B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY

Vandalur, Chennai – 600048

B.TECH. ELCTRONICS & INSTRUMENTATION ENGINEERING

CURRICULUM & SYLLABUS, REGULATIONS 2017

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	BS	MAC 1181	Differential Calculus and Geometry	3	1	0	4	
2.	HS	ENC 1181/ ISC 1181/ LNC 1181/ LNC 1182 / LNC 1183	English / Arabic / Mandarin / German / Japanese	3	0	0	3	
3.	BS	PHC 1181	Physics	3	0	2	4	
4.	BS	CHC 1181	Chemistry	3	0	2	4	
5.	ESF	GEC 1101	Engineering Graphics	2	0	2	3	
6.	ESF	GEC 1102	Engineering Design	2	0	0	2	
7.	ESF	GEC 1103	Basic Engineering Practices Laboratory	0	0	2	1	
8.	ESF	GEC 1104	Computer Programming I	1	0	2	2	**23**

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	MAC 1281	Advanced Calculus	3	1	0	4
2.	BS	-	Physics Elective	2	0	2	3
3.	BS	-	Chemistry Elective	2	0	2	3
4.	ESF	GEC 1211	Basic Engineering Mechanics	3	1	0	4
5.	BS	GEC 1212	Environmental Studies	2	0	0	2
6.	ESF	GEC 1213	Computer Programming II	1	0	2	2

7.	EC	EIC 1211	Electrical Circuits	3	0	2	4	
8.	EC	EIC 1212	Electronic Devices	2	0	0	2	**24**

SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	BS	MAC2181	Partial Differential Equations and Transforms	3	1	0	4	
2.	HS	-	Humanities Elective I	2	0	0	2	
3.	HS	ENC 2181	Oral Communication	0	0	2	1	
4.	EC	EIC 2101	Transducer Engineering	3	0	0	3	
5.	EC	EIC 2102	Electrical, Electronic and Physical Measurements	3	0	0	3	
6.	EC	EIC 2103	Analog and Linear Integrated Circuits	3	1	0	4	
7.	EC	EIC 2104	Electrical Machines	3	0	0	3	
8.	EC	EIC 2105	Transducer Engineering Lab	0	0	2	1	
9.	EC	EIC 2106	Electrical Machines and Measurements Lab	0	0	3	1	
10.	EC	EIC2107	Analog Electronics Lab	0	0	3	1	**23**

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	-	Mathematics Elective I	3	1	0	4
2.	HS	-	Humanities Elective II	2	0	0	2
3.	HS	ENC2282	Written Communication	0	0	2	1
4.	EC	EIC 2211	Thermodynamics and Fluid Mechanics	3	0	2	4
5.	EC	EIC 2212	Digital Electronics	3	1	0	4
6.	EC	EIC 2213	Industrial Instrumentation I	3	0	0	3
7.	EC	EIC 2214	Digital Electronics Lab	0	0	2	1
8.	EC	EIC 2215	Industrial Instrumentation I Lab	0	0	2	1

9.	PE		Programme Elective				3	**23**

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	MS	MSC 3181 MSC 3182	Leadership and CEO Training/ Social Entrepreneurship	3	0	0	3	
2.	GE	-	General Elective I	3	0	0	3	
3.	HS	ENC3181	Communication and soft skill I Career Choice	0	0	2	1	
4.	EC	EIC 3101	Control Systems	3	1	0	4	
5.	EC	EIC 3102	Microprocessor and Microcontroller	3	0	0	3	
6.	EC	EIC 3103	Industrial Instrumentation II	3	0	0	3	
7.	EC	EIC 3104	Control Systems Laboratory	0	0	2	1	
8.	EC	EIC 3105	Microprocessor and Microcontroller Laboratory	0	0	2	1	
9.	EC	EIC 3106	Industrial Instrumentation II Lab	0	0	2	1	
10.	PE		Programme Elective				3	**23**

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	MS	MSC 3181 MSC 3182	Leadership and CEO Training/ Social Entrepreneurship	3	0	0	3
2.	BS	-	Mathematics Elective II	2	0	0	2
3.	HS	ENC3281	Communication and soft skill II Confidence Building	0	0	2	1
4.	EC	EIC 3211	Process control	3	0	0	3
5.	EC	EIC 3212	Communication Engineering	3	0	0	3
6.	EC	EIC 3213	Digital signal processing	3	1	0	4
7.	EC	EIC 3214	Process control Lab	0	0	3	1

8.	PE	-	Programme Elective				6	**23**

SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	GE	-	General Elective II	3	0	0	3	
2.	EC	EIC4101	Digital Process control	3	1	0	4	
3.	EC	EIC4102	Industrial Automation	3	0	0	3	
4.	EC	-	Programme Elective				9	
5.	PE	EIC4103	Industrial Automation Lab	0	0	4	2	
6.	EC	EIC4104	Instrumentation System Design	0	0	4	2	
7.	EC	EIC4105	Internship	0	0	0	1*	**24**

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	
1.	EC	EIC4211	Project Work	0	0	24	12	**12**

Total credits – 175

* Industrial training will be undertaken during Third year summer vacation for 15 days. The credit will be awarded in the 7th Semester.

PROGRAMME ELECTIVES

GROUP I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	EICX01	Biomedical Instrumentation	3	0	0	3
2.	PE	EICX02	Fiber Optic and Laser Instrumentation	3	0	0	3
3.	PE	EICX03	Micro Electro Mechanical Systems	3	0	0	3
4.	PE	EICX04	Qt software	1	0	4	3
5.	PE	EICX05	Telemetry and Tele control	3	0	0	3

GROUP II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	EICX11	Control system components	3	0	0	3
2.	PE	EICX12	Advanced Sensors	3	0	0	3
3.	PE	EICX13	Ultrasonic Instrumentation	3	0	0	3
4.	PE	EICX14	Computer networks	3	0	0	3

GROUP III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	EICX21	Industrial Data Networks	3	0	0	3
2.	PE	EICX22	Robotics and Automation	3	0	0	3
3.	PE	EICX23	Virtual Instrumentation	3	0	0	3
4.	PE	EICX24	Applied Analytical Instrumentation	3	0	0	3
5.	PE	EICX25	Hydraulics and Pneumatics	3	0	0	3

GROUP IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	EICX31	Modeling and Simulation	3	0	0	3
2.	PE	EICX32	Digital Image Processing	3	0	0	3

3.	PE	EICX33	Instrumentation and Control in Petrochemical Industries	3	0	0	3
4.	PE	EICX34	Wireless sensor networks	3	0	0	3

GROUP V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	EICX41	Nonlinear Control System	3	0	0	3
2.	PE	EICX42	Advanced Digital Signal Processing	3	0	0	3
3.	PE	EICX43	Instrumentation and control in Iron and Steel Industries	3	0	0	3
4.	PE	EICX44	Internet of Things for automation	3	0	0	3

GROUP VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	EICX51	Modern Control System	3	0	0	3
2.	PE	EICX52	Embedded System and RTOS	3	0	0	3
3.	PE	EICX53	System Identification	3	0	0	3
4.	PE	EICX54	Industrial Drives and Control	3	0	0	3

GROUP VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	EICX61	Adaptive Control	3	0	0	3
2.	PE	EICX62	Thermal Power Plant Instrumentation	3	0	0	3
3.	PE	EICX63	Applied soft computing for Instrumentation Engineers	3	0	0	3
4.	PE	EICX64	VLSI Design	3	0	0	3
5.	PE	EICX65	Machine Learning	3	0	0	3

Physics Elective Courses

(To be offered in II Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	PHCX 01	Fundamentals of Engineering Materials	2	0	2	3
2.	PHCX 02	Heat and Thermodynamics	2	0	2	3
3.	PHCX 03	Introduction to Nanoscience and Technology	2	0	2	3
4.	PHCX 04	Lasers and their applications	2	0	2	3
5.	PHCX 05	Materials Science	2	0	2	3
6.	PHCX 06	Non-Destructive Testing	2	0	2	3
7.	PHCX 07	Properties of Matter and Acoustics	2	0	2	3
8.	PHCX 08	Properties of Matter and Nondestructive Testing	2	0	2	3
9.	PHCX 09	Semiconductor Physics and Optoelectronics	2	0	2	3

Chemistry Elective Courses

(To be offered in II Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CHCX01	Analytical Instrumentation	2	0	2	3
2.	CHCX02	Corrosion and its Control	2	0	2	3
3.	CHCX03	Electrical Materials and Batteries	2	0	2	3
4.	CHCX04	Engineering Materials	2	0	2	3
5.	CHCX05	Fuels and Combustion	2	0	2	3
6.	CHCX06	Fundamentals of Physical Chemistry	2	0	2	3
7.	CHCX07	Green Technology	2	0	2	3
8.	CHCX08	Organic Chemistry of Biomolecules	2	0	2	3

9.	CHCX09	Polymer Science and Technology	2	0	2	3

Maths Elective Courses

(To be offered in IV Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MACX 01	Discrete Mathematics And Graph Theory	3	1	0	4
2.	MACX 02	Probability And Statistics	3	1	0	4
3.	MACX 03	Random Processes	3	1	0	4
4.	MACX 04	Applied Numerical Methods	3	1	0	4

Maths Elective Courses

(To be offered in VI Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MACX 05	Mathematical Programming	2	0	0	2
2.	MACX 06	Statistical Methods for Data Analysis	2	0	0	2
3.	MACX 07	Numerical Methods for Integral and Differential Equations	2	0	0	2
4.	MACX 08	Mathematical Modelling	2	0	0	2
5.	MACX 09	Graph Theory	2	0	0	2

Humanities Elective I

(To be offered in III Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	SSCX01	Fundamentals of Economics	2	0	0	2
2.	SSCX02	Principles of Sociology	2	0	0	2
3.	SSCX03	Sociology of Indian Society	2	0	0	2

Humanities Elective II

(To be offered in IV Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	SSCX04	Economics of Sustainable Development	2	0	0	2
2.	SSCX05	Industrial Sociology	2	0	0	2
3.	SSCX06	Law for Engineers	2	0	0	2

General Elective

Group I Courses

(To be offered in V semester)

Sl. No.	Course Code	Course Title	Offering Department
1.	GECX101	Disaster Management	Civil
2.	GECX102	Total Quality Management	Mechanical
3.	GECX103	Energy Studies	Mechanical
4.	GECX104	Robotics	Mechanical
5.	GECX105	Transport Management	Automobile
6.	GECX106	Control Systems	EEE
7.	GECX107	Introduction to VLSI Design	ECE
8.	GECX108	Plant Engineering	EIE
9.	GECX109	Network Security	CSE
10.	GECX110	Knowledge management	CSE
11.	GECX111	Cyber security	IT
12.	GECX112	Genetic Engineering	LS
13.	GECX113	Fundamentals of Project Management	CBS
14.	GECX114	Operations Research	Mathematics
15.	GECX115	Nano Technology	Physics / Chemistry
16.	GECX116	Vehicle Maintenance	Automobile
17.	GECX117	Fundamentals of Digital Image Processing	ECE

Group II Courses

(To be offered in VII semester)

Sl. No.	Course Code	Course Title	Offering Department
1.	GECX201	Green Design and Sustainability	Civil
2.	GECX202	Appropriate Technology	Civil / Mechanical
3.	GECX203	Engineering System Modelling and Simulation	Mechanical
4.	GECX204	Value Analysis and Engineering	Mechanical
5.	GECX205	Industrial Safety	Mechanical
6.	GECX206	Advanced Optimization Techniques	Mechanical
7.	GECX207	Mat Lab Simulation	EEE
8.	GECX208	Embedded Systemsand its Applications	ECE
9.	GECX209	Usability Engineering	CSE
10.	GECX210	Supply Chain Management	CBS
11.	GECX211	System Analysis and Design	CA
12.	GECX212	Advanced Materials	Physics & Chemistry
13.	GECX213	National Service Scheme	School of Humanities
14.	GECX214	Automotive Pollution and Control	Automobile
15.	GECX215	Motor Vehicle Act, Insurance and Policy	Automobile
16.	GECX216	Principles of Communication Systems	ECE
17.	GECX217	Lean Management	Civil
18.	GECX218	Spatial Data Modeling & Analysis	Civil

SEMESTER I

MAC 1181 DIFFERENTIAL CALCULUS AND GEOMETRY

L	T	P	C
3	1	0	4

OBJECTIVES:

The aims of this course are to

- introduce eigen values and eigenvectors of matrix algebra.
- make the student knowledgeable in the area of Three Dimensional Analytical Geometry.
- demonstrate the application of Differential Calculus.
- familiarize the student with the functions of several variables.
- develop the use of ODE solvable techniques necessary for engineering applications.
- motivate the students with some basic engineering application problems in ODE.

MODULE I MATRICES 8+2

Characteristic Equation- Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton Theorem (without proof) – Orthogonal matrices – orthogonal transformations of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

MODULE II THREE DIMENSIONAL ANALYTICAL GEOMETRY 7+3

Direction cosines and ratios – angle between two lines – equations of a plane – equations of a straight line, coplanar lines - shortest distance between skew lines - sphere – tangent plane – plane section of a sphere – orthogonal spheres.

MODULE III DIFFERENTIAL GEOMETRY 7+3

Curvature – Cartesian and polar coordinates – centre and radius of curvature –

circle of curvature – involutes and evolutes – envelopes.

MODULE IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 8+2

Functions of two variables – partial derivatives – total differential – Implicit Functions – Jacobian - Taylor's series expansion – Optima of two variables – Lagrange's multiplier method.

MODULE V ORDINARY DIFFERENTIAL EQUATIONS 8+2

Linear equations of second order with constant and variable coefficients – Simultaneous first order linear equations with constant coefficients – homogeneous equations of Euler's type – method of undetermined coefficients, method of variation of parameters

MODULE VI APPLICATIONS OF ORDINARY DIFFERENTIAL EQUATIONS 7+3

Solution of Ordinary Differential Equation Related to Electric Circuits – Bending of Beams- Motion of a Particle in a resisting medium – Simple harmonic motion.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Ramana, B.V, "Higher Engineering Mathematics" Tata McGraw Hill Publishing Co. New Delhi, 2006.
2. Grewal B.S., "Higher Engineering Mathematics" (43rd edition), Khanna Publishers, New Delhi, 2012.
3. John W. Cell "Engineering Problems Illustrating Mathematics" Mc Graw Hill Publishing Co., New York 1943.

REFERENCES:

1. Veerarajan.T., "Engineering Mathematics" (5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012
2. Kreyszig, E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
3. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition,

Cengage Learning, 2011.

4. Dennis G. Zill, Warren S. Wright, “Advanced Engineering Mathematics”, 4th edition, Jones and Bartlett publishers, Sudbury, 2011.

5. Alan Jeffrey, “Advanced Engineering Mathematics”, Academic Press, USA, 2002.

6. Venkataraman, M.K., “Engineering Mathematics”, Volume I, 2nd edition, National Publishing Co., Chennai, 2003.

7. James Stewart “.Calculus” (7th edition),Brooks/Cole cengage learning,UK

OUTCOMES:

After completing the course, student will be able to

- Understand the matrix techniques and compute eigen values and eigenvectors of a given matrix.
- Do the problems based on three dimensional analytic geometry.
- Apply differential calculus in engineering problems.
- Differentiate more than one variable and their applications.
- Solve the differential equations with constant coefficient and variable coefficient.
- Form and solve differential equations.

ENC 1181 ENGLISH

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To train students to use appropriate vocabulary in academic and technical contexts.
- To facilitate students to speak effectively while exchanging ideas and making presentations.
- To develop students' listening skill for comprehending and analyzing information.
- To develop their reading skill through sub skills like skimming , scanning and critical reading of a text.
- To sharpen their academic writing skills.
- To expose them to the correct usage of language and help them to apply that knowledge appropriately.

MODULE I 8

L: Listening for general information
S : Self Introduction, Introducing one another.
R: Predicting the content
W: Paragraph Writing
Language Focus: Affixes, Simple Present tense , Connective & Prepositions.

MODULE II 8

L: Listening for specific information (from dialogues)
S:Exchanging opinion.
R: Skimming technical Passages
W: Argumentative Writing (using the concept of Flipped Learning), Letter to the Editor.
Language Focus: Idioms, use of Modals, Simple Past tense & use of "Wh" and question tags.

MODULE III **7**

L: Learning the ways of describing images and presenting specific information (focusing on note making)

S: Making Presentations using visuals.

R : Scanning short texts for gist of information

W: Letter of Invitation, Expository Writing

Language Focus: Homophones, Homographs, Simple Future & Collocations.

MODULE IV **7**

L: Understanding prepared presentation techniques through videos

S: Short Presentations.

R: Reading for coherence and cohesion

W: Letter seeking permission for Industrial Visit

Language Focus: S-V agreement, Euphemism

MODULE V **8**

L : Understanding Non- Verbal Communications while listening to narration of incidents.

S: Narrating an expereince

R: Inferential Reading

W: Process Description – Transcoding a Flow chart.

Language Focus: Interchange of Active & passive voice, Impersonal Passive voice.

MODULE VI **7**

L: Learning Story telling techniques (stories & visuals) through audio files

S: Discussion in groups

R: Reading for critical appreciation

W: Developing an idea, Slogan writing, Interpreting a Bar Chart.

Language Focus: If clause and phrasal verbs.

TOTAL HOURS :45

REFERENCES:

1. Carol Rosenblun perry(2011). The Fine Art of Technical Writing. Create

Space Independent Publishing Platform, New Delhi.
2. Dutt, P.K. Rajeevan. G and Prakash , C.L.N. (2007) A course in Communication Skills. Cambridge Univesity Press, India.
3. Kala, Abdul & Arun Tiwari (2004). Wings of Fire: An Autobiography (Simplified and A bridged by Mukul Chowdhri). Hyderabad Univeristy Press.
4. Sen, Leena. (2004) Communication Skills. Prentice Hall, New Delhi.
5. Matt Firth, Chris Sowton et.al. (2012). Academic English: An Integrated Skills Course for EAP. Cambridge University Press, Cambridge.

OUTCOMES:

After completion of the course, students will have the ability to

- Demonstrate their range of vocabulary in academic and technical contexts
- Exchange ideas and make presentations
- Comprehend and respond appropriately to listening tasks.
- Read a text efficiently and process information.
- Create and draft different kinds of academic documents
- Communicate effectively using grammatically correct expressions.

ISC1181 ARABIC

L	T	P	C
3	0	0	3

OBJECTIVES:

- To read and write in Arabic language.
- To learn vocabulary of different fields
- To develop situational communication skills.

MODULE I PREPARATORY ARABIC 7

Introducing Arabic Alphabets.
Listening and Reading.
Audio & Video aided listening, Tajweed listening,
Writing Arabic Alphabets (connected & unconnected).
Introducing words.
Reading simple sentences.
Learning names of the things in and around the class room.
Exercises.

MODULE II FUNCTIONAL ARABIC 7

Listening Arabic texts, stories and action verbs
Communicating Simple sentences.
Jumla' Ismiyya and Jumla' Fi'liyya
Situational Conversation:
Greetings, Introduction.
Classroom, College, Picnic.
Dining and Kitchen.
Reading skills.
Exercises

MODULE III FUNCTIONAL ARABIC 8

Implication of effective listening.
Audio aids.
Writing Simple sentences.

Communicating ordinal and cardinal numbers.
Situational communication:
Playground, library.
Forms of plural – Sample sentences.
Introduction to tenses.
Exercises.

MODULE IV FUNCTIONAL ARABIC 8

Communication:
Family, travel
Market, Prayer hall
Writing skills:
Note making.
Sequencing of sentences.
Developing answers from the questions.
Exercises.

MODULE V TECHNICAL ARABIC 8

Importance of technical communication.
Reading and writing skills.
Audio & Video aided listening.
Introduction to Arabic terms related to administration.
Situation communication:
Air travel, Office administration, passport, visa.
Exercises

MODULE VI TECHNICAL ARABIC 7

Situation communication:
Contractual work, machineries and equipments..
Computer, internet browsing.
Banking,
Exercises.

TOTAL HOURS :45

TEXT BOOKS:

1. Arabic for professionals and employees, Kilakarai Bukhari Aalim Arabic College, Chennai, India, 2013.

REFERENCES:

1. Arabic Reader for Non Arabs (Ummul Qura University, Makkah), Kilakarai Bukhari Aalim Arabic College, 2005.

OUTCOMES:

On successful completion of the course, the student will be able to:

- Write correct sentences in Arabic.
- Communicate in Arabic at primary level in working situations in the fields of engineering and administration.

LNC1181	MANDARIN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To improve the proficiency of students in Mandarin language.
- To develop their knowledge of vocabulary.
- To train them in using appropriate grammatical forms during communications.
- To empower them for successful communication in social and academic contexts.
- To make them appreciate the language usage in real life situations.

MODULE I **8**

· General Introduction to Chinese • Pinyin and Tones • Introduction to the Writing System: basic strokes and stroke order · Numbers 1-100, song · Days of the Week · Months of the Year

MODULE II **8**

· Chinese names and related culture · Chinese family structures and values · Greetings · Introducing Yourself · Family members · Occupations

MODULE III **7**

· Languages and Nationalities · Daily Routine · Chinese breakfast · Negative Sentences and Interrogative Sentences · Asking for Personal Information · The Verb *shi* and Basic Sentence Structures

MODULE IV **7**

· Answering an Affirmative-negative Question · Food and drinks · Transportation · Likes and dislikes · Adverbs *bu*, *jiu* and *dou* · Verb-absent Sentences

MODULE V **8**

·*Jisui* and *duoda* Questions · S+V+O Construction · Routines and Daily Activities ·*Haishi* Questions · Modal Verbs · Hobbies and Habits

MODULE VI **7**

· Making Suggestions with *haoma* ·Colors · Clothing · Body parts · Talking about Likes and Dislikes · Measurement Words in Chinese

TOTAL HOURS :45

TEXT BOOKS:

1.Ma, Yanmin, and Li, Xinying. *Easy Steps to Chinese, Vol. 1 Textbook*. Beijing: Beijing Language and Culture University Press, 2006. Print.

2. Ma, Yanmin, and Li, Xinying. *Easy Steps to Chinese, Vol. 1 Workbook*. Beijing: Beijing Language and Culture University Press, 2006. Print.

OUTCOMES:

On completion of the course, students will be able to

- Exhibit proficiency in Chinese Language.
- Use vocabulary in appropriate contexts.
- Use appropriate grammatical forms effectively.
- Use the language in social and academic contexts.
- Appreciate the use of language forms.

LNC1182 GERMAN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To improve the proficiency of students in German language.
- To create awareness of using vocabulary among students.
- To expose them to correct grammatical forms of the language.
- To empower them for successful communication in social and academic contexts.

MODULE I **8**

Introduction to German alphabets, phonetics and pronunciation- Introducing themselves and others using simple sentences and answer to some basic personal questions-: Introduction to different types of articles and verbs, Nouns

MODULE II **8**

Understanding and responding to everyday queries like instruction, questions, -number & gender, pronouns, present and past tense.

MODULE III **7**

Short telephone messages, requests etc., if spoken slowly and clearly-- Detailed overview of articles, adjectives with/without articles, Prepositions

MODULE IV **7**

Ask and giving directions using simple prepositions- Ability to fill basic information on forms while registering for courses / classes.

MODULE V **8**

Ability to extract and understand relevant information in a public announcement, broadcast, newspaper, radio etc-- dative & accusative

MODULE VI **7**

Ability to describe about people, work, immediate environment, education and other topics related to personal needs in a concise manner-- Understanding of matters that are familiar and are encountered regularly like instances at school, work, at public places, places of leisure etc.

TOTAL HOURS :45

TEXT BOOKS:

1. Course book : Tangram aktuell 1 – Lektion 1–4 (Kursbuch + Arbeitsbuch mit Audio-CD zum Arbeitsbuch), Rosa-Maria Dallapiazza, Eduard von Jan, Til Schönherr, Hueber Publisher, ISBN 978-3-19-001801-7
2. Practice book: Tangram aktuell 1 – Lektion 1–4 (Kursbuch + Arbeitsbuch mit Audio-CD zum Arbeitsbuch), Rosa-Maria Dallapiazza, Eduard von Jan, Til Schönherr, Hueber Publisher, ISBN 978-3-19-001801-7.

REFERENCES:

1. NETZWERK A1 TEXTBOOK, Deutsch als Fremdsprache,Stefanie Dengler,Paul Rusch, Helen Schmitz, Tanja Sieber, Langenscheidt and Klett, ISBN : 9788183076968
2. STUDIO D A1 (SET OF 3 BOOKS + CD), Hermann Funk. Cornelsen, ISBN: 9788183073509
3. Willkommen! Beginner's course. Paul Coggle, Heiner Schenke. 2nd edition. (chapter 1 - 6) ISBN: 9781444165159 –
4. Willkommen! Beginner's course. Paul Coggle, Heiner Schenke. ISBN: 978-1-444-16518-0
5. An Introduction to the German Language and Culture for Communication, Updated Edition Lovik, Thomas A., J. Douglas Guy & Monika Chavez. Vorsprung -. New York, Houghton Mifflin Company, 1997/2002. ISBN 0-618-14249-5.

OUTCOMES:

On completion of the course, students will be able to

- Show their proficiency in German Language.
- Use appropriate vocabulary in real life contexts.
- Use appropriate grammatical forms while communicating with people.
- Effectively use the language in social and academic contexts.

LNC1183 **JAPANESE**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To train students to use appropriate vocabulary in academic and technical contexts.
- To facilitate students to speak effectively while exchanging ideas and making presentations.
- To develop their reading skill through sub skills like skimming, scanning and critical reading of a text.
- To sharpen their academic writing skills.
- To expose them to the correct usage of language and help them to apply that knowledge appropriately.

MODULE I **7**

Introduction of the Japanese writing system, i.e. *Hiragana*, *Katakana* and *Kanji*, word-building, writing foreign names and loan words in Katakana.

MODULE II **8**

Oral practice of pronunciation and intonation of Japanese sounds, Japanese greetings, self introduction, identifying things, time of the day, calendar; counting using Japanese numerical classifiers; describing things;

MODULE III **7**

Making comparisons; talking of daily activities, kinship terms used for address and reference, seasons, giving and receiving, shopping; making requests, talking of one's likes and dislikes.

MODULE IV **8**

Extensive practice of basic patterns at the lower intermediate level through drills and exercises.

MODULE V **7**

Comprehension of passages in simple Japanese and writing of composition in

Japanese applying lower intermediate grammatical patterns.

MODULE VI **8**

Diverse texts based on Japanese culture, customs, history, food habits, and science etc, for the development of communicative competence of students; skimming, scanning of texts with emphasis on advanced sentence patterns, grammatical structures and idiomatic phrases, reading and writing of approximately

TOTAL HOURS :45

REFERENCES:

1. Nihongo I, Kokusaigakuyukai, and other supplementary material
2. Exersice book 1of Nihongo 1, and other supplementary material
3. Nippon, the Land and its People & Encyclopedia of Contemporary Japanese
4. Japani: Japanese Conversation for Improving Spoken Proficiency, By P.A. George, Inoue Yoriko and Itsuko Nandi, Books Plus.
5. Chukyu Nihongo, Tokyo Gaikokugo Daigaku; Nihongo II, Kokusaigakuyukai, and other supplementary material.

OUTCOMES:

After completion of the course, students will have the ability to

- Demonstrate their range of vocabulary in academic and technical contexts
- Exchange ideas and make presentations
- Comprehend and respond appropriately to listening tasks.
- Read a text efficiently and process information.
- Create and draft different kinds of academic documents
- Communicate effectively using grammatically correct expressions.

PHC 1181 PHYSICS L T P C

3 0 2 4

OBJECTIVES:

To make students conversant with the

- basic concepts of crystal physics and its structures
- production and applications of ultrasonic waves
- study of thermal conductivities of good and bad conductors
- phenomenon of wave optics and its applications
- principle of fibre optic communication and its applications to sensors
- wave mechanics principle and its applications in electron microscopy
- green energy physics and its environmental impacts to society

MODULE I CRYSTAL PHYSICS 8

Crystalline and amorphous solids – Unit Cell – Seven Crystal Systems – Bravais Lattice – Miller Indices – Interplanar Spacing – Characteristics of Unit Cell - Calculation of Number of atoms per unit cell, Atomic Radius, Coordination Number and Packing Factor for SC, BCC, FCC and HCP and Diamond structures –Defects in crystals-Point defects –Edge and screw dislocations and their significance - Surface Defects.

MODULE II ULTRASONICS AND THERMAL PHYSICS 8

Introduction to Ultrasonics - Properties - Production methods - Magnetostriction Oscillator method- Piezoelectric Oscillator method – Detection of Ultrasonics – Thermal method – Piezoelectric method – Kundt's tube method – Applications of Ultrasonics – Acoustic Grating – SONAR – Depth of sea – Velocity of blood flow, Ultrasonic Flaw detector (qualitative).

Transmission of heat – Conduction, Convection and Radiation – Thermal Conductivity of good Conductor – Forbe's method- Thermal Conductivity of bad Conductor – Lee's Disc method.

MODULE III APPLIED OPTICS 8

Interference – Air Wedge – Michelson's Interferometer – Determination of wavelength of light and thickness of thin transparent sheet.

Introduction to Laser – Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism – Laser Action – Types of Laser: He-Ne laser, CO2 laser and Nd:YAG laser - Applications : Laser Materials Processing .

MODULE IV FIBRE OPTICS 7

Optical fibre – Principle and propagation of light in optical fibre – Numerical aperture and acceptance angle – Types of optical fibres – Attenuation – Absorption, Scattering losses, Bending losses and Dispersion in Optical fibres – Fiber Connectors and Couplers - Applications – Fibre optic communication system (block diagram only)- Fibre optic sensors - displacement and pressure sensors (qualitative) - Medical endoscope.

MODULE V QUANTUM MECHANICS 7

Black body radiation – Planck's theory of radiation – Deduction of Wien's displacement law and Rayleigh – Jean's law from Planck's theory –Dual nature of matter – de Broglie's wavelength- Physical significance of wave function – Schrodinger wave equation – Time independent and time dependent wave equation – Particle in one dimensional box – Harmonic oscillator(qualitative).

MODULE VI RENEWABLE ENERGY SOURCES 7

Present Energy sources and sustainability - Solar energy - Solar photovoltaics - Solar cells – Bioenergy - Biomass – production of liquid fuels from biomass – Wind energy – Wind turbines – energy and power from wind turbines - Geothermal energy - Ocean energy: Wave energy – Wave energy conversion devices – Tidal energy – Tidal power basics – power generation –Tidal energy potential – Environmental benefits and impacts of renewable energy sources

PRACTICALS

1. Determination of Velocity of Ultrasonic waves in a given liquid using Ultrasonic Interferometer.
2. Determination of wavelength of ultrasonic waves using Kundt's tube method.
3. Determination of thickness of a thin wire using Air Wedge method.
4. Determination of wavelength of light using spectrometer diffraction grating.
5. Determination of angle of divergence of a laser beam using He-Ne laser.
6. Determination of particle size of lycopodium powder using semiconductor laser.
7. Determination of wavelength of laser light using semiconductor laser diffraction.
8. Determination of Acceptance angle and Numerical Aperture using fiber optic cable.
9. Determination of thermal conductivity of a good conductor by Forbe's method.
10. Determination of thermal conductivity of a bad conductor by Lee's disc method.

11. Determination of solar cell characteristics.

L – 45; P – 30; TOTAL HOURS – 75

REFERENCES :

1. Gaur R.K. and Gupta S.L., “Engineering Physics’’, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2013.
2. Palanisamy P.K., Physics for Engineers, Vol1 & Vol2, 2nd Edition, Scitech Publications, 2003.
3. Serway R.A. and Jewett, J.W. “Physics for Scientists and Engineers with Modern Physics”. Brooks/cole Publishing Co., 2010.
4. Tipler P.A. and Mosca, G.P., “Physics for Scientists and Engineers with Modern Physics”, W.H. Freeman, 2007.
5. Markert J.T., Ohanian. H. and Ohanian, M. “Physics for Engineers and Scientists”. W.W. Norton & Co. 2007.
6. Godfrey Boyle, “Renewable Energy: Power for sustainable future”, 2nd edition, Oxford University Press, UK, 2009.

OUTCOMES:

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

- understand the different types of crystal structures
- apply the concept of ultrasonic principle in engineering and medical field
- calculate thermal conductivities of good and bad conductors
- differentiate the various laser systems and its applications in engineering and medical field
- apply the principle of fibre optics for communication and sensor applications
- formulate wave mechanics principle for applications in electron microscopy
- Correlate the different renewable energy sources for societal needs.
- To complement the knowledge acquired in the theory class.
- To correlate the experimental results for application.

CHC1181	CHEMISTRY	L	T	P	C
		3	0	2	4

OBJECTIVES:

The students should be conversant with

- the basic problems like hardness, alkalinity, dissolved oxygen associated with the water used for domestic and industrial purpose and treatment process involved.
- the synthesis, properties and applications of nanomaterials.
- the importance of renewable energy sources like solar, wind, biogas, biomass, geothermal, ocean and their limitations.
- the basic analytical techniques like UV-Visible, FT-IR, NMR, AAS, AES, Circular Dichroism and XRD etc.
- photochemistry concepts related to physical processes and chemical reactions induced by photon absorption and their applications.
- basic principles of electrochemistry, cell construction and evaluation and to understand general methodologies for construction & design of electrochemical cell

MODULE I WATER TECHNOLOGY 9

Impurities present in water, hardness : types of hardness, demerits of hard water in boilers, estimation of hardness by EDTA method (problems) – alkalinity : estimation of alkalinity (problems) – dissolved oxygen: estimation of dissolved oxygen – conditioning methods : external treatment method: – lime soda and zeolite process (principle only), Ion exchange process – Internal treatment : colloidal, carbonate, phosphate and calgon methods – drinking water: standards (BIS), treatment of domestic water {screening, sedimentation, coagulation, filtration, disinfection }– desalination: electrodialysis, reverse osmosis.

MODULE II NANOCHEMISTRY 6

Introduction – distinction between molecules, bulk materials and nanoparticles – classification based on dimension with examples – synthesis (top-down and bottom-up approach} : sol-gel, thermolysis (hydrothermal and solvothermal), electrodeposition, chemical vapour deposition, laser ablation – properties and applications (electronic, magnetic and catalytic) – risk factors and future perspectives.

MODULE III ENERGY SOURCES 8

Energy: past, today, and future – a brief history of energy consumption – present energy scenario of conventional and renewable energy sources – renewable energy : needs of renewable energy, advantages and limitations of renewable energy – solar energy: basics, solar energy in the past , photovoltaic, advantages and disadvantages – bioenergy: conversion, bio degradation, biogas generation, biomass gasifier, factors affecting biogas generation, advantages and disadvantages – geothermal energy: geothermal resources (hot dry rock and magma resources, natural and artificial), advantages and disadvantages – wind energy: wind resources, wind turbines, advantages and disadvantages – ocean energy: wave energy, wave energy conversion devices, ocean thermal energy, advantages and disadvantages.

MODULE IV PHOTOCHEMISTRY 7

Introduction: absorption and emission, chromophores, auxochromes – laws of photochemistry : Grotthus-Draper law, Stark Einstein law – quantum yield (problems) –photo physical processes : fluorescence and phosphorescence - Jablonski diagram (electronic states and transitions) – quenching, annihilation – photosensitization: principle and applications – chemiluminescence, bioluminescence.

MODULE V ANALYTICAL TECHNIQUES 7

Spectroscopy: electromagnetic radiation and spectrum – types of transitions – types of spectra (atomic and molecular with their chemical usefulness) – Beer-Lamberts law (problems) – principles, instrumentation and applications of: Colourimetry – UV-Vis spectrophotometer – atomic absorption spectroscopy – atomic emission spectroscopy – principles and applications of: IR, NMR, mass and X-ray diffraction analysis.

MODULE VI ELECTROCHEMISTRY 8

Electrochemistry - types of electrodes (principle and working) : gas (SHE), metal/metal ion electrode, metal-metal insoluble salt (calomel electrode), ion-selective (glass electrode and fluoride ion selective electrode) – Electrolytic and galvanic cells, construction of cell, EMF measurement and applications (problems), standard cell (Weston-cadmium), reversible and irreversible cell, concentration cell. Determination of fluoride ion using fluoride ion selective electrode – Chemically modified electrodes (CMEs) : concept, approaches and applications.

PRACTICALS

1. Estimation of hardness in given water sample.
2. Estimation of the alkalinity of the given water sample.
3. Estimation of strong acid by conductometry.
4. Estimation of Fe^{2+} present in the given sample by potentiometry.
5. Verification of Beer-Lamberts law and estimation of Cu^{2+} present in unknown sample.
6. Estimation of sodium and potassium present in the given sample by flame photometry.
7. Determination of molecular weight and degree of polymerisation of a polymer by viscosity method.
8. Synthesis of thermosetting polymer.

L – 45; P – 30; TOTAL HOURS – 75

REFERENCES:

1. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India Ltd., New Delhi, 2011.

2. G.A. Ozin and A.C. Arsenault, “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, Thomas Graham House, Cambridge, 2005.

3. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).

4. S S Umare & S S Dara, A text Book of Engineering Chemistry, S. Chand&

Company Ltd, New Delhi, 2014.

5. G.D.Rai, “Non conventional energy sources,” Khanna Publishers, New Delhi, 2011.
6. John Twidell and Tony Weir, “Renewable Energy Resources, Taylor & Francis Ltd, London, United Kingdom, 2005
7. Principles of molecular photochemistry: An introduction, Nicholas J. Turro, V.Ramamurthy and Juan C. Scaiano, University Science Books, Sausalito, CA, 2009.

OUTCOMES:

The students will be able to

- solve problems related to hardness, alkalinity, dissolved oxygen associated with the water and describe the treatment processes.
- classify nanomaterials and apply the nanochemistry approach to synthesize the nanomaterials.
- explain the principle and enumerate the advantages and disadvantages of various renewable energy sources.
- state the principle and illustrate the instrumentation of various analytical techniques.
- apply the concepts of photochemistry to elaborate various photo-physical and photochemical reactions.
- construct a electrochemical cell and describe the various types of electrodes and determine the fluoride content.

GEC 1101 ENGINEERING GRAPHICS

L	T	P	C
2	0	2	3

OBJECTIVES:

- To introduce the students of all engineering programs, the basic concepts of engineering drawing, which is the basic communication medium for all engineers
- To provide practical exposure on important aspects like drawing analytic curves, orthographic projections, section of solids, development of surfaces, isometric projection, perspective projection and free hand drawing.
- To introduce computerized drafting.

MODULE I BASICS AND ENGINEERING CURVES 10

Drawing instruments, dimensioning, BIS conventions, types of lines, simple geometric constructions.
Conic sections: ellipse, parabola, hyperbola.
Special curves: cycloid, epicycloid, hypocycloid and involutes.

MODULE II ORTHOGRAPHIC PROJECTION 8

Orthographic projection – first angle, second angle, third angle and fourth angle projections –setup - assumptions, principle. Free hand sketching of orthographic views of simple machine parts as per first angle projection. Orthographic projection of points in all quadrants. Some commands and demonstration of drafting packages.

MODULE III PROJECTION OF STRAIGHT LINES AND PLANES 10

Projection of straight lines in first quadrant – true length and true inclinations – Rotating line and trapezoidal methods –traces of straight line.
Projection of plane lamina in first quadrant and its traces

MODULE IV PROJECTION OF SOLIDS 10

Projection of solids in first quadrant: Axis inclined to one reference plane only- prism, pyramid, cone, cylinder – change of position and auxiliary projection methods.

MODULE V SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12

Section of solids: prism, pyramid, cone, cylinder, and sphere – sectional view – true shape of section Solids in simple position and cutting plane inclined to one reference plane only.

Development of surface of truncated solids: prism, pyramid, cone cylinder – frustum of cone, pyramid and simple sheet metal parts.

MODULE VI PICTORIAL PROJECTIONS 10

Isometric projection: Isometric scale – isometric axes- iso sheet - Isometric projection and view of prism, pyramid, cylinder, cone, frustums, truncated solids and simple products

Perspective projection: station point – vanishing point – Perspective projection and views of prism, pyramid, cylinder and frustums by Visual ray method.

L – 30; P – 30; TOTAL HOURS – 60

TEXT BOOKS:

1. N.D. Bhatt, 'Engineering Drawing' Charotar Publishing house, 53rd Edtion, (2014)

REFERENCES:

1. K.V. Natarajan, 'A text book of Engineering Graphics', Dhanalakshmi publishers, Chennai. (2009)
2. Venugopal. K, and V. Prabhu Raja, Engineering Graphics, New Age International (P) Ltd., Publication, Chennai. (2011)

OUTCOMES:

- Students should be able to read the specifications and standards of technical drawing and able to draw conic sections and special curves.
- Students should be able to understand the insight of orthographic projection and to draw the various views of orthographic projection of a point and various components.
- Students should be able to draw the orthographic views of straight lines and plane figures.
- Students should be able to draw the orthographic views of simple solids.
- Students should be able to draw the sections of solids and development of solid surfaces.
- Students should be able to draw the isometric and perspective projection of simple solids and components.

GEC 1102 ENGINEERING DESIGN

L	T	P	C
2	0	0	2

OBJECTIVES:

- To understand the role of design in Engineering
- To understand the basic design concepts
- To understand the role of innovation in design

MODULE I DESIGN AS A CENTRAL ACTIVITY IN ENGINEERING 08

Product design – products and processes – product design methodology Design of systems; Software design

MODULE II NEED ANALYSIS AND CONCEPT DEVELOPMENT 07

Voice of customers – product specification - need analysis Bench marking Product architecture – concept generation and evaluation;

MODULE III CASE STUDIES IN ENGINEERING DESIGN 08

Product design – process design; system design; software design -Ergonomics – usability

MODULE IV INNOVATION AND DESIGN 07

Role of innovation in Engineering – incremental changes and systemic changes; scientific approach to driving innovation – case studies.

TOTAL HOURS – 30

REFERENCES:

1. Clive L. Dym and David C. Brown,"Engineering Design: Representation and Reasoning", 2nd Edition, Cambridge University Press, New Delhi, 2011.
2. Daniel G. Dorner, G. E. Gorman and Philip J. Calvert, "Information Needs Analysis: Principles and practice in information organizations", Published by Faced Publishing, London. 2015.
3. Cliff Matthews, "Case Studies in Engineering Design", John Wiley & Sons Pvt. Ltd, New York, 1998.
4. Bengt-Arne Vedin, "The Design-Inspired Innovation Workbook", World Scientific,

2011.
5. Navi Radjou, Jaideep Prabhu and Simone Ahuja, “Jugaad Innovation”, Published by Random House India, 2012.

OUTCOMES:

The students will be able to

- Apply the basic knowledge of design in engineering products / process / service.
- Analyse the problems and give innovative solutions.
- Correlate the basic knowledge of design in the real world problems.
- Apply innovative approaches to engineering design.

GEC1103	BASIC ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To provide a practical exposure to basic engineering practices like carpentry, fitting, plumbing, welding and making of simple electrical and electronic circuits
- To have an understanding on the use of various tools, instruments and methods
- To enable the students to appreciate the practical difficulties and safety issues

CIVIL ENGINEERING PRACTICE

1. Study of plumbing in general household and industrial systems
2. Making a small window frame with Lap and Mortise & Tenon Joints
3. Introduction to power tools

MECHANICAL ENGINEERING PRACTICE

1. Fabrication of a small Table frame with Butt, Lap and Fillet Joints
2. Machining of a simple component like a table weight using lathe
3. Mold preparation for simple component

ELECTRICAL ENGINEERING PRACTICE

1. Comparison of incandescent, Fluorescent, CFL and LED lamps.
2. Study of Protection Circuits (small relay, fuse, MCB, HRC, MCCB, ECCB).
3. Familiarization of households Electrical Gadgets (Iron Box, Wet Grinder).
4. Understanding of Domestic and Industrial wiring.
5. Earthing and its significance.
6. Troubleshooting in Electrical Circuits.
7. Study of inverter fed UPS/Emergency lamp

ELECTRONICS ENGINEERING PRACTICE

1. Identifications symbolic representation of active and passive electronic components
2. Soldering and tracing of electronic circuits and checking its continuity
3. Assembling of A.C. to D.C, D.C to A.C. Circuits in bread Board and Mini project.

TOTAL HOURS – 30

OUTCOMES:

Upon the completion of the course, students should be able to

- Appreciate the practical skills needed even in making of simple objects, assemblies and circuits
- Attend minor defects especially in items used in day to day life
- Aware of the safety aspects involved in using tools and instruments

GEC 1104	COMPUTER PROGRAMMING I	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To identify the hardware and software components of the computer.
- To know the basic concept of operating system and get knowledge about different operating systems.
- To learn various database concepts and operations
- To develop efficient algorithms for solving a problem.
- To implement the algorithms in C language.
- To use arrays in solving problems.

