition, 2013

REFERENCES:

1. Narendra Kumar, Sunita Kumbhat, Essentials in Nanoscience and Nanotechnology, Wiley, 1st Edition, 2016
2. G. Cao,Ying Wang, Nanostructures and nanomaterials: Synthesis, properties and applications, Imperial College Press, 2nd Edition, 2011
3. B.S. Murty , P. Shankar , Baldev Raj , B B Rath , James Murday, Textbook of Nanoscience and Nanotechnology, Springer, 1st Edition, 2013

L : 45; TOTAL : 45 PERIODS

Course Code	**PHOTONICS**	**L**	**T**	**P**	**E**	**C**
23SH12E		**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successfully completing the course , the students will be able to:

CO1: explain the basics of photonics (CDL1)

CO2: demonstrate the properties of photonic crystal (CDL1)

CO3: outline the basics of bio photonics (CDL1)

CO4: interpret the quantum confinement in photonic materials(CDL1)

CO5: organize the applications of photonic materials (CDL1)

CO1:explain the basics of photonics

Wave phenomena – interference, diffraction-photon properties - energy, flux, statistics-Interaction of photons with atoms-optical amplification-three and four level system -EDFA-semiconductor light sources-detectors-light manipulation - birefringence - Faraday's rotation - interaction of light with RF and acoustic waves - Raman-Nath diffraction experiment . **L:9**

CO2: demonstrate the properties of photonic crystal

Electromagnetic theory of light-electromagnetic properties of material- polarization of light; Reflection and refraction- Fresnel equations; absorption, dispersion, and scattering of electromagnetic waves -Bragg grating; 1D photonic crystals -photonic band structure-real and reciprocal lattices; 2D and 3D photonic crystals-emerging applications of photonic crystals - 1D Bragg grating - periodic dielectric wave guide - 2D photonic crystal slab and fibre. **L:9**

CO3:outline the basics of bio photonics

Fundamentals of light and matter-basics of light-matter interactions in molecules, cells and tissues -lasers for biophotonics -bioimaging: principles and applications-transmission microscopy, Kohler illumination-optical biosensors-light activated therapy: photo thermal **L:9**

and photo dynamic therapy- tissue engineering with light- optical tweezers, scissors and traps - bio nanophotonics applications - bio chip - DNA micro-arrays - gene chip - lab on chip.

CO4:interpret the quantum confinement in photonic materials

Quantum confined materials: quantum wells, quantum wires, quantum dots, quantum rings, manifestations of quantum confinement, optical properties, quantum confined stark effect, dielectric confinement effect. **L:9**

Nanoplasmonics: optical response of metals, plasmons, optical properties of metal nanoparticles, size dependent absorption and scattering, coupled nanoparticles - metal-dielectric core-shell nanoparticles - local electromagnetic fields in metal nanoparticles.

CO5: organize the applications of photonic materials

Excitation energy transfer – device operation: nanophotonic AND gate - nanophotonic OR gate – interconnection with photonic devices - metamaterials concept; super lens, hyperbolic metamaterials and application in high-resolution imaging: hyper lens - tunable photonic metamaterials based devices - electro-optical metamaterials - phase-change metamaterials - metamaterials in solar energy harvesting - perfect absorbers and thermal emitter **L:9**

TEXTBOOKS:

1. Bahaa E. A. Saleh, Malvin Carl Teich, Fundamentals of Photonics, 3rdEdition, Wiley,2019.
2. Brian Culshaw, Introducing Photonics, Cambridge University Press, 2020.
3. Gerd Keiser, Biophotonics: Concepts to Applications, second edition, Springer Nature Singapore Pvt. Ltd 2022.