MODULE I COMPUTER FUNDAMENTALS 7

Introduction -. Number System - Planning the computer program - Computer Software - Basic operating system concepts - Database Operations

MODULE II PROGRAMMING IN C 8

Introduction to C Programming Language – Operators - Control statements -Iterative statements - Arrays.

LIST OF EXPERIMENTS:

1. Computer organization –Hardware in a typical computer Identification – Booting- error messages and what it means
2. Types of Operating systems – Windows and Linux
3. Structure of a basic program - Hello world program – Debugging it
4. Data types: Type conversions
5. Input / Output: Formatted functions – Unformatted functions – Library functions
6. Properties of operators – Priority of operators – Arithmetic relational logical and bitwise operators
7. If – if else- nested if else- goto- switch case – nested switch case – for loops – nested for loops – while loop – do-while loop – break and continue statement
8. Arrays – Operation with arrays
9. Sorting and searching.

L – 15; P – 30; TOTAL HOURS – 45

REFERENCES:

1. Ashok N Kamthane, “Computer Programming”, Pearson Education, 2nd Edition, ISBN 13: 9788131704370, 2012

2. Paul J. Deitel, Deitel & Associates, “C How to Program”, Pearson Education, 7th Edition, ISBN-13: 978-0132990448, 2012

OUTCOMES:

Students who complete this course will be able to

- Recognize Modular design, logic flow, data abstraction
- Analyze the working of the programming constructs, functions, and I/O.
- Write down programs for sorting and searching algorithms
- Write down programs developing cycle for different applications
- Debug the programs and solve some practical problems in programming
- Develop programs using arrays.

SEMESTER II

MAC 1281	**ADVANCED CALCULUS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVES:

The aims of this course are to

- train the students in solving problems using multiple integration.
- provide knowledge in using special functions to find out the area and volume of a region.
- acquire knowledge in tangent and normal vectors.
- gain knowledge in finding the areas of a curve and surface using vector integration.
- learn about the analytic functions and their properties along with bilinear transformation.
- know complex integration using Cauchy's theorems.

MODULE I MULTIPLE INTEGRATION AND ITS APPLICATIONS 8+2

Multiple integrals– Cartesian and Polar coordinates – change of order of integration – Multiple integral to compute area and volume.

MODULE II TRANSFORMATION OF COORDINATES AND SPECIAL FUNCTIONS 7+3

Change of variables between Cartesian, polar, cylindrical and spherical coordinates - Beta and Gamma functions – Properties and applications.

MODULE III VECTOR DIFFERENTIATION 7+3

Operations on vectors – Scalar Product, Vector Product, Projection of Vectors - Angle between two vectors - Gradient, divergence and curl

MODULE IV VECTOR INTEGRATION 8+2

Line, surface and volume integrals – Green's Theorem, Gauss Divergence

Theorem and Stokes Theorem (statement only) – verification and evaluation of integrals.

MODULE V ANALYTIC FUNCTION 8+2

Analytic function - Necessary and Sufficient condition (statement only) – Cauchy-Riemann equations in polar coordinates - properties of analytic function – determination of analytic function – conformal mapping (w = z+a, az and 1/z) and bilinear transformation.

MODULE VI COMPLEX INTEGRATION 7+3

Statement and application of Cauchy's integral theorem – Cauchy's integral formula – Taylor's series and Laurent's series expansion – singularities - classification – residues - Cauchy's residue theorem – contour integration – Unit circle and semi circular contours (excluding poles on the real axis).

L – 45; T – 15; TOTAL HOURS – 60

TEXT BOOKS:

1. Veerarajan.T., "Engineering Mathematics "(5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012
2. Grewal B.S., "Higher Engineering Mathematics" (43^{rd} edition), Khanna Publishers, New Delhi, 2012.
3. John W. Cell "Engineering Problems Illustrating Mathematics" Mc Graw Hill Publishing Co., New York 1943

REFERENCES:

1. Kreyszig, E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4^{th} edition, Jones and Bartlett publishers, Sudbury, 2011.
4. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.
5. Ramana, B.V., "Higher Engineering Mathematics" Tata Mc Graw Hill Publishing Co. New Delhi, 2006.
6. Venkataraman, M.K., "Engineering Mathematics", Volume 2, 2nd edition, National Publishing Co., Chennai, 2003.

7. James Stewart ".Calculus" (7th edition),Brooks/Cole cengage learning,UK.

OUTCOMES:

After completing the course, student will be able to

- compute the area and volume using multiple integrals.
- apply special functions to solve integration problems.
- apply differentiation in scalar and vector fields.
- find area and volume of a region using vector integration.
- verify analyticity, conformity and bilinearity of complex functions.
- evaluate complex integrals.

GEC 1211 BASIC ENGINEERING MECHANICS

L	T	P	C
3	1	0	4

OBJECTIVES:

- To impart knowledge about the basic laws of statics and dynamics and their applications in problem solving
- To acquaint both with scalar and vector approaches for representing forces and moments acting on particles and rigid bodies and their equilibrium
- To give on exposure on inertial properties of surfaces and solids
- To provide an understanding on the concept of work energy principle, friction, kinematics of motion and their relationship

MODULE I VECTOR APPROACH TO MECHANICS 07

Introduction - Units and Dimensions- Vectors – Vectorial representation of forces and moments –Vector Algebra and its Physical relevance in Mechanics - Laws of Mechanics – Parallelogram and triangular Law of forces -Lame's theorem, Coplanar Forces – Resolution and Composition of forces- Equilibrium of a particle.

MODULE II EQUILIBRIUM OF PARTICLE 06

Forces in space - Equilibrium of a particle in space - Equivalent systems of forces – Principle of transmissibility – Single equivalent force

MODULE III EQUILIBRIUM OF RIGID BODY 06

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis –Vectorial representation of moments and couples – Scalar components of a moment –Varignon's theorem - Equilibrium of Rigid bodies in two dimensions - Examples

MODULE IV PROPERTIES OF SURFACES 08

Determination of Areas – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, Angle section, Hollow section by using standard formula – second and product moments of plane area – Physical relevance - Rectangle, triangle, circle from integration - T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia- Mass moment of Area

MODULE V FRICTION 08

Introduction to friction- types of friction- Laws of Coloumb friction- Frictional force – simple contact friction – Rolling resistance –ladder friction

MODULE VI LAWS OF MOTION 10

Review of laws of motion – Newton's law – Work Energy Equation of particles– Impulse and Momentum – Impact of elastic bodies.

L – 45; T – 15; TOTAL HOURS – 60

REFERENCES:

1. Beer, F.P and Johnston Jr. E.R, "Vector Mechanics for Engineers, Dynamics & Statics", Third SI Metric Edition, Tata McGraw-Hill International Edition, 2001.
2. Hibbeller, R.C., Engineering Mechanics, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2000.
3. Irving H. Shames, Engineering Mechanics – Statics and Dynamics, IV Edition Pearson Education Asia Pvt. Ltd., 2003.

OUTCOMES:

On completion of this course students should be able

- Analyse and resolve forces, moments and solve problems using various principles and laws of Mechanics
- Apply the concept of equilibrium to particles and solve problems
- Apply the concept of equilibrium to rigid bodies and solve problems
- Analyse and determine the properties of surfaces
- Analyse and evaluate the fractional forces between the bodies
- Apply the laws of motion in solving dynamics problems

GEC 1212 ENVIRONMENTAL STUDIES L T P C

2 0 0 2

OBJECTIVES:

The student will be conversant with the

- various natural resources, availability, utilisation and its current scenario
- different ecosystems, energy transfer, values, threats and conservation of biodiversity
- levels of different pollutants and its impact and the causes and effects of natural disasters
- impacts of human population, impact assessment, human rights and environmental acts and sustainable development

MODULE I NATURAL RESOURCES 8

Land resources: land degradation, soil erosion and desertification - Forest resources: use and over-exploitation, deforestation - Water resources: use and over-utilisation of surface and ground water, conflicts over water (inter-state and international), dams (benefits and problems), water conservation (rainwater harvesting and watershed management) - Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, mining - Food resources: world food problems, changes in land use by agriculture and overgrazing, modern agriculture and its effects, fertilizer and pesticide problems, water logging and salinity - Energy resources: increasing energy needs, renewable and non-renewable, use of alternate energy sources.

MODULE II ECOSYSTEM AND BIODIVERSITY 8

Ecosystem- energy flow in the ecosystem - food chains, food webs and ecological pyramids - characteristics, structure and function of (a) Terrestrial ecosystems (forest, grassland, desert) and (b) Aquatic fresh water ecosystems (pond, lake, river) (c) Aquatic salt water ecosystems (ocean, estuary) - ecological succession.

Biodiversity - genetic, species and ecosystem diversity – hot-spots of biodiversity –biogeographic classification of India - endangered, endemic, extinct and invasive species of India - red data book - values of biodiversity: consumptive, productive, social, ethical, aesthetic and option values - threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - conservation of biodiversity: in-situ and ex-situ conservation of biodiversity

MODULE III ENVIRONMENTAL POLLUTION AND NATURAL 8

DISASTER

Definition, cause, effects and control measures of (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards - ill-effects of fireworks and upkeep of clean environment - solid waste management: types (urban, industrial, biomedical and electronic wastes), collection, processing and disposal (incineration, composting and land-fill) - natural disaster and management: flood, cyclone, drought, landslide, avalanche, volcanic eruptions, earthquake and tsunami.

MODULE IV HUMAN POPULATION, HEALTH AND SOCIAL ISSUES 6

Population and population growth, population variation among nations, population explosion, family welfare programme.

Human health: air-borne, water borne diseases, infectious diseases, risks due to chemicals in food and environment.

Sustainable development - environmental legislation and laws: water act, air act, wildlife protection act, forest conservation act, environment protection act - environmental impact assessment, steps in EIA - human rights - women and child welfare.

Case studies related to current situation

TOTAL HOURS – 30

TEXT BOOKS:

1. Erach Bharucha, Textbook for Environmental Studies For Undergraduate Courses of all Branches of Higher Education for University Grants Commission, Orient Blackswan Pvt Ltd, Hyderabad, India, 2013.
2. Benny Joseph, Environmental Studies, Tata McGraw-Hill Education, India, 2009.
3. Ravikrishnan A, Environmental Science and Engineering, Sri Krishna Publications, Tamil Nadu, India, 2015.
4. Raman Sivakumar, Introduction to Environmental Science and Engineering, McGraw Hill Education, India, 2009.
5. Venugopala Rao P, Principles of Environmental Science and Engineering, Prentice Hall India Learning Private Limited; India, 2006.
6. Anubha Kaushik and Kaushik C.P., Environmental Science and Engineering, New Age International Pvt Ltd., New Delhi, India, 2009.

REFERENCES:

1. Masters G.M., Introduction to Environmental Engineering and Science, Prentice Hall, New Delhi, 1997.
2. Henry J.G. and Heike G.W., Environmental Science and Engineering, Prentice Hall International Inc., New Jersy, 1996.
3. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. Boston, USA, 2016.

OUTCOMES:

The student will be able to

- predict the scenario of various natural resources and suggest remedies to curb the exploitation of these resources.
- identify food chain and web and its role in various ecosystems, assess the impacts on biodiversity and provide solutions to conserve it.
- analyse the impacts of pollutants in the environment and propose suitable method to alleviate the pollutants and the natural disasters.
- assess on the impact of human population and the health related issues and the ethics to be followed for sustainable life.

GEC 1213	COMPUTER PROGRAMMING II	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To provide knowledge about the benefits of Object Oriented Programming over Procedure oriented programming.
- To learn various File operations
- To expose fundamental concepts of object-oriented programming in classes, invoking methods and functions.
- To prepare students to get full use of code reusability using object oriented programming.
- To implement the basic concepts of object oriented programming using C++concepts.
- To focus on solving problems based on analyzing, designing and implementing programs in C and C++.

MODULE I PROGRAMMING IN C 7

Functions - Storage Classes - Structures and Unions – Pointers -Self Referential Structures and Linked Lists - File Processing.

MODULE II PROGRAMMING IN C++ 8

Programming in C++ - Overview of OOP in C – Inheritance - Polymorphism - Type Casting – Exceptions.

LIST OF EXPERIMENTS:

1. Functions
2. One dimensional arrays, Pointers
3. Recursion
4. Multi dimensional arrays, Linked lists.
5. Operating on Files.
6. Simple C++ program with Control statements.
7. Getting input from user console.
8. Classes, Object and Constructors.
9. Method overloading.
10. Inheritance

L – 15; P – 30; TOTAL HOURS – 45

REFERENCES:

1. Bjarne Stroustrup," The C++ Programming Language", Addison Wesley, 4th edition, ISBN-13: 978-0321563842, 2013.
2. Brian W. Kernighan and Dennis M. Ritchie, " The C Programming Language", Prentice Hall, ISBN 0-13-110362-8, 2015.
3. Bjarne Stroustrup, " Programming: Principles and Practice Using C++ ", Addison Wesley, 2nd edition, ISBN-13: 978-0321992789, 2014.
4. Brian W. Kernighan and Dennis M. Ritchie, " The C Programming Language (Ansi C Version)", Prentice Hall India Learning Private Limited, 2nd edition, ISBN-13: 978-8120305960, 1990.

OUTCOMES:

Students who complete this course will be able to

- Develop efficient algorithms for solving problems
- Handle files in C
- Use simple data structures like arrays and linked lists in solving problems.
- Write simple programs using concepts of object oriented programming.
- Implement algorithms in C++ Language.
- Demonstrate the Object Oriented Programming concepts applied in networking, web development and Database applications.

EIC 1211 ELECTRIC CIRCUIT ANALYSIS L T P C

3 0 2 4

OBJECTIVES:

- To introduce basic concepts of AC and DC circuits and to explore the basics of R,L, C circuits.
- To explore various network reduction techniques and theorems.
- To introduce the concept of transient analysis of first and second order linear circuits.
- To explore the concept of resonance in Series and Parallel circuits.
- To explore the concept of two port networks and the analysis of three-phase balanced and unbalanced circuits.

MODULE I BASIC CIRCUIT CONCEPTS 10

THEORY

Linear, Nonlinear, Unilateral, Bilateral, Active and Passive elements. Voltage and Current sources: Ideal, Practical, Dependent and Independent. Ohm's and Kirchhoff's Laws. Current and Voltage relationship in R, L, and C circuits, Impedance and admittance, Series and Parallel connections of resistances and impedances - Y-Δ transformation, Voltage and Current division in series and parallel circuits.

PRACTICAL

Experimental verification of Ohm's law, Kirchhoff's voltage and current laws.

MODULE II SINUSOIDAL STEADY STATE ANALYSIS 10

THEORY

Concept of phasor, complex impedance (z) and admittance (y) - Sinusoidal and other periodic waveforms: Average and RMS value, Form factor. Phasor representation of A.C quantities - Analysis of simple series and parallel circuits; Active power, reactive power, apparent power, power factor, concept of complex power, impedance and power triangles, energy associated with these circuits - Resonance in parallel and series circuits: Half power frequencies, Bandwidth, Quality and Dissipation factor.

PRACTICAL

Study of CRO and measurement of frequency, RMS voltage and power factor.

Steady state analysis of series RL and RC circuits.

Design and Simulation of frequency response of series resonant circuits.

Design and Simulation of frequency response of parallel resonant circuits.

MODULE III NETWORK REDUCTION TECHNIQUES AND THEOREMS 10

THEORY

Network reduction: Mesh and Nodal analysis of D.C and A.C circuits. Theorems for D.C and A.C networks:-Superposition, Thevenin's, Norton's, Maximum Power Transfer and Reciprocity.

PRACTICAL

Experimental verification of network theorems (Thevenin's, Norton's, Superposition, maximum power transfer Theorem and reciprocity theorem).

MODULE IV TRANSIENT ANALYSIS OF FIRST AND SECOND ORDER LINEAR CIRCUITS 10

THEORY

Source free RC, RL, RLC Circuit responses. Standard test signals. Step response of RC, RL, RLC series and parallel circuits. Responses of RC, RL and RLC series circuits to sinusoidal excitation.

PRACTICAL

Experimental determination of time constant of series RL, RC circuits.

Experimental determination of frequency response of RLC circuits.

MODULE V MAGNETIC AND COUPLED CIRCUITS 10

THEORY

Electromagnetism, Magnetic materials - MMF, flux, flux density, field intensity, reluctance, permeability – comparison of magnetic and electric circuits - Self and Mutual Inductance in coupled coils, Dot convention, Coefficient of coupling. Sinusoidal steady state analysis of network with coupled inductance.

PRACTICAL

Measurement of Self and Mutual Inductance

MODULE VI THREE PHASE CIRCUITS AND TWO PORT NETWORKS 10

THEORY

Three phase balanced and unbalanced voltage sources and loads– Line voltage, Phase voltage, Phasor diagram, power and Power factor in three -phase circuit. Analysis with star and delta balanced and unbalanced loads. Network terminals and ports: – Z-parameters, T-equivalent of reciprocal network, Y-parameter, π-equivalent of reciprocal networks, h-parameters and g-parameters.

PRACTICAL

Experimental determination of power in a three phase circuits by two-watt meter method.

Determination of Z, Y and h parameters of a two port network.

L – 45; P – 30; TOTAL HOURS – 75

TEXT BOOKS:

1. Boylsted, R.L., "Introductory Circuit Analysis", 12th Edition, Prentice Hall, 2010.

2. Husain, A., "Networks and Systems", 2nd Edition Khanna Publishers, 2006.

REFERENCES:

1. Edminister, J.A. and Nahvi, M., "Electric Circuits", 6thEdition, Schaum's Outline series, McGraw-Hill, 2013.

2. HAYT, Jr.W.H.,Kemmerly, J.E., and Durbin, S.M., "Engineering Circuit Analysis", 7th edition,McGraw-Hill, 2007.

3. Alexander, C.K., Matthew, N.O., and Sadiku, "Fundamentals of Electric Circuits", McGraw- Hill, 2007.

4. Decarlo, R.A. and Lin, P.M., "Linear Circuit Analysis", 2nd Edition,Oxford University Press, 2001.

OUTCOMES:

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

- Analyze the basic concepts of D.C circuits.
- Analyze the A.C circuits and understand the concept of resonance in series and parallel circuits.
- Solve the electrical circuits using the network theorems.
- Understand the transient analysis of first and second order linear networks.
- Analyze magnetic and coupled circuits
- Analyze three phase circuits and be in a position to understand the concept of two port networks.

EIC1212	ELECTRONIC DEVICES	L	T	P	C
		2	0	0	2

OBJECTIVES:

• To acquaint the students with construction, theory and characteristics of the following electronic devices.

1. P-N junction diode
2. Bipolar transistor
3. Field effect transistor
4. Rectifier, filters and regulators

• To familiarize the student with the principle of operation, capabilities and limitation of various electron devices and their applications.

MODULE I DIODES 8

Construction, working, characteristics and Applications**:** PN junction diode, Energy band diagram of PN junction diode, Biasing, Zener diode- Avalanche breakdown, Zener break down, Tunnel diode, Schottky Diode, Gunn Diode.

MODULE II BIPOLAR JUNCTION TRANSISTORS AND FIELD EFFECT TRANSISTORS 8

BJT Construction - Operation of PNP and NPN transistors – Types of Configurations - CC,CE,CB configurations, Transistor Biasing: Methods of Transistor biasing - Bias Stability - Bias Compensation - Transistor as an Amplifier - Comparison of BJT and FET, JFET- Construction - Drain and Transfer characteristics - Pinch off voltage, MOSFET - Types of MOSFET - Construction and Characteristics. Biasing FET and MOSFET.

MODULE III RECTIFIERS 7

Half wave rectifier, ripple factor, full wave rectifier, Harmonic components in a rectifier circuit, clippers, clampers, voltage multipliers.

MODULE IV FILTERS AND REGULATORS 7

Inductor filter, Capacitor filter, L- section filter, p- section filter, Multiple L- section and Multiple p- π section filter and comparison of various filter circuits in terms of ripple factors,. Simple circuit of a regulator using zener diode. Series and Shunt voltage regulators- Analysis and design- Protection circuits for voltage regulators.

TOTAL HOURS – 30

TEXT BOOKS:

1. Jacob Millman & Christos C. Halkias, “Electronic Devices and Circuits” TataMcGraw-Hill, 1991.
2. Millman J and Gabriel A, “Microelectronics”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 3rd Edition, 2000.

REFERENCES:

1. Thomas .L.Floyd, Electronic Devices- Elctron flow Version- 9th Edition,Pearson Education- Prentice Hall of India , 2012
2. S.Salivahanan, N. Sureshkumar and A. Vallavaraj, Electronic Devices and Circuits, TMH, 2008.
3. S.M. Sze, Semiconductor Devices – Physics and Technology, 2nd Edn., John Wiley, 2002.

OUTCOMES:

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

- Understand the characteristics of PN junction diode, biasing and its breakdown mechanism.
- Analyze and design amplifier circuits , oscillators and filter circuits employing BJT, FET devices.
- Acquire knowledge in Rectifier, clipper and clampers.
- Gain knowledge about the working of filters and regulators and its applications.

SEMESTER III

MAC 2181	PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The aims of this course are to

- Familiarize in solving partial differential equation of first, second and higher orders.
- Introduce basics and engineering applications of Fourier series, Laplace Transform, Fourier Transform and Z- Transform.

MODULE I PARTIAL DIFFERENTIAL EQUATIONS 8 + 2

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients.

MODULE II FOURIER SERIES 8+2

Fourier Series and Dirichlet's conditions - General Fourier series - Half range Fourier series - Parseval's identity - Harmonic Analysis.

MODULE III FOURIER TRANSFORMS 7+3

Fourier integral theorem (without proof) - Fourier transform pair - Fourier Inverse Transform – Properties - Convolution theorem - Parseval's identity.

MODULE IV APPLICATIONS OF FOURIER SERIES AND FOURIER TRANSFORMS 7+3

Applications of Fourier series and Fourier Transform to solution of PDEs having constant coefficients with special reference to Heat & Wave equations, Discrete & point Spectrum and Single pulse.

MODULE V LAPLACE TRANSFORM 8+2

Introduction to Laplace transform - Existence of Laplace Transform - Properties of Laplace Transforms - Initial & Final Value Theorems - Inverse Laplace Transform - Convolution Theorem – Circuits to signal square wave: Integral equations with unrepeated complex factors – Damped forced vibrations: repeated complex factors – Resonance - Solution of differential equations

MODULE VI Z – TRANSFORM 7+3

Introduction and Definition of Z-transform - Properties of Z- Transform - Convolution Theorem of Z-Transform - Inverse Z–transform - Convolution Theorem of Inverse Z-Transform - Formation of difference equations - Solving Difference Equations using Z-Transform.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Kreyszig .E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Grewal B.S., "Higher Engineering Mathematics", 42nd edition, Khanna Publishers, New Delhi, 2012.
3. Ramana, B.V, "Higher Engineering Mathematics" Tata Mc Graw Hill Publishing Co. New Delhi, 2006.

REFERENCES:

1. Veerarajan.T., "Engineering Mathematics", 5th edition, Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
2. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
4. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.

OUTCOMES:

After completing the course, student will be able to

- solve the partial differential equations.
- derive a Fourier series of a given periodic function by evaluating Fourier coefficients.
- apply integral expressions for the forward and inverse Fourier transform to a range of non-periodic waveforms.
- solve wave equation and heat flow equation.
- solve ordinary differential equations using Laplace transform.
- solve difference equation using Z-transform.

ENC 2181 ORAL COMMUNICATION

L	T	P	C
0	0	2	1

OBJECTIVES:

- To expose students to a range of professional contexts through podcasts for learning appropriate expressions.
- To train them in making poster presentations.
- To enable them to make effective business presentations.
- To help them learn persuasive and negotiation skills.
- To train them to debate on issues of current relevance
- To train them to participate in group discussions on current affairs

MODULE I **4**

Orientation to the Importance of Oral Communication -— Verbal and non-verbal communication -Paralinguistic features.

One-minute presentations (using Audacity/Voicethread) – Just a minute (JAM) on random topics

MODULE II **4**

Negotiating and persuading through effective arguments – to arrive at a conclusion (pair-work)

Understanding Negotiation, persuasion and marketing skills through Podcasts

Listening to short conversations and monologues for understanding real life conversations

MODULE III **4**

Making Poster presentations on current issues

Understanding nuances of making effective presentations (TED Videos)

MODULE IV **6**

Deliberation on social and scientific issues – Debates (focus on rebuttal skills and deconstructing arguments)

Viewing videos on debates (NDTV Discussions)

MODULE V **6**

Discussing social issues or current affairs in groups

Viewing group discussions and listening for specific information

MODULE VI **6**

Making full length presentation (through Voicethread) with the focus on one's career

plans and prospects (discipline specific)
Listening to interviews for understanding speakers' perception (on industry related issues)

P – 30; Total Hours –30

REFERENCES:

1. Hancock, Mark (2012). *English Pronunciation in Use*. Cambridge University Press, UK.
2. Anderson, Kenneth & et.al (2007). *Study Speaking: A Course in Spoken English for Academic Purposes* (Second Edition). Cambridge University Press, UK.
3. Hurlock, B.Elizabeth (2011). *Personality Development*. Tata McGraw Hill, New York.
4. Dhanavel,S.P (2015). *English and Soft Skills*. Orient Blackswan, Chennai.
5. Whitby, Norman (2014). *Business Benchmark: Pre-Intermediate to Intermediate.* Cambridge University Press, UK.

OUTCOMES:

On completion of the course, students will be able to

- Listen to business conversations and do related tasks.
- Deliver effective poster presentations.
- Make effective business presentations.
- Use persuasive and negotiating skills for justifying arguments.
- Participate effectively in debates.
- Speak English intelligibly, fluently and accurately in group discussions.

EIC2101 TRANSDUCER ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To give knowledge about basic measurement Systems and Units & standards.
- To provide an introductory knowledge about transducers.
- To give adequate knowledge about the characteristics of transducer.
- To have in depth knowledge about Resistive, capacitive and inductive
- transducers.
- To introduce basic knowledge about other types of transducers like
- Piezoelectric, magnetostrictive transducers and smart transducers.

MODULE I SCIENCE OF MEASUREMENT 7

Importance of measurement – Methods of measurement – Functional blocks of a measurement system - Errors - Classification of errors – Error analysis – Statistical methods – Odds and uncertainty and its analysis- Calibration methods.

MODULE II CLASSIFICATION & CHARACTERISTICS OF TRANSDUCERS 9

Definition of transducers - classification of transducers - Static characteristics : Accuracy, precision, resolution, sensitivity, linearity, threshold, hysteresis, bias, range, span and loading effect - Dynamic characteristics: Mathematical model of transducer – Zero, I and II order transducers - Response to impulse, step, ramp , sinusoidal and nonlinear inputs.

MODULE III VARIABLE RESISTANCE TRANSDUCERS 7

Principle of operation, construction details, characteristics and applications of resistance potentiometer, strain gauge, resistance thermometer, thermistor, hotwire anemometer, piezo-resistive sensor and humidity sensor.

MODULE IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS 8

Inductive Transducers: Principle of operation, Construction details,-Induction potentiometer – variable reluctance transducers – EI pick up – LVDT– synchro – MicroSyn. Capacitive transducers: Principle of operation, Construction details three types - capacitor microphone – capacitive pressure sensor - proximity sensor

MODULE V OTHER TRANSDUCERS 7

Piezoelectric transducer – Hall Effect Transducers- magnetostrictive transducer – Introduction to IC sensors -Thick & Thin film sensors (Bio Sensor & Chemical sensor), Photo emissive cells, Photo Multiplier Tube, Environmental Monitoring Sensors, Radiation Detectors

MODULE VI MEMS & NANO TRANSDUCERS 7

Introduction to MEMS – Digital transducers– Smart Transducer – Fiber optic transducer – SQUID(superconducting quantum interference device)-Introduction to nano materials - carbon nano tube - Nano transducers – different types of nano position sensors - nano actuators – applications - nano wire based solar cells.

L – 45; T – 0; Total Hours –45

TEXT BOOKS:

1. Doebelin E.O, and Manik D.N., "Measurement Systems – Applications and Design", Tata McGraw Hill, New York, 2011.
2. Neubert, H.K.P., "Instrument Transducers – An introduction to their Performance and Design", Oxford University Press, Cambridge, 2003

REFERENCES:

1. A.K. Sawhney, "A course in Electrical & Electronic Measurement and Instrumentation", Dhanpat Rai and Co (P) Ltd., 2014.
2. D. Patranabis, "Sensors and Transducers", Prentice Hall of India, 2010.
3. John P. Bentley, "Principles of Measurement Systems", 3rd edition, Pearson Education,2004.
4. D.V.S Murthy, "Transducers and Instrumentation", Prentice Hall of India, 2010.
5. Renganathan S., "Transducer Engineering", Allied Publishers, New Delhi, 2003.

OUTCOMES:

After completion of this course the students will be able to

- Carry out error analysis and find the probable error in a measurement system
- Analyze the static and dynamic characteristics of the

transducers

- Compare the construction, characteristics and operation of different variable resistance transducers
- Select the appropriate variable inductance and capacitive transducers for industrial applications
- Evaluate the characteristics and applications of piezoelectric, magnetostrictive, digital, and smart transducers
- Identify the salient features of nano transducers, nano actuators and solar cells based on nano particles

EIC2102	ELECTRICAL, ELECTRONIC AND PHYSICAL MEASUREMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide an acquaintance of units of measurements and standards.
- To introduce the student to the various measurement of electrical parameters
- To provide the analog meters used for measurements
- To bring out the importance of bridges for measurement of electrical parameters.
- To introduce knowledge of signal generators and analyzers.
- To provide awareness of measurement using Oscilloscopes

MODULE I UNITS, DIMENSIONS AND STANDARDS 6

Measurement - Units of Measurements - Basic Units and their definitions – Derived units – International system of Units – Use of Dimensional analysis – Limitations of Dimensional analysis – Standards – Primary standard – secondary standard – standard unit of length , mass , time , temperature and luminous intensity - Standard Units of Electrical Quantities and non electrical quantities – Resistance, Ampere, Volt and Watts.

MODULE II MEASUREMENT OF ELECTRICAL PARAMETERS 8

Galvanometers – Ballistic, D' Arsonval galvanometer – Theory, calibration, application – Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type, Electrodynamometer type wattmeter – Theory & its errors – Methods of correction – LPF wattmeter – Phantom loading.

MODULE III ANALOG METERS 9

D.C, A.C voltmeters, ammeters - multimeter, Energy meter, power meter, Q-meter, true RMS meter, vector impedance meter, vector voltmeter, component measuring instrument, Electronic ohm meter, Differential Voltmeter - Instrument Transformers.

MODULE IV BRIDGES 9

DC Bridges-Wheatstone bridge – Kelvin double bridge - A.C bridges – Measurement of inductance, capacitance – Q of coil – Maxwell Bridge – Wein's bridge – Hay's bridge – Schering bridge—High voltage Schering bridge – Anderson bridge – Universal Impedance bridge– Bridge sensitivity - Errors, Wagner Earthing Device.

MODULE V SIGNAL GENERATORS & ANALYZERS 7

Sine wave generator – Frequency synthesized sine wave generator – Sweep frequency generator, pulse and square wave generator—Triangular wave generator Wave analyzer – Applications – Harmonic distortion analyzer –Total harmonic distortion analyzer- spectrum analyzer.

MODULE VI OSCILLOSCOPE 6

General purpose oscilloscope - Specification of Oscilloscope - Special oscilloscopes: Digital Storage oscilloscopes – Sampling oscilloscope – Comparison between Analog and Digital oscilloscopes

L – 45; T – 0; Total Hours –45

TEXT BOOKS:

1. E.W. Golding and F. C. Widdis, "Electrical Measurements and Measuring Instruments", 5th Edition, Reem Publications,2011.
2. A.K. Sawhney, "Electrical & Electronic Measurements and Instrumentation", Dhanpath Rai & Co (P) Ltd, 2014.

REFERENCES:

1. J.B.Gupta, "A Course in Electronic and Electrical Measurements and Instrumentation", S.K. Kataria & Sons, Delhi, 2008.
2. H.S.Kalsi, "Electronic Instrumentation", Tata McGraw Hill, 1995.
3. Martia U. Reissland, "Electrical Measurement", New Age International (P) Ltd., 2001.
4. B.M.Oliver and J.M.cage, "Electronic Measurements & Instrumentation", McGraw Hill International Edition, 2009.
5. D. A. Bell, "Electronic Instrumentation and Measurements", Prentice Hall of India, 2010

OUTCOMES:

On completion of this course the student will be able to

- Use appropriate units of measurements and standards
- Choose proper meters for measurement of electrical parameters
- Suggest / Identify typical analog meters for specific applications
- Measure electrical parameters using bridges
- Generate and analyze different test signals using analyzers.
- Choose proper Oscilloscopes during measurements for different applications

EIC2103	ELECTRONIC CIRCUITS AND LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To provide basic knowledge about the characteristics of diodes and transistors
- To give adequate knowledge to design electronic circuits such as amplifiers, power converter circuits, oscillators, rectifiers and power supply circuits.
- To provide information to analyze and design analog electronic circuits by both small and large signal models.

MODULE I BIASING AND ANALYSIS OF SMALL-SIGNAL AMPLIFIERS 10

Various biasing of BJT– Design – Stability- Bias compensation, Thermal stability - Small signal analysis of Common Emitter – Small signal analysis of JFET amplifier - Cascade and Darlington connections - Bootstrapping technique - Cascade amplifier.

MODULE II LARGE SIGNAL AMPLIFIERS 9

Classification of amplifiers - Class A,Efficiency of classes A,complimentary Symmetry Class-B Power Amplifier, Calculation of power output, efficiency and power dissipation. Crossover distortion and methods of eliminating it,RC coupled amplifiers, transformer-coupled power amplifiers.

MODULE III FEEDBACK AMPLIFIER AND OSCILLATORS 10

Feedback Amplifiers : Concept of feedback Amplifiers, General characteristics of negative feedback amplifiers, Effect of Feedback on Amplifier characteristics, Voltage series, voltage shunt ,Current series and current shunt Feedback configurations.

Oscillators: Conditions for oscillations, Frequency and Amplitude Stability of Oscillators, Generalized analysis of LC Oscillators, Quartz, Hartley, and Colpitt's Oscillators

MODULE IV IC FABRICATION AND CHARACTERISTICS OF OPAMP 10

OP- AMP- internal circuit ; characteristics; DC characteristics, AC characteristics - Differential amplifier - CMRR. Applications of op-amp : Inverting and Non Inverting amplifier- summer, differentiator, integrator. Comparators, zero crossing detector, Instrumentation amplifier- data sheet interpretation of OPAMP

MODULE V WAVEFORM GENERATORS AND DATA CONVERTERS 9

Sine wave generator, Square wave generator, Triangular wave generator, function generator- D/A converter (R-2R ladder and weighted resistor types), A/D converter : Dual slope, successive approximation and flash types-data sheet interpretation

MODULE VI FILTERS AND 555 TIMERS 12

First and Second order active filters, V/I & I/V converters, Precision rectifier, peak detector, S/H circuit, 555 Timer circuit – Functional block, applications: Astable, monostable multivibrators, Schmitt Trigger- VCO-PLL

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Robert. L. Boylestad & Lo Nashelsky, "Electronic Devices & Circuit Theory", 8th edition, Pearson Education, Third Indian Reprint, 2002 / PHI.
2. Ramakant A.Gayakward, "Op-amps and Linear Integrated Circuits", 4th edition, Pearson Education, 2003 / PHI.
3. Robert F.Coughlin, Fredrick F.Driscoll, "Op-amp and Linear ICs", Pearson Education,4th edition, 2002 / PHI.

REFERENCES:

1. D.Roy Choudhary, Sheil B.Jani, "Linear Integrated Circuits", 2nd edition, New Age, 2003.
2. David A. Bell, "Electronic Devices & Circuits", Prentice Hall of India/Pearson Education, 4th Edition, Eighth printing, 2003.
3. Jacob Millman & Christos. C. Halkias, "Integrated Electronics: Analog and Digital Circuits and System", Tata McGraw Hill, 1991.

OUTCOMES:

On completion of this course the student will be able to

- Analyse the small signal amplifiers performance.
- Design and anlayse large signal amplifiers using transistor circuits.
- Evaluate the characteristics of feedback amplifiers and different type of oscilloscope.
- Carry out analysis and design of OPAMP circuits for different applications.
- Generate different wave form and convert data from one form to other.
- Apply OP amplifier for signal conditioning.

EIC 2104 ELECTRICAL MACHINES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the working principles of DC machines as Generator types, determination of their no load/load characteristics, starting and methods of speed control of motors.
- To estimate the various losses taking place in D.C. Motor and to study the different testing methods to arrive at their performance
- To familiarize the constructional details, the principle of operation, prediction of performance, the methods of testing the transformers and three phase transformer connections.
- To study the working principles of AC machines as Generator types, determination of their no load/load characteristics,
- To study the working principles of Special electrical machines and its types, applications

MODULE I DC GENERATORS 6

DC Generator: Construction features, emf equation of dc generator, methods of excitation, losses condition for maximum efficiency, armature reaction, interpoles and compensating winding, commutation, methods of improving commutation, characteristics of separately excited and self excited dc generator

MODULE II DC MOTOR 9

Working principle, voltage equation, condition for maximum power, characteristics, operating characteristics of dc motor, torque developed, starting, 3 point and 4 points

MODULE III TRANSFORMER 8

Single phase transformer – equivalent circuit, phasor diagram, Working principle, Construction, types, EMF equation, Transformer on no load and on load, vector diagram, regulation of transformer, losses &efficiency, condition for maximum efficiency, Auto transformer. Introduction to three phase transformer connections

MODULE IV SYNCHRONOUS MACHINE 8

Alternator - Construction and principle of operations Equation of induced EMF and Vector Diagram-Voltage regulation; Synchronous motor - Starting methods, Torque, V

-curves, Speed control techniques

MODULE V AC MACHINES 9

Induction motor, Construction and principle of operation, Classification of induction Motor, Torque equation, Condition for maximum torque, Equivalent Circuit, Power losses, Efficiency, Starting methods and Speed control.

MODULE VI SPECIAL MACHINES 9

Types of single phase motor, Double revolving field theory, Cross field theory, Capacitor start capacitor run motors, Shaded pole motor, Repulsion type motor, Universal motor, Hysteresis motor, Permanent magnet synchronous motor, Switched reluctance motor, Brushless D.C motor(BLDC),stepper motor

L – 45; T – 0; Total Hours –60

TEXT BOOKS:

1. Nagrath I. J and Kothari D. P. ‘Electric Machines’, Fourth Edition, Tata McGraw Hill Publishing Company Ltd, 2010.
2. B.L Theraja ‘Textbook of Electrical Technology : AC and DC Machines (Volume - 2) 1st Revised Edition , S. Chand & Company Ltd-New Delhi

REFERENCES:

1. P. S. Bimbhra Electrical Machinery 7th Edition Khanna Publishers, 2011
2 .E. G. Janardanan Special Electrical Machines.2014

OUTCOMES:

Students can able to

- Analyze the characteristics of DC generator and DC motor
- Test the transformer for various load conditions
- Analyze the speed-torque characteristics of induction motor
- Solve the electrical parameters problems in alternators

EIC 2105 TRANSDUCER ENGINEERING LABORATORY

L	T	P	C
0	0	3	1

OBJECTIVES:

- To provide practical knowledge in sensors and transducers.
- Emphasis on characteristics and response of various transducers like resistive, inductive and capacitive type.

LIST OF EXPERIMENTS

1. Characteristics of LDR and phototransistor
2. Characteristics of Temperature Transducer(RTD, thermocouple and IC temp. sensor) - Temperature compensation circuit
3. Thermistor characteristics and its linearization
4. Characteristics and signal conditioning of Strain Gauge and Load cell
5. Characteristics of Capacitive Transducer
6. Position transducer (potentiometer- Loading Effect of potentiometer, LVDT)
7. Characteristics of Hall Effect Voltage Sensor
8. Characteristics of Piezoelectric Transducer
9. Characteristics of synchro
10. Humidity sensor and piezoresistive sensor
11. Step response of RTD and thermocouple
12. Response of Digital transducer
13. Characterisitcs of Fibre optic transducer

P – 30; Total Hours –30

OUTCOMES:

After completion of this course the students will have

- An enhanced knowledge in characteristics of various transducers like resistive, inductive and capacitive type.
- Skills to use transducer for Instrument and control systems applications.

		L	T	P	C
EIC 2106	**ELECTRICAL MACHINES & MEASUREMENT LABORATORY**	**0**	**0**	**3**	**1**

OBJECTIVES:

- To calibrate and test the voltmeter and Ammeter
- To measure the unknown resistance, Capacitance and inductance
- To test various load conditions on DC shunt and series motors and generators

LIST OF EXPERIMENTS

1. Calibration and testing of Voltmeter and Ammeter.
2. Calibration and testing of Wattmeter
3. Measurement of resistance using Kelvin Double Bridge and Wheatstone Bridge
4. Measurement of Capacitance using Schering Bridge
5. Load test on dc shunt motor to draw speed – torque and horse power – efficiency characteristics
6. Speed Control of a D.C Shunt Motor
7. Swinburne's Test on dc motor.
8. Load test on single phase induction motor to determine its characteristics

9 To draw the equivalent circuit of single phase induction motor and determine performance parameters

10. Conduct an experiment to draw V and Λ curves of synchronous motor at no load and load conditions.

P – 30; Total Hours –30

OUTCOMES:

After completion of this course the students can

- Able to calibrate the voltmeter and ammeter
- Able to measure the unknown resistance, Inductance and capacitance
- Test the DC machines and AC machine for various load conditions
- Able to analyze the characteristics and performance of AC and DC motors

EIC 2107	**ELECTRONIC CIRCUITS AND LINEAR INTERGRATED CIRCUITS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1**

OBJECTIVES:

- To familiarize the students with the analysis and design of basic Transistor,
- amplifier circuits, power supply and oscillators
- To study and verify the characteristics of Op-Amp.
- To design and verify the linear and non-linear applications of Op-Amp
- To verify the operation of special purpose ICs namely 555 timer

LIST OF EXPERIMENTS

1. Characteristics of BJT for CE configuration.
2. Characteristics of FET.
3. Characteristics of Half wave and Full wave Rectifier.
4. Design and testing of Hartley oscillators.
5. Design and testing of collpitts oscillators.
6. Series and shunt voltage regulator.
7. Frequency Response of CE amplifier
8. Characteristics of op-amp and op-amp linear applications.
9. Waveform generation using op-amp
10. 555 timer in mono stable and Astable operation
11. Instrumentation amplifier (IC form)

P – 30; Total Hours –30

OUTCOMES:

On completion of this course the student will have skills to

- Design simple amplifier circuits.
- Analyse and design Voltage regulators
- Design simple linear integrated circuits like comparator, Astable and Monostable multivibrator using Op-Amp.
- Design waveform generation circuits.

SEMESTER IV

ENC 2282	WRITTEN COMMUNICATION	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To help students identify content specific vocabulary and learn its usage.
- To expose them to reading for specific purposes, especially in professional contexts.
- To expose them to the process of different kinds of formal writing.
- To help them learn corporate correspondence for different purposes.
- To train them in preparing effective applications with résumé
- To make them write different types of reports.

MODULE I 4

Introduction - process of writing – Fundamentals of academic and professional writing – Understanding short, real world notices, messages, etc.

MODULE II 4

Reading industry related texts (ex. Manufacturing, textile, hospitality sector etc.) for specific information.

Writing Instructions and recommendations

MODULE III 6

Understanding format and conventions of writing email, memo, fax, agenda and minutes of the meeting.

Writing email, memo, fax, agenda and minutes of the meeting for various purposes (industry specific)

MODULE IV 6

Viewing letter of application and Résumé, letter calling for an interview, letter of inquiry and Promotional letter

Writing Functional résumé and letter of application using Edmodo,

MODULE V 6

Viewing a Video and reading a case study (industry specific) – collaborative writing using Edmodo –reading and information transfer

Writing reports- Survey, feasibility and progress – exposure to discipline specific reports

MODULE VI **4**

Writing Statement of purpose (Higher Education)-- Justifying and writing about one's preparedness for job (Statement of Purpose highlighting strengths and weaknesses) – Peer evaluation skills through Edmodo.