REFERENCES:

1. Joseph W. Haus, Fundamentals and Applications of Nanophotonics, Woodhead Publishing, 2016.
2. W.Cai and V. Shalaev, Optical Metamaterials: Fundamentals and Applications, 2nd Edition, Springer, 2024.
3. P PYupapin, K Srinuanjan, S Kamoldilok, Devices, Circuits and Systems: Nanophotonics, Pan Stanford Publishing, 2013.
4. Paulo Ribeiro, Maria Raposo, "Optics, Photonics and Laser Technology", Springer International publishing, 1st Edition, 2018

L : 45; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH13E	**BIOLOGY FOR COMPUTING**	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES:

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

CO1: describe the structure, interaction and applications of biomolecules
CO2: interpret the structure and functions of the gene and protein using the bioinformatics data
CO3: simulate the behavior of simple biological models using computational softwares
CO4: identify and design molecules for new drug development by computational methods

CO1: describe the structure, interaction and applications of biomolecules **L:9**

Biomolecules-I :

Introduction – monomeric units and polymeric structures of carbohydrates, proteins, nucleic acids and lipids. Enzymes: enzymatic action via Lock and key – Enzyme therapy - immune response monitoring – molecular modification – encapsulation. Agarose gel electrophoresis:

SDS, PAGE and 2D – Molecular interactions: covalent and non-covalent interactions, antigen – antibody interactions. Methods to measure the interactions: UV-visible and single crystal X-ray diffraction.

Biomolecules -II **L:9**

Chromosome structure and function – chromosome abnormalities – chromosome dynamics – nuclear architecture. DNA transcription, replication and segregation. DNA finger printing. Pedigree analysis. Identifying human disease genes (functional cloning versus positional cloning; mutation screening). Human genome project: introduction – steps – salient features. Hap map project – salient features.

CO2: interpret the structure and functions of the gene and protein using the bioinformatics data **L:9**

Bioinformatics: introduction – biological databases – types. DNA databases – EMBL, gene bank, DDBJ. Protein databases: Swiss Prot/TrEMBL, PIR. Sequence motif databases - Pfam, PROSITE, Protein structure databases, protein data Bank – SCOP, CATH, and KEGG. Sequence analysis – methods of sequencing: sangar method, maxama - gilbert method and edman degradation method, NGS methods of sequencing.Basic local alignment search tool (BLAST) – types – determining the identity of an organism from its r DNA gene nucleotide sequence. Softwares for handling the databases – ChemDiff.

CO3: simulate the behavior of simple biological models using computational softwares **L:9**

Quantum mechanics: influence of physics on theoretical chemistry. Semi empirical methods – slater determinants – Hartree – Fock equation. Semi empirical models - Ab-initio calculations: Thermodynamic functions – koopmans's theorem – isodesmic reactions, Density functional theory for larger molecules. Introduction to Gaussian and ADF : Geometry optimization, frequency calculation, location of transition state, intrinsic reaction co-ordinates, molecular orbitals and population analysis, natural bond orbital analysis, calculation of equilibrium constants and rate constants. Introduction to GROMACS: GROMACS input files, simulations of liquid water, water methanol mixtures, S-peptide and free energy of salvation. Introduction to SCILAB- Scilab programming: Curve fitting, integral transforms and introduction to molecular dynamics. Execution of programs for liquid argon.

CO4: identify and design molecules for new drug development by computational methods **L:9**

Drug design: General approach to discovery of new drugs – lead modification – calculation of the various drug likeness rules like Lipinski's rule, MDDR - like rule, Veber rule, Ghose filter, BBB rule, CMC-50 like rule and Quantitative estimate of drug-likeness (QED) using DruLiTo and Swiss ADMEsoftware. Pharmacokinetic properties of drug using Osiris and Molinspiration software. Structure-based drug designing approaches - target identification and validation - physiochemical principles of drug action – drug stereo chemistry – drug action - 3D database – computer aided drug design. Identification of the suitable target using Pharmmapper - Molecular docking programs using Autovina softwares and visualization tools - Preparation of protein and ligand using ADT and pymol-generation of paper publication-quality images and data analysis-protein-protein docking-Protein DNA docking

TEXT BOOKS

1. Shawn T. O'Neil, A Primer for Computational Biology, Oregon State Campus, Corvallis, USA, 2019.
2. Frank Jensen, Introduction to Computational Chemistry, 3rd Edition, Wiley publishing LLC. USA, 2016
3. Philly Charles, Genes, Genomes, Genetics and Chromosomes, Nottinghamshire, England, 2020.

REFERENCE BOOKS

1. Ariel Fernández Stigliano, Biomolecular Interfaces: Interactions, Functions and Drug Design, 1st Edition, Springer International Publishing AG, London, 2016.
2. S.C. Rastogi, P.Rastogi, N.Mendiratta, Bioinformatics: Methods and Applications - Genomics, Proteomics and Drug Discovery, 5th Edition, PHI Learning Pvt. Ltd., Delhi, 2022.
3. Robert A. Copeland, Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis, 3rd Edition, Wiley-Blackwell, New York, 2023.

L: 45; TOTAL: 45 PERIODS

Course Code		L	T	P	E	C
23SH14E	**BIOLOGICAL SYSTEMS FOR ENGINEERS**	3	0	0	0	3

COURSE OUTCOMES:

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

CO1: understanding of bio design principles to create novel devices and structures and cell biology

CO2: explain the structure and stability of biomolecules

CO3: describe the principle, components and applications of various instruments for medical diagnosis

CO4: interpret the major bio-energetic pathways

CO5: explain the properties characterization and application of various biomaterials

CO1: understand the basic principles of biology to create novel devices **L:9**

Cell - prokaryotic and eukaryotic cells - plant cell and animal cell - structural and function of Mitochondria - Chloroplast - Lysosomes - Golgi bodies - Nucleus. Cell cycle: mitosis and meiosis. Bioinspired devices: GPS, aircrafts, swim suits, bullet train, super hydrophobic and self-cleaning surfaces.

CO2: explain the structure and stability of biomolecules **L:9**

Introduction - monomeric units and polymeric structures of carbohydrates, proteins, nucleic acids and lipids. Molecular interactions: covalent and non-covalent interactions – methods of quantification and determination: UV – visible, CD, and SPR.

Enzymes - classification - specific activity - enzyme activity - chemical nature of enzymes. Protein and non-protein nature of enzymes. Metalloenzymes and metal activated enzymes. Industrial applications of enzymes: biosensors and bio bleaching.

CO3: describe the principle and applications of various instruments for medical diagnosis **L:9**

Basic concepts of instrumentation: static and dynamic characteristics, design criteria, instrumentation, amplifiers. Biopotential electrodes: fundamentals - body surface electrodes - microelectrodes - Principle, components and applications of microscope: light and electron microscope. Electrocardiograph, glucometer, CT, magnetic resonance imaging, ultrasonic imaging. Artificial Intelligence for disease diagnosis.

CO4: interpret the major bio-energetic pathways **L:9**

Thermodynamics in biological systems - exothermic and endothermic versus endergonic and exergonic reactions - concept of K_{eq} and its relation to standard free energy - spontaneity - ATP as an energy currency. Glucose synthesis from CO_2 + H_2O (photosynthesis) – decomposition of glucose (Glycolysis and Krebs cycle). Energy

yielding and energy consuming reactions. Concept of energy charge. Regulation of glycogenesis - measurement of blood glucose level.

CO5: explain the properties, characterization, and applications of various biomaterials. **L:9**

Biomaterials: introduction - types: alloys, polymers. Composites - properties: biocompatibility, elasticity, immune compatibility, resorbability, cytotoxicity, hemocompatibility and biodegradability. Physicochemical characterization: XRD and SEM. Applications: tissue engineering, heart valves, dental and orthopaedic implants.

TEXT BOOKS

1. Y.Nelson, L.David, Lehninger, "Principles of Biochemistry", International Edition. New York, 7th Edition, 2017.
2. Nagata, Kazuhiro, Real-Time Analysis of Biological Interactions, Springer, Japan, 3rd Edition, 2015.
3. I. Bertini, H.B Gray, Bioinorganic Chemistry, University Science Book, California, 4thEdition, 2014.

REFERENCE BOOKS:

1. P.N.Bartlett, Bioelectrochemistry: Fundamentals, Experimental Techniques and Applications, 2nd Edition, John Wiley & Sons, New Delhi, 2014.
2. Ratner and Hoffmann, Biomaterial Science: An Introduction to Materials in Medicine, 2nd Edition, Elsevier Academic Press, London, 2015.
3. Lesile Cromwell, "Bio-medical instrumentation and measurement", Prentice Hall of India, New Delhi, 2nd Edition, Reprint, 2017.