P – 30; Total Hours –30

REFERENCES:

1. Riordan,D (2013). *Technical Report Writing Today*. Cengage Learning, 10th edition. USA.
2. Oliu, W. E., Brusaw, C.T., & Alred, G.J.(2012). *Writing that Works: Communicating Effectively on the Job* . Bedford/St. Martin's. Eleventh Edition.
3. Garner, B.A. (2013). *HBR Guide to Better Business Writing (HBR Guide Series)*. Harvard Business Review Press. USA.
4. Sharma, R.C. & Krishna M. (2002). *Business Correspondence and Report Writing*. Tata MacGraw – Hill Publishing Company Limited, New Delhi.
5. Macknish, C. (2010). *Academic and Professional Writing for Teachers*. McGraw-Hill Education. USA.
6. Whitby, Norman (2014). *Business Benchmark: Pre-Intermediate to Intermediate.* Cambridge University Press, UK.

OUTCOMES:

On completion of the course, the students will have the ability to

- Identify content specific vocabulary and also use them in appropriate contexts.
- Demonstrate reading skills with reference to business related texts.
- Draft professional documents by using the three stages of writing.
- Create different types of documents for various corporate correspondences.
- Write effective letter of applications, résumé and statement of purpose.
- Write business related reports efficiently.

EIC2211	**THERMODYNAMICS AND FLUID MECHANICS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVES:

- To study the concepts and laws of thermodynamics and their application in analyzing cyclic process
- To gather knowledge in the working of various thermal systems like engines and turbines
- To learn the basic properties of fluids and laws of fluid mechanics
- To understand the laws governing the fluid flow

MODULE I BASIC CONCEPTS AND LAWS OF THERMODYNAMICS 8

Basic concepts, types of thermodynamic systems, Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics – concept of temperature and heat, Concept of ideal and real gases, First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process, Second law of thermodynamics – Kelvin's and Clausius statements.

MODULE II POWER GENERATING MACHINES 10

Layout of thermal power station, Standard Rankine cycle, Air standard Cycles for IC engines: Otto cycle - plot on P-V, T-S planes, Thermal efficiency and working of SI engines, Diesel cycle - plot on P-V, T-S planes, Thermal efficiency and working of CI engines.

MODULE III COMPRESSORS, REFRIGERATION AND AIR CONDITIONING 10

Classification of Compressors, Vapour Compression Refrigeration System, Air conditioning systems, Basics of Heat Transfer

MODULE IV BASIC CONCEPTS AND PROPERTIES OF FLUIDS 12

Introduction, Properties of fluids - Density, Specific weight, Specific volume, Specific gravity, Viscosity, Compressibility,Vapour pressure, Surface tension and Capillarity, Fluid pressure and its measurement.

MODULE V FLUID FLOWS AND FLUID MECHANICS 8

Types of Fluids, Classification of fluid flows, the concepts of streamline and stream tube, the principles of continuity, energy and momentum, Bernoulli's Equation, flow measurement by Orifice meter, Venturi meter and Pitot tube.

MODULE VI TURBINES AND PUMPS 12

Turbines: definition and classifications – Pelton turbine, Francis turbine, Kaplan turbine – working principles, velocity triangle, work done, specific speed, efficiencies, performance curve for turbines.

Pumps: definition and classifications - Centrifugal pump, Reciprocating pump - working principles, velocity triangles, specific speed, efficiency and performance curves.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Nag P K, “Engineering Thermodynamics”, Tata McGraw Hill, Delhi, 2004.
2. Bansal R.K “Fluid Mechanics and hydraulics Machines“, (5th edition), Laxmi Publications (P) Ltd, New Delhi, 1995.

REFERENCES:

1. Cengel Y Al and Boles M A "Thermodynamics, An Engineering Approach” Tata McGraw Hill, 2003.
2. Holman J P, “Thermodynamics”, Tata McGraw Hill, 1998.
3. Holman J P, "Heat Transfer", 9th edition, Tata McGraw Hill Inc., New York, 2008.
4. White, F.M., Fluid Mechanics”, Tata Mc Graw hill, 5th Edition, New Delhi.-2003.
5. Streeter Wylie and Bedford, "Fluid Mechanics", McGraw- Hill Publishing Company Limited, New York, 1998.

OUTCOMES:

Students will be able to

- Realize and apply the laws of thermodynamics to any real life situation.
- Design and analyze steam and air power cycles.
- Elite the various Compressors, Refrigeration and Air conditioning systems.
- Conceptualize the behavior of fluids and fluid flows.
- Recognize the behavior of fluids under static and dynamic conditions.

Apply knowledge in the design and analysis of hydraulic turbines and pumps.

EIC 2212 DIGITAL ELECTRONICS

L	T	P	C
3	1	0	4

OBJECTIVES:

- To provide knowledge on various number systems and to simplify the mathematical expressions using Boolean functions – simple problems.
- To impart implementation of combinational circuits.
- To learn the design of various synchronous and asynchronous circuits.
- To expose the students to various memory devices.

MODULE I NUMBER SYSTEMS & BOOLEAN ALGEBRA 9

Number systems and data representation, Binary, Octal, Hexadecimal representations and their conversions, Signed numbers and floating point number representation. Codes, Basic logic operations, Boolean algebra, De-Morgan theorems, Algebraic reductions, Digital logic gates-NAND and NOR based logic

MODULE II GATE –LEVEL MINIMIZATION & GATE LEVEL IMPLEMENTATION 9

Canonical logic forms, Extracting canonical forms, Karnaugh maps and Tabular methods, Don't care conditions, minimisation of multiple output functions. NAND and NOR implementation of Boolean functions – Two –Level Implementaion and Multilevel implementation.

MODULE III COMBINATIONAL CIRCUITS 12

Synthesis of combinational functions: Arithmetic circuits-Adder, carry look-ahead adder, number complements subtraction using adders, signed number addition and subtraction, Multiplier (any one type) BCD adders. Design of comparators, code converters, encoders, decoders, multiplexers and demultiplexers. Function realization using gates & multiplexers.

MODULE IV SEQUENTIAL LOGIC CIRCUITS 12

Flip flops - SR, D, JK and T. Design of synchronous sequential circuits: state diagram; state reduction; state assignment, Counters: synchronous, asynchronous, up-down and Johnson counters, Modulo counter; shift registers.

MODULE V ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Design of asynchronous sequential machines – Transition Table, Flow Table, Race conditions, stability considerations-Hazards

MODULE VI PROGRAMMABLE LOGIC DEVICES / LOGIC FAMILIES 9

Memories : ROM, PROM, EPROM. PLA, classification of PLD, FPGA, digital logic families: TTL, ECL,CMOS

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. M.M. Mano and Ciletti M.D., , "Digital Design", 4th Edition, Prentice Hall of India,2006
2. Floyd T.L, "Digital Fundamentals", 8th Edition, Universal Book Stall, New Delhi, 2005.
3. J.P. Uyemura, "A First Course in Digital Systems Design", Brooks/Cole Publishing Co. (Available from Vikas Publishing House in India).

REFERENCES:

1. J.M. Rabaey, "Digital Integrated Circuits: A Design Perspective", 2nd Edition, Prentice Hall of India, 2005.
2. D. Hodges and H. Jackson, "Analysis and Design of Digital Integrated Circuits", 2nd Edition, McGraw Hill, 1988.
3. N.H.E. Weste, and K. Eshraghian, "Principles of CMOS VLSI Design: A Systems Perspective", 2nd Edition, Pearson Education Inc., (Asia), 2002.

OUTCOMES:

- At the end of the course, the students would be acquainted with the basic concepts of digital electronics.
- Students will be able to implement the logics in combinational circuits.
- Students will use the skill to design the synchronous and asynchronous circuits.

EIC2213	INDUSTRIAL INSTRUMENTATION – I	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide sound knowledge about various techniques used for the measurement of Industrial Parameters.
- Introduction to Load cells, torque meter and various velocity pickups.
- Exposure to various accelerometer pickups, vibrometers, density and viscosity measuring instruments.
- To provide an adequate knowledge about pressure measuring instruments.
- To provide an idea about the temperature standards, calibration and signal conditioning used in RTD's.
- To provide knowledge regarding characteristics of thermocouples and signal conditioning modules.
- To learn about measuring high temperatures with pyrometers.

MODULE I MEASUREMENT OF FORCE, TORQUE AND VELOCITY 7

Electric balance – Different types of load cells – Magnets - Elastic load cells– Strain gauge load cell – Different methods of torque measurement – Strain gauge, relative regular twist – Speed measurement – Revolution counter-Capacitive tacho-drag cup type tacho – D.C. and A.C. tacho generators – Stroboscope.

MODULE II MEASUREMENT OF ACCELERATION AND VIBRATION 7

Accelerometers – LVDT, piezoelectric, strain gauge and variable reluctance type accelerometers. – Mechanical type vibration instruments – Seismic instrument as an accelerometer and vibrometers – Calibration of vibration pickups.

MODULE III PRESSURE MEASUREMENT 10

Modules of pressure – Manometers – Different types – Elastic type pressure gauges – Bourdon type bellows – Diaphragms – Electrical methods – Elastic elements with LVDT and strain gauges – Capacitive type pressure gauge – Piezo resistive pressure sensor - Measurement of Vacuum – McLeod gauge– Thermal conductivity gauges - Ionization gauge – Testing and calibration of pressure gauges – Dead weight tester. Differential Pressure Transmitter, Low Pressure Measurement.

MODULE IV TEMPERATURE MEASUREMENT 7

Different types of filled in system thermometer Bimettalic thermometer – Electrical methods of temperature measurement, signal conditioning of industrial RTD and their characteristics - three lead and four lead RTD. Fabrication of industrial thermocouples – signal containing of thermocouples - commercial circuits for cold junction compensation smart temperature transmitter and its advantages.

MODULE V HIGH TEMPERATURE MEASUREMENTS 7

Types of thermocouple - Response of thermocouple – special techniques for measuring high temperature using thermocouples. Radiation method of Temperature measurements - Radiation fundamentals, Total Radiation and selective Radiation , pyrometer optical pyrometer-Two colour radiation pyrometers. Fibre optic temperature measurements systems.

MODULE VI CASE STUDY 7

Selection of pressure, Temperature, using sensors and transducers: mounting and installations -Typical application of sensors in chemical industries petrochemical industries -iron and steel industries and Bio medical instrumentation.

L – 45; Total Hours –45

TEXT BOOKS:

1. E.O. Doebelin, "Measurement Systems – Application and Design", Tata McGraw Hill Publishing Company, 2008.
2. R.K. Jain, "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 1999.

REFERENCES:

1. D.S. Kumar, "Mechanical Measurements and Control", 3rd edition, Metropolitan books, 1979.
2. Jone's "Industrial Technology", Vol.2, Butterworth – Meineman, International Edition, 2003.

OUTCOMES:

After completion of this course the students will be able to

- Know relevant details pertaining to Process Industries.
- Select transducers like LVDT, Strain gauge and load cells etc to identify
- pplications in various process Industries.
- Effectively carry out operation and maintenance of pressure, temperature and flow instruments in process industries.

EIC2214	DIGITAL ELECTRONICS LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To study Boolean function and implementation using basic gates.
- To design and implement combinational and sequential circuits using basic gates and specialized ICs

LIST OF EXPERIMENTS

1. Realization of basic gates using universal logic gates
2. Design and implementation of Adders and Subtractors using logic gates.
3. Design and verification of code converters using logic gates
4. To exhibit the use of IC 7483 as 4–bit binary Adder/ Subtractor and BCD adder
5. To design and implement a 2 Bit Magnitude Comparator using logic gates and 8 Bit Magnitude Comparator using IC 7485
6. Design and implementation of encoder and decoder using logic gates and study of IC 7445 and IC 74154
7. Design and implementation of Multiplexer and De-multiplexer using logic gates and study of IC 74150 and IC 74154
8. Implementation and study of SR ,JK, D, T Flip Flops.
9. Design and implementation of 3-Bit synchronous counter
10. Construction and verification of Asycnhronous counters
11. Implementation of universal shift registers / Modulo counters using ICs.

P – 30; Total Hours –30

OUTCOMES:

On Completion of this course the student will be able to formulate

- The design, implementation and operation of combinational circuits like adders, subtractors, code converters, multiplexer – demultiplexer, encoder – decoder and magnitude comparator.
- The design, implementation and operation of sequential circuits like flip flops, counters and shift registers.
- To select and Integrate digital circuits for mini projects.

EIC2215	INDUSTRIAL INSTRUMENTATION LABORATORY- I	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To provide good hands on experience on industrial instruments.
- To familiarize with pressure Instruments, vacuum Instruments, pyrometers.
- They may able tackle any problem when working in core industry.
- To expose the students pertaining to various lab instruments which they will come across in the Industry.

LIST OF EXPERIMENTS

1. Measurement of Pressure using Diaphragms, Bellow and Bourdon.
2. Measurement of acceleration, velocity displacement using Accelerometer.
3. Torque measurement.
4. Vacuum pressure measurement
5. IR spectrophotometer UV-visible spectrophotometer
6. Speed control of stroboscope
7. Signal conditioning of RTD
8. Cold junction compensation of thermocouple.
9. Radiation pyrometer.
10. Blood pressure measurement, ECG and Oxymetry
11. Study on industry standards
12. Three way and Five way manifold

P – 30; Total Hours –30

OUTCOMES:

After completion of this course the students will be able to

- Know various instruments pertaining tom process industries.
- Acquire knowledge in load cell, strain gauge and torque measurements.
- Acquire knowledge in spectrometer, measurements of temperature and related cold junction compensation and high temperature measurement using radiation parameter.
- This will be stepping stone for the student to work in process industries

SEMESTER V

MSB 3181 LEADERSHIP & CEO TRAINING

L	T	P	C
3	0	0	3

OBJECTIVES:

The course aims at

- Bringing about positive transformation in students' attitude.
- Building unique leadership competencies that would ensure successful transition of students across all career stages.
- Sensitizing students to identify their strengths & weakness and training them to deal with it
- Assisting students in enhancing their expressive ability and inducing a high level of self confidence to manage both business and emotions
- Training students to become more adaptable and flexible to changing business environment

MODULE I INTRODUCTION TO LEADERSHIP 12

Leadership concept - meaning, definitions, importance of leadership, leadership traits. Leadership functions- general functions, listening, observing, managing and decision making. Components of leadership - leaders, followers and situation. Leadership theories – Trait theory, Skills theory, Style theory, Situational theory, Transformational theory, Transactional theory, Path Goal Theory and LMX. Assessing emotional intelligence and exploring the capabilities and inherent traits through psychometric tests - Multi factor leadership questionnaire and personal reflections

MODULE II LEADERSHIP STYLE AND COMMUNICATION 08

Leadership styles-visionary, Coaching, Affiliative, Democratic, Pacesetting Commanding, Transformational, Transactional. Autocratic, Participative, Laissez-Faire Leader versus Managers. Leadership communication - Rationale, tactic, assertive, formal, informal, communication in crisis- leadership and negotiations, Leadership Presentations-convincing and impressive style

MODULE III LEADERSHIP ROLES 08

Facets of leadership- Leader as an individual – personality and leadership, values, attitudes and ethics of a leader. **Leader as a relationship builder-**

empowering people to meet higher order needs, initiating organization wide motivational programs, involvement with all stakeholders- focusing on organization growth. **Leader as an inspirer**- motivation and leadership, recognizing and appreciating contributions, empowering others to lead **Leader as an innovator** –leader's role in shaping culture and values in an organization. **Leader as a Liaison- Leader as team player**

MODULE IV LEADERSHIP CHALLENGES AND STRATEGIES 09

Challenges in leadership: Perception of organization culture and values, interpreting the power dynamics in the organization, establishing work life balance. Bad leadership – Reasons and impact.-Case Study of Marissa Mayer-Yahoo.Inc Organizational transformation through efficient leaders-Case study of Apple Inc. Blue Ocean Leadership-Steps to Blue ocean Leadership-Four Pillars of Blue Ocean leadership-Blue Ocean leadership grid

MODULE V LEADERSHIP AND CEO TRAINING 08

Leader as a CEO: Traits of a successful CEO, Key responsibilities of a CEO, the path to be a CEO ,Training on Board Room Discussions, Meeting the CEO –Live sessions with industry CEO's. Requirements of Leadership: - Cognitive skills, Interpersonal skills, Business skills, Strategic skills. Role of Emotional Intelligence in taking up key-positions in the organization.

Teaching Pedagogy:

Nurturing – Based on the identified strengths and weaknesses, training will be given to enhance the strengths and overcome the weakness.

Assessment - Continuous evaluation will be effected through group discussions, oratory assignments and situational enactments. Pre-and post-training assessment through peer reviews and faculty feedback.

Sustained development – Training will be imparted for self-development and monitoring of leadership skills to ensure sustained applicability of the skills learnt.

L – 45; Total Hours – 45

REFERENCES:

1. Andrew J DuBrin. "Leadership: Research Findings, Practice, and Skills", 8th Edition, South-Western College Pub, 2015.
2. Yukl G , "Leadership in Organisations", 8th Edition, Pearson Education, 2013.
3. Richard L Daft , "Leadership", 5th Edition, South Western Cengage

Learning 2012.
4. Stephen P. Robbins and Timothy A. Judge. “Organizational Behaviour”, 15th Edition, New Delhi: Pearson, 2013.
5. Fred Luthans, “Organizational Behavior, An Evidence Based Approach”, 12th Edition, New Delhi: McGraw Hill Education, 2013.
6. Emotional Intelligence, Why it can matter no more than IQ by Daniel Goleman (include a book) Publisher: Bloomsbury Publishing India Private Limited; Latest edition (2017)
7. Primal Leadership: Unleashing the Power of Emotional Intelligence by Prof Daniel Goleman , Richard Boyatzis and McKee ,Harvard Business Review Press

Recommended Readings:

1. Jim Collins, (2001). “Good To Great: Why Some Companies Make the Leap...And Others Don't”, Random House Publishers India Pvt.Ltd, New Delhi
2. George, B. with Sims, P. True North: Discover Your Authentic Leadership, The Times Group Books; First edition (1 October 2015)
3. Kim, W. C., & Mauborgne, R. A. (2014). Blue ocean strategy, expanded edition: How to create uncontested market space and make the competition irrelevant. Harvard business review Press.
4. Leadership Wisdom by Robin Sharma Jaico Publishing House;

OUTCOMES:

The students will be able to

- Explore through self-introspection one’s own leadership style, their strength and weakness
- Gain self confidence to lead a team in the organization
- Realize the role of leadership in making or breaking of an organization
- Acquire the practice of self introspection and development of leadership competencies thorough continuous efforts
- Manage their own emotions as well as other resulting in successful relationship building with all stakeholders

MSB 3182 SOCIAL ENTREPRENEURSHIP

L	T	P	C
3	0	0	3

OBJECTIVES:

- To be able to understand the field of social entrepreneurship and Social problems
- To be able to describe and understand the traits of social entrepreneurs
- To recognize the social business opportunities
- To synthesize the resource mobilization ways for social entrepreneurship
- To understand the social entrepreneurship models
- To recognize the impact of social entrepreneurship on societies

MODULE I INTRODUCTION TO SOCIAL ENTREPRENEURSHIP 07

Introduction - Emergence and Development of Social Entrepreneurship. Social Problems in India: An Overview. Social Development: The Indian Scenario. Emergence of Social Entrepreneurs and Sustainable Solutions to Social Problem. Characteristics and Context of Social Entrepreneurship .The Role of Social Entrepreneurship in Societies & Economies.

MODULE II SOCIAL ENTREPRENEURSHIP: DRIVERS AND CHALLENGES 07

The Drivers of Social Entrepreneurship. Elements of the Social Entrepreneurial Personality. Challenges of financial constraints. Challenge to attract and cultivate talented workers. Challenge of evaluation of social entrepreneur impact. Challenge of scaling and its impact. Cases

MODULE III SOCIAL ENTREPRENEURSHIP: OPPORTUNITY RECOGNITION 07

Opportunity Recognition and Planning Process. Opportunities for Social Entrepreneurs. The Nature of Social Entrepreneurial Opportunities. Social Problems into Opportunities. Idea development and conceptualization of social problem. Cases

MODULE IV RESOURCE MOBILIZATION FOR SOCIAL VENTURE 08

Resources at Initial Stage. Social Network as a role of Social Capital. Team and Collective Efforts. Need and Determination of Important Resources. Resource of

Knowledge, Skills and Abilities. Overview of venture capital and angel investment. Cases

MODULE V BUSINESS MODELS AND BUSINESS PLAN FOR SOCIAL ENTERPRISES 08

Design Principles of Social Entrepreneurship Business Models , Evaluation of the Root Cause of a Societal Problem. Developing business plan for social ventures. Developing an investor presentation. Feasibility study and report. How to start a business - Procedures for registration of small scale industry

MODULE VI THE IMPACT OF SOCIAL ENTREPRENEURSHIP ON SOCIETY 08

Static Impact of Social Entrepreneurship. Impact of Charitable NGOs vs. Social Entrepreneurship, Impact of For-Profit Companies vs. Social Entrepreneurship. Social entrepreneurship report preparation by students.
Case Study of Social Entrepreneurs

L – 45; Total Hours –60

REFERENCES:

1. "Social Entrepreneurship : New models of sustainable social change" . Alex Nicholls, Oxford University Press 2006
2. The Process of social value creation : A multiple case study on Social Entrepreneurship in India , Archana Singh Springer 2016
3. "Social Entrepreneurship and social business" Christine K Volkmann, Springer Gabler 2012
4. "Social Entrepreneurship" Manuel London ,Routlege, 2010

OUTCOMES:

The students can able to

- Conceptualize social entrepreneurship in terms of a theoretical framework between changing social values and institutions
- Think and communicate about social values
- Learn about practical models of social change to launch, lead, manage, and evaluate a social venture
- Analyze funding needs and sources for the social venture

Experience the ideas can be critically and collaboratively examined prior to commitment.

ENC 3181 **COMMUNICATION AND SOFT SKILLS - I CAREER CHOICE**

L	T	P	C
0	0	2	1

OBJECTIVES:

- To create awareness of industrial trends and market demands.
- To encourage students to explore career opportunities in an industry and evaluate themselves in relation to industry preparedness

MODULE I **6**

Knowledge about specific industry-Discussion with industry experts --Self evaluating career prospects through survey questionnaire (based on his/her eligibility for taking up a job (industry preparedness)

MODULE II **6**

. Knowing case studies of industries(pertaining to students' choice of career)- Reading and discussing about job markets-goal setting, working on creativity.

MODULE III **4**

SWOC analysis and discussing outcomes--exploring mini projects or case studies of latest industries.

MODULE IV **6**

Writing statement of purpose pertaining to career choice---- Outcomes

MODULE V **8**

Project or case study presentations (Presentation in pairs) -mini project report or case study report.

Total Hours – 30

REFERENCES:

1. Brown,D.(2002). Career Choice and Development. Wiley,J. & Sons.USA
2. Lore,N.(1998). The Pathfinder: How to Choose or Change Your Career for a Lifetime of Satisfaction and Success. Simon & Schuster.USA.
3. Shell, G.R.(2013). Springboard Launching your Personal Search for Success.Portfolio.USA.

OUTCOMES:

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

- Speak about their career choice.
- Self evaluate their strengths and weaknesses and speak about it.
- Make effective presentations on case studies or relating to projects.
- Write the statement of purpose relating to their career choice.

EIC3101 CONTROL SYSTEMS

	L	T	P	C
	3	1	0	4

OBJECTIVES:

1. To understand the use of transfer function models for analysis of different systems.
2. To provide adequate knowledge in the time response of systems and steady-state error analysis.
3. To accord basic knowledge in obtaining the open-loop and closed-loop frequency responses of systems and design of compensators.
4. To introduce the different techniques for stability analysis of systems.
5. To introduce state variable representation of systems and study the effect of state feedback and need for pole placement. To understand the basics involved in the design of state observers.
6. To understand the different features of nonlinear systems and different techniques involved in its linearization and stability analysis.

MODULE I SYSTEM MODELLING 12

Introduction to Control System - Open loop and Closed loop systems - Differential equation representation of systems - Transfer function representation of systems - Modelling of Electric systems, Translational and rotational mechanical systems - Block diagram reduction Techniques - Signal flow graph

MODULE II TIME DOMAIN ANALYSIS 8

Time domain specifications - First Order Systems - Step and Impulse Response analysis of second order systems - Error coefficients - Generalized error series - Steady state error - P, PI, PD and PID modes of feedback control - Time response analysis

MODULE III FREQUENCY DOMAIN ANALYSIS 12

Frequency Response - Bode Plot - Polar Plot - Nyquist Plot - Frequency Domain specifications from the plots - Correlation between frequency domain and time domain specifications - Constant M and N Circles - Nichols Chart - Use of Nichols Chart in Control System Analysis - Series, Parallel, Series-Parallel Compensators - Effect of Lag, lead and lag-lead compensation on frequency response - Lag/Lead compensator design using Bode plots

MODULE IV SYSTEM STABILITY ANALYSIS 6

Stability - Characteristics equation - Routh-Hurwitz Criterion - Root Locus Technique, Construction of Root Locus, Stability, Dominant Poles, Application of Root Locus Diagram - Nyquist Stability Criterion - Relative Stability

MODULE V STATE MODEL 10

State space representation of linear and time-invariant Systems - State equations - Transfer function from/to State Variable Representation - Solutions of the state equations - Concepts of Controllability and Observability - State space representation for Discrete-time systems - Effect of State Feedback - Necessary and Sufficient Condition for arbitrary pole placement - Pole Placement Design - Design of state observers

MODULE VI INTRODUCTION TO NON-LINEAR SYSTEMS 12

Features of linear and non-linear systems - Classification and types of non-linearity - Phenomena peculiar to non-linear systems - Linearization based on Taylor’s series expansion, Jacobian Linearization - Phase trajectory and its construction - Singular points - Existence of limit cycles - Phase-plane analysis of linear and non-linear systems - Isocline method - Describing function of typical non-linearities - Stability analysis by Describing function method - Stability analysis by Lyapunov’s indirect and direct methods

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Gopal, M., "Control Systems, Principles and Design", Tata McGraw-Hill Pub. Co., 2nd Edition, New Delhi, 2012.
2. Nagrath, I.J. and Gopal, M., "Control System Engineering", 4th edition, New-age International (P) Ltd., New Delhi, 2006.

REFERENCES:

1. Ogata, K., "Modern Control Engineering", Prentice Hall of India Ltd., 4th Edition, New Delhi, 2006.
2. Kuo, B.C., "Automatic Control Systems", Prentice Hall of India Ltd., New Delhi, 2003.

OUTCOMES:

On completion of the course the student will be able to

- Obtain the mathematical model of physical system.
- Analyse physical systems using block diagram algebra and SFG
- Find the response of different physical systems for standard test inputs
- Draw frequency response plots and determine the relative stability
- Analyse the stability of control system using root locus and RH criterion
- Design phase lag, phase lead compensations to get desired performance

EIC3102	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		3	0	0	3

OBJECTIVES:

During the course the student will be able

- To know the concept of microprocessors and microcontroller.
- To acquire knowledge on interfacing devices.
- To learn about simple applications of microcontroller.
- To familiarize with advanced processors.

MODULE I ARCHITECTURE OF MICROPROCESSOR AND MICROCONTROLLER 7

Introduction to microprocessor and microcontroller architecture, Comparison, Advantages and applications of each Harvard and Von Neumann architecture, RISC and CISC comparison, Definition of embedded system and its characteristics- 8085 microprocessor architecture -Intel 8051 microcontroller - architecture, pin diagram, special function registers, stack, external memory - interface with 8051, I/O ports.

MODULE II 8051 INSTRUCTION SET 9

8051 instruction set – Moving data – Introduction – Address modes – External data moves – Code memory data moves – Push & pop – Data exchanges – Logical operations – Introduction – Byte level logical operation – Bit level – Rotate and swap – Arithmetic operation – Introduction – Flags – Increment & decrement – Addition – Subtraction – Multiplication & division – Decimal arithmetic – Jump and call instructions – Introduction – Range – Short and long absolute range – Jumps – Calls –Stack –Interrupts and returns – Detailed interrupts.

MODULE III 8051 TIMERS, INTERRUPTS, AND SERIAL PORTS 8

ON – Chip Timers – Modes of operation – mode 0 – mode 1 – mode 2 – mode 3, On chip serial port – Features modes – Interrupts – Timer Flag – Serial port Interrupt – External Interrupts – Reset – Interrupt control – Interrupt Priority – Interrupt Destinations, Timer /Counter Programming in assembly and C, Serial Port Programming in assembly and C, Interrupts Programming in assembly and C

MODULE IV PERIPHERAL INTERFACING DEVICES 7

Interfacing Serial I/O (8251) - parallel I/O (8255) –Keyboard and Display controller (8279)–ADC/DAC Interfacing Bus – RS232C-RS485-GPIB

,Introduction, Generation of I/O Ports, Sample-and-Hold Circuit and Multiplexer, Programmable Interval timers (Intel 8253, 8254), Printer Interface.

MODULE V APPLICATIONS OF 8051 7

Application – Stepper motor control, speed and position control of dc motors, closed loop control of servo motor, control of physical parameters like temp, pressure, flow and level, case study - home protection system, Traffic light control, Smart card application.

MODULE VI ADVANCED MICROPROCESSOR AND MICROCONTROLLER 7

Architecture, Memory Organisation, I/O Ports, Timers/ Counters of: PIC Microcontroller, AVR microcontroller, LPC 2148 Microcontroller, MSP 430 Microprocessor, Aurdino Uno - ATmega328- Raspberry Pi

L – 45; Total Hours –45

TEXT BOOKS:

1. Mohammed Ali Mazidi, "The 8051 Microcontroller and embedded systems using Assembly and C"
2. Subrata Ghoshal, "8051 Microcontroller Internals, Instructions, Programming and Interfacing", Pearson press.
3. The PIC Microcontroller and Embedded systems – Using Assembly and C for PIC18," Muhammad Ali Mazidi, Rolin D. McKinlay, and Danny Causey, Prentice Hall, 2013
4. The AVR Microcontroller and Embedded Systems Using Assembly and C, By Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi, Pearson Education.

REFERENCES:

1. Ramesh .S.Gaonkar, "Microprocessor architecture, programming and applications with the 8085", 5th Edition, Prentice Hall, 2010Ayala, "The 8051 Microcontroller" 3rd Edition.
2. ARM System-on-Chip Architecture,Second Edition, by Steve Furber,PEARSON, 2013
3. Lyla B Das," Embedded Systems-An Integrated Approach",Pearson2013.
4. Programming and Customizing the AVR Microcontroller, By Dhananjay Gadre, McGraw Hill Education

OUTCOMES:

- Compare the concept of microprocessor and microcontroller
- Effectively utilize instructions and develop an assembly language program using 8051
- Grasp the working of timers, interrupts and serial port in 8051 microcontroller
- Interface external I/O devices with 8-bit microcontroller
- Design an interface that allows microcontroller to communicate with external devices like LED, LCD, Motors etc
- Gain knowledge on advanced microprocessor and Microcontroller.

EIC3103 INDUSTRIAL INSTRUMENTATION II

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide knowledge on density, viscosity, humidity and moisture measurements
- To familiarize with area flow meters, mass flow meters and calibration techniques.
- To expose various types of level measurements adopted in industrial environment.
- Being engineering practioners, who would help solve industry's technological problem
- Will interact with peers in industry and society and contribute to the economic growth of the country.

MODULE I MEASUREMENT OF DENSITY AND VISCOSITY 7

Modules of density, specific gravity and viscosity used in industries – Baume scale, API scale – Pressure head type densitometer – Float type densitometer– Ultrasonic densitometer – Bridge type gas densitometer – Viscosity – Saybolt viscometer, Redwood Viscometer

MODULE II MEASUREMENT OF HUMIDITY & MOISTURE 8

Humidity terms – Dry and wet bulb psychrometers – Hot wire electrode type hygrometer – Dew cell – Commercial type dew point meter – moisture terms– Different methods of moisture measurement – Moisture measurement in granular materials, solid penetrable materials like wood, web type material.

MODULE III VARIABLE HEAD FLOW METERS AND VARIABLE AREA METERS 8

Flow measurement: Introduction, definitions and MODULEs, Reynolds number. Theory of fixed restriction variable head type flow meters –Orifice plate – Venturi tube – Flow nozzle – Dall tube – Pitot tube- Installation of head flow meters – Piping arrangement for different fluids. Rota meter– Theory and installation

MODULE IV QUANTITY FLOW METERS AND MASS FLOW METERS 7

Positive displacement flow meters – Constructional details and theory of operation of nutating disc, oval gears and helix type flow meters- Angular momentum mass flow meter – Coriolis mass flow meters – Thermal mass flow meters - Calibration of flow meters – Dynamic weighing method

MODULE V ELECTRICAL TYPE FLOW METER 7

Principle and constructional details of electromagnetic flow meter – Different types of excitation schemes used -Ultrasonic flow meters – transit time-frequency difference type – Coriolis - Vortex shedding flow meter –– Solid flow rate measurement– Guidelines for selection of flow meter.

MODULE VI LEVEL MEASUREMENT 8

Gauge glass techniques – Float type level indication – Different schemes – Level switches, level measurement using displacer and torque tube – Bubble system. Boiler drum level measurement – Differential pressure method – Hydra step systems – Electrical types of level gauges using resistance, capacitance, nuclear radiation, Radar, and Doppler sensors.

L – 45; Total Hours –45

TEXT BOOKS:

1. E.O. Doebelin, "Measurement Systems – Application and Design", Tata McGraw Hill publishing company, 2004.
2. R.K. Jain, "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 2010.
3. D.S.Kumar, "Mechanical measurements and control", 3rd edition, Metropolitan
4. Liptak, B.G., "Mechanical and Industrial Measurements" Khanna Publishers, Delhi, 1999.

REFERENCES:

1. S.K. Singh, "Industrial Instrumentation and Control", Tata McGraw Hill, 2003.
2. D.P. Eckman, "Industrial Instrumentation", Wiley Eastern Ltd.,
3. D. Patranabis, "Principles of Industrial Instrumentation", Tata McGraw Hill Publishing Company Ltd, 1996.
4. A.K. Sawhney, "A Course on Mechanical Measurements, Instrumentation and Control", Dhanpath Rai and Co, 2004.

OUTCOMES:

After completion of the course the student will be,

- Able to function with multidisciplinary team

- Understand professional and ethical responsibility
- Has the ability to use the techniques, skills and modern engineering tools for engineering practice.
- Will have the relevant knowledge to select electrical type meters, mechanical flow meters
- With the knowledge gained he/she will select appropriate instruments for liquid level, solid level measurement.
- Depending upon the industry need with the knowledge gained he/she will select a proper viscosity and density measuring instruments.

EIC3104 CONTROL SYSTEMS LABORATORY

L	T	P	C
0	0	3	1

OBJECTIVES:

- To familiarize oneself with different tuning techniques of the controller.
- To get knowledge about software packages required for solving algebraic equations.
- To simulate system application involving nonlinear models.
- To design different controllers.

LIST OF EXPERIMENTS:

1. Simulation of first order and second order system with and without dead time.
2. For a FOPDT system with P controller, find out the ultimate controller gain and the frequency of oscillation.
3. For a FOPDT system, calculate the PI and PID settings by Ziegler-Nichols continuous cycling method. Compare the servo and regulatory performances.
4. Design of Discrete P+I+D controller and a Deadbeat controller for a first order system.
5. Solving nonlinear single and simultaneous nonlinear algebraic equations.
6. Solving initial value problem for ordinary differential equations.
7. To find the eigenvalues, eigenvectors of a given matrix.
8. For a given set of nonlinear model equations of a system, linearize the model equations to get the transfer function model. Design a PI controller. Simulate the performance of the controller on the nonlinear system.
9. For a given set of nonlinear model equations of a system, linearize the model equations to get the state space model. Implement State feedback control of a process by pole placement.
10. Implement State estimation of a process using full order and reduced order observers.

OUTCOMES:

The student will be able to

- Model a process and analyse the time domain specification
- Perform stability analysis given a system
- Automate the process using conventional on-off or PID controller
- Determine the transfer function of DC motor and DC generator by conducting suitable experiment
- Plot the time response and open loop / closed loop frequency responses of different systems
- Estimate the stability margins using bode plot and Nyquist plot
- Design and implement lead and lag compensators to improve the performance

REFERENCES

D.Xue, Y.Chen & D.P.Atherton, "Linear Feedback Control: Analysis and Design with MATLAB", SIAM, Philadelphia, 2007.

OUTCOMES

1. Ability to get familiarized with Matlab/Simulink for solving mathematical models.
2. Ability to design different controllers for industrial applications.
3. Ability to analyze the response of nonlinear systems.

EIC3105	MICROPROCESSOR AND MICROCONTROLLER LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To familiarize the students to use assembly language for programming a microcontroller
- To impart the students to understand the hardware and software components of a microcontroller-based system to implement system level features.
- To teach students both hardware and software aspects of integrating digital devices (such as memory and I/O interfaces) into microcontroller-based systems.
- To provide students the operating principles and hands-on experience with, common microcontroller peripherals such as UARTs, timers, and analog-to-digital and digital-to-analog converters.

LIST OF EXPERIMENTS:

1. Arithmetic operations using 8051
   a. Addition and subtraction of 8-bit numbers
   b. Addition and subtraction of 16-bit numbers
   c. Multiplication and division of 8-bit numbers
   d. To find Largest and Smallest number in a number series
   e. To arrange the number series in ascending and descending order.
2. Logical operations using 8051
3. To transfer a block of data from one memory zone to the others.
4. Code conversion of Decimal number to HEXA and HEXA to Decimal number

APPLICATION PROGRAMS USING 8051

5. Stepper motor interfacing with 8051
   a. for full and half step rotation
   b. for rotating motor in clockwise and anticlockwise direction
6. Write a program to transmit ASCII character continuously with 9600 based by polled operation using 8251.
7. Interfacing of D/A converter MODULEs with 8051 to generate the following waveform and to measure the time period and frequency of each waveform.
   a. Saw tooth waveform

   b. Triangular waveform

   c. Square waveform
8. Interface 8253 to generate 1 MHZ square wave.
9. Interfacing traffic light control system
10. Interface 8279 with 8051 to perform the following functions
   a. To display different alphabets and numbers in the 7 segment display
   b. to read various keys form the keyboard
11. Build a Home security system with 4 sensor and 2 alarms interfaced to 8051 or aurdino uno

OUTCOMES:

- The students will effectively carryout programming of microcontroller interfacing for industrial applications.

EIC3106	INDUSTRIAL INSTRUMENTATION II LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To provide an overview of different types of power semi-conductor devices and their switching characteristics.
- To make the students to understand the operation, characteristics and performance parameters of controlled rectifiers.
- To study the characteristics of DC and AC drives
- To learn the different modulation techniques of pulse width modulation
- To provide knowledge about the practical application for power electronics converters in conditioning the power supply.

LIST OF EXPERIMENTS:

1. Determination of Discharge coefficient of Orifice plate
2. Measurement of flow rate using Orifice, Venturi.
3. Level Measurement using DP transmitter.
4. Electrical level measurement using resistance and capacitance methods
5. Measurement of conductivity of test solutions.
6. Measurement of pH values of test solutions.
7. Calibration of temperature transducers
8. Calibration of pressure gauges
9. Characteristics of P /I and I /P Converters.
10. Determination of Viscosity using Saybolt and Redwood Viscometer
11. Study of P&I diagrams.
12. Study of IR spectrophotometer.
13. Study of smart transmitter and smart valve positioner.

OUTCOMES:

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

- Analyze the characteristics of power semiconductor devices
- Evaluate the characteristics of single phase and three phase converter
- Solve the power conversion problems for renewable energy source systems
- Analyze the different methods of speed control for AC and DC drives
- Use the power electronic devices for industrial application such as UPS, Induction and dielectric heating
- Carry out mini project by hardware implementation of converters, inverters etc.

SEMESTER VI

ENC 3281	COMMUNICATION AND SOFT SKILLS - II	L	T	P	C
	CONFIDENCE BUILDING	0	0	2	1

OBJECTIVES:

- To develop professional skills like work ethics, analytical skills, presentation skills etc.
- To train them in problem solving skills and leadership skills pertaining to industries.
- To train them in team building skills.
- To train in setting up career goals

MODULE I **6**

Brief about Multinational companies- Analysing work ethics of multinational companies and small industries- discussing as pairs-Knowledge about etiquette (different types)

MODULE II **6**

Visit to an Industry and prepare reports --Critically reading of industry specific journal articles and write ups-- preparing reports.

MODULE III **4**

Analysing problem solving situations in industries (relating to application of core subject to specific jobs) and discussing about them- working on a sample case

MODULE IV **6**

Developing Leadership in team projects-- debating about various aspects of leadership: for example, responsibility and reliability-time management

MODULE V **8**

Team building skills-- group discussions pertaining to industries-- presenting career goals. --preparing for interviews- interpersonal skills

Total Hours – 30

REFERENCES:

1. Covey,S.R. (2004). The 7Habits of Highly Effective People: Powerful Lessons in Personal Change. Free Press.UK
2. Fine, P.M.& Alice Olins. (2016).Step up: Confidence, Success and Your Stellar Career in 10 Minutes a Day. Vermilion.UK
3. Pai, A. (1993).How to Develop Self-Confidence. Amazon.com
4. Wentz,F.H.(2012). Soft skills training: A Workbook to Develop Skills for Employment. Amazon.com

OUTCOMES:

After completing the course students would be able to

- Exhibit critical reading skills through review of industry specific articles.
- Provide solutions to problem based situations.
- Exhibit leadership qualities by debating over industry specific issues.
- Participate in group discussions confidently.
- Present their career goals.

EIC3211 PROCESS CONTROL

L	T	P	C
3	1	0	4

OBJECTIVES:

- To impart basic knowledge in the analysis and design of process control systems required for an instrumentation engineer
- To develop mathematical model of selected processes from first principle
- To illustrate the characteristics of different control modes and selection of appropriate control mode for a given application
- To provide clear concept about the importance and methods of finding the optimum controller settings
- To illustrate the construction, characteristics and design of the control valves
- To provide knowledge about the important advanced control techniques used in process industries along with case studies

MODULE I INTRODUCTION TO PROCESS CONTROL 9

Need for process control, Process characteristics- Modeling of liquid, thermal, pressure, chemical process, interacting and non- interacting processes, continuous and batch processes, degrees of freedom, Self regulating process, Servo and regulator operations, Lumped and distributed models, Linearization of non-linear systems, piping and Instrumentation diagram.

MODULE II BASIC CONTROL ACTIONS 9

Discontinuous: ON/OFF, Multiposition Control, Floating Control. Continuous: Proportional, integral, derivative mode. Composite controller modes: P-I, PD, P-I-D. Selection of control modes for processes like level, pressure, temperature and flow, Electronic and Pneumatic PID Controller, Auto/Manual transfer, Bumpless transfer, Reset windup, Practical forms of PID.

MODULE III OPTIMUM CONTROLLER SETTINGS 9

Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio – determination of optimum settings for mathematically described processes using time response and frequency response – Tuning – Process reaction curve method – Ziegler Nichols method – Damped oscillation method, Auto tuning

MODULE IV ADVANCED CONTROL TECHNIQUES 9

Cascade control, Feed forward control, feedback- feedforward control, Ratio control, Selective Control, Split range control- Basic principles, Design Criteria, Controller Algorithm and Tuning, Implementation issues - Multivariable process control, interaction of control loops, case study – Distillation column – Introduction to IMC

MODULE V FINAL CONTROL ELEMENTS 9

I/P converter - Pneumatic and electric actuators – Valve Positioner – Control Valves – Characteristic of Control Valves:- Inherent and Installed characteristics – Modeling of pneumatic control valve – Valve body:-Commercial valve bodies – Control valve sizing – Cavitation and flashing – Selection criteria.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2004.

2. Stephanopoulos, G., “Chemical Process Control - An Introduction to Theory and Practice”, Prentice Hall of India, 2005.

REFERENCES:

1. D.Patranabis, “Principles of process control”, McGraw - Hill Education(India) Pvt Ltd, 3rd Edition, 2014.

2. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., “Proces Dynamics and Control”, Wiley John and Sons, 2nd Edition, 2003.

3. 2 Coughanowr, D.R., “Process SystemsAnalysis and Control”, McGraw - Hill International Edition, 2004.

4. Eckman. D.P., “Automatic Process Control”, Wiley Eastern Ltd., New Delhi, 1993.

OUTCOMES:

At the end of this course, the students will

- know about process dynamics and be able to develop process model.
- Determine the optimum controller(P, PI, PID) settings using various tuning methods and able to compare the performance of enhanced PID controllers with that of conventional PID controller
- Gain knowledge about the construction, operation, characteristics and selection of control valves.
- Get familiarized with different multi loop control schemes and their applications

EIC 3212 COMMUNICATION ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the concepts of various modulations
- To understand the properties of transmission medium.
- To introduce the concepts of various communication systems and protocol.
- To study the study the satellite, optical and fibre communications.

MODULE I MODULATION SYSTEMS 07

Time and frequency domain representation of signals, amplitude modulation and demodulation, frequency modulation and demodulation, super heterodyne radio receiver. Frequency division multiplexing. Pulse width modulation.

MODULE II TRANSMISSION MEDIUM 08

Transmission lines – Types, equivalent circuit, losses, standing waves, impedance matching, bandwidth; radio propagation – Ground wave and space wave propagation, critical frequency, maximum usable frequency, path loss, white Gaussian noise.

MODULE III DIGITAL COMMUNICATION 10

Pulse code modulation, time division multiplexing, digital T-carrier system. Digital radio system. Digital modulation: Frequency and phase shift keying – Modulator and demodulator, bit error rate calculation.

MODULE IV DATA COMMUNICATION AND NETWORK PROTOCOL 10

Data Communication codes, error control. Serial and parallel interface, telephone network, data modem, ISDN, LAN, ISO-OSI seven layer architecture for WAN

MODULE V SATELLITE COMMUNICATIONS 10

Orbital satellites, geostationary satellites, look angles, satellite system link models, satellite system link equations; advantages of optical fibre communication- Fibre communication - Light propagation through fibre, fibre loss, light sources and detectors.

L – 45; Total Hours –45

REFERENCES:

1. Wayne Tomasi, 'Electronic Communication Systems', Pearson Education, 3rd Edition, 2001.
2. Roy Blake, 'Electronic Communication Systems', Thomson Delmar, 2nd Edition, 2002.
3. William Schweber, 'Electronic Communication Systems', Prentice Hall of India, 2002.
4. G. Kennedy, 'Electronic Communication Systems', McGraw Hill, 4th edition, 2002.
5. Miller, 'Modern Electronic Communication', Prentice Hall of India, 2003.

OUTCOMES:

The students can able to

- Understand the concepts of various modulations
- Study the properties of transmission medium.
- Apply the concepts of various communication systems and protocol.
- Study the satellite communications.

EIC3213 DIGITAL SIGNAL PROCESSING

	L	T	P	C
	3	1	0	4

OBJECTIVES:

- To introduce the basic concepts of Digital Signal processing.
- To make the students familiarize various mathematical tools for analyzing Discrete Time Systems.
- To make the students design Digital Filters based on the Filter specifications.
- To provide the exposure to the architectures of DSP processors.
- To implement various algorithms in DSP for solving Real-time problem.

MODULE I DISCRETE TIME SIGNALS AND SYSTEMS 10

Digital signal processing: Block diagram, advantages and applications. Discrete time systems : Classification and characterization with examples – Static & dynamic, causal & non causal, linear & non linear, time variant & time invariant, stable & unstable, FIR & IIR.
Linear and circular convolution, convolution techniques for long duration sequence, autocorrelation and cross correlation.

MODULE II FREQUENCY DOMAIN ANALYSIS AND DFT 10

Review of DTFS (Discrete Time Fourier Series), DTFT(Discrete Time Fourier Transform) and Z-Transform – Definition, Properties, ROC and its properties, Inverse Z Transform. Stability analysis of DT systems using Z Transforms
DFT properties, magnitude and phase representation – Direct computation of DFT

MODULE III FAST FOURIER TRANSFORM 10

Efficient computation of DFT - FFT algorithms – Radix -2 FFT algorithms - Decimation in Time - Decimation in Frequency algorithms, Computing Inverse DFT.

MODULE IV DESIGN OF DIGITAL FILTERS- IIR FILTER 10

Introduction, design procedures for digital IIR filters, frequency transformation techniques – Digital Butterworth and Chebyshev IIR filter design using impulse invariant and bilinear transformation – Realization of IIR filters.

MODULE V DESIGN OF DIGITAL FILTERS- FIR FILTER 10

Introduction, advantages of FIR over IIR filters - linear phase filters – Windowing technique: Rectangular, Triangular, Hamming, Hanning and Kaiser Windows – Realization of FIR filter structures

MODULE VI APPLICATIONS OF DSP 10

Sampling theorem - Reconstruction of a Signal from its samples, aliasing -Sampling rate conversion, Interpolation and Decimation, Decimation and Interpolation by an integer factor, Quadrature Mirror Filter banks, Sub-band Coding, few applications using sub-band coding. Adaptive echo cancellation-Adaptive noise cancellation, Model of Speech Wave Form –Vocoder- Signal Processing tool box.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. John G.Proakis and Dimitus G.Manolakis, "Digital Signal Processing, Principles, Algorithms and applications", 3rd edition, Prentice Hall of India, New Delhi, 2008
2. Johnson, J.R., "Introduction to Digital Signal Processing", Prentice Hall of India, 2009.

REFERENCES:

1. Mitra, S.K., "Digital Signal Processing" – A Computer Based Approach, Tata McGrawHill, 2001.
2. Uyemura, J.P., "A first course in Digital System Design An integrated approach", Cengage Learning, 2000.
3. Lonnie C.Ludeman, "Fundamentals of Digital Signal Processing" John Wiley & Sons,1986.
4. NPTEL Video Lecture series on, "Digital Signal Processing" by Prof. S.C. Dutta Roy, IIT Delhi..

OUTCOMES:

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

- Ability to apply various mathematical tools for analyzing discrete time system based on the knowledge of mathematics •
- Ability to design digital filters.
- Ability to come out with solutions for solving simple/complex problem.
- Ability to use DSP Processor for real-time implementation.

EIB3214 PROCESS CONTROL LABORATORY

L	T	P	C
0	0	3	1

OBJECTIVES:

1. To impart practical knowledge in PC based data acquisition, analysis and control of different process trainers.
2. To familiarize the process modelling and control using simulation tools.
3. Learn the procedure for obtaining the servo and regulatory responses of process control loops such as level, pressure, flow and temperature.
4. understand the procedure for obtaining the optimum controller settings using various tuning methods by experimental and mathematically described processes.
5. learn and analyze the control schemes for multiloop processes such as three tank and four tank

LIST OF EXPERIMENTS:

1. Identification of FOPDT and SOPDT process using time domain and frequency domain techniques.
2. Tuning of PID Controller for FOPDT and SOPDT process using different standard technique.
3. PID Implementation Issues
4. Study of Different Process trainers.[Temperature, Pressure, Level, Flow]
5. Characteristics of Control Valve (with and without Positioner)
6. Pressure to Current & Current to Pressure Converter.
7. PC based Data acquisition system.
8. Design of PID Controller for any process(Level Process/Temperature/Flow/Pressure process stations) and evaluate servo/regulatory responses.
9. Design of Cascade and Feed forward-feedback Controller using simulation software.
10. PID Enhancements –Reset windup and Auto-tuning of PID Controller
11. Analysis of Multi-input Multi-output system – three tank system.
12. Study of pH Control setup.

OUTCOMES:

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

- Conduct the experiments and obtain the servo and regulatory responses of process control loops such as level, pressure, flow and temperature.
- Arrive the optimum controller settings using various tuning methods by experimental and mathematically described processes.

- Analyze and design control schemes for multiloop processes such as three tank and four tank systems.

SEMESTER VII

EIC4101	DIGITAL PROCESS CONTROL	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To provide knowledge on discrete time systems and control, control algorithms, digital controller, and identification, predictive and adaptive control.

MODULE I DISCRETE TIME SYSTEMS AND CONTROL 12

Continuous and discrete systems sample data system- Z transform – inverse Z transform- selection of sampling period – mathematical representation of sampler- transfer function of zero order hold and first order hold device-Pulse transfer function – open loop and closed response of linear sample data control system for step input – stability analysis: Jury's test and bilinear transformation-State space representation of sample data systems.

MODULE II DIGITAL CONTROL ALGORITHMS 10

Deadbeat Algorithm – Dahlin's method – ringing – Kalman's approach – discrete equivalent to an analog Controller – design for load changes. PID Algorithms - Velocity & Position forms of Digital PID Controller – tuning techniques. Selection of sampling time. Dead time Compensation – Smith Predictor Algorithm

MODULE III COMPUTER AS A CONTROLLER 10

Basic building blocks of computer control system- Data Acquisition systems-Direct Digital Control – Introduction to AI and expert control system – Design of computerized multiloop controller.

MODULE IV MODEL IDENTIFICATION 10

Modelling and identification – ARMAX model structure – Model structure selection – Least square method of estimating the model parameters – Extended least square method – Real time identification.

MODULE V PREDICTIVE CONTROL 8

Introduction - Model predictive control – Dynamic matrix control – Model algorithmic control – Generalized predictive control.

MODULE VI ADAPTIVE CONTROL 10

Introduction Adaptive control – Gain scheduling – Self tuning regulator – Model reference adaptive control – Design of model reference controller.

L – 45; T-0;Total Hours –45

TEXT BOOKS:

1. P.B. Deshpande and RH. Ash, "Elements of Computer Process Control", Instrument Society of America. 1981.
2. M.Chidambaram, "Computer control of processes", Alpha Science International Ltd, 2002.
3. Shanthisasidharan, "Computer control of process", CBA Publishers, 2011.

REFERENCES:

1. B.W.Bequette. "Process control" Prentice Hall Inc. 2006.
2. C.L. Smith, "Digital Computer Process Control", Intext Educational Publishers, 1972.
3. Vance Vandoren, "Techniques for Adaptive Control" BH publishers, 2003.

OUTCOMES:

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

- Design digital control systems using state space techniques.
- Analyse digital systems using control algorithms.
- Mathematically formulate, model and identify digital control systems using predictive and adaptive control.

EIC4102	INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- Learn and familiarize with the technologies which typically exist in an industrial facility.
- Study of components used in data acquisition systems interface techniques.
- To educate on the components used in PLC, DCS and SCADA.
- To introduce the communication buses used in automation industries.

MODULE I INTRODUCTION 8

Automation overview - Requirement of automation systems - Architecture of Industrial Automation system - Real time systems - Real time specifications and design techniques - Real time kernels - Inter-task communication and synchronization - Real time memory management - Supervisory control - direct digital control - Distributed control - PC based automation - Industrial data networks

MODULE II DATA ACQUISITION SYSTEMS 8

Computers in Process control - Data Loggers - Data acquisition systems (DAS) - Direct Digital Control (DDC) - Characteristics of digital data - Controller software - Computer Process interface for Data Acquisition and control

MODULE III PROGRAMMABLE LOGIC CONTROLLERS 8

Hard Relay Logic - Programmable logic controllers - Organisation - Hardware details - I/O - Power supply - CPU - Standards - Programming aspects - Ladder programming - Sequential function charts - Man-machine interface - Detailed study of one model - Case studies

MODULE IV LARGE SCALE CONTROL SYSTEM - SCADA 7

SCADA: Introduction - SCADA Architecture - Different Communication Protocols -

Common System Components - Supervision and Control - HMI - RTU and Supervisory Stations - Trends in SCADA - Security Issues

MODULE V LARGE SCALE CONTROL SYSTEM - DCS 7

DCS: Introduction - DCS Architecture - Local Control (LCU) architecture - LCU languages - LCU-Process interfacing issues - communication facilities - configuration of DCS - displays - redundancy concept - case studies in DCS

MODULE VI INDUSTRIAL COMMUNICATION NETWORKS 7

Introduction - Evolution of signal standard - HART communication protocol and communication modes - HART and OSI model - Modbus - Profibus - Foundation field bus - Introduction to AS-Interface (As-i) - Device net and Industrial Ethernet

.

L – 45; Total Hours –45

TEXT BOOKS:

1. Petrezeulla, Programmable Controllers, tenth edition , Mc-Graw Hill, 2010.
2. Michael P.Lucas, Distributed Control System, Van Nastrand Reinhold Company, New York,1986.
3. Romilly Bowden, HART application Guide, HART Communication Foundation, 1999.

REFERENCES:

1. G.K.Mc-Millan, Process/Industrial Instrument and controls and handbook, Mc Graw Hill, New York, 1999.
2. Hughes T, Programmable Logic Controllers, ISA Press, 1989.
3. W. Bolton, ―PLC‖, Elsevier Newnes.

OUTCOMES:

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

- Get the appropriate knowledge and skills in Industrial automation systems with the use of DCS, PLCs.
- Interface DCS and the Level, Pressure process systems.
- Implement appropriate industrial automation systems

EIC4103 INDUSTRIAL AUTOMATION LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

1. Ability to acquire a detailed knowledge of data acquisition system interface.
2. Acquire knowledge about the working of SCADA system and about PLC & DCS controllers.

LIST OF EXPERIMENTS

1. Implement control of a process using any relevant embedded controller.
2. Interface and acquire data using a data acquisition card (DAQ) in PC.
3. Develop DAQ-PC based control of a process.
4. Implement Logic gates operations, Timing Operations, counter operations and math operations using any Programmable Logic Controller (PLC).
5. Control of any sequential operation (Bottle Filling/Motors) using PLC
6. Real-Time data acquisition from a measurement system using PLC.
7. Real-Time Control of a plant using PLC.
8. Configure Function Blocks and develop SCADA using Function Blocks in any Distributed Control System (DCS).
9. Develop Feedback and Cascade Control Strategies using Function Blocks in DCS.
10. On-line monitoring and control of a plant using a DCS.

REFERENCES

1. E.A. Parr, Newnes, New Delhi, “Industrial Control Handbook”, 3rd Edition, 2000.
2. Gary Dunning, Thomson Delmar, “Programmable Logic Controller”, Cengage Learning, 3rd Edition, 2005.

OUTCOMES:

Familiarize with different industrial power and automation equipment and acquire hands-on experience on them through various experiments.

EIC4104	**INSTRUMENTATION SYSTEM DESIGN**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

OBJECTIVES:

- This course will provide a basic understanding of instrumentation system design and implications of working with process control systems
- To provide the various methods of signal transmission, selection and implementation.
- To provide knowledge in selection of the equipment used in current loops, temperature measurement, pressure measurement, level measurement, flow measurement, output devices.

MODULE I INTRODUCTION 5

Introduction to Instrumentation System Design (ISD), Scope of ISD in Process Industry, An overview of General transducer Design, Selection of Transducer, General procedure for Testing of transducer.

MODULE II DESIGN USING OPERATIONAL AMPLIFIER 8

Design using operational Amplifier and PCB Design: Design of instrumentation amplifiers – multivibrators – comparators – active filter: low and high pass.

MODULE III DESIGN OF SIGNAL CONDITIONING CIRCUITS AND SYMBOLS 8

Design of signal conditioning circuits and symbols: Design of bridge circuits for strain gauge - design of RTD – design of reference junction compensation for thermocouple –thermistor based temperature measurement.

MODULE IV INSTRUMENTATION CONTROLLERS 8

Instrumentation controllers: Design of ON/OFF controller design - design of pneumatic – electronic controller – PID controllers Orifice Sizing: design of square root extractor – Orifice sizing for Liquid, Gas and steam applications.

MODULE V CONTROL VALVE SIZING AND ANNUNCIATORS 8

Control valve sizing and Annunciators: Choice of valve body, materials – flow – lift characteristics – control valve sizing procedure. Cavitation and flashing – Selection criteria. Annunciators & Data Loggers: Annunciators - PLC as an annunciator – Data loggers

MODULE VI PCB DESIGN 8

PCB Design: PCB board design guide lines – layout scheme – single and multi layer PCB.

Total Hours –45

TEXT BOOKS:

1. B. G. Liptak, “Instrument Engineers Handbook”, Vol. I and II, 3rd edition, Chilton and Book Company, 2010.
2. D. M. Considine, “Process/Industrial Instruments and Control Handbook”, 4th Edition, McGraw-Hill Inc., 1999.
3. C. D. Johnson, “Process Control Instrumentation Technology”, 4th Edition, PHI, 2005.

REFERENCES:

1. Andrew and Williams, “Applied Instrumentation in Process Industries”, Vol. I, II, III, IV, Gulf Publishing Company, 1979.
2. John P. Bentley, “Principles of Measurement Systems”, Addison-Wesley publication, 1999.
3. T.R.Padmanabhan, “Industrial Instrumentation: Principles and Design”, Springer-Verlag Publications, 1999.
4. B. C. Nakra and K. K. Choudhari, “Instrumentation: Measurement and Analysis”, Tata McGraw Hill pub, 2008.

OUTCOMES:

At the end of the course, the students will possess knowledge and achieve skills on the following:

- Be able to interpret and formulate design specifications for instrumentation systems.
- Be able to design, construct, and verify an instrumentation system to meet desired specifications, with the aid of computer-aided design techniques.

SEMESTER VIII

EIC4211	PROJECT	L	T	P	C
		0	0	24	12

OBJECTIVES:

- To design, develop, and deploy advanced state-of-the-art instrument systems and custom application software in support of the ongoing experimental research efforts.
- To provide in-house solutions to assist the researcher through a complete life cycle of system development.
- To gain competency in analyzing experimental data and in comparing the results to data and theories in the literature.
- To acquire more knowledge in designing of hardware as well as applications of softwares like CAD tool, Matlab, LabVIEW & embedded C.
- To apply basic and contemporary science, engineering, and experimentation skills to identifying manufacturing problems and developing practical solutions.

COURSE OUTLINE

Project shall be carried out in the following areas,

- Design/ fabrication of sensors and transmitters,
- Microcontroller based digital control system design,
- Embedded system design for automation,
- Micro-electronics and VLSI Design,
- Applications of Digital image processing for process industries,
- Analysis and design of advanced process control techniques,
- Medical imaging and instrumentation,
- Microsensors and Microactuators design and
- MEMS in instrumentation and biomedical.

SOFTWARE:

MATLAB/SIMULINK, PSPICE, LabVIEW and CAD tool, embedded C, MEMS software

OUTCOMES:

On completion of the course the student will be able to

Apply Knowledge of Mathematics, Science and Engineering

- Design, model, analyze and improve a manufacturing process or system utilizing modern technologies

- Design and conduct experiments, as well as to analyze and interpret data
- Identify, formulate and solve engineering problems
- Use the techniques, skills and modern engineering tools necessary for engineering practice
- Function on multi-disciplinary teams and to communicate effectively

PROFESSIONAL ELECTIVES
GROUP I

		L	T	P	C
EICX01	**BIO MEDICAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To provide an acquaintance of the physiology of the heart, lung, brain and biopotentials.
- To introduce the student to the various electrodes and amplifiers and typical measurement devices of electrical origin
- To provide the latest ideas on devices of non-electrical devices
- To bring out the important and modern methods of imaging techniques and latest knowledge of medical assistance / techniques and therapeutic equipments.
- To provide awareness of electrical safety of medical equipments

MODULE I PHYSIOLOGY AND BASIC CONCEPTS OF MEDICAL NSTRUMENTATION 5

Generalized Medical Instrumentation system – Medical and physiological parameters - Nervous system: Functional organisation of peripheral nervous system – Structure of nervous system, neurons - synapse – transmitters and neural communication – Cardiovascular system – respiratory system - Resting and Action Potential – Bio potentials.

MODULE II ELECTRO – PHYSIOLOGICAL MEASUREMENTS 5

Electrodes – Limb electrodes – floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Blood glucose sensors - Practical hints in using electrodes. Bio potential amplifiers: Basic requirements– ECG preamplifiers and ECG isolation amplifiers.

MODULE III ORIGIN OF BIOPOTENTIALS 10

Electrocardiogram (ECG) –Electroencephalogram (EEG) – Electromyogram (EMG) – Electroretinogram (ERG) – Lead systems and recording methods – Typical waveforms – case study of ECG, EEG.

MODULE IV NON-ELECTRICAL PARAMETER MEASUREMENTS 10

Measurement of blood pressure: Direct and indirect measurement – Blood flow meters – Cardiac output – Heart rate – Heart sounds – Pulmonary function measurements: lung volume spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analyzers :finger-tip oxymeter - BSR, GSR measurements.

MODULE V ASSISTING AND THERAPEUTIC EQUIPMENTS 10

Computer tomography – PET - MRI – Ultrasonography – Endoscopy – Mammography - Different types of biotelemetry systems - patient monitoring - Pacemakers – Defibrillators - Diathermy – Dialysers.

MODULE VI ELECTRICAL SAFETY 5

Electrical safety in medical environment: Physiological effects of Electricity – micro and macro shock hazards – Protection against shock - Electrical Safety analyzers.

L – 45; Total Hours –45

TEXT BOOKS:

1. J.Webster, "Medical Instrumentation – Application and Design", 4th Edition, John Wiley & Sons, 2009.

REFERENCES:

1. R.S.Khandpur, "Hand Book of Bio-Medical Instrumentation", 12th reprint, Tata McGraw Hill Publishing Co Ltd., 2008.
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, "Bio-Medical Instrumentation and Measurements", 2nd edition, Pearson Education, 2008 / PHI.
3. M.Arumugam, "Bio-Medical Instrumentation", Anuradha Agencies, 2009.
4. L.A. Geddes and L.E.Baker, "Principles of Applied Bio-Medical Instrumentation", John Wiley & Sons, 1975.

OUTCOMES:

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

- Analyze typical waveforms of bio potentials of the human system
- They will be able provide safety during measurement.
- Capable of pursuing biomedical engineering and biotechnology at master level programme.
- Able to apply the knowledge of biomedical for designing biomedical equipments

EICX02	FIBRE OPTICS AND LASER INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge about the characteristics, losses and fabrication of optical fibres.
- The impart knowledge of optical fibre as a sensor for different applications.
- To provide the use of laser for various measurements and applications

MODULE I OPTICAL FIBRES AND THEIR PROPERTIES 7

Principles of light propagation through a fibre – Fibre materials and their characteristics-Different types of fibres and their properties - Transmission characteristics of optical fibre- Absorption losses -Scattering losses - Dispersion- Optical fibre measurement.

MODULE II OPTICAL SOURCES AND DETECTORS 7

Introduction to Optical sources LED-structures, Types, characteristics, Applications, LD. Optical detectors, PIN structures, Types, characteristics, Applications, APD -, Wavelength Division Multiplexing.

MODULE III INDUSTRIAL APPLICATIONS OF OPTICAL FIBRES 9

Fibre optic sensors- Fibre optic instrumentation system-Different types of modulators –Detectors-Application in instrumentation- Interferometer method of measurement of length-Moiré fringes-Measurement of pressure, Temperature, current, Voltage, liquid level and strain–Fibre optic gyroscope– polarization.

MODULE IV LASER FUNDAMENTALS 8

Fundamental characteristics of laser-Three level and four level lasers-Properties of lasers-Laser modes-Resonator configuration-Q-switching and mode locking-Cavity dumping-Types of laser-Gas laser, solid laser, liquid laser, semi conductor laser.

MODULE V INDUSTRIAL APPLICATION OF LASER 7

Laser for measurement of distance, length, velocity, acceleration, current, voltage, and atmospheric effect-Material processing-Laser heating, welding, melting and trimming materials, removal and vaporization

MODULE VI HOLOGRAPHY & MEDICAL APPLICATIONS OF LASER 7

Holography- Basic principle, methods-Holographic interferometer and applications – Holography for non destructive testing-Holographic components-Medical application of lasers-laser and tissue interaction-Removal of tumors of vocal cards-Plastic surgery-Endoscopy.

L – 45; Total Hours –45

TEXT BOOKS:

1. Gerd Keiser, "Optical Fibre Communications", McGraw-Hill, International Edition, 2010

REFERENCES:

1 D.C.O'shea, Russel Callen, "Introduction to lasers and their applications", Mc Millan, 1977.
2 John and Harry, "Industrial lasers and their applications", McGraw Hill, 1974.
3 John senior, "Optical communications", PHI
4 Thyagarajan.K, Ajoy k Ghata, "Laser theory and applications", Plenna press, 1981
5 John F Ready, "Industrial applications of lasers", Academic press, 1978.
6 Monte Ross, "Laser applications", McGraw Hill, 1968.
7 Ghatak A.K. and Thiagarajan K, "Optical electronics foundation book", TMH, New Delhi, 1991.
8 John Palais, "Fibre Optic Communications", Pearson Education.

OUTCOMES:

- Students will be able to select suitable optical and laser instruments for various engineering and biomedical applications.

EICX03 INTRODUCTION TO MEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide knowledge on Micro electro mechanical systems, basic mechanics for design and modeling.

MODULE I INTRODUCTION TO MEMS 8

MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Micro accelerometers and Micro fluidics, MEMS materials, Micro fabrication.

MODULE II MECHANICS FOR MEMS DESIGN 8

Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics – actuators, force and response time, Fracture and thin film mechanics

MODULE III ELECTRO STATIC DESIGN 8

Electrostatics: basic theory, electro static instability. Surface tension, gap and finger pull up, Electro static actuators, Comb generators, gap closers, rotary motors, inch worms, Electromagnetic actuators. Bistable actuators.

MODULE IV CIRCUIT AND SYSTEM ISSUES 8

Electronic Interfaces, Feedback systems, Noise, Circuit and system issues, Case studies – Capacitive accelerometer, Piezo electric pressure sensor.

MODULE V INTRODUCTION TO OPTICAL AND RF MEMS 8

Optical MEMS - System design basics – Gaussian optics, matrix operations, resolution. Case studies, MEMS scanners and retinal scanning display, Digital Micro mirror devices. RF MEMS – design basics, case study – Capacitive RF MEMS switch, performance.

MODULE VI MODELING OF MEMs 9

Modelling of MEMS systems, CAD for MEMS. Modelling the dynamics of MEMs resonators

L – 45; Total Hours –45

TEXT BOOKS:

1. Stephen Santuria," Microsystems Design", Kluwer publishers, 2000.

REFERENCES:

1. Nadim Maluf, "An introduction to Micro Electro Mechanical System Design", Artech House, 2000
2. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

OUTCOMES:

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

- Select Micro electro mechanical systems for specific application.
- Identify specific sensor for design pertaining to different applications.
- Model Micro electro mechanical systems using CAD software.

EICX04 **Qt SOFTWARE** **L T P C**

2 0 2 3

OBJECTIVES:

- To introduce the students to the basics of OOPs
- To create awareness of Qt basics
- To provide knowledge on object based, embedded programming
- To make the students understand user interface
- To make the students understand custom UI

MODULE I OBJECT ORIENTED PROGRAMMING 6

OOPS: Definition, Concepts - Relationship with C++ - C++: Program Structure - Compiling and Linking - File Organization -Pointers, Classes and Structures - Templates, Virtual Inheritance, Abstract Classes & Interfaces

MODULE II Qt: INTRODUCTION 6

Qt: Introduction - Types of Applications - Relationship with C++ - Program Structure - File Organization - Compiling and Linking - Pointers, Classes and Structures – Qt Creator IDE Introduction - Console Applications in Qt – Debugging

MODULE III OBJECT BASED PROGRAMING 6

Object Based Programing - Program Design – File IO - Class Libraries

MODULE IV USER INTERFACE 6

UI Classes - Simple UI Programing - Signals and Slots - Serial IO - Programing for the Internet

MODULE V PROGRAMMING 6

Embedded Programing - Controller Programing - Custom UI - HMI Development - Charts - Final Assignment

L – 30; P – 30; Total Hours –60

REFERENCES:

1. https://www.qt.io/
2. qt-project.org/
3. Qt Programming for Linux and Windows 2000, Patrick Ward, 2001
4. Practical Qt: Real World Solutions to Real World Problems Paperback,

Matthias Kalle Dalheimer & Jesper Pedersen , 2004

5. Advanced Qt Programming: Creating Great Software with C++ and Qt 4 (Prentice Hall Open Source Software Development Series) Hardcover – 11 Jul 2010

OUTCOMES:

The students will be able to

- Write programming using OOPs
- Create structure and apply using Qt software
- Design and program using object based, embedded programming
- Do simple UI programming for HMI and the internet
- Write programs on embedded based and control HMI

EICX05	TELEMETRY AND TELECONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge on telemetry fundamentals, landline, radio, optical and biotelemetry
- To make the students to understand telecontrol methods

MODULE I TELEMETRY FUNDAMENTALS AND CLASSIFICATION 8

Fundamental concepts – Significance, Principle, functional blocks of Telemetry and Telecontrol system - Methods of telemetry – Electrical, Pneumatic, Hydraulic and Optical Telemetry – State of the art-Telemetry standards.

MODULE II LANDLINE TELEMETRY 8

Electrical Telemetry-Current Systems – Voltage Systems - Synchro Systems– Frequency systems – Position and Pulse systems – Example of a landline telemetry system

MODULE III RADIO TELEMETRY 8

Block diagram of a Radio Telemetry system – Transmitting and receiving techniques – AM, FM, PM, Multiplexing and demultiplexing – Transmitting and receiving techniques – Digital coding methods – Advantages of PCM, PWM, PM, FSK – Delta modulation – coding and decoding equipment – Example of a radio telemetry system.

MODULE IV OPTICAL TELEMETRY 8

Optical fibers for signal transmission – Sources for fiber optic transmission – Optical detectors – trends in fiber – optic device development – Example of an optical telemetry system.

MODULE V TELECONTROL METHODS 8

Analog and Digital techniques in telecontrol, telecontrol apparatus – Remote adjustment, Guidance and regulation – Telecontrol using information theory – Example of a telecontrol system.

MODULE VI BIO TELEMETRY METHODS 5

Bio telemetry – single channel telemetry – multi channel telemetry – telemetry for biomedical applications.

L – 45; Total Hours –45

REFERENCES:

1. Gruenberg. L "Handbook of telemetry and remote control", McGraw Hill, New York, 1987.
2. Swobodoa. G., "Telecontrol methods and applications of Telemetry and Remote Control", Reinhold Publishing Corp., London, 1988.
3. Young R.E., "Telemetry Engineering", Little Books Ltd, London 1988.

OUTCOMES:

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

- Apply the concepts to design a radio telemetry system.
- Design a biotelemetry system.
- Choose optical cables to meet specific requirement .

EICX11	CONTROL SYSTEM COMPONENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

MODULE I Control System Parameters 5

Introduction - Accuracy and Mode of Control - Closed Loop Control System - Components of Control System

MODULE II CAMS 7

Introduction - Components of Cam - Types of Cams - Types of follower - Classification of Cams according to constraints - Cam motions - Cam as a mechanical function generator - 3D Cam

MODULE III Gears & Gyroscope 10

Introduction - Types of Gears : Spur Gear and Pinion, Rack and pinion, Helical Gear, Herringbone Gear, Bevel Gear, Worm Gear - Gear for Load Matching, Design of Gear Trains - Backlash in Gears Introduction - Gyroscopic effect - Positional References - Construction of the Gyroscope - Working and application of Horizontal Gyroscope - Construction and use of vertical gyroscope - Equations of Gyroscope - Application of Gyroscope

MODULE IV Potentiometer & Synchros 8

Introduction - Types of potentiometers - Applications of Potentiometers - selection of Potentiometers - Synchro Construction and Operation - Charactersitics - Application - Synchro pair as error detector

MODULE V Servomotors & Stepper Motors 8

Introduction - DC Servo motors : Transfer function of DC Servomotor, Transfer function of field controlled DC Servomotor, Armature controller DC Servomotor, AC Servo motor : Construction, Theory of operation of Induction Motor, Ac Servomotor Introduction - Permanent Magnet stepper motor - Variable Reluctance motor - Hybrid Stepper Motor - Applications

MODULE VI Tachometers 7

Introduction - Characteristic requirements of tachogenerator - DC Tachogenerator : Construction, working, Advantages & Disadvantages, EMF equation - AC Tachogenerators : AC Induction Tachogenerator, working, sources of error - Tachometer applications : Position control, Tachometer as an integrator

L – 45; Total Hours –45

TEXT BOOKS:

1.Control System Components, M.D. Desai, PHI Learning, New Delhi - 110 001, 2008, ISBN 9788120336056

REFERENCES:

OUTCOMES:

At the end of the course, the students will

1. Identify the components suitable for a process

2. To apply the components for automation solutions

3. To understand the construction of the different control system components

4. To integrate the required components to build a control loop

5. To design the components

6. To assess the performance for a particular application

EICX12	ADVANCED SENSORS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge on measurement using resistance strain gauge, motion sensors, heat and temperature detectors and electronics sensors.
- Being Engineering practioners who would help to solve Industries technological problem
- Will interact with peers in Industry and society and contribute to economic growth of the country.
- To familiarize with recent trends in sensor technology.

MODULE I STRAIN AND PRESSURE MEASUREMENT 8

Resistance strain gauge, piezoelectric pressure gauge, characteristics. Electronic circuits for strain gauge, load cells. Interferometer, Fibre-optic methods. Pressure gauges Aneroid capacitance pressure gauge, ionization gauge, using the transducers for applications.

MODULE II MOTION SENSORS 8

Capacitor plate sensor, Inductive sensors, LVDT Accelerometer systems, rotation sensors drag cup devices, piezoelectric devices. Rotary encoders.

MODULE III LIGHT RADIATION 8

Color temperature, light flux, photo sensors, photomultiplier, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber-optic applications, light transducer, solid-state, transducers liquid crystal devices.

MODULE IV HEAT AND TEMPERATURE 8

Bimetallic strip, Bourdon temperature gauge, thermocouples, Resistance thermometers, thermistors, PTC thermistors, bolometer, Pyroelectric detector.

MODULE V ELECTRONIC SENSORS 5

Proximity detectors – Inductive and capacitive, ultrasonic, photo beam detectors Reed switch, magnet and Hall-effect modules, Doppler detectors, liquid level detectors, flow sensors, smoke sensors.

MODULE VI SMART SENSORS & RECENT TRENDS IN SENSOR TECHNOLOGY 8

Primary sensors, compensation, non-linearity approximation and regression, information, coding processing, data communication, standards for smart sensor interface, automation. Thin film sensors, semi conductor IC technology, diffusion and ion-implementation, MEMS, Nano sensors.

L – 45; Total Hours –45

TEXT BOOKS:

REFERENCES:

1. Doebelin, E O, “Measurement Systems, Application and Design” , McGraw Hill, 5th Edition, 2004.
2. Jack P Holman, “Experimental Methods for Engineers”, 7th edition, McGraw Hill, USA, 2001.
3. Ian R Sinclair, “Sensors and Transducers”, 3rd edition, Newnes publishers, 2001.
4. Robert G Seippel, “Transducers, Sensors and Detectors”, Reston Publishing Company, US.

OUTCOMES:

After completion of the course the student will be,

- Apply the common methods for converting a physical parameter into an electrical quantity for measurement of temperature, strain, motion, position and light for industrial applications.
- Able to function with multi disciplinary team
- Understand potential and ethical responsibility
- Will have the relevant knowledge to select different kind of sensors for that particular application

EICX 13	ULTRASONIC INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge about the basic principles and generation of ultrasonic waves.
- To provide the various testing method and measurement of ultrasonic waves
- To impart knowledge on applications of ultrasonic waves in medical field, Imaging field and nondestructive testing.

MODULE I ULTRASONIC WAVES 8

Principles and propagation of various waves. Characterization of Ultrasonic transmission–reflection and transmission coefficients, intensity and attenuation of sound beam. Power level.

MODULE II GENERATION OF ULTRASONIC WAVES 9

Magnetostrictive Piezoelectric effects and Electrostriction. Search MODULE– types, construction, characteristics. Detection of ultrasound: kund's tubekoeing's tube-thermal detection .Multiple Element Ultrasound transducer Piezoelectric ultrasound generator: Design and its frequency response .Focus transducer, Phase array transducer-Transducer damage

MODULE III ULTRASONIC TEST METHODS 8

Ultrasonic Test methods - Pulse echo, Normal beam transmission, Angular beam transmission techniques. Transit time, resonance, direct contact and immersion type, Ultrasonic methods of flaw detection-Acoustic Flaw detector.

MODULE IV ULTRASONIC MEASUREMENT 6

Ultrasonic method of measuring thickness, Level, flow etc. Doppler Effect - Doppler flow meter-various types. Density measurement: Sludge densitometer-sonic densitometer-Microprocessor based sludge densitometer. Temperature Measurement: Ultrasonic thermometers-variable types.

MODULE V ULTRASONIC APPLICATIONS IN MEDICAL DIAGNOSIS 6

Blood flow measurement-Beam deflection flow meter-Doppler flow meter- Fetal heart movement measurement-phonocardiography-Echocardiography-tissue destruction and Therapy.

MODULE VI INDUSTRIAL APPLICATIONS OF ULTRASOUND 6

Acoustical holography-Principle, various types. Interface Detection-Sound Navigation and Ranging- non destructive testing

L – 45; Total Hours –45

TEXT BOOKS:

1.James A. Zagzebski, “Introduction to Essential of ultrasound”, Mosby, Incorporated, 1996

2. Srinivasan M.R. “Physics for Engineers”, New Age International, 2009

3. Liptac, “Process Design and Instrumentation”, John wiley and sons, 2003

4. R.S.Khandpur, “Hand Book of Bio-Medical instrumentation”, Tata McGraw Hill Publishing Co Ltd.,2003.

REFERENCES:

1. Krauthsamer J and Krauthsamer H, “Ultrasonic Testing of Materials”, Springer Verlag, Berlin,New York. 2. Wells N T, “Biomedical Ultrasonic”, Academic Press, London, 1977.

OUTCOMES:

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

- Detect the defects in test specimen and capable of measuring various physical quantities using ultrasonic waves.
- Implement ultrasound technique in NDT testing for quality measurement
- Analyze the various ultrasound methods to measure the physical quantities
- Detect and analyze various flaw in products
- Diagnose the medical related issues using ultrasonic waves.

EICX15	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To lay the foundation on emerging network and data communication technologies and their potential impact
- To provide knowledge on socket programming using TCP and UDP.
- To explore the modern network architectures from a design and performance perspective.
- To understand and design the mobile and wireless network protocols.
- To identify various network parameters to increase QoS for multimedia networks.

MODULE I DATA COMMUNICATIONS 8

Components – Direction of Data flow – networks – Components and Categories – types of Connections – Topologies –Protocols and Standards – ISO / OSI model – Transmission Media – Coaxial Cable – Fiber Optics – Line Coding – Modems – RS232 Interfacing sequences

MODULE II DATA LINK LAYER 10

Error – detection and correction – Parity – LRC – CRC – Hamming code – low Control and Error control - stop and wait – go back-N ARQ – selective repeat ARQ- sliding window – HDLC. - LAN - Ethernet IEEE 802.3 - IEEE 802.4 - IEEE 802.5 - IEEE 802.11 – FDDI - SONET – Bridges.

MODULE III NETWORK LAYER 10

Internetworks – Packet Switching and Datagram approach – IP addressing methods – Subnetting – Routing – Distance Vector Routing – Link State Routing – Routers.

MODULE IV TRANSPORT LAYER 9

Duties of transport layer – Multiplexing – Demultiplexing – Sockets – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control – Quality of services (QOS) – Integrated Services.

MODULE V APPLICATION LAYER 8

Domain Name Space (DNS) – SMTP – FTP – HTTP - WWW – Security – Cryptography.

L – 45; Total Hours –45

TEXT BOOKS:

1. Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw-Hill, 2004.

REFERENCES:

1. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Pearson Education, 2003.
2. Larry L.Peterson and Peter S. Davie, "Computer Networks", Harcourt Asia Pvt. Ltd., Second Edition.
3. Andrew S. Tanenbaum, "Computer Networks", PHI, Fourth Edition, 2008

OUTCOMES:

- Compare and contrast the OSI reference model and TCP/IP model.
- Examine the various application layer protocols and propose the solutions based on the need.
- Review the protocols, network interfaces, and performance issues in local area networks and wide area networks.
- Identify different congestion control techniques and critique upon them.
- Analyze and interpret the effect of QoS Parameters in the multimedia networks.

GROUP III

		L	T	P	C
EICX21	**INDUSTRIAL DATA NETWORKS**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To educate on the basic concepts of data networks
- To introduce the basics of inter networking and serial communications
- To provide details on HART and Field buses
- To educate on MODBUS, PROFIBUS and other communication protocol
- To introduce industrial Ethernet and wireless communication

MODULE I DATA NETWORK FUNDAMENTALS 8

Networks hierarchy and switching – Open System Interconnection model of ISO – Data link control protocol – Media access protocol – Command / response – Token passing – CSMA/CD, TCP/IP

MODULE II INTERNET WORKING and RS 232, RS 485 9

Bridges – Routers – Gateways – Standard ETHERNET and ARCNET configuration special requirement for networks used for control – RS 232, RS 485 configuration Actuator Sensor (AS) – interface, Device net

MODULE III HART AND FIELDBUS 8

Introduction – Evolution of signal standard – HART communication protocol – HART networks – HART commands – HART applications – Fieldbus – Introduction – General Fieldbus architecture – Basic requirements of Fieldbus standard – Fieldbus topology – Interoperability – Interchangeability – Introduction to OLE for process control (OPC).

MODULE IV MODBUS AND PROFIBUS PA/DP/FMS AND FF 6

MODBUS protocol structure – function codes – troubleshooting Profibus, Introduction, Profibus protocol stack, Profibus communication model – communication objects – system operation – troubleshooting – review of foundation fieldbus – Data Highway

MODULE V INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION 6

Industrial Ethernet, Introduction, 10 Mbps Ethernet, 100 Mbps Ethernet – Radio and wireless communication, Introduction, components of radio link – radio spectrum and frequency allocation – radio MODEMs-Introduction to wireless HART and ISA100.

L – 45; Total Hours –45

TEXT BOOKS:

1. Steve Mackay, Edwin Wright, Deon Reynders, John Park, Practical Industrial Data Networks Design, Installation and Troubleshooting' Newnes Publication, Elsevier First Edition, 2004.
2. William Buchanan, Computer Buses, CRC Press, 2000.
3. A. Behrouz Forouzan ,Data Communications & Networking ,5th edition, Tata Mc Graw hill,2012.

REFERENCES:

1. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Prentice Hall of India Pvt. Ltd., 5th Edition. 2011.
2. Theodore S Rappaport, Wireless Communication: Principles and Practice, Prentice Hall of India 2nd Edition, 2001.
3. William Stallings, Wireless Communication & Networks, Prentice Hall of India, 2nd Edition, 2005.

OUTCOMES:

- Ability to understand and analyze Instrumentation systems and their applications to various industries.
- Ability to develop an understanding of and be able to select and use most appropriate technologies and standards for a given application.
- Ability to design and ensuring that best practice is followed in installing and commissioning the data communications links to ensure they run fault-free.

EICX22	ROBOTICS AND AUTOMATION	L	T	P	C
	(Pre Requisite: Mathematics, Control Systems)	3	0	0	3

OBJECTIVES:

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the Euler, Lagrangian formulation of Robot dynamics.
- To study the trajectory planning for robot.
- To study the control of robots for some specific applications.

MODULE I BASIC CONCEPTS 9

Definition and history of robotics – degrees of freedom – Asimov"s laws of robotics – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Their Functions – Need for Robots – Various fields of Robotics .

MODULE II POWER SOURCES AND SENSORS 9

Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors

MODULE III MANIPULATORS, ACTUATORS AND GRIPPERS 9

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – Various types of grippers – design considerations.

MODULE IV KINEMATICS AND PATH PLANNING 9

Solution of inverse kinematics problem – multiple solution jacobian work envelop – hill Climbing Techniques – robot programming languages.

MODULE V CASE STUDIES 9

Robot Maintenance and Safety - nano robots and mobile robots - Mutiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.

L – 45; Total Hours –45

TEXT BOOKS:

- Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., "Industrial Robotics", Mc Graw-Hill Singapore, 1996.
- Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.

REFERENCES:

- Deb. S.R.,"Robotics Technology and flexible Automation", John Wiley, USA 1992.
- Klafter R.D., Chimielewski T.A., Negin M., "Robotic Engineering – An integrated approach", Prentice Hall of India, New Delhi, 1994.
- Mc Kerrow P.J. "Introduction to Robotics", Addison Wesley, USA, 1991.
- Issac Asimov "Robot", Ballantine Books, New York, 1986.
- Barry Leatham – Jones, "Elements of industrial Robotics" PITMAN Publishing, 1987.
- Mikell P.Groover, Mitchell Weiss, Roger N.Nagel Nicholas G.Odrey, "Industrial Robotics Technology, Programming and Applications ", McGraw Hill Book Company 1986.
- Fu K.S. Gonzaleaz R.C. and Lee C.S.G., "Robotics Control Sensing, Vision and Intelligence" McGraw Hill International Editions, 1987.