L: 45; TOTAL: 45 PERIODS

Course Code		L	T	P	E	C
23SH15E	POLYMER SCIENCE AND TECHNOLOGY	3	0	0	0	3

COURSE OUTCOMES:

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

CO1: acquire knowledge on structure - property relationship of polymers

CO2: identify the suitable polymerization techniques for the large scale synthesis of polymers

CO3: explain the basic principles of various polymer processing techniques and their applications

CO4: interpret the chemical, thermal, electrical, and mechanical properties of the polymers

CO5: familiar with plastics waste disposal, value addition, associated environmental issues and legislation

CO1: acquire knowledge on structure - property relationship of polymers **L: 9**

Basic concepts of polymerization - polydispersity - conformation and configuration of macromolecules - stereo isomerism and tacticity in polymers - geometrical isomerism. Structure - property relationship -molecular force and chemical bonding in polymers - effect of polymerization on PDI. General rules for polymer solubility - crystallinity and orientation in polymers. Polymer chain flexibility: concept - factors deciding polymer flexibility - amorphous and crystalline polymers - crystallinity in polymers - factors affecting crystallinity - properties affected by crystallinity of polymers. Glass transition temperature and crystalline melting points. Factors affecting glass transition temperature.

CO2: identify the suitable polymerization techniques for the large scale synthesis of polymers **L:9**

Basic aspects of polymer synthesis - bulk, solution and suspension polymerization (styrene and MMA) - emulsion polymerization (vinyl acetate, styrene) - preparation of phenolic and epoxy resins. Modern techniques in polymerization: metathesis polymerization - controlled polymerization methods, viz., nitroxide mediated polymerization (NMD), atom transfer radical polymerization (ATRP), group transfer polymerization (GTP), and reversible addition fragmentation termination (RAFT).

CO3: explain the basic principles of various polymer processing techniques and their applications **L:9**

Plastics technology: raw materials - additives for compounding (fillers, plasticizers and softeners, lubricants, promoters, anti-aging additives, flame retarders, colorants, blowing agents, UV stabilizers,) - requirements and functions of additives. Pre-compounding operations: mixing, drum blenders, ribbon blenders, mixing rolls, internal mixers, mixing extruders, blenders for making organosol and plastisol, granulators, pelletizers.

Advanced fabrication techniques: RTM, RIM, filament winding, BMC/SMC. Post-forming and finishing, machining, welding and design of polymers products. Selections of polymers, additives, mold design. Analysis of defects in moulded products. Processing of reinforced thermoplastics and thermosets: manual processing methods and semi-automatic processing methods. Rubber processing: internal mixer and open mill.

CO4: interpret the chemical, thermal, electrical, and mechanical properties of polymers **L:9**

Physical testing: density, mechanical behaviour, MFI, and water/solvent adsorption. Chemical testing: ignition - pyrolysis - solvent extraction - elemental analysis. Thermal analysis: vicat softening point - dynamic mechanical thermal analysis. Morphological analysis: atomic force microscopy and chemical force microscopy. Spectroscopic analysis: IR peaks assigned for rubber. Study of hydrogenation, halogention, evidence for cyclization and formation of ionomers. Analysis of carbon filled rubber - Case studies.

CO5: familiar with plastics waste disposal, value addition, associated environmental issues and legislation **L-9**

Polymer waste: sources, collection, segregation, and identification by simple techniques. Life cycle assessment, risk factor analysis. Plastics waste management techniques: chemical recycling, thermal conversion technologies, microbial, microwave, and ultrasonic. Use of plastics waste for value addition. Plastics waste management rule - environmental issues.

TEXT BOOKS

1. Premamoy Ghosh, Polymer Science and Technology: Plastics, Rubber, Blends and Composites, 3rd Edition, McGraw Hill Education, 2017.
2. Richard A Petherick, Polymer Science and Technology for Engineers and Scientists, Whittles Publishing, 2010.
3. Michael L. Berins, SPI Plastics Engineering Handbook of the Society of the Plastics Industry, Inc. 1st Edition, Springer New York, 2012
4. Vishu Shah, Handbook of Plastics Testing Technology,2nd Revised edition, Wiley–Blackwell, 1998**.**

REFERENCES

1. Gowarikar V R, Polymer science, 5th Edition, New Age International Private Limited, 2023
2. Fred W. Billmeyer, Textbook of Polymer Science, 3rd Edition, John Wiley & Sons, 2007
3. Nayak S.K, Text Book on Fundamentals of Plastics Testing, Springer (I) Private Limited, 2020
4. J S Anand, Recycling & Plastics Waste Management, Central Institute of Plastics Engineering and Technology, 1997.
5. Korschwitz J, Polymer Characterization and Analysis, John Wiley and Sons, 1990.