OUTCOMES:

Upon completion of the course, the student should be able to:

- Explain the basic concepts of working of robot
- Analyze the function of sensors in the robot
- Write program to use a robot for a typical application
- Use Robots in different applications

EICX23 VIRTUAL INSTRUMENTATION

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To study the basic building blocks of virtual instrumentation.
- To study the various graphical programming environment in virtual instrumentation.
- To provide knowledge about how to control an external measuring device by interfacing a computer.
- Provide to become competent in data acquisition and instrument control.
- To study a few applications in virtual instrumentation.

MODULE I FUNDAMENTALS OF VIRTUAL INSTRUMENTATION(VI) 8

Introduction-Graphical system design model-Design flow with GSD-VI-Hardware and software-VI for test ,control and design-VI in the Engineering Process-Introduction to LabVIEW-Data types-Modular Programming-Creating a Standalone application-For and while loop-Shift register-Control timing-Local and global variables

MODULE II ARRAYS and CLUSTER OF INSTRUMENTS IN VI SYSTEM 7

Creating two dimensional and multidimensional arrays using loops--Array functions-auto indexing-matrix operations with array, creating cluster controls and indicators-creating cluster constant-order of cluster elements-cluster operations-assembling clusters-disassembling clusters- conversion between clusters and arrays-error handling-error cluster.

MODULE III STRUCTURES, STRINGS AND FILE I/O 8

Case structures-sequence structures-customizing structures-timed structures-Formula nodes-Event structures-Lab VIEW mathscript-creating string control-String functions-editing, formatting and parsing strings-Configuring string controls and indicators- Basics of file I/O-Choosing a file I/O format-file I/O Vis

MODULE IV INSTRUMENTATION CONTROL AND DATA ACQUISITION 7

Signal processing and analysis-professional development tools-Control design and simulation tools-Tool kits: Digital filter design – spectral measurement -control design –PID control-system identification- IMAQ vision -Express VI development-simulation interface-report generation-control design and simulation module.

MODULE V LABVIEW TOOLS 8

GPIB (General Purpose Interface Bus) communication-Software architecture-instrument I/O assistant-instrument drivers-Serial port communication-transducers-signals-Signal conditioning-DAQ hardware configuration-Analog I/O –DAQ software architecture-DAQ assistant-Channels and task configuration-Selecting and configuring a data acquisition device-components of computer based measurement system.

MODULE VI GSD APPLICATIONS 7

Data logging and supervisory control –Embedded module-Material handling system-Plastic injection molding system-semiconductor production control system- Machine vision application areas.

L – 45; Total Hours –45

TEXT BOOKS:

1. Gupta,"Virtual Instrumentation Using Lab View", Tata McGraw Hill, New Delhi,1st Edition, 2008.
2. Jerome Jovitha, "Virtual Instrumentation and LABVIEW", PHI Learning, New Delhi, 1st Edition, 2010.
3. Robert H. Bishop, 'Learning with Lab-view', Prentice Hall, 2003.

REFERENCES:

1. S. Gupta and J.P Gupta, 'PC Interfacing for Data Acquisition and Process Control', Instrument society of America, 1994.
2. Ronald W. Larsen, "LabVIEW for Engineers", Prentice Hall Ltd, USA Jan 2010.
3. Sanjay Gupta and Joseph John, " Virtual Instrumentation using LabVIEW", Tata Mc Graw – Hill Publishing Company Limited, New Delhi, 1st Edition, 2005.
4. Kevin James, 'PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control', Newness, 2000.
5. Gary W. Johnson, Richard Jennings, 'Lab-view Graphical Programming', McGraw Hill Professional Publishing, 2001.
6. LabVIEW: Basics I & II Manual, National Instruments, 2005.
7. Peter W. Gofton, 'Understanding Serial Communications', Sybex International.

OUTCOMES:

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

- Acquire knowledge on how virtual instrumentation can be applied for data acquisition and instrument control.
- Identify salient traits of a virtual instrument and incorporate these traits in their projects.
- Experiment, analyze and document in the laboratory prototype measurement systems using a computer, plug-in DAQ interfaces and bench level instruments.

EICX24	APPLIED ANALYTICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce analytical instruments, properties, sampling and common process parameters and the various regions of the Electromagnetic spectrum.
- To provide knowledge on various components and performance of visible ultraviolet and IR spectrophotometers
- To give unique methods of separation of closely similar materials, using chromatography.
- To study important methods of industrial gas analysers.
- To study characteristics of different types of NMR and mass spectrometers

MODULE I FUNDAMENTALS OF ANALYTICAL INSTRUMENTS 8

Introduction to Analytical Instruments – Elements of an analytical instruments - Applications of chemical composition measurement in industries - Classifications of analytical instruments based on properties - Sample – Sampling points —- performance requirements of analytical instruments: Errors in chemical analysis – Calibration and verification – Advantages of automated analysis - Common process parameters and its application - Electromagnetic radiation, spectrum - Beers Lambert's Law – Deviation from Beer's Law

MODULE II SPECTROPHOTOMETERS 9

Radiation sources: Blackbody sources, Discharge Lamps, Lasers - Detectors: Photovoltaic, Photoemissive, Photomultiplier tube, silicon diode detectors – Infrared Spectroscopy - Radiation sources – Detectors: Quantum Type Detector, thermal Detectors – FTIR spectrophotometers – Atomic absorption spectrophotometers – Sources and Detectors - Typical Industrial applications to measure particle size and distribution – estimation of proteins – qualitative and quantitative analysis.

MODULE III CHROMATOGRAPHY 8

Chromatography - Gas chromatograph: Basic parts, Carrier Gas / Mobile phase, Sample Injection system, Chromatographic column – Detectors: Thermal Conductivity detector, Flame Ionization detector, Flame photometric detector, electron capture detector –Liquid Chromatographs – Types of Liquid chromatography: Column, thin layer, paper partition – HPLC – Detectors: Refractive index detectors, Thermal detectors, Electrical Conductivity detectors - Typical Industrial applications- qualitative and quantitative analysis

MODULE IV INDUSTRIAL ANALYSERS 6

Water Analysis: pH, Conductivity, Silica, Dissolved Oxygen, Hydrocarbons analyzer, Sodium analyzer - Chlorine analyzer- Analysis of DM water – Flame Photometer - Flue gas analysis: Paramagnetic and diamagnetic – Insitu - Infrared Gas analyzer – Carbon Monoxide analyzer – Sulphur dioxide analyzer – Nitrogen Oxides analyzer – smoke detection: Ringleman Chart - Dust analyser - Typical Industrial applications

MODULE V ELECTROMAGNETIC RESONANCE AND MICROSCOPIC TECHNIQUES 6

Nuclear Magnetic Resonance Spectroscopy: Principle of NMR – Types of NMR Spectrometers – Constructional Details of NMR spectrometer – Constructional Details of ESR spectrometer – SEM : Basic principle and applications – TEM: Basic principle and applications – Mass spectrometers: Basic principle Types, Components and applications – Typical Industrial applications

L – 45; Total Hours –45

TEXT BOOKS:

1. R.S. Khandpur, "Handbook of Analytical Instruments", Tata McGraw Hill publishing Co. Ltd., 2008.
2. H.H. Willard, L.L.
3. Merritt, J.A. Dean, F.A. Settle, "Instrumental Methods of Analysis", CBS publishing & distribution, 1995.

REFERENCES:

1. Douglas A. Skoog, "Principles of Instrumental Analysis" (7th International Edition), Thomson Brooks/Cole 2017
2. Robert D. Braun, "Introduction to Instrumental Analysis", McGraw Hill, Singapore, 1987.
3. G.W. Ewing, "Instrumental Methods of Analysis", McGraw Hill, 2008.
4. D.A. Skoog and D.M. West, "Principles of Instrumental Analysis", Holt, Saunders Publishing, 1985.

OUTCOMES:

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

- Identify common process parameters and analyze the function and general requirements of analytical instruments
- Effectively compare the components and performance of visible and UV spectrophotometers
- Identify working concept of different components of IR spectrophotometer
- Group the operating principle and applications of chromatography
- Select suitable gas analyzer for industrial applications
- Compare the characteristics of different types of NMR and mass spectrometers

EICX25	HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the application of fluid mechanics and governing laws in hydraulic and pneumatic systems.
- To familiarize the working principle of various components used in hydraulic and pneumatic systems.
- To learn the selection of different components used in hydraulic and pneumatic systems.
- To study the design of hydraulic and pneumatic circuits.
- To introduce Industrial applications of hydraulic and pneumatic circuits.

MODULE I INTRODUCTION TO HYDRAULICS AND PNEUMATICS 8

Introduction to oil hydraulics and pneumatics, their structure, advantages and limitations. Properties of fluids, Fluids for hydraulic systems, governing laws. Distribution of fluid power, ISO symbols, energy losses in hydraulic systems.

MODULE II PUMPS 10

Types, classification, principle of working and constructional details of vane pumps, gear pumps, radial and axial plunger pumps, screw pumps, power and efficiency calculations, characteristics curves, selection of pumps for hydraulic Power transmission.

Power units and accessories: Types of power units, reservoir assembly, constructional details, pressure switches, temperature switches.

Accumulators: Types, selection/ design procedure, applications of accumulators. Types of Intensifiers, Pressure switches /sensors, Temperature switches/sensors, Level sensors.

MODULE III HYDRAULIC ACTUATORS 9

Linear and Rotary. (ii) Hydraulic motors - Types- Vane, Gear, Piston types, radial piston. (iii) Methods of control of acceleration, deceleration. (iv) Types of cylinders and mountings. (v) Calculation of piston velocity, thrust under static and dynamic applications, considering friction, inertia loads. (vi) Design considerations for cylinders. Cushioning of cylinders. (Numerical treatment).

MODULE IV INDUSTRIAL CIRCUITS 8

Simple reciprocating, Regenerative, Speed control (Meter in, Meter out and bleed off), Sequencing, Synchronization, transverse and feed, circuit for riveting machine, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, circuit for hydraulic press, unloading circuit (Numerical treatment), motor breaking circuit.

MODULE V PNEUMATICS 10

Principle of Pneumatics: (i) Laws of compression, types of compressors, selection of compressors. (ii) Comparison of Pneumatics with Hydraulic power transmissions. (iii) Types of filters, regulators, lubricators, mufflers, dryers. (iv) Pressure regulating valves, (v) Direction control valves, two way, three way, four way valves. Solenoid operated valves, push button, lever control valves. (vi) Speed regulating - Methods used in Pneumatics. (vii) Pneumatic actuators-rotary, reciprocating.(viii) Air motors- radial piston, vane, axial piston (ix) Basic pneumatic circuit, selection of components, (x) Application of pneumatics in low cost automation and in industrial automation. Introduction to vacuum and vacuum measurement, Vacuum pumps, types, introduction to vacuum sensors and valves. Industrial application of vacuum.

L – 45; Total Hours –45

TEXT BOOKS:

1. Esposito, Fluid Power with application, Prentice Hall
2. Majumdar S.R, Oil Hydraulic system- Principle and maintenance ,Tata McGraw Hill
3. Majumdar S.R ,Pneumatics Systems Principles and Maintenance ,Tata McGraw Hill
4. H.L.Stewart, Hydraulics and Pneumatics , Taraporewala Publication.

REFERENCES:

1. J. J. Pipenger, Industrial Hydraulics, McGraw Hill
2. Pinches, Industrial Fluid Power, Prentice Hall
3. D. A. Pease, Basic Fluid Power, Prentice Hall
4. B. Lall, Oil Hydraulics, International Literature Association
5. Yeaple, Fluid Power Design Handbook
6. 6. Andrew A. Parr, Hydraulics and Pneumatics, Elsevier Science and Technology Books.

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

- Use the Working principle of various components used for hydraulic & pneumatic systems.
- Identify various components of hydraulic & pneumatic systems.
- Select appropriate components required for hydraulic and pneumatic systems.
- To design hydraulic and pneumatic system for industrial applications.
- To correlate industrial applications of hydraulic and pneumatic system.
- To Troubleshoot hydraulic & pneumatic circuits.

GROUP IV

EICX31	MODELING AND SIMULATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

MODULE I Overview of Mathematical Modeling 7

Mathematical Model, classification of model equations, Development of mathematical model, Simulation, Nonlinear Differential Equations, Conservation of Mass/Energy/Momentum, Black Box Models

MODULE II Model developments for simple systems 8

Settling velocity of spherical particle, Vaporization from a single droplet in quiescent air, Modeling of a surge tank, Modeling of the pH process, Modeling of a Jacketed Heater, reaction, PDE model for tubular reactor with axial dispersion.

MODULE III Model developments for complex systems 8

Isothermal CSTR, Lineraisation of a nonlinear equation, Bioreactor Modeling, Magnetic levitation (unstable systems), Choletts model with input multiplicities, Model for predators and Prey populations, Non-Isothermal continuous stirred tank reactor.

MODULE IV Numerical solutions of model equations 8

Newton – Raphson's method for a system of nonlinear algebraic equations; Runge-Kutta Methods of solving numerically IVP ODEs, Numerical solution of nonlinear BVP ODEs**,** Numerical solution of nonlinear PDE, Least square Curve Fitting ,Variable transformation to get a linear equation.

MODULE V Empirical Models 7

Introduction; First order plus dead time process models; Integrator plus dead time ; Discrete Time Autoregressive Models

MODULE VI Case studies **7**

Development of model of evaporator, boiler and distillation column

L – 45; Total Hours –45

TEXT BOOKS:

1. Bequette, B.W., "Process Dynamics: Modeling, Analysis and Simulation", Prentice-Hall International, Singapore, 1998
2. Jana, A.K., " Chemical Process Modeling and Computer simulation", Prentice-Hall-India, New Delhi, 2011
3. Finlayson, B.A., "Introduction to Chemical Engineering Computing", Wiley Student Edition, Singapore, 2006
4. Chidambaram M., "Mathematical Modeling and Simulation for Engineers", Cambridge University Press, New Delhi, 2017

REFERENCES:

OUTCOMES:

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

- get an overview of the procedure used for mathematical modeling and model equations
- develop models for simple systems such as surge tank and pH process
- develop models for complex systems such as CSTR, bioreactor and levitation system
- obtain numerical solutions for the nonlinear model equations, both ODEs and PDEs
- simulate various types of nonlinear models and find solutions using MATLAB and SCILAB
- develop the models for selected process equipment such as boiler and distillation column.

EICX32	**DIGITAL IMAGE PROCESSING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

The student should be made to:

- Learn digital image fundamentals.
- Be exposed to simple image processing techniques.
- Be familiar with image compression and segmentation techniques
- . • Learn to represent image in form of features.

MODULE I DIGITAL IMAGE FUNDAMENTALS 8

Introduction – Origin – Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - color models.

MODULE II IMAGE ENHANCEMENT 10

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering – Frequency Domain: Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters.

MODULE III IMAGE RESTORATION AND SEGMENTATION 9

Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

Segmentation: Detection of Discontinuities–Edge Linking and Boundary detection – Region based segmentationMorphological processing- erosion and dilation.

MODULE IV IMAGE REPRESENTATION AND RECOGNITION 9

Wavelets – Subband coding - Multiresolution expansions - Compression: Fundamentals – Image Compression models – Error Free Compression – Variable Length Coding – Bit-Plane Coding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding – Compression Standards.

MODULE V IMAGE REPRESENTATION AND RECOGNITION 9

Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier Descriptor, moments- Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

L – 45; Total Hours –45

TEXT BOOKS:

1.Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2010.

REFERENCES:

1.Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, Third Edition Tata McGraw Hill Pvt. Ltd., 2011.

2. Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt. Ltd., 2011.

3. Willliam K Pratt, “Digital Image Processing”, John Willey, 2002.

4. Malay K. Pakhira, “Digital Image Processing and Pattern Recognition”, First Edition, PHI Learning Pvt. Ltd., 2011.

5. http://eeweb.poly.edu/~onur/lectures/lectures.html.

6. http://www.caen.uiowa.edu/~dip/LECTURE/lecture.html

OUTCOMES:

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

• Discuss digital image fundamentals.

• Apply image enhancement and restoration techniques.

• Use image compression and segmentation Techniques.

(Represent features of images.

EICX33	INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- understand the different oil recovery methods, oil gas separation and its processing.
- learn about the most important unit operations in petrochemical industries like cracking, reforming etc.
- gain knowledge on the important derivatives obtained from petroleum, its uses steps followed for ensuring intrinsic safety.
- study about the different control schemes applied to processes like distillation column, PVC production unit, cracking and reforming.

MODULE I OIL EXTRACTION AND PROCESSING 9

Petroleum Exploration - methods of oil extraction - recovery techniques - Primary and Secondary recovery - Enhanced oil recovery - separation of gas and water from oil - control loops in oil gas separator.

MODULE II PETROLEUM REFINING 9

Unit operations in refinery - thermal cracking - catalytic cracking - catalytic reforming - polymerization - isomerization - alkylation - Production of ethylene, acetylene and propylene from petroleum.

MODULE III CHEMICALS FROM PETROLEUM 9

Chemicals from methane, acetylene, ethylene and propylene - production routes of important petrochemicals such as polyethylene, polypropylene, ethylene dioxide, methanol, xylene, benzene, toluene, styrene, VCM and PVC

MODULE IV CONTROL LOOPS IN PETROCHEMICAL INDUSTRY 9

Control of binary and fractional distillation columns - Control of catalytic and thermal crackers - control of catalytic reformer - control of alkylation process - Control of polyethylene production – Control of VCM and PVC production

MODULE V SAFETY IN INSTRUMENTATION SYSTEMS 9

Area and material classification as per National Electric Code (NEC) - Classification as per International Electrotechnical Commission (IEC) - Techniques used to reduce explosion hazards - Pressurization techniques - Type X, Type Y and Type Z - Intrinsic safety - Mechanical and Electrical isolation - Lower and Upper explosion limit

L – 45; Total Hours –45

TEXT BOOKS:

1. Balchen J.G and Mumme K.I., Process Control Structures and Applications, Von Nostrand Reinhold Company, New York, 1988.
2. www.scribd.com/doc/2336259/ABB-Oil-Gas-production-Hand-Book.

REFERENCES:

1. Liptak B.G., Instrumentation in Process Industries, Chilton Book Company, 2005.
2. Waddams A.L., Chemicals from Petroleum, Butter and Janner Ltd., 1968.
3. Ram Prasad, Petroleum Refining Technology, Khanna Publishers, New Delhi, 2000.

OUTCOMES:

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

- Implement the oil recovery methods, oil gas separation and the important derivatives obtained from petroleum and its uses.
- analyze the unit operations like cracking, reforming etc.
- Infer the important derivatives obtained from petroleum and its uses.
- apply different control schemes to processes like distillation column, PVC production unit, cracking and reforming.
- Interpret the safety measures required for petrochemical industries.

		L	T	P	C
EICX34	**WIRELESS SENSOR NETWORKS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- Able to study the characteristic of WSN
- Analyse the different types of MAC Prtocals.
- Familiar with different types of adhoc networks.
- Expose to the TCP issues in adhoc network.

MODULE I Characteristics Of WSN 8

Characteristic requirements for WSN - Challenges for WSNs – WSN vs Adhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

MODULE II Medium Access Control Protocols 9

Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts – Contentionbased protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol.

MODULE III Routing And Data Gathering Protocols 10

Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP - Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.

MODULE IV Embedded Operating Systems 9

Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS - OSPM - EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.

MODULE V Applications Of WSN 9

WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling.

L – 45; Total Hours –45

TEXT BOOKS:

1.Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.

2. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks",John Wiley & Sons, Ltd, 2005.

REFERENCES:

1. K. Akkaya and M. Younis, "A survey of routing protocols in wireless sensor networks", Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349

2.Philip Levis, " TinyOS Programming"

3.Anna Ha´c, "Wireless Sensor Network Designs", John Wiley & Sons Ltd,

OUTCOMES:

- To understand the concepts, network architectures and applications of ad hoc and wireless sensor networks
- Analyze the protocol design issues of ad hoc and sensor networks
- Design routing protocols for ad hoc and wireless sensor networks with respect to some protocol design issues
- Evaluate the QoS related performance measurements of ad hoc and sensor networks

GROUP V

EICX41	NONLINEAR CONTROL SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to basics of non-linear systems
- To introduce the phase plane method to determine the stability of the system
- To familiarize with the singular points to construct the phase portrait
- To introduce describing function to analyse stability of the system
- To expose Autonomous and non autonomous system using Lyapunov function

MODULE I Nonlinear Systems 7

Introduction to Nonlinear systems - properties of nonlinear systems - classification of nonlinearities - Inherent nonlinearities : Saturation, Dead zone, On-Off Nonlinearity, On-Off Nonlinearity with hysteresis Nonlinear friction - Backlash - Nonlinear Spring - Absolute Value Nonlinearity - Intentional Nonlinearities

MODULE II Phase Plane Method 7

Introduction - Limit Cycle - Jump Resonance - Phase plane method : basic concept of phase plane method - Isocline method - Application of phase plane method to Linear control system - Second order nonlinear system on phase plane

MODULE III Different types of phase portraits 7

Phase portraits for Type 0 system : Stable system with complex roots, unstable system with complex roots, marginally stable system with complex roots, stable system with real roots, unstable system with positive real roots, unstable system with one positive and one negative real root - Forced second order type 0 system - Phase portraits for type 1 system - Phase portraits for type 2 system - singular points of a nonlinear system - Delta method

MODULE IV Analysis of nonlinear system 10

Introduction - Describing function : Theory, Saturation, Relay with hysteresis, Heating system, Quantization error and sampling - Stability analysis by linearization : Theory for continuous time systems: Pendulum, Chain Wheel, population growth - State space descriptions - Pendulum - Separators - Chaos

MODULE V Lyapunov's stability analysis 8

Introduction - Stability in the sense of Lyapunov - Asymptotic stability, Asymptotic stability in the Large - Instability - Graphical Representation - Positive Definiteness - Negative definiteness - Positive Semidefiniteness -Negative semidefinte - Indefiniteness - Liapunov's second method - Liapunov's stability theorem - Stability of Linear and Nonlinear systems - Krasovskii's method - Direct method of Liapunov and the linear system

MODULE VI Lyapunov analysis of non-autonomous system 6

Nonlinear control system design - feedback linearization

L – 45; Total Hours –45

TEXT BOOKS:

1. Ad Damen, Modern Control Theory, 2002
2. Professor Zdzislaw Bubnicki, Modern Control Theory, Springer Verlag Berlin Heidelberg, 2005

REFERENCES:

1. Jean Jacques E. Slotine, "Applied Nonlinear Control", Prentice Hall Englewood Cliffs, New Jersey, 1991
2. Vidhyasagar. M, "Nonlinear System Analysis", Prentice Hall Englewood Cliffs, New Jersy, 1978.

OUTCOMES:

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

1. Analyse different nonlinearities
2. Apply the phase plane method to determine the stability of the system
3. Determine the singular points and construct the phase portrait
4. Apply describing function for different application to analyse stability of the system
5. Analyse Autonomous system using Lyapunov function
6. Analyse Non-Autonomous system using Lyapunov Function

EICX42 ADVANCED DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To bring out the concepts related to stationary and non-stationary random signals
- To emphasize the importance of true estimation of power spectral density
- To introduce the design of linear and adaptive systems for filtering and linear prediction
- To introduce the concept of wavelet transforms in the context of image processing

MODULE I DISCRETE-TIME RANDOM SIGNALS 9

Discrete random process – Ensemble averages, Stationary and ergodic processes, Autocorrelation and Autocovariance properties and matrices, White noise, Power Spectral Density, Spectral Factorization, Innovations Representation and Process, Filtering random processes, ARMA, AR and MA processes.

MODULE II SPECTRUM ESTIMATION 9

Bias and Consistency, Periodogram, Modified periodogram, Blackman-Tukey method, Welch method, Parametric methods of spectral estimation, Levinson-Durbin recursion.

MODULE III LINEAR ESTIMATION AND PREDICTION 9

Forward and Backward linear prediction, Filtering - FIR Wiener filter- Filtering and linear prediction, non-causal and causal IIR Wiener filters, Discrete Kalman filter.

MODULE IV ADAPTIVE FILTERS 9

Principles of adaptive filter – FIR adaptive filter – Newton's Steepest descent algorithm – LMS algorithm – Adaptive noise cancellation, Adaptive equalizer, Adaptive echo cancellers.

MODULE V WAVELET TRANSFORM 9

Multiresolution analysis, Continuous and discrete wavelet transform, Short Time Fourier Transform, Application of wavelet transform, Cepstrum and Homomorphic filtering.

L – 45; Total Hours –45

TEXT BOOKS:

1. Monson H, Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, Indian Reprint, 2007.
2. John G.Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson, Fourth 2007.
3. Dwight F. Mix, "Random Signal Processing", Prentice Hall, 1995.

REFERENCES:

1. Sophocles J. Orfanidis, "Optimum Signal Processing, An Introduction", McGraw Hill, 1990.

OUTCOMES:

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

- Explain the parametric methods for power spectrum estimation.
- Discuss adaptive filtering techniques using LMS algorithm and the applications of adaptive filtering.
- Analyze the wavelet transforms.

EICX44	**INTERNET OF THINGS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT protocols
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real world scenario.

MODULE I INTRODUCTION TO IoT 9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology.

MODULE II IoT ARCHITECTURE 9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.

MODULE III IoT PROTOCOLS 9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security.

MODULE IV BUILDING IoT WITH RASPBERRY PI & ARDUINO 9

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks - Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces - Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

MODULE V CASE STUDIES AND REAL-WORLD APPLICATIONS 9

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

L – 45; Total Hours –45

TEXT BOOKS:

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.
3. Honbo Zhou, ―The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012.
4. Jan Ho¨ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012

OUTCOMES:

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

- Analyze various protocols for IoT
- Develop web services to access/control IoT devices.
- Design a portable IoT using Rasperry Pi
- Deploy an IoT application and connect to the cloud.
- Analyze applications of IoT in real time scenario

EICX51	MODERN CONTROL SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide the students a comprehension about the state space model and to understand the importance of the system state.
- To give the students a comprehension of the relation between continuous and digital controller design and to make the students able to apply nonlinear system analysis.
- To provide the knowledge about the design aspects to design state feedback

controllers.

- To provide students an understanding of basic analysis and synthesis of control systems and to provide opportunities for students to gain practical experience in the use of computer design and analysis tools in Matlab and Simulink.

MODULE I STATE SPACE ANALYSIS OF SYSTEMS

Classical Vs modern control theory ,concept of state, state space and state variables, state model for typical linear systems, construction of state model from differential equations, block diagram representation of state models, state space model for electrical circuits, mechanical systems, electro-mechanical system-DC motors, state transition matrix from cayleigh - hamilton theorem. Simulation of state space model of DC motors using control system toolbox.

MODULE II TRANSFORMATION IN STATE SPACE MODEL

State space model from transfer functions, transfer from state space model, different cannonical models- phase variable form, observable canonical model, diagonal canonical model, Jordan canonical model. state variable description of discrete time systems.

MODULE III STATE FEEDBACK AND OBSERVER DESIGN

State and output controllability of systems, criterion for controllability, observability of systems, ,state feedback controller design using pole placement method- ackerman's formula, design of full state and reduced order observers. State feedback and observer design using control system toolbox

MODULE IV NONLINEAR CONTROL SYSTEMS

Introduction to nonlinearities and non linear phenomenon, Nonlinear system behavior. methods of linearization, Phase Plane Analysis: Concepts of Phase Plane Analysis: Phase Portraits; Singular Points; Symmetry in Phase Plane Portraits, Methods of Constructing Phase Portraits: Analytical method, the method of Isoclines, limit cycles

MODULE V DESCRIBING FUNCTION METHOD

Basic concepts, describing functions for common nonlinearities, stability analysis by describing function approach, jump resonance, lyapunov stability criterion, popov's stability criterion.

MODULE VI MIMO SYSTEMS

Models of MIMO system – Matrix representation – Transfer function representation – Poles and Zeros – Decoupling – Introduction to multivariable Nyquist plot and singular values analysis – Model predictive control

L – 45; Total Hours –45

TEXT BOOKS

1. Gopal, M., "Digital Control and State Variable Methods", 3rd Edition, Tata McGraw Hill, 2008.
2. Gopal, M., "Modern Control Engineering", New Age International, 2005.

REFERENCES:

1. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", 8th Edition, Pearson Education, 2004.
2. Gopal, M., "Control Systems: Principles and Design", 2nd Edition, Tata McGraw Hill, 2003.
3. Katsuhiko Ogata, "Discrete-Time Control Systems", Pearson Education, 2002.

OUTCOMES:

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

- Solve simple to moderately complex control systems using Lyapunov and Popov's theory.
- Apply concepts and methods from modern control theory to design state and output feedback controllers in industries and Research and Development.

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EICX52	**EMBEDDED SYSTEM AND RTOS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

Learn the architecture and programming of ARM processor.

- Be familiar with the embedded computing platform design and analysis. Be exposed to the basic concepts of real time, Operating system. Learn the system design techniques and networks for embedded systems.

MODULE I INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS 9

Complex systems and micro processors– Embedded system design process –Design example: Model train controller- Instruction sets preliminaries - ARM Processor – CPU: programming input and outputsupervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance- CPU power consumption.

MODULE II EMBEDDED COMPUTING PLATFORM DESIGN

The CPU Bus-Memory devices and systems–Designing with computing platforms – consumer electronics architecture – platform-level performance analysis - Components for embedded programs - Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.

MODULE III PROCESSES AND OPERATING SYSTEMS

Introduction – Multiple tasks and multiple processes – Multirate systems- Preemptive real-time operating systems- Priority based scheduling- Interprocess communication mechanisms – Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE

MODULE IV SYSTEM DESIGN TECHNIQUES AND NETWORKS

Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques- Distributed embedded systems – MPSoCs and shared memory multiprocessors.

MODULE V CASE STUDY

Data compressor - Alarm Clock - Audio player - Software modem-Digital still camera - Telephone answering machine-Engine control unit – Video accelerator

L – 45; Total Hours –45

TEXT BOOK:

1. Marilyn Wolf, “Computers as Components - Principles of Embedded Computing System Design”, Third Edition “Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.

REFERENCES:

1. Jonathan W.Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, Third Edition Cengage Learning, 2012.
2. David. E. Simon, “An Embedded Software Primer”, 1st Edition, Fifth Impression, Addison-Wesley Professional, 2007.
3. Raymond J.A. Buhr, Donald L.Bailey, “An Introduction to Real-Time Systems- From Design to Networking with C/C++”, Prentice Hall, 1999.
4. C.M. Krishna, Kang G. Shin, “Real-Time Systems”, International Editions, Mc Graw Hill 1997
5. K.V.K.K.Prasad, “Embedded Real-Time Systems: Concepts, Design & Programming”, Dream Tech Press, 2005.
6. Sriram V Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata Mc Graw Hill, 2004.

OUTCOMES:

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

- Describe the architecture and programming of ARM processor.
- Outline the concepts of embedded systems
- Explain the basic concepts of real time Operating system design.
- Use the system design techniques to develop software for embedded systems
- Differentiate between the general purpose operating system and the real time operating system
- Model real-time applications using embedded-system concepts

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EICX53	SYSTEM IDENTIFICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

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OBJECTIVES :

The student should be made to:

- Understand the concept of parametric and non-parametric identification
- Gain knowledge in identification using intelligent techniques etc

MODULE I NONPARAMETRIC IDENTIFICATION 6

Transient and frequency analysis methods, impulse and step response methods, correlation method, spectral analysis.

MODULE II PARAMETRIC IDENTIFICATION 7

Steps in identification process, determining model structure and dimension, Linear and nonlinear model structures, Input signals: commonly used signals, spectral properties, and persistent excitation.

MODULE III PARAMETRIC ESTIMATION 8

Linear regression, least square estimation, statistical analysis of LS methods, Minimizing prediction error- identifiability, bias, Least squares, Instrumental Variable Method - parametric estimation using ARX, ARMAX, OE, BJ methods

MODULE IV CLOSED LOOP IDENTIFICATION 7

Identifiability considerations – direct identification – indirect identification - Subspace Identification methods: classical and innovation forms, free and structures parameterizations - Relay feedback identification of stable processes and unstable processes.

MODULE V SYSTEM IDENTIFICATION USING INTELLIGENT TECHNIQUE 8

Identification of empirical data from process using Neural networks - Neural Network ARX (NNARX), NNARMAX, Identification using Takagi Sugeno Fuzzy System

L – 45; Total Hours –45

TEXT BOOK:

1. Ljung .L, System Identification: Theory for the user, Prentice Hall, Englewood Cliffs, 1987.
2. Torsten Soderstrom, Petre Stoica, System Identification, Prentice Hall International (UK) Ltd. 1989.
3. Juang, Jer-Nan, Applied System Identification, Prentice Hall PTR, Englewood Cliffs, New Jersey, 1994.

REFERENCES:

1. Arun K. Tangirala, “Principles of System Identification: Theory and Practice”, CRC Press,2014.
2. F. Van der Heijden, R.P.W. Duin, D. de Ridder and D.M.J. Tax, Classification, Parameter Estimation and State Estimation, An Engineering Approach Using MATLAB, John Wiley & Sons Ltd., 2004.
3. W.T.Miller, R.S.Sutton and P.J.Webrose, “Neural Networks for Control”, MIT Press,

1996.
4. C.Cortes and V.Vapnik, "Support-Vector Networks, Machine Learning", 1995.
5. Karel J. Keesman," System Identification an Introduction", Springer, 2011.
6. Tao Liu, Furong Gao, "Industrial Process Identification and control design, Step-test and relay-experiment-based methods", Springer- Verilog London Ltd, 2012.

OUTCOMES:

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

1. Identify a system using transient and frequency method
2. Determine the model structure and dimension for identification
3. Estimate the system parameters
4. perform closed loop identification
5. Identify a complex system using Intelligent techniques
6. Pre-process the empirical data and validate the model

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EICX 54	INDUSTRIAL DRIVES AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

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- To provide an overview of different types of power semi-conductor devices and their switching characteristics.
- To make the students to understand the operation, characteristics and performance Parameters of controlled rectifiers.
- To study the characteristics of DC and AC drives
- To learn the different modulation techniques of pulse width modulation
- To provide knowledge about the practical application for power electronics converters in conditioning the power supply.

MODULE I POWER DEVICES 9

Power diode – Power transistor – Power MOSFET – SCR – TRIAC – GTO – IGBT – Protection circuits for power devices.

MODULE II CONVERTERS 9

Introduction to half wave, full wave rectifiers – Single phase and three phase half controlled and fully controlled converters – Dual converters – Introduction to cyclo converters and AC controllers.

MODULE III CHOPPER 6

Step up converter-Step down converter-Buck Regulator, boost Regulator and Buck-boost regulators DC Choppers: Class A, B, C, D, and E. DC to DC convertor applications in renewable energy systems

MODULE IV INVERTER 6

Single phase inverter voltage source inverter-Three phase Voltage source inverter(180^0 conduction mode & 120^0 Conduction mode) ; Current source Inverters; PWM technique; Types of PWM

MODULE V DC AND AC DRIVES 9

Steady state characteristic of DC motors – Control of DC motor using converters and choppers – Regenerative and dynamic braking – Closed loop control scheme – Speed-torque characteristic of induction motor – Static stator voltage control – V/f control – Static rotor resistance control – Slip power recovery scheme – Self control of synchronous motor.

MODULE VI POWER ELECTRONIC APPLICATIONS 6

Electric vehicle - Voltage regulators – Online and offline UPS – Switched mode power supply – Principle and application of induction and dielectric heating

L – 45; Total Hours –45

TEXT BOOK:

REFERENCES:

1. G. K. Mithal, “Industrial Electronics”, Khanna Publishers, Delhi, 2008.
2. F. D. Petruzulla, “Industrial Electronics”, McGraw Hill, Singapore, 1996.
3. M. H. Rashid, “Power Electronics Circuits, Devices and Application”, PHI, 3rd edition, 2004.
4. G. M. Chute and R. D. Chute, “Electronics in Industry”, McGraw Hill Ltd, Tokyo, 1995.

OUTCOMES:

.

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

- analyze the various characteristics of power semiconductor devices

- Design a converter circuits for DC loads
- Implement DC converters in renewable energy applications
- Analyze the various PWM techniques in inverters
- Select drives for various applications

EICX61	ADAPTIVE CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

.
The student should be made to:

- Understand the application of adaptive control
- Gain knowledge in different ways of adaptive control techniques

MODULE I INTRODUCTION TO ADAPTIVE CONTROL 6

Introduction - Linear Feedback - Effects of Process Variations - Adaptive Schemes - Adaptive Control Problem - Applications

MODULE II REAL TIME PARAMETER ESTIMATION AND SELF TUNING REGULATORS 10

Introduction - Least Square and Regression Models - Estimating Parameters in Dynamical Systems - Experimental Conditions - Simulation of Recursive Estimation Pole Placement Design - Indirect Self-tuning regulators - Continuous Time Self Tuners - Direct Self tuning regulators

MODULE III MODEL REFERENCE ADAPTIVE SYSTEM 7

Introduction - MIT Rule - Determination of the Adaptation Gain - Lyapunov Theory - Design of MRAS using Lyapunov Theory - Applications of Adaptive Control - Relations between Model Reference Adaptive system and Self tuning Regulator

MODULE IV GAIN SCHEDULING 8

Introduction - Design of Gain Scheduling Controllers - Conventional & Fuzzy Gain Schduler - Nonlinear Transformations - Applications of Gain Scheduling

MODULE V APPLICATIONS AND PERSPECTIVES OF ADAPTIVE CONTROL 7

Introduction - Industrial Adaptive controllers - Automobile control - Ship steering - Ultrafiltration Adaptive Signal processing - Expert control system - Learning systems - Future trends

L – 45; Total Hours –45

TEXT BOOK:

1. Bequette B W, Process control modeling-design and simulation, Prentice Hall of India, 2004.
2. K.J.Astrom, Adaptive Control, Addison-Wesley, 1995

REFERENCES:

1 Krstic, Kanellakopoulos, and Kokotovic, Nonlinear and Adaptive Control Design, John Wiley & Sons, 1995.

1 Marino and Tomei, Nonlinear Control Design: Geometric, Adaptive, Robust, Prentice-Hall, 1995.

OUTCOMES:

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

1. Apply the different adaptive schemes to various applications
2. Estimate the process parameters and apply self tuning regulator
3. Implement model reference adaptive control for a process loop
4. Schedule the controller using gain scheduling technique to accommodate the nonlinear system
5. apply the perspectives of the adaptive controllers

		L	T	P	C
EICX62	**THERMAL POWER PLANT INSTRUMENTATION**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To provide an overview of different methods of Power Generation, with a particular emphasis on thermal power Generation.
- To get knowledge about the various measurements involved in power generation plants.
- To provide knowledge about the different types of analysers used for analysis.
- To impart knowledge about the different types of controls and control loops.
- To familiarize the student with the methods of monitoring different parameters like speed, vibration of turbines and their control.

MODULE I OVERVIEW OF POWER GENERATION 9

Brief survey of methods of power generation – Hydro, thermal, nuclear, solar and wind power – importance of instrumentation in power generation – Thermal power plants – Block diagram – Details of boiler processes – P & I diagram of boiler – Cogeneration

MODULE II MEASUREMENTS IN POWER PLANTS 9

Measurements – Flow of feed water, fuel, air and steam with correction factor for temperature – Steam pressure and steam temperature – Drum level measurement – Smoke density measurement – Dust monitor

MODULE III ANALYSERS IN POWER PLANTS 9

Flue gas oxygen analyser – Analysis of impurities in feed water and steam – Dissolved oxygen analyser – Chromatography – pH meter – Fuel analyser – Pollution monitoring instruments, conductivity meter; Silica Analyser.

MODULE IV CONTROL LOOPS IN BOILER & PROTECTION 9

Combustion control - Air fuel ratio control – Furnace draft control – Drum level control – Main steam and reheat steam temperature control – Super heater control – Air temperature – Deaerator Control – Distributed control system in power plants – Interlocks in boiler operation

MODULE V TURBINE MONITORING

Speed, vibration, shell temperature monitoring and control – Lubricant oil temperature control – Cooling system- Interlocks In turbine operation

L – 45; Total Hours –45

TEXT BOOK:

1. Sam G.Dukelow, “The Control of Boilers”, Instrument Society of America, 1991.
2. P.K.Nag, “Power Plant Engineering”, Tata McGraw Hill, 2001.
3. “Modern Power Station Practice” Vol. 6, Instrumentation controls and Testing, Pergaman Press

REFERENCES:

1. S.M.Elonka and A.L.Kohal, “Standard Boiler Operations”, Tata McGraw Hill, New Delhi, 1994.
2. R.K.Jain, “Mechanical and Industrial Measurements”, Khanna Publishers, New Delhi, 1995.
3. E.Al. Wakil, “Power Plant Engineering”, Tata McGraw Hill, 1984.

OUTCOMES:

.The students will be able to

- Evaluate different methods of power generation and boiler operation in thermal

power plants.
- Select suitable instrument for the measurement of different parameters in a boiler
- Compare the working principle and performance of different analyzers used in thermal power plants
- Design the important control loops and interlocks in boiler
- Anlayse the parameters to be monitored and controlled in steam turbines
- Design the control loops and interlocks in steam turbines

EICX63	APPLIED SOFT COMPUTING FOR INSTRUMENTATION ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- study the fundamentals of Neural networks and their architecture.
- gain knowledge on the applications of Neural networks for modelling and control.
- introduced to the concept of fuzzy set theory
- Understand Fuzzy logic theory for modelling and control.
- Develop hybrid control Schemes and apply optimization algorithms.

MODULE I ARTIFICIAL NEURAL NETWORK 9

Review of fundamentals – Biological neuron, artificial neuron, activation function, single layer perceptron – Limitation – Multi layer perceptron – Back propagation algorithm (BPA) – Recurrent neural network (RNN) – Adaptive resonance theory (ART) based network – Radial basis function network – online learning algorithms, BP through time – RTRL algorithms – Reinforcement learning.

MODULE II NEURAL NETWORKS FOR MODELING AND CONTROL 9

Modeling of non-linear systems using ANN – Generation of training data – Optimal architecture – Model validation – Control of non-linear systems using ANN – Direct and indirect neuro control schemes – Adaptive neuro controller – Familiarization with neural network toolbox

MODULE III FUZZY SET THEORY 9

Fuzzy set theory – Fuzzy sets – Operation on fuzzy sets – Scalar cardinality, fuzzy cardinality, union and intersection, complement (Yager and Sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation – Fuzzy membership functions

MODULE IV FUZZY LOGIC FOR MODELING AND CONTROL 9

Modeling of non-linear systems using fuzzy models – TSK model – Fuzzy logic controller – Fuzzification – Knowledge base – Decision making logic – Defuzzification – Adaptive fuzzy systems – Familiarization with fuzzy logic toolbox

MODULE V HYBRID CONTROL SCHEMES 9

Fuzzification and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy neuron – Introduction to GA – Optimization of membership function and rule base using Genetic Algorithm – Introduction to support vector machine – Particle swarm optimization – Case study – Familiarization with ANFIS toolbox

L – 45; Total Hours –45

TEXT BOOK:

1. Laurence Fausett, "Fundamentals of Neural Networks", Prentice Hall, Englewood Cliffs, N.J., 1992
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill Inc., 1997

REFERENCES:

1. Goldberg, "Genetic Algorithm in Search, Optimization and Machine learning", Addison Wesley Publishing Company Inc. 1989.

2. Millon W.T., Sutton R.S. and Webrose P.J., "Neural Networks for Control", MIT press, 1992
3. Ethem Alpaydin, "Introduction to Machine learning (Adaptive Computation and Machine Learning series)', MIT Press, 2004

4. Zhang Huaguang and Liu Derong, "Fuzzy Modeling and Fuzzy Control Series: Control Engineering", 2006.

OUTCOMES:

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

- Evaluate the different structures of artificial neural network and the techniques used for their learning.
- Apply neural networks for modeling of systems and design of controllers
- Evaluate the characteristics of fuzzy systems and the methods of framing fuzzy rules
- Design of fuzzy logic controller for selected applications
- Optimize membership function and rule base of FLC using GA and other optimization algorithms and develop neuro fuzzy control system

EICX64	VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

.

MODULE I BASIC MOS TRANSISTOR 9

Enhancement mode & Depletion mode – Fabrication (NMOS, PMOS, CMOS, BiCMOS) Technology – NMOS transistor current equation – Second order effects – MOS Transistor Model.

MODULE II MOS & CMOS INVERTER AND GATES 9

NMOS & CMOS inverter – Determination of pull up / pull down ratios – Stick diagram – lamda based rules – Super buffers – BiCMOS & steering logic

MODULE III SYSTEM DESIGN & LAYOUT 9

Structured design of combinational circuits – Dynamic CMOS & clocking – Tally circuits – (NAND-NAND, NOR-NOR and AOI logic) – EXOR structure – Multiplexer structures – Barrel shifter.

MODULE IV DESIGN OF COMBINATIONAL ELEMENTS & REGULAR ARRAY LOGIC 9

NMOS PLA – Programmable Logic Devices - Finite State Machine PLA – Introduction to FPGA.

MODULE V VHDL PROGRAMMING 9

RTL Design – Combinational logic – Types – Operators – Packages – Sequential circuit – Sub-programs – Test benches. (Examples: address, counters, flipflops, FSM, Multiplexers / Demltiplexers).

L – 45; Total Hours –45

TEXT BOOK:

1. D.A.Pucknell, K.Eshraghian, ‘Basic VLSI Design’, 3rd Edition, Prentice Hall of India, New Delhi, 2003.
2. Eugene D.Fabricius, ‘Introduction to VLSI Design’, Tata McGraw Hill, 1990.

REFERENCES:

1. N.H.Weste, 'Principles of CMOS VLSI Design', Pearson Eduction, India, 2002.
2. Charles H.Roth, 'Fundamentals of Logic Design', Jaico Publishing House, 1992.
3. Zainalatsedin Navabi, 'VHDL Analysis and Modelling of Digital Systems', 2nd Edition, Tata McGraw Hill, 1998.
4. Douglas Perry, 'VHDL Programming by example', Tata McGraw Hill, 3rd Edition, 2003.

OUTCOMES:

OUTCOMES:

Upon completion of the course, students should

- Explain the basic CMOS circuits and the CMOS process technology.
- Design chip using programmable devices.
- Programme and Model the digital system using Hardware Description Language..

EICX65	**MACHINE LEARNING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To understand the need for machine learning for various problem solving
- To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning
- To understand the latest trends in machine learning
- To design appropriate machine learning algorithms for problem solving

MODULE I	**UNIT I INTRODUCTION**	**9**

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

MODULE II	**NEURAL NETWORKS AND GENETIC ALGORITHMS**	**9**

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

MODULE III	**BAYESIAN AND COMPUTATIONAL LEARNING**	**9**

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

MODULE IV	**INSTANT BASED LEARNING**	**9**

K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning

MODULE V	**ADVANCED LEARNING**	**9**

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

L – 45; Total Hours –45

TEXT BOOK:

1. D.A.Pucknell, K.Eshraghian, 'Basic VLSI Design', 3rd Edition, Prentice Hall of India, New Delhi, 2003.
2. Eugene D.Fabricius, 'Introduction to VLSI Design', Tata McGraw Hill, 1990.

REFERENCES:

4. N.H.Weste, 'Principles of CMOS VLSI Design', Pearson Eduction, India, 2002.
5. Charles H.Roth, 'Fundamentals of Logic Design', Jaico Publishing House, 1992.
6. Zainalatsedin Navabi, 'VHDL Analysis and Modelling of Digital Systems', 2nd Edition, Tata McGraw Hill, 1998.
4. Douglas Perry, 'VHDL Programming by example', Tata McGraw Hill, 3rd Edition, 2003.

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

- Differentiate between supervised, unsupervised, semi-supervised machine learning approaches
- Discuss the decision tree algorithm and indentity and overcome the problem of overfitting
- Discuss and apply the back propagation algorithm and genetic algorithms to various problems
- Apply the Bayesian concepts to machine learning
- Analyse and suggest appropriate machine learning approaches for various types of problems

PHCX 01	**FUNDAMENTALS OF ENGINEERING MATERIALS**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

OBJECTIVES:

- To help students to acquire the properties and applications of conducting and semiconducting materials.
- To familiarize students with basic ideas about the properties of dielectric and magnetic materials and their applications.
- To familiarize students with basic knowledge of nanomaterials and its electrical, electronic, mechanical and magnetic properties.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I CONDUCTING AND SEMICONDUCTING MATERIALS 7

Conductors: properties, Fermi distribution function, Fermi energy in metals- density of states- conducting polymers-properties-applications, semiconductors: intrinsic and extrinsic semiconductors-carrier concentration, conductivity and energy band gap, semiconducting polymers- properties- applications.

MODULE II DIELECTRIC MATERIALS 8

Polarization- dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – Internal field - Clausius Mosotti relation - dielectric loss – dielectric breakdown – applications of dielectric materials (capacitors and transformers) – Pyroelectricity, Piezoelectricity, ferroelectricity and applications in Ferroelectric Random Access Memory (FeRAM) - multiferroic materials and its applications.

MODULE III MAGNETIC MATERIALS 7

Origin of magnetism-magnetic moment, susceptibility, permeability – Bohr magneton – Dia, Para and Ferro magnetism –Spontaneous magnetization- Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its application - Giant Magneto-resistance effect (GMR) - Magnetic resonance imaging(MRI).

MODULE IV NANOMATERIALS 8

Properties of nanomaterials – size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties – quantum confinement – classification of nanomaterials – quantum well, quantum wire, quantum dot - nanoporous materials - carbon nanotubes, graphene - nanocomposites – applications of nano materials.

PRACTICALS

1. Determination of energy band gap of a semiconductor.
2. Determination of resistivity of metals by four point probe method.
3. Determination of dielectric constant of dielectric material.
4. Determination of time constant of a capacitor using RC circuit.
5. Determination of paramagnetic susceptibility of given liquid.
6. Determination of hysteresis loss in a transformer using BH curve.
7. Analysis of size effect on the absorption spectrum of nanomaterials.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. William D. Callister, “Material Science and Engineering”, Wiley Publications, 2006.
2. Raghavan, V., “Materials Science and Engineering”, 5th edition, Printice Hall of India Pvt Ltd. New Delhi, 2004.
3. Wahab. M.A, “Solid State Physics: Structure and Properties of Materials”, Narosa Publishing House Pvt. Ltd., New Delhi , 2nd Edition, 2010.
4. Pillai, S.O., “Solid State Physics”, New Age International, New Delhi, 2005.
5. Charles P. Poole and Frank J. Owens, ”Introduction to nanotechnology”, Wiley (India), 2009.
6. Pradeep. T., “Textbook of Nanoscience and Nanotechnology”, McGraw Hill Education (India) Private Limited, New York, 2012.

OUTCOMES:

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

- apply the concepts of conducting and semiconducting materials for solid state devices.
- comprehend the significance of properties of dielectric magnetic materials and derive these properties from synthesized materials.
- differentiate between the properties of the nanomaterials compared to bulk materials.
- complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 02 HEAT AND THERMODYNAMICS L T P C

Physics Elective Courses
(To be offered in II Semester)

		2	0	2	3

OBJECTIVES:

- To familiarize students with basic concepts of heat.
- To help students acquire the fundamentals of heat conduction and radiation.
- To enable students acquaint with the basics of thermodynamic concepts.
- To make students understand the fundamentals of heat based experiments.

MODULE I CONCEPTS OF HEAT 10

Definition of temperature, thermal and thermodynamic equilibrium - relationship between temperature and kinetic energy - definition of solid, liquid, gas - Introduction to phase transitions, critical and triple points- definition of heat capacity, mechanical equivalent of heat -Joule's calorimeter- latent heat- microscopic model of ideal gas - equation of state, internal energy, equipartition theorem- equation of state for non-ideal gases.

MODULE II CONDUCTION AND RADIATION 10

Thermal conductivity – rectilinear flow of heat – thermal conductivity of a good conductor – Forbe’s method – thermal conductivity of a bad conductor – Lee’s disc method – conduction of heat through compound media - radiation – Planck’s law of blackbody radiation – Wien’s law – Stefan’s law – Newton’s law of cooling from Stefan’s law – Solar constant – Pyrometry.

MODULE III FUNDAMENTALS OF THERMODYNAMICS 10

Thermodynamic equilibrium – zeroth law of thermodynamics – first law of thermodynamics – Reversible and irreversible processes – second law of thermodynamics - Heat engine – Carnot’s engine – Carnot’s theorem – Internal combustion engines – petrol and diesel engines (qualitative) – Entropy and available energy – temperature – entropy diagram for Carnot’s cycle - Third Law of thermodynamics (qualitative).

PRACTICALS

1. Determination of mechanical equivalent of heat by Joule’s calorimeter.
2. Relation between temperature of a body and time by plotting a cooling curve- Newton’s law of cooling.

3. Determination of specific heat capacity of liquid by cooling.
4. Determination of thermal conductivity of a good conductor-Forbe's method
5. Determination of thermal conductivity of a bad conductor-Lee's disc method

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. Mathur. D.S, “Heat & Thermodynamics”, S.Chand & Co., 2009.
2. Brijlal & Subramaniam, “Heat and Thermodynamics”, S.Chand & Co, Delhi, 2010.
3. Gupta. A.B and Roy. H, “Thermal Physics”, Books and Allied Ltd., 2002.
4. Sharma. J.K and Sarkar. K.K, “Thermodynamics and statistical Physics”, Himalaya Publishing House, 1988.

OUTCOMES:

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

- understand the concepts of heat and its properties.
- comprehend the ideas governing the conduction and radiation processes.
- apply the knowledge of laws of thermodynamics in thermodynamic systems.
- perform heat based experiments and determine its various properties.

PHCX 03 **INTRODUCTION TO NANOSCIENCE AND TECHNOLOGY** **L T P C**

2 0 2 3

OBJECTIVES:

- To acquire basic knowledge about the nanomaterials and applications.
- To learn about the synthesis and imaging techniques of nanomaterials.
- To gain the basic concepts of fabrication techniques.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I NANOMATERIALS AND APPLICATIONS 10

Properties of nanomaterials – size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties – quantum confinement – classification of nanomaterials – quantum well, quantum wire, quantum dot - nanoporous materials - zeolite, mesoporous materials, carbon nanotubes, grapheme - nanocomposites - applications (qualitative): Molecular electronics-nanoelectronics – nanophotonics - single electron transistor-drug delivery.

MODULE II SYNTHESIS AND IMAGING TECHNIQUES 12

Top-down and bottom up approaches – mechanical alloying and mechanical ball milling - sol-gel approach - hydrothermal method - precipitation method - spray pyrolysis - spin coating-self assembled monolayer (SAM) - Chemical vapour deposition method – Physical vapour deposition method: laser ablation method, sputtering method.

Optical microscopy – Phase contrast and interference microscopy – confocal microscopy - high resolution Scanning electron microscope (HRSEM) - high resolution Transmission electron microscope (HRTEM) - Atomic force microscope - Scanning Tunnelling microscope (STM).

MODULE III NANOFABRICATION 8

Photolithgraphy - electron beam lithography - X-ray and Ion beam lithography - nanoimprint lithography - soft lithograpy - nanoelectromechnical systems (NEMS) - nanoindentation principles.

PRACTICALS

1. Synthesis of nanomaterials by sol-gel method.

2. Synthesis of nanomaterials by hydrothermal method.
3. Synthesis of nanomaterials by solid state reaction method.
4. Synthesis of nanomaterials by chemical bath deposition method.
5. Synthesis of nanomaterials by co-precipitation method.
6. Synthesis of nano thin films by spray pyrolysis method.
7. Synthesis of nano thin films by pulsed laser deposition (PLD) method.
8. Analysis of size effect on the absorption spectrum of nanomaterials.
9. SEM characterization of nanomaterials.
10. AFM characterization of nano thin films.
11. Phase confirmation by XRD.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. Charles P.Poole and Frank J. Owens, ”Introduction to nanotechnology”, Wiley (India), 2009.
2. Cao. G., “Nanostructures & Nanomaterials: Synthesis, Properties & Applications”, Imperial College Press, 2004.
3. Gaddand. W., Brenner. D., Lysherski. S. and Infrate. G.J., “Handbook of NanoScience Engineering and Technology”, CRC Press, 2002.
4. Pradeep. T., “Textbook of Nanoscience and Nanotechnology”, McGraw Hill Education (India) Private Limited, New York, 2012.
5. Chris Mack, “Fundamental Principles of Optical Lithography: The Science of Microfabrication”, John Wiley & Sons, 2008.
6. Bandyopadhyay A.K., “Nano Materials”, New Age International Publishers, New Delhi, 2008.

OUTCOMES:

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

- understand the importance and basic concepts of the nanomaterials.
- comprehend the imaging techniques for nanomaterials.
- illustrate the various nanofabrication techniques.
- complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 04 LASERS AND THEIR APPLICATIONS

L	T	P	C
2	0	2	3

OBJECTIVES:

- To recognize the fundamentals of laser and its characteristics.
- To comprehend and compare the different laser systems.
- To apply lasers in metrology and material processing.
- To understand the working of laser instrumentation.
- To correlate the experimental results for applications.

MODULE I LASER THEORY 8

Spontaneous and stimulated emission - Population inversion – Einstein's A & B coefficients - Threshold condition – super-radiance Laser – Three level and four level laser systems -conditions for CW and pulsed laser action. Q-Switching - experimental methods - cavity dumping - Mode locking - experimental methods - Spatial and Temporal coherence.

MODULE II DIFFERENT LASER SYSTEMS 8

Laser systems – General description - Laser structure - excitation mechanism - Different laser systems- He-Ne laser, Carbon-dioxide laser - Excimer laser – Free electron laser- Alexandrite laser - Ti-Sapphire laser – Semiconductor diode laser - Diode pumped solid state laser - Pulsed-CW dye laser- Fibre laser.

MODULE III METROLOGICAL AND MATERIAL PROCESSING APPLICATIONS 8

CW and Pulsed laser beam characteristics and its measurements - Beam focusing effects - spot size - Power and Energy density Measurements - Distance measurement - Interferometric techniques - LIDARS - different experimental arrangements - Pollution monitoring by remote sensing - Laser gyroscope - Laser welding, drilling, machining and cutting - Laser surface treatment - Laser vapour deposition – Biophotonic applications.

MODULE IV LASER INSTRUMENTATION 7

Laser for measurement of length, current and voltage – Laser Doppler Velocimetry - Holography and speckle in displacement and deformation measurements - Laser for communication with fiber optics as channel.

PRACTICALS

1. Tuning of Dye Laser using DFDL Arrangement
2. Determination of Brewster Angle using He-Ne laser
3. Study of transversely Pumped Dye Lasers
4. Study of longitudinally Pumped Dye Lasers
5. Determination of power and wavelength using Distributed Feedback Dye Laser (DFDL)
6. Determination of fibre optic losses using semiconductor laser.
7. Bandgap determination of a semiconductor diode.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. William T. Silfvast, “Laser Fundamentals”, Cambridge University Press, 2009.
2. Ghatak. A. & Thyagarajan. K. “Optical Electronics”, Cambridge University, 1994.
3. Laud.B.B., “Laser and Non-Linear Optics”, Second Edition, New Age International (p) Limited Publishers, 2011.
4. Nambiar. K.R., “Lasers Principle, Types and Applications”, New Age International (p) Ltd, 2004.
5. Wilson. J. & Hawkes. J.F.B., “Opto Electronics - An Introduction”, Prentice Hall, 1992.
6. William M.Steen, ”Laser Material Processing”, Springer-Verlag, Berlin, Third Edn., 2005.

OUTCOMES:

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

- To complement the knowledge acquired in the theory class.
- To work with dye lasers for tunability of laser wavelength.
- To measure the loss of information involved in fibre optic communication.
- To correlate the results for application.

PHCX 05	MATERIALS SCIENCE	L	T	P	C

2 0 2 3

OBJECTIVES:

- To gain basic knowledge in conducting and semiconducting materials and their properties.
- To provide basic understanding of properties and applications of dielectric materials.
- To impart knowledge on magnetic and optical materials and their properties & applications.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I CONDUCTING AND SEMICONDUCTING MATERIALS 10

Quantum free electron theory of metals and its importance - Energy distribution of electrons in metals - Fermi distribution function - Density of energy states and carrier concentration in metals - Fermi energy – Classification of solids into conductors, semiconductors and insulators on the basis of Band theory – Introduction to Elemental and Compound semiconductors - Carrier concentration derivation for Intrinsic semiconductors - Density of electrons in conduction band & Density of holes in valence band- intrinsic carrier concentration - Fermi energy & Variation of Fermi energy level with temperature - Mobility and electrical conductivity - Band gap determination.

MODULE II DIELECTRIC MATERIALS 7

Introduction to dielectric materials & basic definitions – Electronic, Ionic, Orientation & Space charge polarizations - Total polarization – Frequency and temperature dependence of polarization - Internal field in a dielectric material - Deduction of Clausius - Mosotti's relation - dielectric loss & loss tangent – Different types of dielectric breakdown – Applications of dielectric materials : Capacitors and Transformers.

MODULE III MAGNETIC MATERIALS 6

Introduction to magnetic materials & origin of magnetic moment - Different types of magnetic materials and their properties - Ferromagnetism & Domain theory of ferromagnetism - Hysteresis, Soft and Hard magnetic materials - Antiferromagnetic materials - Ferrites and its applications – Applications of magnetic materials : Data storage.

MODULE IV OPTICAL MATERIALS 7

Optical properties of semiconductors - Direct and Indirect bandgap semiconductors – Traps, recombination centre, color center and exciton – Luminescence : Fluorescence and Phosphorescence - Liquid crystal display : twisted nematic crystal display – Applications of Optical materials - Optical Sources : light emitting diode and laser diode - Photo detectors : PIN photodiode and Avalanche Photodiode - Pyroelectric devices - Electro optic effect : Kerr effect and Faraday effect.

PRACTICALS

1. Resistivity measurement of a semiconductor using four point probe method.
2. Determination of band gap of a semiconductor diode.
3. Determination of Hall coefficient of a given semiconductor material.
4. Determination of dielectric constant of a given non-polar liquid.
5. Determination of magnetic susceptibility of a given paramagnetic liquid using Quincke's method.
6. Determination of energy loss of a given transformer core using hysteresis method.
7. To study the I-V characteristics of a photodiode.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. Palanisamy P.K., ''Physics II'', Material Science for ECE, Scitech Publications (India) Pvt. Ltd., 2006.
2. Kasap. S.O., ''Principles of Electronic materials and devices'', McGraw Hill Publishers, 3rd Edition, 2007.
3. Arumugam. M, "Physics II'', Material Science for ECE, Anuradha Publishers, 5th Edition, 2005.
4. Sze. S.M., ''Semiconductor Devices – Physics and Technology'', John Wiley, 2nd Edition. 2002.
5. Raghavan. V, ''Materials Science and Engineering'', Prentice Hall of India, 5th Edition, 2004.

OUTCOMES:

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

- Gain knowledge about fundamentals of conducting and semiconducting materials.
- Understand concepts and applications of Dielectric and Magnetic materials.
- Familiarize Optical materials and their applications in Engineering and Medical fields.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 06 NON-DESTRUCTIVE TESTING

L	T	P	C
2	0	2	3

OBJECTIVES:

- To study the process and applications of ultrasonic inspection method.
- To understand the basic concepts of radiographic inspection method.
- To acquire the knowledge about the various surface Non-Destructive Testing (NDT) techniques.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I ULTRASONIC INSPECTION METHOD 10

Ultrasonic Testing - Principle of operations - types of sound waves - types of Transducers - transmission and pulse-echo method - straight beam and angle beam, instrumentation - calibration methods - ultrasonic testing technique- data representation, A Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight. Diffraction - thickness determination - advantages, disadvantages and applications.

MODULE II RADIOGRAPHIC INSPECTION METHOD 10

Radiographic testing – Principle - Interaction of X-ray with matter - X-ray radiography - method of generation-industrial radiography inspection techniques – Equipment - Exposure charts - Types of films – Fluoroscopy - Xero-Radiography – Limitations - Gamma radiography - Equipment, radiation sources - method of generation - film processing - interpretations of radiography - safety in industrial radiography.

MODULE III SURFACE NDT TECHNIQUES 10

Liquid Penetrant Testing – Principles, Characteristics and types of liquid penetrants – developers - advantages and disadvantages of various methods - Inspection Procedure and Interpretation of results. Applications of Liquid Penetrant testing.

Magnetic Particle Testing - Principle-magnetizing technique - procedure –equipment - Interpretation and evaluation of test indications - applications and limitations - demagnetization.

PRACTICALS

1. Inspection of welds using solvent removable visible dye penetrant.
2. Inspection of welds using solvent removable fluorescent dye penetrant.

3. Inspection on non magnetic materials by eddy current method.
4. Inspection on magnetic materials by eddy current method.
5. Inspection of welds by Eddy current Testing.
6. Inspection of welds by Magnetic Particle Testing - Dry method.
7. Inspection of welds by Magnetic Particle Testing - Wet method.
8. Ultrasonic flaw detector - Inspection of defects.
9. Demonstration of Radiographic inspection.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. Baldev Raj., Jayakumar T.,Thavasimuthu., “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
2. Ravi Prakash., “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010.
3. ASM Metals Handbook of Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, Volume-17, 2000.
4. Paul E Mix,”Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005.
5. Charles J., Hellier, “Handbook of Nondestructive evaluation”, McGraw Hill, New York, 2001.

OUTCOMES:

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

- illustrate the ultrasonic inspection methods of NDT.
- understand the basic concept of radiographic inspection method.
- test the surfaces by the various surface NDT techniques.
- complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 07	PROPERTIES OF MATTER AND ACOUSTICS	L	T	P	C

2 0 2 3

OBJECTIVES:

- To understand principles and properties of elasticity.
- To understand the basic concepts and application of viscosity.
- To analysis acoustic of building.
- To know about photoelasticity and its applications.

MODULE I ELASTICITY 8

Stress and strain - Hooke's Law of elasticity - Elastic moduli - Stress-Strain Diagram - Poisson's Ratio - Relation between elastic constants - Work done in stretching and twisting a wire - Twisting couple on a cylinder- Expression for bending moment - Cantilever–Expression for depression - Uniform bending and Non-uniform bending of beams (theory & experiment) - I form Girders (qualitative treatment) and applications.

MODULE II VISCOSITY 8

Viscosity- Newton's formula for viscous flow - Streamline and turbulent motion - Reynolds number - Poiseuille's formula - Determination of coefficient of viscosity- factors affecting viscosity - capillary flow method - Stoke's formula- viscosity of highly viscous liquids – Stoke's method - Lubricants and its applications –viscosity measurements - Viscometer - Variation of Viscosity with Temperature.

MODULE III ACOUSTICS OF BUILDING 7

Basic requirement for the acoustically good halls - Reverberation and time of reverberation – Sabine's formula for reverberation time - Absorption coefficient and its measurement -Transmission of sound and transmission loss - Factors affecting the architectural acoustics and their remedy-sound absorbing materials - vibration and noise control systems for buildings.

MODULE IV PHOTOELASTICITY 7

Polarization - double refraction - Theory of Plane, Circularly and Elliptically polarized light - Quarter wave plate and half wave plate - photo elasticity - Theory of photo-elasticity - Stress optic relations - model materials - analysis techniques - Photo elastic bench - Three dimensional photo elasticity - Digital photo elasticity - Photo elastic coatings.

PRACTICALS

1. Determination of viscosity of liquid by Poiseuille's method.
2. Determination of viscosity of liquid by Stoke's method.
3. Analysis of stress by photo elastic method.
4. Verification of Hooke's law by spring method.
5. Determination of Young's modulus of the cantilever beam.
6. Determination of rigidity modulus by static torsion method.
7. Visit to acoustically good auditorium and identifying the sound absorbing materials in the auditorium.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. Mathur D.S., "Elements of Properties of Matter", S.Chand & Co, Delhi, 2009.
2. Gaur R.K., Gupta S.L.,"Engineering Physics", Dhanpat Rai Publishers, 2010.
3. Brijlal and Subramaniam.," Properties of Matter", Eurasia Publishing Co, New Delhi, 2002.
4. Smith C.J.," General Properties of Matter", Orient & Longman,1960.
5. Kenneth G. Budinski and Michel K., Budinski, "Engineering Materials Properties and Selection", Pearson, Singapore, 2002.

OUTCOMES:

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

- understand the basic concepts of the elasticity of materials.
- comprehend the concepts of viscosity of liquid and measurement.
- demonstrate the acoustical aspects of building and its importance in construction.
- apply the fundamental concept of photo elasticity for the stress analysis of the object.

PHCX 08	PROPERTIES OF MATTER AND NONDESTRUCTIVE TESTING	L	T	P	C

2 0 2 3

OBJECTIVES:

- To impart knowledge about the principles and properties of elasticity.
- To learn the laws governing the dynamic of rigid bodies.
- To acquire the knowledge of the various techniques of Non-Destructive Testing (NDT) of materials.
- To understand the principle and basic concept of low temperature applications.

MODULE I ELASTICITY 8

Stress and strain - Hooke's Law of elasticity - Elastic moduli - Stress-Strain Diagram - Poisson's Ratio - Relation between elastic constants - Work done in stretching and twisting a wire - Twisting couple on a cylinder- Expression for bending moment- Cantilever–Expression for depression - Uniform Bending and Non-uniform bending of beams (theory & experiment) - I form Girders (qualitative treatment) and applications.

MODULE II DYNAMICS OF RIGID BODIES 8

Rigid bodies - angular acceleration - Torque on a particle - angular momentum - law of conservation of angular momentum - moment of inertia and its significance - Theorem of parallel and perpendicular axis - moment of inertia of a thin uniform bar - moment of inertia of a rectangular lamina - moment of inertia of uniform circular disc - Moment of inertia of hollow and solid cylinders – flywheel
(qualitative) - kinetic energy of rotating body – Routh rule.

MODULE III NDT TECHNIQUES 6

Ultrasonic Testing- types of Transducers-transmission and pulse-echo method- Radiographic testing- Principle-Interaction of X-ray with matter-X-ray radiography- method of generation-industrial radiography inspection techniques- Liquid Penetrant Testing**-** Inspection Procedure and Interpretation of results.

MODULE IV LOW TEMPERATURE PHYSICS 8

Definition of Refrigeration and Air-Conditioning - Types of **Refrigeration Systems-** Applications- Comfort Air Conditioning, Industrial Refrigeration, Food processing and food chain - **Cryogenic treatment - Low temperature properties of**

engineering materials: Mechanical properties, Thermal properties, Electrical properties.

PRACTICALS

1. Verification of Hooke's law by spring method.
2. Determination of Young's modulus of the beam by bending method.
3. Inspection of welds using solvent removable visible dye penetrant.
   Inspection of welds using solvent removable fluorescence dye penetrant.
5. Inspection of welds by Magnetic Particle Testing.
6. Determination of moment of inertia of the disc by torsion pendulum method.
7. Determination of moment of inertia of the disc by static torsion method.
8. Demonstration of working of flywheel.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. Mathur D.S.,"Elements of Properties of Matter", S.Chand & Co, Delhi, 2009.
2. Brijlal & Subramaniam," Properties of Matter", Eurasia Publishing Co, Delhi, 2002.
3. Gaur R.K., Gupta S.L., "Engineering Physics" Dhanpat Rai Publishers, 2010.
4. Baldev Raj.,Jayakumar T., Thavasimuthu M.,"Practical Non-Destructive testing", Narosa Publishing House, 2009.
5. Brijlal & Subrahmanyam., "Heat and Thermodynamics" S.Chand & Company Ltd, 2002.
6. Paul E Mix.," Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition, New Jersey, 2005.
7. Charles J., Hellier.," Handbook of Nondestructive evaluation", McGraw Hill, New York, 2001.

OUTCOMES:

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

- understand the basic of concept of elasticity of materials.
- comprehend the basic concepts of motion of rigid bodies and its applications.
- demonstrate the various NDT techniques and its importance.
- know the low temperature systems and its applications.

PHCX 09 SEMICONDUCTOR PHYSICS AND OPTOELECTRONICS **L T P C**

2 0 2 3

OBJECTIVES:

- To understand the Physics of Semiconductor devices.
- To make the students learn the fundamentals of Photoluminous - semiconductors, Optoelectronic devices, Optical modulators/detectors.
- To make them understand the technology behind latest Display devices like LCD, Plasma and LED Panels.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I PHYSICS OF SEMICONDUCTORS 8

Elemental and compound semiconductors – Drift and diffusion current - Intrinsic semiconductors – Carrier concentration (derivation) – Fermi energy – Variation of Fermi energy level with temperature – Mobility and electrical conductivity – Band gap determination – Extrinsic semiconductors – Carrier concentration in n-type and p-type semiconductor (derivation) – Variation of Fermi level with temperature and impurity concentration – Variation of Electrical conductivity with temperature – Hall effect – Experiment and applications of Hall effect.

MODULE II OPTOELECTRONIC DEVICES 7

Light Emitting Diodes (LED) – power and efficiency - double hetero LED - LED structure - LED characteristics - White LED – Applications. Liquid crystal displays – Dynamic scattering and Twisted nematic display, Semiconductor Lasers, Homojunction and Heterojunction laser diodes - Optical processes in semiconductor lasers.

MODULE III OPTICAL MODULATORS 7

Modulation of light – birefringence –Modulation Techniques - Electro optic effect – Electro optic materials –Types of Electro optic Modulators : Kerr and Pockel modulators –- Magneto optic effect - Magneto optic Modulators – Acousto Optic modulators.

MODULE IV OPTICAL DETECTORS 8

Photo detectors - photodiodes - phototransistors - noise characteristics - PIN diode – Avalanche Photodiode (APD) characteristics - APD design of detector arrays – Charged Couple Device - Solar cells - Materials and design considerations, Thin film solar cells, amorphous silicon solar cells.

PRACTICALS

1. Resistivity measurement of a semiconductor using four point probe method.
2. Determination of band gap of a semiconductor diode.
3. Determination of Hall coefficient of a given semiconductor material.
4. Determination of the wavelength of a given laser source using diffraction grating.
5. Determination of Planck's constant using LED.
6. To study the I-V characteristics of photodiode and phototransistor.
7. To study the characteristics of a solar cell.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. Arumugam. M, "Physics II", Anuradha Publishers, 5th Edition, 2005.
2. Sze. S.M., "Semiconductor Devices – Physics and Technology", 2nd edn. John Wiley, 2002.
3. Wilson & J.F.B. Hawkes, "Optoelectronics – An Introduction", Prentice Hall, India, 1996.
4. Bhattacharya, "Semiconductor optoelectronic devices", Second Edn, Pearson Education, 2002.
5. Safa O. Kasap, "Optoelectronics & Photonics:Principles & Practices", Second Edn, Pearson Education,2013.
6. Palanisamy P.K., "Semiconductor physics and optoelectronics" Scitech Publications, 2003.

OUTCOMES:

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

- understand the principles of Physics behind semiconductor devices.
- choose the correct semiconductors for electronic devices and display.
- differentiate the working principle of LED and Diode Laser.
- apply the knowledge of modulation of light for different types of optical modulators.
- select suitable photodetectors for different types of applications.
- complement the knowledge acquired in the theory class and correlate the results for applications.

Chemistry Elective Courses
(To be offered II Semester)

		L	T	P	C
CHCX01	**ANALYTICAL INSTRUMENTATION**	**2**	**0**	**2**	**3**

OBJECTIVES:

To make the student conversant with

- principles, instrumentation and applications of different electroanalytical techniques
- different chromatographic techniques
- principles, instrumentation and applications of various types of absorption and emission spectroscopy
- different thermal analytical methods and their applications

MODULE I ELECTROANALYTICAL TECHNIQUES 7

Principle and applications: conductometric titrations – potentiometrIc titrations, ion-selective electrodes and pH-metry – coulometry – voltammetry - polarography, amperometric titrations.

MODULE II CHROMATOGRAPHY 8

Basic concepts of chromatography – paper chromatography – column chromatography – thin layer chromatography – gas chromatography – high performance liquid chromatography – gel permeation chromatography.

MODULE III SPECTROSCOPY 8

Absorption spectroscopy (principle, instrumentation and applications): Colorimetric analysis – UV-Visible spectroscopy – FTIR spectroscopy - Emission Spectroscopy (principle, instrumentation and applications): fluorescence, phosphorescence and chemiluminescence – Atomic absorption spectroscopy – flame emission spectroscopy.

MODULE IV THERMAL ANALYSIS 7

Principle, instrumentation and applications: Thermo gravimetric analysis – Differential thermal analysis – Differential scanning calorimetry

PRACTICALS

1. Conductometric titrations: acid-base and precipitation titrations
2. Potentiometric titrations
3. Determination of pH of the unknown solution
4. Estimation of alkali metals using flame emission spectroscopy
5. Estimation of metal ions of coloured solutions using colorimetric analysis
6. Separation of compounds using gas chromatography
7. Separation of compounds using high performance liquid chromatography
8. Analysis of the given sample and interpretation of the data using IR, UV-Visible spectroscopy
9. Demonstration of TGA/DTA and DSC and interpretation of data.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. Skoog D.A., West D.M., Holler F.J. and Crouch S.R., Fundamentals of Analytical Chemistry, 8th Edition, Thomson Brooks/Cole Publication., Singapore, 2004.
2. Willard H.H., Merritt L.L., Dean J.A. and Settle F.A., Instrumental Methods of Analysis, 7th Edition, CBS Publication, New Delhi Reprint, 2004.
3. A.I. Vogel, Vogel's Textbook of Practical Organic Chemistry, 5th Edition, Prentice Hall, London, 2008.
4. Christian G.D., Analytical Chemistry, 6th Edition, John Wiley, Singapore, 2003.
5. Fifield F.W. and Kealey D., Principles and Practice of Analytical Chemistry, 5th Edition, Blackwell Publication, London, 2000.
6. Settle F. (Editor), Handbook of Instrumental Techniques for Analytical Chemistry, Pearson Education, Singapore, 2004.

OUTCOMES:

The student will be able to

- state the principle and applications of various electro-analytical techniques
- identify the right separation method for a given sample using different chromatographic techniques
- explain the principle, instrumentation & applications of various spectroscopic methods and also to interpret the data
- elaborate the principle, instrumentation and applications of various thermal analytical techniques and interpret the data.

CHCX02 CORROSION AND ITS CONTROL L T P C

2 0 2 3

OBJECTIVES:

The students should be conversant with the

- Basic concepts, principles and factors affecting corrosion
- Types and mechanism of corrosion
- Control measures of corrosion by material selection, proper design and by applying organic coatings
- Control of corrosion by applying inorganic coating

MODULE I BASIC CONCEPTS OF CORROSION 8

Corrosion – causes and impacts of corrosion – mechanism of corrosion: Dry corrosion- oxidation corrosion - corrosion by other gases – Pilling-Bedworth rule- Corrosion by hydrogen: hydrogen blistering, hydrogen embritttlement, decarburization and hydrogen attack – corrosion of silver and copper by sulphur compounds – liquid metal corrosion (embritttlement or cracking) – Wet corrosion : hydrogen evolution – presence and absence of oxygen and absorption of oxygen – difference between dry and wet corrosion-factors influencing corrosion-polarization-passivity-emf series and galvanic series- corrosion current -rate of corrosion.

MODULE II FORMS OF CORROSION 7

Forms of corrosion-conditions for electrochemical corrosion –galvanic corrosion – differential aeration corrosion: pitting, water line, wire fencing, crevice and filiform corrosion – stress corrosion – Intergranular corrosion- erosion corrosion – soil corrosion – microbiological corrosion- fretting corrosion- corrosion in composites.

MODULE III CORROSION CONTROL AND ORGANIC COATINGS 8

Corrosion control – selection of materials and designing- cathodic protection – sacrificial anode and impressed current cathodic protection – corrosion inhibitors: anodic, cathodic and vapour phase inhibitors.

Organic protective coatings – paints: constituents – functions – varnishes : types- constituents – functions – lacquers : constituents – functions –enamels- constituents – functions – special paints : fire retardant, water repellant, heat resistant, temperature indicating and luminous paints.

MODULE IV INORGANIC COATINGS 7

Treatment of metal surface-inorganic coatings- classification- metallic coatings : anodic and cathodic coatings-hot dipping : galvanizing and tinning- electroplating— electroless plating – cementation (diffusion) : sherardizing, calorizing and chromizing – metal cladding-metal spraying – non metallic coatings (chemical conversion coatings) : phosphate, chromate, oxide coatings and anodizing – comparison of anodic and cathodic protection.

PRACTICALS

1. Determination and comparison of rate of corrosion of metals in the presence of acid, base and neutral medium by weight loss method.
2. Determination of rate of corrosion of iron in the presence of various acids by weight loss method.
3. Determination of rate of corrosion of iron in the presence and absence of anodic Inhibitor by weight loss method.
4. Determination of rate of corrosion of iron in the presence and absence of cathodic Inhibitor by weight loss method.
5. Electroplating of base metal with copper.
6. Electrolessplating of base metal with copper
7. Chemical conversion coatings such as chromate and phosphate coatings.
8. Demonstration on the study of rate of corrosion by using cyclic voltametry.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
2. S S Umare & S S Dara, A text Book of Engineering Chemistry, S. Chand& Company Ltd, New Delhi, 2014.
3. M.G. Fontana and N.G. Green, Corrosion Engineering, McGraw Hill Book Company, NewYork, 1984.
4. S. Banerjee, A.K. Tyagi, Functional Materials- Preparation, Processing and Applications, ELSEVIER Publications, London ; Waltham, MA : 2011

OUTCOMES:

Students will be able to

- explain the mechanism, compare and enumerate the factors affecting corrosion

- describe and identify the place and types for a given situation.
- choose and elaborate the suitable organic coating method for a given real time situation.
- apply a suitable metallic coating for a given situation

CHCX03 ELECTRICAL MATERIALS AND BATTERIES L T P C

2 0 2 3

OBJECTIVES:

The students should be conversant with

- preparation, properties and applications of plastics used in electrical and electronic applications
- properties and uses of electrical engineering materials
- classification and description of different types of batteries.
- classification and types of fuel cells

MODULE I POLYMERS FOR ELECTRICAL AND ELECTRONIC APPLICATIONS 8

Preparation, properties and applications **:** polyethylene, polypropylene, EPDM, Nylon-6,6, PVC, PTFE, polycarbonates, ABS, phenol formaldehyde, urea formaldehyde, epoxy resins – polymer blends and alloys.

MODULE II ELECTRICAL ENGINEERING MATERIALS 7

Conductors: Silver, Copper, Gold, Aluminum – Semiconductors: Germanium, Silicon, Gallium Arsenic – Insulating Materials: Rubbers, Mica, Plastics, Ceramics, Insulating papers – Magnetic Materials: ferromagnetic materials, paramagnetic materials, diamagnetic materials, antiferromagnetic materials, ferrites

MODULE III BATTERIES 7

Electrochemical and electrolytic cell – batteries: types (primary, secondary and flow cell) – primary batteries: dry cells, alkaline batteries – secondary batteries: nickel-cadmium cell – lead acid storage cell, lithium battery: primary and secondary type – solar cell – dye sensitized solar cell.

MODULE IV FUEL CELLS 8

Difference between batteries and fuel cells - chemistry of fuel cells - types of fuel cell (based on temperature and electrolyte) – principle, characteristic features, advantages, disadvantages and applications of polymer electrolyte membrane or proton exchange membrane fuel cell (PEMFC), direct methanol fuel cell (DMFC), alkaline fuel cell (AFC), phosphoric acid fuel cell (PAFC), molten carbonate fuel cell (MCFC) and solid oxide fuel cells (SOFC).

PRACTICALS

1. Free radical polymerization of styrene.
2. Free radical polymerization of PMMA.
3. Preparation of phenol-formaldehyde.
4. Preparation of urea-formaldehyde.
5. Synthesis of epoxy resin.
6. Demonstration of mechanical properties of insulating materials using UTM
7. Demonstration of electrical properties of insulating materials
8. Construction of batteries using natural resources
9. Measurement of EMF for different batteries.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. Jain P.C. and Renuka Jain, Engineering Chemistry, Dhanpat Rai Publication Co. (P) Ltd., New Delhi, 2013.
2. Michael L. Berins, Plastics Engineering Hand Book, 5th Edition, Chapman and Hall, New York, 1991.
3. H.F. Mark and N. Gaylord, Encyclopedia of Polymer Science and Technology, Vol. 1 to XIV Interscience, 2nd Ed. 1988.
4. Gowarikar V.R., Viswanathan N.V and Jayadev Sreedhar, Polymer Science, Wiley Eastern Limited, Madras, 1981.
5. R.K. Rajput,A Textbook of Electrical Engineering Materials, Firewall Media, 2004
6. Vladimir S. Bagotsky, Fuel Cells: Problems and Solutions, 2nd Edition, John Wiley and Sons, 2012.
7. B. Viswanathan and M. Aulice Scibioh, Fuel Cells: Principles and Applications, Taylor and Francis Group, 2007.

OUTCOMES:

The student will be able to

- summarise the preparation, properties and applications of plastics used in electrical and electronic applications
- enumerate the properties and uses of electrical engineering materials
- illustrate various types of batteries with the aid of a diagram
- classify the fuel cells and elaborate the different types of fuel cells.

CHCX04	**ENGINEERING MATERIALS**	**L**	**T**	**P**	**C**

2 0 2 3

OBJECTIVES:

The students should be conversant with

- properties and uses of different types of refractories and abrasives
- adhesives, cements and lime, setting of cements and their chemical behaviors.
- types, properties and uses of lubricants.
- various types of composite materials.

MODULE I REFRACTORIES AND ABRASIVES 8

Introduction refractory: -classification - based on chemical nature- characteristic and selection of good refractory - general manufacture of refractory- preparation properties and uses of: silica refractory - magnesite refractory - zirconia refractory, properties of refractories: refractoriness - refractoriness under load - thermal spalling - porosity and dimensional stability, Cermets - super refractory.

Abrasives : introduction - Moh's scale - natural abrasives: diamond – corundum – emery - garnet and quartz, synthetic abrasives: preparation properties and uses: carborundum (silicon carbide)– alundum - boron (norbide) carbide

MODULE II ADHESIVES AND BINDING MATERIALS 7

Introduction - classification of adhesives –advantage –limitation of adhesive bonding – development of adhesive- factors influencing adhesive action: chemical and physical, application techniques of adhesive – Lime: classification – manufacture - setting and hardening, Gypsum: -Manufacture and properties and uses - Cement : chemical composition- Manufacture – setting and hardening – concrete – weathering of cement and concrete and its prevention- special cements: high alumina cement - sorel cement - white portland cement – water proof cement.

MODULE III LUBRICANTS 7

Introduction –functions of lubricant- mechanism of lubrication - classification of lubricant – liquid lubricant: vegetable and animal oils – mineral oils, semisolid: grease(calcium, lithium, aluminium) – petroleum jelly, solid lubricant: graphite - molybdenum disulphide, Properties of lubricant: viscosity - viscosity index - flash point and fire point - cloud point and pour point – oiliness - aniline point - carbon residue.

MODULE IV COMPOSITE MATERIALS 7

Introduction – advantageous characteristics of composites, applications of composites, main constituent of composites, types and applications of composites: RCC fibre-reinforced plastics (glass , carbon and aramid) - particulate composite - metal matrix composite - layered composites - failures in fibre-reinforced composites, ceramic matrix composites (CMC) – properties and applications.

PRACTICALS

1. Preparation of refractory bricks
2. Preparation of abrasive papers/cloth
3. Preparation of simple adhesives
4. Estimation of alkalinity in cements
5. Determination of cloud point and pour point
6. Determination of flash point and fire point
7. Preparation of fibre-reinforced composite

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd., New Delhi (2013).
2. B.Sivasnakar, “Engineering Chemistry”, Tata McGrow-Hill Publication Limited, New Delhi, second reprint 2008.
3. Engineering Chemistry, Wiley India Editorial Team, Willey India Publisher, New Delhi, 2011.
4. S S Umare & S S Dara, A text Book of Engineering Chemistry, S. Chand& Company Ltd, New Delhi, 2014.

OUTCOMES:

The student will be able to

- classify and describe the manufacture the refractories and enumerate the properties and uses of abrasive materials.
- elaborate the manufacture, properties and uses of various adhesives and binding materials.
- classify lubricants and describe the properties and uses of them
- enumerate the properties and uses of various composite materials.

CHCX05	**FUELS AND COMBUSTION**	**L**	**T**	**P**	**C**

2 0 2 3

OBJECTIVES:

To make the students conversant with the

- three types of fuels available and the different processes involved in it.
- analysis of fuel characteristics and manufacture of fuels
- calculations involved in calorific values and minimum air requirement for complete combustion.
- classification, functions, mechanism and properties of lubricants.

MODULE I SOLID FUELS 7

Characteristics of good fuel. Solid fuel – Wood, Coal – Ranking of coal – selection of coal. Analysis of coal – Proximate analysis. Pulverized coal – Metallurgical coke – Carbonization of coal – types. Manufacture of metallurgical coke – Beehive oven and Otto Hoffman's by-product oven methods.