L: 45; TOTAL: 45 PERIODS

Course Code		L	T	P	E	C
23SH16E	SENSORS FOR ENGINEERING APPLICATIONS	3	0	0	0	3

COURSE OUTCOMES:

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

CO1: Gain knowledge on basic concepts of sensors and Transducer.

CO2: know about the thermal and motion sensors for various applications.

CO3: enumerate the principles and applications of optical and magnetic sensors and transducers used in various field.

CO4: explain the construction, working principle and applications of electrochemical and electric sensors.

CO5: Design the sensors for environmental monitoring

CO1: Gain knowledge on basic concepts of sensors and Transducer. **L: 9**

Introduction – Historical development of sensors – Human body as a sensor system – sensors and transducers. Principle and classification of sensor. Sensor characteristics – sensor properties – various transducers – piezoelectric effect – pyroelectric effect – seebeck effect and peltier effect. Advantages and limitations of Sensors.

CO2: know about the thermal and motion sensors for various applications. **L:9**

Thermal sensors: introduction – types - primary sensor: gas thermometer and He low temperature thermometer. Secondary sensor: Resistance thermometer and NQR thermometer. Temperature sensing technologies: IC sensor, resistive temperature detectors, thermocouples and thermistor.

Motion sensors: Introduction and principle. Types: Infra red and microwave. Specialized motion sensor: proximity and ranging sensor. Motion Sensors in everyday life: The role of motion sensors in home security.

CO3: enumerate the principles and applications of optical and magnetic sensors and transducers used in various field **L:9**

Magnetic sensors: Introduction – principle and applications: magnetic field sensors and magneto-resistive Sensors, hall effect sensors.

Optical sensors: light intensity – wavelength and color – light dependent resistors, photodiode, photo transistor, CCD, CMOS sensors. Pulse oximeter, portable pulse oximeter, wearable pulse oximeter; wearable capnometer for monitoring of expired.

CO4: explain the construction, working principle and applications of electrochemical and electric sensors **L-9**

Electrochemical sensors: Introduction - fundamental concepts – chemiresistors. Conductometric sensor: amperometric sensor - potentiometric sensors - impendence sensors.

Electric sensors: Introduction- conventional volt and ammeters, high current sensors, (current transformers), high voltage sensors, High power sensors. Real time applications: Glucose Monitoring

Devices, GlucoWatch G2 Biographer, GlucoTrackTM; Pulse oximeter, Portable Pulse Oximeter, wearable pulse oximeter.

CO5: Design the sensors for environmental monitoring **L-9**

Environmental Sensor: Introduction - environmental quantities**:** time, moisture acidity/alkalinity, wind-chill, radioactive count rate. Surveying and security. Sensors for environmental monitoring. Smoke and fire detector. Pressure sensor in emission testing, pollution devices, and wind management systems.

TEXT BOOKS

1. Jacob Fraden, Handbook of Modern Sensors: Physics, Design and Applications, 5th edition, Springer Nature, New Delhi, 2016
2. D. Patranabis, Sensors and Transducers, 2nd Edition, PHI Learning Private Limited, New Delhi, 2013.
3. John Veteline, Aravind Raghu, Introduction to sensors, CRC press, New Delhi, 2011.
4. S Nihtianov, A. Luque Smart Sensors and MEMS, 2nd Edition, Woodhead Publishing Limited, New Delhi, 2018.
5. Edward Sazonov and Michael R. Neuman, Wearable Sensors - Fundamentals, Implementation and Applications, Elsevier publishing company, Amsterdam, Netherland,2014.

REFERENCE BOOKS

1. Shantanu Bhattacharya,A K Agarwal, NripenChanda, Ashok Pandey and Ashis Kumar Sen Environmental, Chemical and Medical Sensors, Springer Verlag, Singapore,2018 .
2. Krzysztof Iniewski, Optical, Acoustic, Magnetic, and Mechanical Sensor Technologies, 1st Edition, CRC Press, New Delhi, 2017.

L: 45; TOTAL: 45 PERIODS