MODULE II LIQUID AND GASEOUS FUELS 8

Liquid fuel: Petroleum: Refining of petroleum, Liquid fuels derived from petroleum – Cracking: Thermal (Liquid and Vapour phase) – Catalytic (fixed bed and moving bed cracking – Synthetic petrol: Fischer-Tropsch method– Knocking in petrol and diesel engine: octane number and antiknocking – cetane number and improvement of cetane number – biodiesel (trans-esterification) – Gaseous fuels: Compressed natural gas (CNG) – LPG – oil gas – producer gas – water (blue) gas – biogas.

MODULE III COMBUSTION 8

Calorific value: Gross and net caloric value – Bomb Calorimeter, Gas calorimeter - Definition of combustion – calculation of minimum requirement of air (problems) – theoretical calculation of calorific values (Dulong's formula), Gross and net calorific values ((problems) – Analysis of flue gas: Orsat's gas analysis method, explosive range, Ignition temperature. Introduction to air pollution from IC (Internal combustion) engines, photochemical smog, primary and secondary pollutants.

MODULE IV LUBRICANTS 7

Friction and wear – lubricants: definition, functions and mechanism of lubrication (thick film and thin film) –classification: liquid lubricants: animal and vegetable origin, mineral oil, blended oils, lubricating emulsions and silicones – properties of lubricating oils: viscosity and viscosity index; Flash and fire-point, Cloud and pour point, oiliness, emulsification number, volatility, carbon residue, aniline point – semisolid lubricant: greases and waxes – solid lubricant: graphite and molybdenum disulphide –nanolubricants.

PRACTICALS

1. Testing of fuels - proximate analysis (moisture, volatile matter, ash content and fixed carbon present in coal, coke, charcoal etc)
2. Ash content and carbon residue test
3. Biodiesel synthesis by trans-esterification method (from coconut, groundnut, mustard oil, palm oil)
4. Determination of calorific value of a solid fuel using Bomb calorimeter (coal, charcoal, coke etc)
5. Determination of calorific value of a liquid fuel using Bomb calorimeter (petrol, diesel, biodiesel etc)
6. Determination of cloud point and pour point of a lubricant
7. Determination of flash and fire point of diesel.
8. Aniline Point of diesel
9. Viscosity Index of lubricants and Fuels by Viscometer
10. Flue gas analysis by Orsat's gas analysis method – Demonstration
11. Working of internal combustion engine – Demonstration

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi, 2001.
2. Engineering Chemistry, Wiley India Editorial Team, Willey India Publisher, New Delhi, 2011.
3. John Griswold, Fuels Combustion and Furnaces, Mc-Graw Hill Book Company Inc. University of Michigan, 1946.
4. J.B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill International Editions, 1989.
5. Bahl B.S., Tuli and Arun Bahl, Essentials of Physical Chemistry, S. Chand and Company Ltd., New Delhi, 2004.

OUTCOMES:

The students will be able to

- compare and contrast the solid, liquid and gaseous fuels and also describe the processes involved in liquid and gaseous fuels.
- analyse the fuel properties such as moisture, votalite matter, ash content, calorific value etc
- calculate minimum air required for complete combustion and calorific values of fuels.
- categorize different lubricants into three types, explain the preparation and determine their properties.

CHCX06 **FUNDAMENTALS OF PHYSICAL CHEMISTRY** **L T P C**

2 0 2 3

OBJECTIVES:

The students will be conversant with the

- various thermodynamic terms and relate the laws of thermodynamics in chemical processes
- molecularity and order of reaction and derive the rate constant for different order of reactions
- basics of adsorption of different materials and propose mechanisms and surface area measurement
- conditions for equilibrium and learn different components at equilibrium

MODULE I BASIC THERMODYNAMICS 8

Introduction - Thermodynamic terms - Thermodynamic equilibrium and processes - 1st law of thermodynamics: internal energy, enthalpy, heat capacity, isothermal and adiabatic expansion, Joule-Thomson effect - Zeroth law of thermodynamics: absolute temperature - 2nd law of thermodynamics: - spontaneous and cyclic process, Entropy in isothermal, isobaric and isochoric processes, work and free energy function, Maxwell's relation - 3rd law of thermodynamics

MODULE II CHEMICAL KINETICS 8

Rate of chemical reaction - order and molecularity of a reaction - Rate constant - kinetics of opposing, parallel and consecutive and chain reactions - isotope effects - effect of temperature on reaction rate - collision theory - absolute reaction rate theory - kinetics in enzyme catalysis

MODULE III SURFACE SCIENCE AND CATALYSIS 8

Adsorption - adsorption isotherms - uni and bimolecular adsorption reactions - parahydrogen conversion - factors affecting adsorption – Langmuir adsorption isotherm - Hinshelwood mechanism and *Eley-Rideal* mechanism with example - adsorption of gases on solids and surface area measurement by BET method - Terms in catalysis - homogeneous and heterogeneous and enzyme catalysis with example

MODULE IV PHASE RULE 6

Terms involved - Conditions for equilibrium - application of phase rule to water, lead-silver system, freezing mixtures, thermal analysis: cooling curves.

PRACTICALS

1. Determination of the heat capacity of benzoic acid, internal energy of combustion of camphor using Bomb calorimeter. Calculation of enthalpy of combustion and formation for camphor.
2. Determination of adsorption isotherm of (i) acetic acid on charcoal (ii) oxalic acid on charcoal.
3. *Kineticsoffirst and second order reactions.*
4. Phase rule experiments with organic compounds: (i) naphthalene and p-dichloro benzene (ii) naphthalene and diphenyl (iii) m-dinitrobenzenzene and p-nitro toluene.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. Rajaram J. and Kuriacose J.C., Chemical Thermodynamics: Classical, Statistical and Irreversible, Pearson Education, India, 2013.
2. Samuel Glasstone, Thermodynamics for Chemists, Read Books, United Kingdom, 2007.
3. James E. House, Principles of Chemical Kinetics, 2^{nd} Edition, Academic Press, United States of America, 2007.
4. Keith J. Laidler, Chemical Kinetics, Pearson Education, India, 1987.
5. Douglas M. Ruthven, Principles of Adsorption and Adsorption Processes, John Wiley & Sons, 1984.
6. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 47^{th} Edition, Vishal Publishing Co. India, 2016.

OUTCOMES:

The student will be able to

- calculate entropy, enthalpy and free energy change for different chemical processes
- calculate the rate constant for any chemical and biochemical processes
- differentiate the adsorption processes and calculate the surface area and predict the suitability of catalysts for different chemical processes
- predict the equilibrium conditions for water, alloys, freezing mixtures and draw the thermal curves for phase transition

CHCX07	**GREEN TECHNOLOGY**	**L**	**T**	**P**	**C**

2 0 2 3

OBJECTIVES:

To make students conversant with the

- basic principles of green chemistry and green technology.
- wastes that causes hazards to human health
- chemicals that harms our environment
- need for green processes in various industries

MODULE I GREEN CHEMISTRY PROTOCOL 7

Need – Significance – 12 Principles with examples – R4 model – Life cycle analysis – sustainable and cleaner production - Green Technology: definition, examples: CFC free refrigerants, green building, energy, 3D printers, nanotechnology – Awards for Green chemistry – organization promoting green chemistry.

MODULE II WASTE & WASTE MINIMISATION 8

Source of wastes: domestic, industrial, medical, nuclear, e-waste; problems; prevention – economy of waste disposal – Waste minimization techniques: general waste treatment and recycling – alternate waste water treatment technologies: hybrid process – Green computing: goals, green cloud, green ICT - Pollution statistics from various industries (Industrial case studies).

MODULE III GREEN SYNTHESIS 7

Introduction - Solvent free reactions - green reagents, green solvents in synthesis - microwave and ultrasound assisted reactions – supercritical fluid extraction – green oxidation and photochemical reactions – catalyst and biocatalysts.

MODULE IV GREEN INDUSTRIAL PROCESSES 8

Polymer industry: biodegradable polymer - textile industry: greener approaches of dyeing, waste disposal – ecofriendly agrochemicals: biofertilizers, biopesticides – Pharmaceutical industry: atom economy, reduction of toxicity, use of biocatalyst, zero waste disposal – Leather industry: greener process in tanning, crusting, surface coating – ecofriendly batteries & fuel cells.

PRACTICALS

1. Synthesis of an ionic liquids (Ex: imidazolium) and testing the solubility of organic chemicals.
2. Green bromination of stilbene (using pyridine hydrobromide).

3. Green synthesis: Photocatalytic reactions, solvent-free organic reaction – Aldol; green oxidation, green reduction.
4. Microwave assisted chemical reaction. (synthesis of aspirin, pinacol-pinacolone reaction, etc).
5. Comparison of conventional reaction with microwave assisted reactions (atom economy, solvent, etc) [Ex: aldehyde and ketones with hydrazines to give hydrazones].
6. Diels-Alder reaction in eucalyptus oil (green process).

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2001.
2. V. K. Ahluwalia, Green Chemistry: Environmentally Benign Reactions, Ane Books India, New Delhi, 2006.
3. Paul Anastas, John C.Warner, John Warner Joint; Green Chemistry: Theory & Practice New Ed Edition; Oxford University press, USA, 2000.
4. Rashmi Sanghi, M. M. Srivastava, Green chemistry, Narosa publishers, New Delhi, 2003.

OUTCOMES:

The students will be able to

- outline the principles and implications of green chemistry.
- comprehend the potential risks of waste generated and analyse the threats to human and environment.
- integrate information into design of molecules to avoid/eliminate toxic solvents & reagents or reduce toxic products.
- identify various alternate greener technologies for various industries.

CHCX08 ORGANIC CHEMISTRY OF BIOMOLECULES L T P C

2 0 2 3

OBJECTIVES:

To make students conversant with the

- basic concepts in organic chemistry
- types and structure of carbohydrates and lipids
- formation of different structures of proteins from amino acid
- structure of nucleic acids

MODULE I BASIC CONCEPTS IN ORGANIC CHEMISTRY 8

Classification and IUPAC nomenclature of organic compounds – stereochemistry – optical, stereo and geometrical isomerism – types of reagents: electrophiles and nucleophiles – types of reactions: addition, substitution, elimination and rearrangement reactions.

MODULE II CARBOHYDRATES, LIPIDS AND VITAMINS 7

Structure and functions of carbohydrates: mono, di, oligo and polysaccharides – lipids: phospholipids, glycolipids, sphingolipids – cholesterol – steroids – Structure, functions and deficiency disorders of fat soluble vitamins: A, D, E & K - Water soluble vitamins B & C: Thiamine, riboflavin, pantothenic acid, niacin, pyridoxine, biotin, cobalamine, folic acid and ascorbic acid.

MODULE III AMINO ACIDS, PEPTIDES AND PROTEINS 7

Aminoacids: classification, properties - peptides – polypeptides – proteins: primary, secondary, tertiary and quaternary structure – glycoproteins – lipoproteins – Enzymes: classification and functions

MODULE IV NUCLEIC ACIDS 8

Nucleic acids – importance - structure of purines and pyrimidines – nucleotides – polynucleotides - RNA – types & structure - DNA – phosphodiester bonds – chemical, helical structure and functions – DNA replication – gene modification.

PRACTICALS

1. Qualitative tests to identify carbohydrates.
2. Quantitative estimation of carbohydrates.

3. Separation of sugars – TLC and/or paper chromatography.
4. Quantitative estimation of lipids.
5. Separation of amino acids – TLC and/or paper chromatography.
6. Quantitative estimation of proteins by Lowry's method.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. V. K. Ahluwalia, Organic Reaction Mechanism, Narosa Publishers, New Delhi, 2002.
2. Johnson Arthur T., Biology for Engineers, CRC Press, Finland, 2011.
3. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2001.
4. David L. Nelson, Michael M. Cox, Lehninger Principles of biochemistry, Macmillan press, London, 2010

OUTCOMES:

The students will be able to

- classify organic compounds and explain the mechanism of various organic reactions.
- draw the structures and enumerate the functions of carbohydrate, lipids and vitamins.
- correlate the relationship among amino acids, peptides and proteins.
- recognize the role of nucleic acid in the formation of RNA & DNA and differentiate DNA & RNA using their structure and function.

CHCX09	POLYMER SCIENCE AND TECHNOLOGY	L	T	P	C
		2	0	2	3

OBJECTIVES:

To make the student conversant with the

- basic concepts of polymers, classification, types of polymerization and molecular weight & its distribution
- preparation, properties and applications of thermoplastics and introduction to biodegradable polymers
- properties and applications of thermosets, elastomers and FRP
- different types of moulding techniques

MODULE I BASIC CONCEPTS OF POLYMERS 8

Definitions: monomer, polymer, functionality, degree of polymerization – classification of polymers: source, structure, application, thermal processing behavior (thermoplastics and thermosets), composition and structure (addition and condensation), mechanism (chain growth and step-wise growth) – copolymer: types – Definition –nomenclature of polymers – tacticity – types of polymerization : free radical, cationic and anionic polymerization (concepts only) – average molecular weight of polymer: number, weight – molecular weight distribution (problems)

MODULE II THERMOPLASTICS AND BIODEGRADABLE POLYMERS 8

Preparation, properties and applications : LDPE, HDPE, polypropylene, PVC, PTFE, PET, polyamides (Nylon-6 and Nylon 6,6) and polycarbonates – polymer blends and alloys – basics of biodegradable polymers.

MODULE III THERMOSET RESINS, ELASTOMERS AND FRP 7

Thermoset resins : phenolic resins, amino resins (urea and melamine formaldehyde), epoxy resins, unsaturated polyesters – polyurethanes – elastomers : vulcanization of natural rubber, diene based elastomers –fibre reinforced plastics: glass, aramid and carbon.

MODULE IV MOULDING TECHNIQUES 7

Moulding constituents: functions – moulding techniques: compression, injection, extrusion (single screw), blow moulding, thermoforming, (mechanical and vacuum forming), lamination.

PRACTICALS

1. Determination of molecular weight and degree of polymerization using Oswald's viscometer.
2. Free radical polymerization of styrene.
3. Free radical polymerization of PMMA.
4. Preparation of phenol-formaldehyde.
5. Preparation of urea-formaldehyde.
6. Synthesis of epoxy resin.
7. Synthesis of unsaturated polyester.
8. Preparation of FRP laminates.
9. Demonstration of injection moulding, compression moulding and blow moulding.

L – 30; P – 30; TOTAL HOURS – 60

REFERENCES:

1. Billmeyer F.N., Text Book of Polymer Science, 3rd Edition, John Wiley and Sons, New York, 1994.
2. George Odian, Principles of Polymerisation, 3rd Edition, McGraw Hill Book Company, New York, 1991.
3. Michael L. Berins, Plastics Engineering Hand Book, 5th Edition, Chapman and Hall, New York, 1991.
4. Jacqueline I., Kroschwitz, Concise Encyclopedia of Polymer Science and Engineering, John Wiley and Sons, New York, 1998.
5. Encyclopedia of Polymer Science and Technology, Vol. 1 to XIV, H.F. Mark and N. Gaylord, Interscience, 2nd Ed. 1988.
6. Gowarikar V.R., Viswanathan N.V and Jayadev Sreedhar, Polymer Science, Wiley Eastern Limited, Madras, 1981.

OUTCOMES:

The student will be able to

- classify various polymers, name the polymers and types of polymerization reactions, calculate molecular weight of polymers,

- summarise preparation, properties and applications of thermoplastics and give examples of biodegradable polymers
- elaborate the properties and applications of thermosets, elastomers and FRP
- select the appropriate moulding technique for a given polymer, based on the application

Maths Elective Courses
(to be offered in IV
Semester)

		L	T	P	C
MACX 01	**DISCRETE MATHEMATICS AND GRAPH THEORY**	**3**	**1**	**0**	**4**

OBJECTIVES:

The aims of this course are to

- introduce Logical and Mathematical ability to deal with abstraction.
- familiarize the basic mathematical ideas and terminologies used in computer science.
- translate real life situations into diagrammatic representations.

MODULE I PROPOSITIONAL CALCULUS 8

Propositions – Logical connectives – Compound propositions – Conditional and biconditional propositions – Truth tables – Tautologies and contradictions – Contrapositive – Logical equivalences and implications – DeMorgan's Laws – Normal forms – Principal conjunctive and disjunctive normal forms – Rules of inference – Arguments – Validity of arguments.

MODULE II PREDICATE CALCULUS 7+3

Predicates – Statement function – Variables – Free and bound variables – Quantifiers – Universe of discourse – Logical equivalences and implications for quantified statements – Theory of inference – The rules of universal specification and generalization – Validity of arguments.

MODULE III FUNCTIONS 7+3

Functions – Classification of functions –– Composition of functions – Inverse functions – Binary and n–ary operations – Characteristic function of a set – Hashing functions – Recursive functions – Permutation functions.

MODULE IV ALGEBRAIC SYSTEMS 8+2

Groups, Cyclic Groups, Subgroups, Cosets, Lagrange's theorem, Normal subgroups – Codes and group codes – Basic notions of error correlation – Error recovery in group codes.

MODULE V GRAPH THEORY 7+3

Graphs – incidence and degree – subgraphs – isomorphism – complement of a graph – operations on graphs

MODULE VI PATH AND CIRCUIT 8+2

Walks, trails and paths – Eulerian graphs – Konigsburg bridge problem - Hamiltonian graphs

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Trembly J.P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 30th Reprint 2011.
2. Kenneth H.Rosen, "Discrete Mathematics and its Applications:, 7th Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, Special Indian Edition, 2011.

REFERENCES:

1. Ralph.P.Grimaldi, "Discrete and Combinatorial Mathematics: An Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.
2. Thomas Koshy, "Discrete Mathematics with Applications", Elsevier Publications, 2006.
3. C.L.Liu, D.P.Mohapatra, "Elements of Discrete Mathematics", 4th Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 2012.

OUTCOMES:

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

- use the concepts of propositional calculus.
- use the concepts of predicate calculus.
- identify types of functions and their importance.
- decode and encode the messages using group theory concepts.
- apply the basic concepts of graph theory.
- represent some real life situations into diagrammatic representation.

MACX 02 PROBABLITY AND STATISTICS

L	T	P	C
3	1	0	4

OBJECTIVES:

The aims of this course are to impart the

- knowledge of the theory of probability and random variables
- techniques to carry out probability calculations and identifying probability distributions
- application of statistical inference in practical data analysis

MODULE I BASICS OF PROBABILITY AND STATISTICS 8+2

Sample space, events- axioms of probability and interpretation – Addition, multiplication rules – conditional probability, Independent events - Total probability – Baye’s theorem - Descriptive Statistics.

MODULE II ONE DIMENSIONAL RANDOM VARIABLE AND PROBABILITY DISTRIBUTION FUNCTIONS 7+3

Discrete random variable –continuous random variable – Expectation - probability distribution - Moment generating function – Binomial, Poisson, Geometric, Uniform (continuous), Exponential and Normal distributions.

MODULE III TWO DIMENSIONAL RANDOM VARIABLES 8+2

Joint, marginal, conditional probability distributions –covariance, correlation - transformation of random variables.

MODULE IV SAMPLING AND ESTIMATION 7+3

Sampling distributions – basic knowledge on Random , simple random , stratified and cluster samplings – Test of Hypotheses - concepts- Point estimation and Interval estimation.

MODULE V THEORY OF INFERENCE 8+2

Large sample tests – test for single and difference on proportions, single mean, difference of means, difference of variances – confidence intervals. Small sample tests – Student’s t test, F test and Chi square test on theory of goodness of fit and analyses of independence of attributes.

MODULE VI DESIGN OF EXPERIMENTS 7+3

Analysis of variance – one way classification – two way classification – Completely Randomised Block Designs – Randomised Block Design – Latin square designs - Interpretations - case studies.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. T.Veerarajan, "Probability and Statistics", Tata McGraw-Hill Education, 2008.
2. Miller, I., Miller, M.,Freund, J. E., "Mathematical statistics", 7th Edition, Prentice Hall International, 1999.
3. S.P.Gupta, "Applied Statistics", Sultan Chand & Sons

REFERENCES:

1. S.M.Ross, "Introduction to Probability and Statistics for Engineers and Scientists" Fifth Edition, Elesvier.
2. S.C.Gupta and V.K.Kapoor, "Fundamentals of Mathematical Statistics" First edition, Sultan Chand and Sons.
3. Arora and Arora, "Comphrensive Statistical Methods", S. Chand, 2007

OUTCOMES:

On completion of the course, students will be able to

- do basic problems on probability and descriptive statistics.
- derive the probability mass / density function of a random variable.
- calculate probabilities and derive the marginal and conditional distributions of bivariate random variables.
- calculate point and interval estimates.
- apply some large sample tests and small sample tests.
- carry out the data collection representation analysis and implications and the importance of inferences.

MACX 03 RANDOM PROCESSES

L	T	P	C
3	1	0	4

OBJECTIVES:

The aims of the course are to

- acquire the knowledge of the theory of probability and random variables
- study discrete and continuous probability distributions.
- demonstrate the techniques of two dimensional random variables and its distributions.
- introduce the random process, stationarity, Markov process and the study of correlation function and spectral analysis.

MODULE I Basics of Probability 7+3

Sample space, events- axioms of probability and interpretation – Addition, multiplication rules – conditional probability, Independent events - Total probability – Baye's theorem - Tchebychev's inequality.

MODULE II One dimensional Random variable and Probability Distribution functions 7+3

Discrete random variable –continuous random variable – Expectation - probability distribution - Moment generating function – Binomial, Poisson, Geometric, Uniform (continuous), Exponential and Normal distributions.

MODULE III Two dimensional random variables 7+3

Joint, marginal, conditional probability distributions - covariance, correlation and regression lines - transformation of random variables.

MODULE IV RANDOM PROCESSES 8+2

Classification of Random process - Stationary process - WSS and SSS processes - Poisson process – Markov Chain and transition probabilities.

MODULE V CORRELATION FUNCTIONS 8+2

Autocorrelation function and its properties - Cross Correlation function and its properties - Linear system with random inputs – Ergodicity.

MODULE VI SPECTRAL DENSITY 8+2

Power spectral Density Function - Properties - System in the form of convolution - Unit Impulse Response of the System – Weiner-Khinchine Theorem - Cross Power Density Spectrum.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Veerarajan T., “Probability, Statistics and Random Processes”, Tata McGraw Hill,3rd edition, 2008.
2. Papoulis, “Probability, Random Variables and Stochastic Processes”, 4th Edition, Tata McGraw Hill Company, 2002.
3. S.M.Ross, “Introduction to Probability and Statistics for Engineers and Scientists” Fifth Edition, Elesvier

REFERENCES:

1. Scott L. Miller,Donald G. Childers, Probability and Random Processes, Academic Press,2009.
2. Trivedi K S, “ Probability and Statistics with reliability, Queueing and Computer Science Applications”,Prentice Hall of India,New Delhi,2nd revised edition, 2002

OUTCOMES:

On completion of the course, students will be able to

- do basic problems on probability.
- derive the probability mass / density function of a random variable.
- calculate probabilities and derive the marginal and conditional distributions of bivariate random variables.
- identify and study the different random processes.
- compute correlation functions and related identities.
- compute power spectral density functions and apply Weiner-Khinchine formula.

MACX 04	**APPLIED NUMERICAL METHODS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVES:

The aims of the course are to

- introduce basic computational methods for analyzing problems that arise in engineering and physical sciences.
- acquire knowledge about approximation theory and convergence analysis associated with numerical computation.

MODULE I NUMERICAL SOLUTIONS OF EQUATIONS 7+3

Bisection method - Regula Falsi method – Secant method - Fixed point iteration method - Newton's Raphson method –Gauss Elimination method - Gauss-Jordon method – Gauss Jacobi method - Gauss-Seidel method.

MODULE II INTERPOLATION 8+2

Finite difference operators – Gregory Newton's forward and backward interpolations – Cubic spline interpolation - Lagrange interpolation - Newton's divided difference formula.

MODULE III NUMERICAL DIFFERENTIATION AND INTEGRATION 8+2

Numerical differentiation using Newton's forward and backward formulae – Numerical integration : Trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Gaussian Two Point and Three Point Quadrature formulae – Double integrals using Trapezoidal and Simpson's 1/3 rule.

MODULE IV INITIAL VALUE PROBLEMS FOR FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS 7+3

Numerical solutions by Taylor's Series method, Euler's method, Modified Euler's Method - Runge – Kutta Method of fourth order – Milne's and Adam's Bashforth Predictor and Corrector methods

MODULE V INITIAL AND BOUNDARY VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 8+2

Numerical solutions by Taylor's Series method - Runge – Kutta Method of fourth order of second order ODE. Finite difference methods.

MODULE VI BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS 7+3

Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace equation.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Grewal, B.S., "Numerical methods in Engineering and Science", 7th edition, Khanna Publishers, 2007.
2. C.F.Gerald, P.O.Wheatley, "Applied Numerical Analysis" ,Pearson Education, New Delhi, 2002.

REFERENCES:

1. Chapra S.C, Canale R.P. "Numerical Methods for Engineers", 5th Ed., McGraw Hill, 2006.
2. M.K.Jain, S.R.K.Iyengar, R.K.Jain, "Numerical methods for Scientific and Engineering Computation", New Age International Publishers, New Delhi, 2003

OUTCOMES:

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

- solve algebraic, transcendental and system of equations.
- apply interpolation techniques.
- carry out numerical differentiation and integration using different methods.
- solve first order ODE using single and multi step methods.
- solve second order ODE, initial and boundary value problems.
- solve the boundary value problems in PDE.

Maths Elective Courses
(To be offered in VI Semester)

		L	T	P	C
MACX 05	**MATHEMATICAL PROGRAMMING**	**2**	**0**	**0**	**2**

OBJECTIVES:

The aims of the course are to

- acquire knowledge and training in optimization techniques.
- obtain knowledge about optimization in utilization of resources.
- understand and apply operations research techniques to industrial operations.

MODULE I LINEAR PROGRAMMING PROBLEM 10

Linear programming – formulation of the problem - graphical interpretation of optimality - Simplex method – to obtain basic feasible solution – types of linear programming solution – complications and their resolution.

MODULE II ADVANCED LINEAR PROGRAMMING PROBLEMS 8

Artificial variable - Big M method – Two phase method – alternative optimal solution – unbounded solution - Duality – primal dual relationships.

MODULE III TRANSPORTATION PROBLEM 7

Transportation problems – Initial basic feasible solutions, MODI method, Unbalanced transportation problem, Degeneracy in transportation models,.

MODULE IV ASSIGNMENT PROBLEM 5

Assignment problem – Minimization and Maximization type of problems by Hungarian method.

Total Hours –30

TEXT BOOKS:

1. Hamdy A Taha, "Operations Research - An introduction", 8th edition, Phil Pearson, 2007.
2. Winston.W.L., "Operations Research", 4th edition, Thompson-Brooks/Cole, 2003.

REFERENCES:

1. Wayne.L. Winston, “Operations Research Applications and Algorithms”, 4th edition, Thomson learning, 2007.
2. Frederick. S. Hiller and Gerald J Lieberman, “Operations Research Concepts and Cases”, 8th edition (SIE), Tata McGraw – Hill Pub. Co. Ltd., New Delhi, 2006.
3. A. Ravindran, D. T. Phillips and J. J. Solberg, "Operations Research: Principles and Practice", 2nd edition, John Wiley & Sons, New York, 1992.
4. Robertazzi. T.G., “Computer networks and systems-Queuing theory and performance evaluation”, 3rd edition, Springer, 2002.

OUTCOMES:

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

- formulate industrial problems as mathematical programming problems.
- solve linear programming problems by different methods.
- solve transportation problems by different methods.
- solve assignment problems by Hungarian method.

MACX 06	STATISTICAL METHODS FOR DATA ANALYSIS	L	T	P	C
		2	0	0	2

OBJECTIVES:

The aim of the course is to

- introduce statistical quality control tools.

MODULE I — TESTS OF HYPOTHESES AND STATISTICAL INFERENCES — 8

Small sample tests – Student's ' t ' test for single mean , difference of means, paired t test – F test for difference of variances – Chi square test on theory of goodness of fit and analyses of independence of attributes.

MODULE II — DESIGN OF EXPERIMENTS — 7

Analysis of variance – one way classification – two way classification – Completely Randomised Block Designs – Randomised Block Design – Latin square designs - Statistical analysis -Interpretations - case studies.

MODULE III — STATISTICAL QUALITY CONTROL-I — 8

Quality improvement and statistics –Statistical quality control- statistical process control – control charts – design of control charts –analysis of patterns on control charts - X bar chart, R chart and S chart.

MODULE IV — STATISTICAL QUALITY CONTROL-II — 7

Process and product control – attribute charts – P, np and C charts – control charts performance.

Total Hours –30

TEXT BOOKS:

1. Douglas C.Montgomery, George C. Runger "Applied Statistics and probability for Engineers" V Edition – John Wiley & Sons Inc.
2. Miller, I., Miller, M., Freund, J. E. "Mathematical statistics" 7th Edition. Prentice Hall International, 1999.

REFERENCES:

1. Dekking, F.M., Kraaikamp, C., Lopuhaä, H.P., Meester, L.E. "A Modern Introduction to Probability and Statistics" Springer, 2nd Edition.

2. Chin Long chiang "Statistical Methods of Analysis "World Scientific Books, 2003.
3. S.C.Gupta and V.K. Kapoor, "Mathematical Statistics" , Sultan Chand publications.
4. Veerarajan "Fundamentals of Mathematical Statistics" I Edition, Yes Dee Publishing Pvt. Ltd., 2017.

OUTCOMES:

On completion of the course, students will be able to

- develop and test hypothesis for different statistical tests
- design an experiment and case study the experiment with different data.
- analyze the industrial data using quality control design tools statistically.
- analyze the industrial data using process and product control tools statistically.

MACX 07	NUMERICAL METHODS FOR INTEGRATION AND DIFFERENTIAL EQUATIONS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- This course aims to solve numerically integral and differential equations.

MODULE I NUMERICAL INTEGRATION 8

Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two Point and Three point Gaussian quadrature formulae.

MODULE II NUMERICAL DOUBLE INTEGRATION 6

Double integrals using trapezoidal and Simpson's 1/3 rules

MODULE III NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS 8

Milne's Predictor and Corrector Method – Adam's Predictor-Corrector Method - Finite difference methods for two – point Boundary Value problems for Ordinary Differential Equations.

MODULE IV BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS 8

Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations

Total Hours –30

TEXT BOOKS:

1. M.K.Jain, S.R.K.Iyengar, R.K.Jain, "Numerical methods for Scientific and Engineering Computation", New Age International Publishers, New Delhi, 2003.
2. Grewal, B.S., "Numerical methods in Engineering and Science" 7th edition, Khanna Publishers, 2007

REFERENCES:

1. C.F.Gerald, P.O.Wheatley, "Applied Numerical Analysis" Pearson Education, New Delhi 2002.
2. P.Dechaumphai, N. Wansophark, "Numerical Methods in Engineering", Narosa Publications, 2012.

OUTCOMES:

At the end of the course students will be able to

- solve the integration by numerical methods.
- solve the double integration by numerical methods
- find numerical solution of ordinary differential equations in engineering problems.
- find numerical solution of partial differential equations in engineering problems.

MACX 08 MATHEMATICAL MODELLING

L	T	P	C
3	0	0	3

OBJECTIVES:

The aims of the course are to

- provide basic idea of formation and use of Mathematical models for different purposes.
- determine the extent to which models are able to replicate real-world phenomena under different conditions

MODULE I PRINCIPLES OF MATHEMATICAL MODELING 7

Mathematics as a modelling language - Classification of models - Building, studying, testing and using models - Black and white box models – Difference equations

MODULE II PHENOMENOLOGICAL MODELS 7

Linear, Multiple linear and nonlinear regression - Neural networks - Fuzzy model - Stability and higher dimensional systems

MODULE III MECHANISTIC MODELS –I 8

Setting up ODE models – Initial and Boundary value problems - Numerical solutions - Fitting ODE to data - Applications

MODULE IV MECHANISTIC MODELS –II 8

Linear and nonlinear equations - Elliptic, parabolic and hyperbolic equations - Closed form solutions - Finite difference and finite element methods

Total Hours –30

TEXT BOOKS:

1. G . Ledder , “Calculus, modelling , probability and dynamic systems”, Springer 2013
2. Kei Velten, “Mathematical modelling and simulation”, J. Wiley and sons,2009

REFERENCES:

1. Michael D Alder, “An introduction to Mathematical modelling”, Heaven for Books.com
2. Alfio Quarteroni, “Mathematical models in science and engineering”, Notices of AMS
3. J.N. Kapur, “Mathematical models in Biology and Medicine”, Affiliated East-

West Press Private Limited, New Delhi, 1992.

OUTCOMES:

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

- identify the relationship between real world and mathematical models
- Classify the data and choose the appropriate model
- Distinguish between linear and nonlinear models
- identify the relationship between empirical and mechanistic models

MACX 09 **GRAPH THEORY** **L T P C**

3 0 0 3

OBJECTIVES:

The aims of this course are to

- represent the real life situations diagrammatically.
- appraise different methods to find solutions to graph theory problems.

MODULE I INTRODUCTION TO GRAPH THEORY 8

Graphs - finite and infinite graphs - Incident and degree-isolated vertex, pendent vertex and null vertex.

MODULE II PATH AND CIRCUIT 8

Isomorphism – sub graphs-walks, paths and circuits – connected and disconnected graphs- Euler graphs – operation on a graph.

MODULE III TREES AND FUNDAMENTAL CIRCUITS 7

Trees- some properties of trees- pendent vertices in a tree – rooted binary tree- spanning trees-fundamental circuits.

MODULE IV CUT SETS AND CUT VERTICES

Cut sets – some properties of cut sets- fundamental circuits and cut sets- network flows.

Total Hours –30

TEXT BOOKS:

1. NARSINGH DEO, Graph theory with applications to Engineering and Computer Science, Prentice Hall INC, New Delhi,
2. J.A. Pondy and U.S.R. Murthy, North Holland, Oxford, New York Graph theory with applications

REFERENCES:

1. Trembly J.P and Manohar R, “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 30th Reprint 2011
2. Kenneth H.Rosen, “Discrete Mathematics and its Applications”, 7th Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, Special Indian Edition, 2011

3. Md. Saidur Rahman, “Basic graph theory”, Springer, 2017

OUTCOMES:

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

- demonstrate the basic concepts of Graph theory.
- explore connected and disconnected graphs.
- identify the real life problems with trees and circuits.
- bring out the cut set properties and network flows properties.

Humanities Elective I

(To be offered in III Semester)

SSCXO1	FUNDAMENTALS OF ECONOMICS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To identify and present the basic concepts of demand, supply and equilibrium.
- To explain and discuss the types and concepts of national income and inflation.
- To illustrate the fundamental concepts of money, banking and public finance.
- To apprise the students about Indian economy and the role of engineers in economic development.

MODULE I DEMAND AND SUPPLY ANALYSIS 8

Classification of economy – open and closed economy, Demand - Types of demand - Determinants of demand – Law of Demand - Demand elasticity - Supply - Determinants of Supply – Law of Supply - Supply elasticity - Pricing strategies.

MODULE II NATIONAL INCOME AND INFLATION 7

Concepts of National income and measurement – Importance and difficulties of estimating National Income in India - Aggregate demand and aggregate supply, Macroeconomic equilibrium – meaning of inflation- types - causes and preventive measures

MODULE III MONEY, BANKING AND PUBLIC FINANCE 9

Money – Meaning, types, functions, importance - Commercial Banks - Central Bank - Monetary policy – meaning, objectives, Methods of Credit Control By RBI, Government Budget – Government revenue and Expenditures – Fiscal policy - Its objectives, instruments and limitations - Deficit Financing - The Fiscal Responsibility and Budget Management Act, 2003 (FRBMA) .

MODULE IV INDIAN ECONOMY AND THE ROLE OF ENGINEERS 6

Economic reforms – Liberalization, Privatization and Globalization - challenges and opportunities, Engineers – Engineers' contributions to the economic growth.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Dutt and Sundharam (2013), *Indian Economy*, S. Chand & Company Pvt. Ltd, New Delhi.
2. Hussain, Moon Moon (2015), *Economics for Engineers*, Himalaya Publishing House, New Delhi.

REFERENCES:

1. Cleaver Tony (2004), "*Economics: The Basics*", Routledge, London.
2. Mell Andrew and Walker Oliver (2014), "*The Rough Guide to Economics*", Rough Guide Ltd.

OUTCOMES:

On successful completion of this course,

- Students will have had exposure to the basic concepts of demand, supply and various pricing strategies.
- Students will have understood the macroeconomic concepts of national income and inflation.
- Students will be able to apply the knowledge of money, banking and public finance in their real life situations.
- Students will have an overview of the economic reforms introduced in Indian economy.

SSCXO2	PRINCIPLES OF SOCIOLOGY.	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To acquaint the students with Concepts and perspectives of Sociology
- To explain the reflection of society in Individuals and vice versa
- To describe the hierarchical arrangement of individuals and groups in society
- To explicate the dimensions, forms and factors of Social change.
- To examine the context, impact and agencies of Globalization

MODULE I THE FOUNDATIONAL CANON 8

Sociology-Definition, scope and importance; Major theoretical perspectives-Functionalism, Conflict Theorising and Interactionism; Elements of social formation-Society, Community, Groups and Association; Associative Social Process- Co-operation, Accommodation and Assimilation; Dissociative Social Process-Competition and Conflict.

MODULE II INDIVIDUAL AND SOCIETY 7

Culture-definition, characteristics, functions, types, cultural lag and civilization, Socialization – definition, process, stages, agencies and anticipatory socialization; Social Control- definition, characteristics, importance, types & agencies.

MODULE III SOCIAL INEQUALITY AND STRATIFICATION 7

Concepts- inequality, hierarchy, differentiation, Social Exclusion, and Social Stratification. Forms of Social Stratification- Caste, Class and Estate. Gender and Social Stratification- sex and gender, patriarchy, factors perpetuating gender stratification; Globalization and gender inequality

MODULE IV SOCIAL CHANGE AND GLOBALIZATION 8

Social Change-definition, nature, direction; Forms- evolution, development, progress and transformation; Factors of social change- demography, economy, technology, polity and culture. Globalization- definition, characteristics, historical and social context and Impact, agencies of globalization- IGOs, INGOs, Nation-State, MNEs and Media

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Giddens A. 1989. “Sociology” Cambridge: Polity Press.
2. Heald Haralambos, R.M(2014) . ‘‘Sociology Themes and Perspectives”, Oxford, New Delhi-92
3. Bhushan Vidya and D.R. Sachdeva (2012). ‘‘Fundamental of Sociology”, Pearson, Delhi.

REFERENCES:

1. Das Gupta, Samir and Paulomi Saha (2012), ‘‘An Introduction to Sociology”, Pearson, Delhi
2. Bottomore, T.B. 1972. *Sociology- A Guide to Literature and Problems*, New Delhi,

OUTCOMES:

On successful completion of this course,

- Students will have exposure to the fundamentals tenets of Sociology.
- Students will be trained to understand social reality with sociological perspective.
- Students will be oriented to constructively analyze human interactions, social relationship and social issues
- Students will gain exposure to the dynamics of human society with special reference to the contemporary trends of globalization.

SSCXO3 SOCIOLOGY OF INDIAN SOCIETY.

L	T	P	C
2	0	0	2

OBJECTIVES:

- To present a portrayal of the components of the Indian Social structure
- To describe the nature and contemporary structure of Indian social Institutions.
- To examine the causality and magnitude of social problem facing the contemporary India.
- To elucidate the processes forms and impact of change and development in Indian society

MODULE I INDIAN SOCIAL STRUCTURE 7

Unity and Diversity; Concepts of unity and diversity- racial, religious, ethnic and linguistic composition of India. Types of communities-rural, urban and tribal; Social backwardness- OBC, SC and ST; Indian minorities- religious, ethnic, linguistic and LGBT

MODULE II INDIAN SOCIAL INSTITUTIONS 7

Family- definition, types, characteristics, functions of family; Joint Family- definition features, utility, changes; Marriage- definition, characteristics, marriage as sacrament or contract. Caste- definition, principles, contemporary changes, dominant caste, caste -class interface.

MODULE III SOCIAL PROBLEMS IN INDIA 8

Social Problem-definition, nature, social disorganization; Population explosion-causes, effects, relationship with development; Child Labour- causes, magnitude and consequences; Unemployment-nature , types, causes and effects; Gender issues-social status of women, violence against women and women in work place; Contemporary issues- communalism, terrorism and corruption.

MODULE IV SOCIAL CHANGE AND DEVELOPMENT IN INDIA 8

Socio-cultural Change- Sanskritization, Westernization, Secularization, Modernization; Processes of Social change- Industrialization, Urbanization, Globalization; Development- definition, elements, role of government, industry and corporate sector. Technology and change- invention and innovation, impact of technology on social institutions, technology and development.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Sharma,K.L.2008. *Indian Social Structure and Change*. Jaipur: Rawat Publications,.
2. Shah, A.M. 1998. *The Family in India: Critical Essays*. New Delhi: Orient Longman,
3. Ahuja Ram. 1999. *Social problems in India*, Rawat Publication: New Delhi.
4. Ahuja Ram. 2014. *Society in India,*, Rawat Publication: New Delhi.

REFERENCES:

1. Jayapalan, N.(2001), "Indian Society and Social Institutions" Atlantic Publishers & Distri,
2. Atal, yogesh (2006), "Changing Indian Society" Rawat Publications, Jaipur

OUTCOMES:

On successful completion of this course,

- Students will gain an in-depth understanding of the social structure and social institutions that constitute society in India.
- Students will be sensitized to the various categories ,Inequalities and their challenges
- Students will be exposed to the social problems encountered in contemporary India.
- Students will gain knowledge about the various forms and trends of the social change.
- Students will become aware about the challenges in the path of progress of Indian society and realize relevance of their role in bringing about development

Humanities Elective II

(To be offered in IV Semester)

SSCXO4	ECONOMICS OF SUSTAINABLE DEVELOPMENT	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To have an increased awareness on the concept and components of sustainable development.
- To develop the ability to demonstrate the need of sustainable development and international responses to environmental challenges.
- To have an insight into global environmental issues and sustainable globalization.
- To establish a clear understanding of the policy instruments of sustainable development.

MODULE I CONCEPT OF SUSTAINABLE DEVELOPMENT 7

Evolution of the Concept – Rio Summit and sustainable development - various definitions of sustainable development - Components of sustainable development: Social, environmental and economic components.

MODULE II NEED FOR SUSTAINABLE DEVELOPMENT 8

Need for sustainability – Global environmental challenges: population growth, resource depletion, pollution, energy use, climate change, pollution, growing water scarcity, other urban problems, loss of biodiversity, hazardous wastes disposal.International responses to environmental challenges - Global policy such as Kyoto Protocol, Montreal Protocol, Basel Convention.

MODULE III GLOBALIZATION AND ENVIRONMENT SUSTAINABILITY 8

Impact of Globalization on sustainable development, Co - existence of globalization and Environment sustainability, Globalization and Global Governance.Green economy - Renewable energy, sustainable transport, sustainable construction, land and water management, waste management.

MODULE IV POLICIES FOR ACHIEVING SUSTAINABLE DEVELOPMENT 7

Principles of environmental policy for achieving sustainable development:

precautionary principle and polluter pays principle – Business Charter for Sustainable Development.Policy instruments for sustainable development: direct regulation – market based pollution control instruments such as pollution tax, subsidy, pollution permits.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Anderson, David A (2010), "*Environmental Economics and Natural Resource Management*", Routledge, 3rd edition.
2. Karpagam M (1999), "*Environmental Economics: A Textbook*", Sterling Publishers Pvt. Ltd, New Delhi.

REFERENCES:

1. Karpagam M and Jaikumar Geetha (2010), "*Green Management Theory and Applications*", Ane Books Pvt. Ltd, New Delhi.
2. Sengupta Ramprasad (2004), "*Ecology and Economics: An Approach to Sustainable Development*", Oxford University Press, New Delhi.

OUTCOMES:

On successful completion of this course,

- The students will have understood the concepts and components of sustainable development.
- The students will have a holistic overview on the challenges of sustainable development and International responses to environmental challenges.
- The students will have gained knowledge on the global environment issues and demonstrate responsible globalization through global governance.
- The students will have developed awareness of the ethical, economic, social and political dimensions that influence sustainable development.

SSCXO5 **INDUSTRIAL SOCIOLOGY**

L	T	P	C
2	0	0	2

OBJECTIVES:

- To introduce sociological approaches and perspectives to understand the social relationship in manufacturing industries and corporate sector.
- To explain the structure and functions of industrial organizations.
- To elucidate the dynamics of organizational behavior, leadership and communication.
- To inculcate professional ethics and values to equip students to work in organizational settings.

MODULE I INTRODUCTION 8

Industrial Sociology- definition, scope and importance; Theoretical approaches- scientific management, human relations approach, theory of bureaucracy, Fordism and post-fordism; Production system- concept and characteristics of factory system, automation and rationalization; Industrial conflict- strike , lockout and trade unions.

MODULE II INDUSTRIAL ORGANIZATION 7

Formal organization- definition, features, utility; Informal organization- definition, characteristics, types and relevance; Structure of industrial organization- features and functions of line organization, characteristics and roles of staff organization, distinction;

Industrial hierarchy-white collar, blue collar, supervisors and managers.

MODULE III DYNAMICS OF INDUSTRIAL RELATIONS 8

Group dynamics- Definition, Group behaviour model, Group decision making process, group cohesiveness; Leadership- definitions, style and effective supervision; Communication- concepts, types, model barriers; Job satisfaction- nature, employee compensation and job satisfaction.

MODULE IV PROFESSIONAL ETHICS AND VALUES 7

Concepts- values- morals, and ethics, Integrity, work ethics , service learning - Civic Virtue - caring - Sharing - Honesty - Courage - Valuing Time - Co-operation - commitment - empathy - Self-Confidence - Environmental Ethics, Cyber issues - computer ethics, cyber crimes, plagiarism Ethical living-concept of harmony in life.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Narender Singh, Industrial Sociology, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.
2. Gisbert Pascal, Fundamentals of Industrial Sociology, Tata Mc. Graw Hill Publishing Co., New Delhi, 1972
3. Schneider Engeno. V, Industrial Sociology 2nd Edition, Mc. Graw Hill Publishing Co., New Delhi, 1979.

REFERENCES:

1. Robbins, Stephen, Organizational Behaviour , Prentice Hall of India PVT ltd new Delhi, 1985
2. Devis Keith , Human Behaviour at work place, Mc. Graw Hill Publishing Co., New Delhi,1984

OUTCOMES:

On successful completion of this course,

- Students will have acclimatized with sociological perspectives for dealing with social relationships in production and service organizations.
- Students will be familiar with structure of authority, roles and responsibility in organizational settings.
- Students will imbibe leadership, communication and behavioral acumen to govern organization
- Students will be sensitized to standards of desirable behavior to engage in industrial and corporate sector.

SSCXO6 LAW FOR ENGINEERS

L	T	P	C
2	0	0	2

OBJECTIVES:

- To understand the Constitution and Governance of our country.
- To apprise the students of human rights - local and international and redressal mechanism.
- To have an insight into the industrial, corporate and labour laws of our country.
- To establish a clear understanding about the importance of intellectual property related laws.

MODULE I INDIAN CONSTITUTION AND GOVERNANCE 8

Constitution – salient features, Preamble, Citizenship, Fundamental rights, Fundamental duties, Directive principles, Union executive, Legislature – Union – State and union territories – Election Commission – Election for parliament and state legislature, Judiciary- basic functioning of the Supreme Court and High Courts, Right to information Act 2005 – evolution – concept – practice.

MODULE II HUMAN RIGHTS 7

Human rights – meaning and significance, Covenant on civil and political rights, Covenant on Economic, Social and Cultural rights, UN mechanism and agencies, The Protection of Human Rights Act, 1993 – watch on human rights and enforcement.

MODULE III INDUSTRIAL, CORPORATE AND LABOUR LAWS 8

Corporate laws – meaning and scope, Companies Act 1956 – Indian Contract Act 1872 - Principles of Arbitration - Industrial Employment (Standing Orders) Act 1946 - Industrial Disputes Act 1947 - Workmen's Compensation Act 1923 - The Factories Act, 1948.

MODULE IV LAWS RELATED TO IPR 7

IPR – meaning and scope, International organization – WIPO – TRIPS, Major Indian IPR Acts – Copyright laws, Patent and Design Act, Trademarks Act, Trade Secret Act, Geographical Indicator.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. M.P. Jain (2005) *Indian Constitutional Law*, Wadhwa & Co.
2. H. D, Agarwal (2008), *International Law and Human Rights,* Central Law Publications,
3. Rao, Meena (2006), *Fundamental Concepts in Law of Contract*, 3rd edn., Professional offset.
4. Ramappa (2010), *Intellectual Property Rights Law in India*, Asia Law House.
5. Singh, Avtar (2007), *Company Law*, Eastern Book Co.
6. R.F, Rustamji (1967)*, Introduction to the Law of Industrial Disputes*, Asia Publishing House.

REFERENCES:

1. Acts: Right to Information Act, Industrial Employees (standing order) Act, Factories Act, Workmen Compensate Act.

OUTCOMES:

On successful completion of this course,

- Students will `be able to apply the basic concepts of Indian Constitution, Governance and power in their real life situation.
- Students will have gained knowledge in human rights, cultural, social and political rights.
- Students will have synthesized knowledge about industrial, corporate and labour laws of our country.
- Students will have an overview of IPRs and laws related to Intellectual Property Rights.

General Elective Courses
Group I courses
(To be offered in V Semester)

GECX101	DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an exposure to various environmental hazards and disasters: and various concepts and principles to manage disaster.
- To give exposure to various environmental policies & programs in India for disaster management

MODULE I ENVIRONMENTAL HAZARDS 7

Environmental hazards, Environmental Disasters and Environmental stress- Meaning and concepts. Vulnerability and disaster preparedness.

MODULE II NATURAL DISASTERS 7

Natural hazards and Disasters - Volcanic Eruption, Earthquakes, Tsunamis, Landslides, Cyclones, Lightning, Hailstorms, Floods, Droughts, Cold waves, Heat waves and Fire.

MODULE III MAN-MADE DISASTERS 7

Man induced hazards & Disasters - Soil Erosion, Chemical hazards, Population Explosion

MODULE IV DISASTER MANAGEMENT 8

Emerging approaches in Disaster Management- Preparing hazard zonation maps, Predictability / forecasting & warning, Preparing disaster preparedness plan, Land use zoning, Communication. Disaster resistant house construction, Population reduction in vulnerable areas, Awareness - Rescue training for search & operation at national & regional level - Immediate relief, Assessment surveys, Political, Administrative, Social, Economic, Environmental Aspects.

MODULE V NATURAL DISASTER REDUCTION & MANAGEMENT 8

Provision of Immediate relief measures to disaster affected people, Prediction of

Hazards & Disasters, Measures of adjustment to natural hazards

MODULE VI ENVIRONMENTAL POLICIES & PROGRAMMES IN INDIA 8

Regional survey of Land Subsidence, Coastal Disaster, Cyclonic Disaster & Disaster in Hills with particular reference to India. Ecological planning for sustainability & sustainable development in India, Sustainable rural development: A Remedy to Disasters, Role of Panchayats in Disaster mitigations, Environmental policies & programmes in India- Institutions & National Centers for Natural Disaster reduction, Environmental Legislations in India, Awareness, Conservation Movement, Education & training.

L – 45; Total Hours –45

REFERENCES:

1. Satender, "Disaster Management in Hills", Concept Publishing Co., New Delhi, 2003.
2. Singh, R.B. (Ed.), "Environmental Geography", Heritage Publishers, New Delhi,1990.
3. Savinder Singh, "Environmental Geography", Prayag Pustak Bhawan,1997.
4. Kates, B.I. and White, G.F., "The Environment as Hazards", Oxford University Press, New York, 1978.
5. Gupta, H.K., (Ed), "Disaster Management", University Press, India, 2003.
6. Singh, R.B.,"Space Technology for Disaster Mitigation in India (INCED)", University of Tokyo, 1994.
7. Bhandani, R.K., "An overview on Natural & Manmade Disaster & their Reduction", IIPA Publication, CSIR, New Delhi, 1994.
8. Gupta, M.C., "Manuals on Natural Disaster management in India", National Centre for Disaster Management, IIPA Publication, New Delhi, 2001.

OUTCOMES:

At the end of the course, the students will

- achieve sufficient knowledge on the disaster prevention strategy, early warning system, disaster preparedness, response and human resource development.
- be familiar with the National Policy on Disaster Management.

GECX102 TOTAL QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the various principles, practices of TQM to achieve quality.
- To get acquainted with the various statistical tools and approaches for quality control and continuous improvement.
- To get aware of the importance of ISO and Quality Systems.

MODULE I INTRODUCTION 8

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

MODULE II TQM PRINCIPLES 7

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits.

MODULE III TQM IMPROVEMENT PROCESS 8

Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

MODULE IV STATISTICAL PROCESS CONTROL (SPC) 8

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

MODULE V TQM TOOLS 7

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

MODULE VI QUALITY SYSTEMS 7

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System– Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits

L – 45; Total Hours –45

TEXT BOOKS:

1. Dale H.Besterfiled, et al., “Total Quality Management”, Pearson Education, Inc. 2003.

REFERENCES:

1. James R.Evans & William M.Lidsay, “The Management and Control of Quality”, 5th Edition, South-Western (Thomson Learning), 2002.
2. Feigenbaum.A.V., “Total Quality Management”, McGraw-Hill, 1991.
3. Oakland.J.S., “Total Quality Management”, Butterworth Hcinemann Ltd., Oxford, 1989.
4. Narayana V. and Sreenivasan. N.S., “Quality Management – Concepts and Tasks”, New Age International, 1996.
5. Zeiri, “Total Quality Management for Engineers”, Wood Head Publishers, 1991.

OUTCOMES:

The student should be able to

- apply the various statistical tools and approaches for Quality control.
- achieve continuous process improvement through TQM.

GECX103	ENERGY STUDIES	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To learn the growing demand, supply of energy on global and national levels and the need for renewable energy promotion.
- To understand the basic need for energy conservation and waste heat recovery.
- To learn the important aspects of energy audit and management.
- To get acquainted with the global environmental issues and carbon credits.

MODULE I GLOBAL AND NATIONAL ENERGY SCENARIO 7

Role of energy in economic development, various energy resources - overall energy demand and availability- Energy consumption in various sectors and its changing pattern - Exponential increase in energy consumption and projected future demands. Need for renewable energy.

MODULE II SOLAR ENERGY 8

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

MODULE III OTHER RENEWABLE ENERGY SOURCES 8

Power from wind – wind turbine working and types, solar thermal power plants – low medium and high power generation, power from wave , tidal, geothermal sources, OTEC system. MHD power plants – working, types, merits and demerits. Energy from biomass.

MODULE IV COGENERATION, WASTE HEAT RECOVERY AND COMBINED CYCLE PLANTS 8

Cogeneration principles- topping and bottoming cycles, role in process industries. Energy from wastes- waste heat recovery- heat recovery from industrial processes. Heat exchange systems – recuperative and regenerative heat exchangers – commercially available waste heat recovery devices. Combined cycle plants – concept, need and advantages, different combinations and practical scope.

MODULE V ENERGY CONSERVATION AND MANAGEMENT 7

Need for energy conservation – use of energy efficient equipment. Energy conservation opportunities - in educational institutions, residential, transport, municipal, industrial and commercial sectors – concept of green building. Energy audit in industries – need, principle and advantages. Case studies.

MODULE VI GLOBAL ENERGY ISSUES AND CARBON CREDITS 7

Energy crisis, fossil consumption and its impact on environmental climate change. Energy treaties – Montreal and Kyoto protocols - Transition from carbon rich and nuclear to carbon free technologies, carbon foot print – credits – clean development mechanism.

L – 45; Total Hours –45

TEXT BOOKS:

1. S.S. Rao and B.B. Parulekar, “Energy Technology”, 3rd Edition, Khanna Publishers, New Delhi, 2011.
2. O. Callaghn. P.W., “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.

REFERENCES:

1. G.D. Rai, “Non Conventional Energy Sources”, Khanna Publishers, New Delhi, 2011.
2. Archie, W Culp. “Principles of Energy Conservation”, McGraw Hill, 1991.
3. D Patrick and S W Fardo, “Energy Management and Conservation”, PHI,1990
4. P. O’Callaghan: “Energy Management”, McGraw - Hill Book Company, 1993.
5. Kenney, W. F., “Energy Conservation in Process Industries”, Academic Press, 1983.

OUTCOMES:

The student should be able to

- Realize the global and national energy status and need to switch over to renewable energy technology.
- Energy audit and suggest methodologies for energy savings.
- Utilize the available resources in an optimal way.
- Concern about the global environmental issues & promote carbon credits.

GECX104	ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To learn about the robots, various components, of Robots, programming and their applications.

MODULE I **8**

Definition- Need - Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence- basic parts - functions – specifications. of robot, degrees of freedoms, end effectors – types, selection

MODULE II ROBOT DRIVES AND CONTROL **8**

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

MODULE III ROBOT SENSORS **8**

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

MODULE IV ROBOT PROGRAMMING & AI TECHNIQUES **7**

Types of Programming – Teach pendant programming – Basic concepts in AI techniques – Concept of knowledge representations – Expert system and its components.

MODULE V ROBOTIC WORK CELLS AND APPLICATIONS OF ROBOTS **7**

Robotic cell layouts – Inter locks – Humanoid robots – Micro robots – Application of robots in surgery, Manufacturing industries, space and underwater.

MODULE VI ROBOT KINEMATICS AND DYNAMICS 7

Forward and inverse Kinematic equations, Denvit – Hartenbers representations Fundamental problems with D-H representation, differential motion and velocity
of frames - Dynamic equations for sing, double and multiple DOF robots – static force analysis of robots.

L – 45; Total Hours –45

REFERENCES:

1. Yoram Koren," Robotics for Engineers", Mc Graw-Hill, 1987.
2. Kozyrey, Yu, "Industrial Robots", MIR Publishers Moscow, 1985.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.
4. Deb, S.R. "Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, "Industrial Robotics Technology, Programming and Applications", Mc Graw- Hill, Int. 1986.
6. Timothy Jordanides et al,"Expert Systems and Robotics", Springer – Verlag, New York, May 1991.

OUTCOMES:

Students would be able to

- Understand about the robots, its various components.
- Design Robots for industrial applications.
- Do programming for robots and apply them in real time applications.

GECX105 TRANSPORT MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the transport fleet and their related activities for minimizing operational cost.
- To understand the need of maintenance and its importance.
- To understand the functions and applications of various types of transport system.

MODULE I INTRODUCTION 7

Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

MODULE II ORGANISATION AND MANAGEMENT 7

Forms of Ownership – principle of Transport Management – Staff administration – Recruitment and Training – welfare – health and safety. Basic principles of supervising. Organizing time and people. Driver and mechanic hiring - Driver checklist - Lists for driver and mechanic - Trip leasing - Vehicle operation and types of operations.

MODULE III TRANSPORT SYSTEMS 9

Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. chain of responsibility, forms of ownership by state, municipality, public body and private undertakings.

MODULE IV SCHEDULING AND FARE STRUCTURE 8

Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling.

MODULE V MOTOR VEHICLE ACT 7

Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.

MODULE VI MAINTENANCE 7

Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout.

L – 45; Total Hours –60

TEXT BOOKS:

1. John Duke, "Fleet Management", McGraw-Hill Co, USA, 1984.
2. Kitchin.L.D., "Bus Operation", III edition, Illiffee and Sons Co., London, 1992

REFERENCES:

1. Government Motor Vehicle Act, Publication on latest act to be used as on date.

OUTCOMES:

Upon completion of the course, students will

- Know about different aspects related to transport system and management.
- Features of scheduling, fixing the fares
- Know about the motor vehicle act and maintenance aspects of transport.

GECX106 CONTROL SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the system modeling and to derive their transfer function.
- To provide adequate knowledge of time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of Control systems.

MODULE I BASIC CONCEPTS AND SYSTEM REPRESENTATION 8

Control System - Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Block diagram reduction techniques – Signal flow graphs.

MODULE II TIME RESPONSE ANALYSIS AND DESIGN 8

Time response – Time domain specifications – Types of test input – First and Second order system - Type I and Type II System – Response - Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

MODULE III FREQUENCY RESPONSE ANALYSIS AND DESIGN 7

Performance specifications - correlation to time domain specifications - bode plots and polar plots – gain and phase margin – constant M and N circles and Nichols chart – all pass and non-minimum phase systems.

MODULE IV STABILITY 8

Characteristics equation – Location of roots in s plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criterion.

MODULE V COMPENSATOR DESIGN 8

Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plots and root locus technique.

MODULE VI CONTROL SYSTEM COMPONENTS AND APPLICATION OF CONTROL SYSTEMS 6

Synchros – AC servomotors - DC Servo motors - Stepper motors - AC Tacho generator - DC Tacho generator - Typical applications of control system in industry.

L – 45; Total Hours –60

REFERENCES:

1. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education, New Delhi, 2003.
2. I.J. Nagrath & M. Gopal, "Control Systems Engineering", New Age International Publishers, 2003.
3. C.J.Chesmond, "Basic Control System Technology", Viva student edition, 1998.
4. I.J.Nagarath and M.Gopal, "Control System Engineering", Wiley Eastern Ltd., Reprint, 1995.
5. R.C.Dorf and R.H.Bishop, "Modern Control Systems", Addison-Wesley (MATLAB Reference), 1995.

OUTCOMES:

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- Proper understanding of basics of Control Systems.
- Ability and skill to carry-out time domain and frequency domain analysis.
- Capable of determining stability of the system using Routh Hurwitz criterion, Root locus and Nyquist criterion.
- Ability to design lag, lead and lag lead compensator networks.

GECX107	INTRODUCTION TO VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Basic concepts of HDL.
- Verilog language and its syntax constructs.
- Programmable Logic Devices and FPGAs
- MOS devices theory
- CMOS based combinational and sequential circuits

PREREQUISITES:

Fundamentals of Electronics

Basics knowledge in Digital Electronics.

MODULE I REVIEW OF BASIC DIGITAL SYSTEMS 7

Boolean algebra, Building blocks of combinational logic design-Adders, multiplexer, encoder, decoder, comparator, Latches & flip-flops, counters, shift registers.

MODULE II LOGIC DESIGN USING VERILOG HDL 8

Overview of Digital Design with Verilog HDL, Levels of Design Description, Concurrency, Hierarchical Modeling Concepts, Modules and Ports, Component instantiation Data flow and RTL, structural, gate level, switch level modeling and Behavioral Modeling.

MODULE III LANGUAGE CONSTRUCTS OF VERILOG HDL 7

Identifiers- gate primitives, gate delays, operators, timing controls, procedural assignments, conditional statements Variable types, arrays and tables, Tasks and functions, Test bench.

MODULE IV BUILDING BLOCKS OF DIGITAL VLSI SYSTEMS 8

HDL Design -Data Path Operations-Addition/Subtraction, Parity Generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multiplication, Shifters, Memory Elements. Programmable logic elements and AND-OR arrays, FPGAs programming methods.

MODULE V TRANSISTOR THEORY 7

Introduction to MOS Transistors-NMOS & PMOS Characteristics, Current Equations, Complementary CMOS Inverter-DC Characteristics, Static Load MOS Inverters.

MODULE VI BASICS OF DIGITAL CMOS DESIGN 8

NMOS & PMOS Logic Gate, CMOS Logic Gate, Basic layout design of simple gate-stick diagram, CMOS Logic Structures-full adder, multiplexers.

Total Hours –45

TEXT BOOKS:

1. M.Morris Mano "Digital Design", 3rd Edition, Prentice Hall of India Pvt. Ltd New Delhi, 2003

REFERENCES:

1. Michael D. Ciletti“Advanced Digital Design with the Verilog HDL" (2nd Edition) Hardcover – January 31, 2010
2. J.Bhasker: Verilog HDL primer, BS publication, 2001.
3. J. P. Uyemura, "Introduction to VLSI Circuits and System", Wiley, 2002
4. Neil Weste and K. Eshragian, “Principles of CMOS VLSI Design: A System Perspective,” 2nd edition, Pearson Education (Asia) Pvt.Ltd., 2000
5. Douglas A Pucknell& Kamran Eshragian , “Basic VLSI Design” PHI 3rd Edition (original edition – 1994)

OUTCOMES:

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

- Create basic Register Transfer Level (RTL) models for combinational circuits & Sequential circuits using Verilog HDL.
- Create basic behavioral models for combinational circuits & Sequential circuits using Verilog HDL.
- Describe the usage of Programmable Logic Devices and FPGAs.
- Describe MOS devices theory and inverter circuit DC characteristics
- Design the basic digital building blocks using MOS circuit.
- Apply VLSI design concepts based on the requirements to conduct experiments or projects

GECX108 PLANT ENGINEERING

	L	T	P	C
	3	1	0	4

OBJECTIVES:

- To provide in depth knowledge on Plant Engineering
- To introduce detail engineering and P&ID
- To learn about the support to Instrumentation from other disciplines
- To study about the Installation and commissioning

MODULE I INTRODUCTION OF PLANTS 7

General Project Cycle – Feed – Sales - Plant Description, Component / Areas of Plant, Plant Layout, Plant Interfaces, Plant Location

MODULE II ELEMENTS OF PLANT 8

Main Elements of a Plant, Process Flow Scheme (PFD – Process Flow Diagram) P&ID's, Plant Legend Finalization.

MODULE III DETAIL ENGINEERING 10

P& ID Development with PFD's, Major Discipline Involvement & Inter discipline Interaction, Major Instrumentation & Control Systems - Development Phase – Instrument List , I/O Count, Specification Sheets, Instrument Installation (Hook ups) , Control Philosophy – Detail Engineering.

MODULE IV SUPPORT FROM OTHER DISCIPLINE 8

Other Discipline Supports to Instrumentation – Plot Plan, Piping / Equipment Plan, Electrical Area Classification, Fire Hazardous Classification Telecommunication Systems - Control Network architecture.

MODULE V INSTALLATION AND COMMISSIONING 7

Plant Construction - Key Drawings for Construction Support Construction Activities, System Testing, Startup / Commissioning, Production.

MODULE VI CASE STUDIES 5

Case studies of Water Treatment Plant - Paper Industry – Power Plant etc

L – 45; Total Hours –45

REFERENCES:

1. Duncan C. Richardson, Plant Equipment and Maintenance Engineering Handbook, McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto, 2014 McGraw-Hill Education

2. Gabriel Salvendy, Handbook of Industrial Engineering - Technology and operations management, John Wiley & Sons, 2001

3. Robert C Rosaler, Standard Handbook of Plant Engineering, McGraw-Hill third edition, 2004.

4. R. Keith Mobley, Plant Engineer's Handbook, Technology and Engineering, 2001.

OUTCOMES:

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

- Review and correct P&IDs
- Do installation and commissioning of new plants
- Apply plant engineering in design and maintenance of water treatment plant / power plant etc

GECX109 NETWORK SECURITY

L	T	P	C
3	0	0	3

OBJECTIVES:

The students should be able to

- Discuss the basic concepts of computer security, model and attacks
- Examine the major types of threats and the associated attacks
- Identify the encryption techniques in real time applications
- Understand the special requirements for wireless security and how authentication is implemented in wireless systems
- Understand the functions of Network Security Device Firewall and its types
- Interpret the various network intrusion such as computer viruses, network worms etc

MODULE I INTRODUCTION 6

Computer Security Concepts - The OSI Security Architecture - Security Attacks - Security Services - Security Mechanisms - A Model for Network Security - Standards – classical encryption techniques.

MODULE II SYMMETRIC ENCRYPTION AND MESSAGE CONFIDENTIALITY 7

Symmetric Encryption Principles - Symmetric Block Encryption Algorithms - Random and Pseudorandom Numbers - Stream Ciphers and RC4 - Cipher Block Modes of Operation

MODULE III PUBLIC KEY CRYPTOGRAPHY AND MESSAGE AUTHENTICATION 8

Approaches to Message Authentication - Secure Hash Functions - Message Authentication Codes - Public-Key Cryptography Principles - Public-Key Cryptography Algorithms - Digital Signatures

MODULE IV KEY DISTRIBUTION ,USER AUTHENTICATION AND TRANSPORT-LEVEL SECURITY 8

Symmetric Key Distribution Using Symmetric Encryption - Kerberos - Key Distribution Using Asymmetric Encryption - X.509 Certificates - Public-Key

Infrastructure -Federated Identity Management - Web Security Considerations - Secure Socket Layer and Transport Layer Security - Transport Layer Security

MODULE V WIRELESS NETWORK SECURITY, ELECTRONIC MAIL SECURITY AND IP SECURITY 8

IEEE 802.11 Wireless LAN Overview -IEEE 802.11i Wireless LAN Security - Wireless Application Protocol Overview - Wireless Transport Layer Security - WAP End-to-End Security - Pretty Good Privacy - S/MIME – Domain Keys Identified Mail- IP Security Overview -IP Security Policy - Encapsulating Security Payload - Combining Security Associations - Internet Key Exchange - Cryptographic Suites

MODULE VI SYSTEM SECURITY 8

Intruders -Intrusion Detection -Password Management - Types of Malicious Software - Viruses Virus Countermeasures – Worms - Distributed Denial of Service Attacks- The Need for Firewalls - Firewall Characteristics - Types of Firewalls - Firewall Basing - Firewall Location and Configurations

L – 45; Total Hours –45

REFERENCES:

1. William Stallings,”Network security Essentials:Applications and standards“, Prentice Hall, Fifth Edition , ISBN-13: 978-0134527338, 2013
2. William Stallings, “Cryptography and Network Security: Principles and Practice”, Pearson, ISBN-13:978-0-273-79335-9,2013
3. Behrouz Forouzan, Debdeep Mukhopadhyay,Cryptography and network security (sie) 2nd edition, ISBN-13: 978-0070702080, 2016
4. Wikipedia, “Network Security and Management” , https://en.wikipedia.org/wiki/Book:Network Security and Management, 2014.
5. Nitesh Dhanjani, Justin Clarke, “Network Security Tools”, O'Reilly Media, ISBN-13: 9780596007942, 2005.

OUTCOMES:

Students who complete this course will be able to

- Recognize the computer security concepts, architecture attacks and model
- Distinguish the symmetric and asymmetric encryption techniques
- Apply the cryptographic algorithms in different applications

- Express the network security designs using available secure solutions such as PGP,SSL, IPSec, etc.
- Describe the firewalls principles and different types of firewalls applied in organization
- Identify abnormalities within the network caused by worms, viruses and Network related security treats.

GECX110 KNOWLEDGE MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

The course

- Focuses on positioning knowledge as a valuable commodity, embedded in products and in the tacit knowledge of highly mobile individual employees.
- Presents KM as a deliberate and systematic approach to cultivating and sharing an organization's knowledge base.
- Brings out the paradigm in terms of information technology and intellectual capital.

MODULE I KNOWLEDGE MANAGEMENT 6

KM Myths – KM Life Cycle – Understanding Knowledge – Knowledge, intelligence – Experience – Common Sense – Cognition and KM – Types of Knowledge – History of Knowledge Management - From Physical assets to Knowledge Assets – Expert knowledge – Human Thinking and Learning.

MODULE II KNOWLEDGE MANAGEMENT SYSTEMS AND MODELS 9

Challenges in Building KM Systems – Conventional Vs KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – KM cycle - Different variants of KM cycle - KM models - Implications and practical implementations.

MODULE III CAPTURING KNOWLEDGE AND SHARING 9

Tacit knowledge capture - Explicit knowledge codification – Knowledge taxonomies - Knowledge sharing - Communities - Obstacles to knowledge capture and sharing.

MODULE IV KNOWLEDGE MANAGEMENT TOOLS 9

KM System tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Knowledge capture and creation tools - Content creation tools - Data mining and knowledge discovery – Content management tools - Knowledge sharing and dissemination tools – Group ware and Collaboration tools - Intelligent filtering tools.

MODULE V KNOWLEDGE APPLICATION 6

KM at individual level - Knowledge workers - Task analysis and modeling - Knowledge application at group and organizational levels – Knowledge repositories - Knowledge reuse -Case study: e-learning.

MODULE VI VALUE OF KNOWLEDGE MANAGEMENT 6

KM return on investment and metrics - Benchmarking method – Balanced scorecard method - House of quality method - Results based assessment method - Measuring success - Future challenges for KM.

L – 45; Total Hours –45

TEXT BOOKS:

1. Elias M. Awad, Hassan M. Ghaziri, “Knowledge Management”, Prentice Hall, 2nd Edition, 2010.
2. Jay Liebowitz, “Handbooks on Knowledge Management”, 2nd Edition, 2012.
3. Irma Becerra-Fernandez, Rajiv Sabherwal, ”Knowledge Management: Systems and Processes”, 2010.

OUTCOMES:

Students who complete this course will be able to

- Describe the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management.
- Explains the core concepts, methods, techniques, and tools for computer support of knowledge management.
- Critically evaluate current trends in knowledge management and apply it for e-learning

GECX111	CYBER SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Cyber Security Standards and Policies.
- To know the legal, ethical and professional issues in Cyber security.
- To understand Cyber Frauds and Abuse and its Security Measures.
- To know the technological aspects of Cyber Security.
-

MODULE I FUNDAMENTALS OF CYBER SECURITY 7

Security problem in computing – Cryptography Basics – History of Encryption – Modern Methods – Legitimate versus Fraudulent Encryption methods – Encryption used in Internet.

MODULE II CYBERCRIME AND CYBEROFFENSES 8

Cybercrime and Information Security – Cybercriminals – Classifications of Cybercrimes – Email Spoofing – Spamming – Cyber defamation – Internet Time Theft – Forgery – Web jacking – Hacking – Online Frauds – Software Piracy – Mail Bombs – Password Sniffing – Cyberoffenses – Categories – Planning the attacks – Cyberstalking – Cybercafe and Cybercrimes – Botnets.

MODULE III CYBERCRIME: MOBILE AND WIRELESS DEVICES 8

Proliferation of Mobile and Wireless Devices – Trends in Mobility – Credit card frauds in Mobile and Wireless Computing – Security Challenges – Authentication Service Security – Attacks on Mobile Phones.

MODULE IV TOOLS AND METHODS USED IN CYBERCRIME 8

Proxy Servers and Anonymizers – Phishing – Password Cracking – Keyloggers and Spywares – Virus and Worms – Trojan Horses and Backdoors – Steganography – DoS and DDoS Attacks.

MODULE V SECURITY POLICIES 7

Introduction - Defining User Policies – Passwords – Internet Use – Email Usage – Installing/ Uninstalling Software – Instant Messaging – Defining System Administrative Policies – Defining Access Control – Developmental Policies – Standards, Guidelines and Procedures – Basics of Assessing a System.

MODULE VI COMPUTER FORENSICS 7

General Guidelines – Finding Evidence on the PC - Finding Evidence in System Logs – Windows Logs – Linux Logs – Getting Back Deleted Files – Operating System Utilities – The Windows Registry.

L – 45; Total Hours –45

TEXT BOOKS:

1. Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley, 2011.
2. Chuck Easttom, “Computer Security Fundamentals”, 2nd Edition, Pearson Education, 2012.

REFERENCES:

1. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, 3rd Edition, Pearson Education, 2003.
2. William Stallings, “Cryptography and Network Security – Principles and Practices”, 3rd Edition, Pearson Education, 2003.
3. Atul Kahate, “Cryptography and Network Security”, Tata McGraw Hill, 2000.

OUTCOMES:

Upon completion of this course, students will be able to

- Explain the general security issues.
- Discuss various cybercrimes and offenses.
- Outline the occurrence of Cybercrime in mobile and wireless environment.
- Use relevant tools and methods in cybercrime
- Apply security policies in cyber forensics.

- Outline the strategies adopted in computer forensics.

GECX112 GENETIC ENGINEERING

	L	T	P	C
GECX112 GENETIC ENGINEERING	**4**	**0**	**0**	**4**

OBJECTIVES:

The course aims to provide an advanced understanding of the core principles and topics of Cell and Organism reproduction and the Principles of heredity and their experimental basis, and to enable students to be able to apply these principles in assessment of pedigrees to identify genotypes and predict the mating outcomes.

MODULE I GENETICS AND ORGANISM 10

Genetics and human affairs, Genetics and Biology, Genes and Environment, Techniques of genetic analysis, The chromosome theory of heredity, Sex chromosomes, Sex linkage, The parallel behaviour of autosomal genes and chromosomes.

MODULE II MENDELISM AND LINKAGE 12

Mendel's laws of inheritance, Interaction of genes, Variations on dominance, Multiple alleles, Lethal alleles, Several genes affecting the same character, Penetrance and expressivity, Linkage- Basic eukaryotic chromosome mapping, The discovery of linkage, Recombination linkage symbolism, Linkage of genes on X chromosomes, Linkage maps, Examples of linkage maps.

MODULE III FINE STRUCTURE OF GENES 10

The concept of promoter, Coding sequence, Terminator, Induction of gene for expression. The concept of extranuclear genome in higher plants and animals, Overview of mitochondrial genome, Chloroplast genome.

MODULE IV RECOMBINATION IN BACTERIA AND VIRUSES 10

Conjugation recombination and mapping the E.coli chromosomes, Transformation, Transduction, Chromosome mapping. Population genetics: Darwin's revolution, Variation and its modulation, The effect of sexual reproduction on variation, The sources of variation, Selection quantitative genetics

MODULE V PRINCIPLES OF PLANT BREEDING 9

Objectives, Selfing and crossing techniques, Male sterility,Incompatability, Hybrid vigour.

MODULE VI HUMAN GENOME PROJECT 9

Genetic diseases in humans, Genetics and society

L – 45; T – 15; Total Hours –60

REFERENCES:

1. In Introduction to genetic analysis, Griffiths, Miller, Suzuki, Lewontin and Gelbart, Freeman and Company.
2. Genetics, A.V.S.S. Sambamurty, Narosa Publishing House.
3. Concepts of Genetics, Klug & Cummings, Prientice Hall.
4. Molecular Cloning, Moniatisetal, Cold Spring Harbor Laboratory.

OUTCOMES:

At the end of the course students will be able to

- Describe the structure, function and replication of DNA as the genetic material
- Describe gene structure, expression and regulation
- Describe the chromosomal basis of inheritance and how alterations in chromosome number or structure may arise during mitosis and meiosis

GECX113 FUNDAMENTALS OF PROJECT MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

The students would gain knowledge on

- Technicalities attached to Project Management and Significance of Quality Consideration
- Project management methodologies – tools and techniques, supplemented with examples from case studies
- The importance of Efficient HR team and role of Communication in executing Projects.
- Managing Risks in Project Management

MODULE I INTRODUCTION TO PROJECT MANAGEMENT 9

Introduction to Project and Project Management-Project Management as a Career-Project Management Skill Sets-Project Scope Management: Project Charter, Scope Creep, Scope Validation, Scope Change Control-Type of Organization: Organization Structure-Influence of Organization Structure on Project, Project Stakeholders and Organizational Productivity.

MODULE II PROJECT MANAGEMENT PROCESS, TOOLS AND TECHNIQUES 8

Project life cycle-Initiation, Planning, Execution, Monitoring and Closing Phase; - Link between project management process, process groups and knowledge areas; Project management tools and techniques- Project Stakeholders description and mapping - Stakeholder Management Process

MODULE III PROJECT QUALITY, COST AND SCHEDULE MANAGEMENT 10

MODULE IV PROJECT HR MANAGEMENT 5

Organizational Goals- (MBO/MBE/MBP)-Responsibility Assignment Matrix (RAM)-Types of Powers- Manage or Lead-Conflict management Techniques-Performance Evaluation Process-Motivation Theories and its Application for execution of Projects-Leadership Styles-Project Team Building-Project Staffing Constraints/Policies

MODULE V COMMUNICATION MANAGEMENT 5

Communication Management: Understanding Body languages of Project Personnel-Effective Communications- Interpersonal Skills for project Managers-PMIS-Communicating with the Customer-Communicating with Management- Formal vs. Informal Communications-Written, Verbal and Non-Verbal Communications.

MODULE VI PROJECT PROCUREMENT & RISK MANAGEMENT 8

Introduction to Project Procure Management: Soliciting RFQ/RFP-Contract Proposals-Contract Negotiation-Contract Closure-Risk Management: Defining risks-Risk management process-Risk identification-Qualitative and Quantitative Risk-Probability and Decision trees-Risk Response strategies / methods-Expected monetary value-Risk vs. life cycle phases

L – 45; Total Hours –45

REFERENCES:

1. Jack. R. Meredith, Samuel. J. Mantel & Scott. M. Shafer, Project Management in Practice, Fifth Edition, Bangalore: Wiley, 2015
2. Bob Hughes, Mike Cotterrel "Software Project Management", Tata McGraw-Hill, 2009

OUTCOMES:

- Learners will be able to identify the Key Knowledge Areas and apply PM process in hypothetical project assignments given as continuous assessment.
- They would be able to suitably recognize tools and techniques required for various phases included in a project.
- They would also be able to manage scope, time, cost and other major components that would help them to execute the project efficiently.

GECX114 OPERATIONS RESEARCH

L	T	P	C
3	0	0	3

OBJECTIVES:

- To acquire knowledge and training in optimization techniques.
- To get knowledge about optimization in utilization of resources.
- To understand and apply operations research techniques to industrial operations

MODULE I LINEAR PROGRAMMING PROBLEM 8

Linear programming – formulation of the problem - graphical interpretation of optimality - Simplex method – to obtain basic feasible solution – types of linear programming solution – complications and their resolution.

MODULE II ARTIFICIAL VARIABLE AND TWO PHASE METHOD, DUALITY 6

Artificial variable - Big M method – Two phase method – alternative optimal solution – unbounded solution - Duality – primal dual relationships - rules of constructing the dual from primal.

MODULE III TRANSPORTATION PROBLEM & ASSIGNMENT PROBLE 8

Transportation problems – Initial basic feasible solutions, MODI method, Unbalance in transportation, Degeneracy in transportation models, Assignment problem – Minimization and Maximization type of problems by Hungarian method.

MODULE IV NETWORK AND SEQUENCING PROBLEMS 8

PERT and CPM – Network diagram – Fulkerson's rule - CPM Probability of achieving completion date – Crash time – Cost analysis. Sequencing N jobs through 2 machines and 3 machines.

MODULE V QUEUING THEORY & SIMULATION 7

Poisson arrivals and exponential service times – characteristics of Queuing models – single channel – Introduction to multi channel models – Random number generation – Monte Carlo Simulation.

MODULE VI INVENTORY CONTROL, REPLACEMENT MODELS AND GAME THEORY 8

Types of inventory- Inventory cost - EOQ - Deterministic inventory problems – Introduction to probabilistic models & system level inventory control - Replacement models – Replacement of items that deteriorate with time – value of money changing with time – not changing with time – Individual and group replacement policy - Game theory – simple games.

L – 45; Total Hours –45

TEXT BOOKS:

3. Hamdy ATaha, "Operations Research an introduction", 8th edition, Phil Pearson, 2007.
4. Winston.W.L., "Operations Research", 4th edition, Thompson-Brooks/Cole, 2003.

REFERENCES:

1. Wayne.L. Winston, "Operations Research applications and algorithms", 4th edition, Thomson learning, 2007.
2. Frederick. S. Hiller and Gerald.J.Lieberman, "Operations Research concepts and cases", 8th edition (SIE), Tata McGraw – Hill Pub. Co. Ltd., New Delhi, 2006.
3. A. Ravindran, D. T. Phillips and J. J. Solberg, "Operations Research:Principles and Practice", 2nd edition, John Wiley & Sons, New York, 1992.
4. Robertazzi. T.G., "Computer networks and systems-Queuing theory and performance evaluation", 3rd edition, Springer, 2002.

OUTCOMES:

At the end of the course students will be able to

- solve linear programming problems
- solve transportation and assignment problems.
- solve network and sequencing problems.
- apply the operations research techniques to solve industrial problems.

GECX115 NANO TECHNOLOGY

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of Nanoscience relevant to the field of engineering.
- To provide an exposure about the importance of various synthesis method.
- To enrich the knowledge of students in various characterisation techniques.

MODULE I INTRODUCTION & CLASSIFICATION OF NANOMATERIALS 9

Definition - Origin of nanotechnology - Difference between bulk and nanomaterials- Top-down and bottom-up processes - Size dependent properties (magnetic, electronic,transport and optical), Classification based on dimensional property - 0D, 1D, 2D and 3D nanostructures – Kubo gap.

MODULE II TYPES OF NANOMATERIALS 9

Metal oxides and metal nano particles - Ceramic nano particles - Semi conducting quantum dots - Core-shell quantum dots - Nanocomposites - Micellar nanoparticles.

MODULE III PRODUCTION OF NANOPARTICLES 7

Sol-gel, hydrothermal, solvothermal, Plasma Arcing, Electro deposition, RF sputtering, Pulsed laser deposition, Chemical vapour, deposition.

MODULE IV CARBON BASED NANOMATERIALS 6

Carbon nanotubes: Single wall nanotubes (SWNT), Multiwall nanotubes (MWNT) - structures-carbon nanofibre, Fullerenes-Application of carbon nanotubes and Fullerenes.

MODULE V NANOPHOTONICS 7

Light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, nanoparticles and nanostructures; Nanostructured polymers, Photonic Crystals, Solar cells.

MODULE VI CHARACTERISATION TECHNIQUES 7

Basic principles of scanning Electron Microscopy (SEM), Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), Scanning probe microscopy (SPM) and Transmission electron microscopy (TEM), Particle size analyzer, Luminescence techniques.

L – 45; Total Hours –45

TEXT BOOKS:

1. Hari Singh Nalwa, "Handbook of Nanostructured Materials and Nanotechnology", Academic Press, 2000.
2. Guozhong Cao, "Nanostructures and Nano materials-Synthesis, Properties and Applications", Imperial College Press (2011).
3. Zhong Lin Wang, "Handbook of Nanophase and Nanomaterials (Vol 1 and II)", Springer, 2002.
4. Mick Wilson, Kamali Kannangara, Geoff smith, "Nanotechnology: Basic Science and Emerging Technologies", Overseas press, 2005.

REFERENCES:

1. A. Nabok, "Organic and Inorganic Nanostructures", Artech House, 2005.
2. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: "Nanotechnologies and Nanophysics", Springer-Verlag Berlin Heidelberg, 2007.
3. Mick Wilson, Kamali Kannangara, Michells Simmons and Burkhard Raguse, "Nano Technology – Basic Science and Emerging Technologies", 1st Edition, Overseas Press, New Delhi,2005.
4. M.S. Ramachandra Rao, Shubra SinghH, "Nanoscience and Nanotechnology: Fundamentals to Frontiers", Wiley, 2013.

OUTCOMES:

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

- Apply the knowledge of different types of nanomaterials for various engineering applications.
- Acquire the knowledge of various methods of production of nanomaterials.
- Familiarize with various characterization techniques.

GECX116	VEHICLE MAINTENANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know about the various methods of maintaining procedure, vehicle insurance and basic problems in a vehicle.
- The student able to impart knowledge in maintaining of engine components and subsystems.
- The student able to impart knowledge in maintaining of transmission, driveline, steering, suspension, braking and wheels.
- The student able to impart carefully maintaining their vehicle and can increase driving safety.

MODULE I MAINTENANCE, WORKSHOP PRACTICES, SAFETY AND TOOLS 7

Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations – workshop manual - vehicle identification. Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools – special service tools – measuring instruments – condition checking of seals, gaskets and sealants. Scheduled maintenance services – service intervals - Towing and recovering.

MODULE II ENGINE AND ENGINE SUBSYSTEM MAINTENANCE 8

General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management service - fault diagnosis- servicing emission controls.

MODULE III TRANSMISSION AND DRIVELINE MAINTENANCE 8

Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, transaxle- road testing- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

MODULE IV STEERING AND SUSPENSION MAINTENANCE 7

Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Inspection, Maintenance and Service of steering linkage, steering column, Rack and pinion steering, Recirculating ball steering service- Worm type steering, and power steering system.

MODULE V BRAKE AND WHEEL MAINTENANCE 7

Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, parking brake. Bleeding of brakes. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation.

MODULE VI AUTO ELECTRICAL AND AIR CONDITIOING MAINTENANCE 8

Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection- AC Charging- Fault diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

L – 45; Total Hours –45

TEXT BOOKS:

1. Ed May, "Automotive Mechanics Volume One" , Mc Graw Hill Publications, 2003
2. Ed May, "Automotive Mechanics Volume Two" , Mc Graw Hill Publications, 2003
3. Vehicle Service Manuals of reputed manufacturers
4. Vehicle maintenance and garage practice by Jigar A.Doshi Dhru U.Panchal,Jayesh P.Maniar. 2014
5. A Practical Approach to Motor Vehicle Engineering and Maintenance 3rd Edition by Allan Bonnick.

REFERENCES:

1. Bosch Automotive Handbook, Sixth Edition, 2004.
2. Advanced Automotive Fault Diagnosis by Tom Denton 2011.
3. Nissan Patrol Automotive Repair Manual: 1998-2014 by Haynes Manuals Inc.
4. Automobile electrical manual a comprehensive guide by Haynes manual car repair.

OUTCOMES:

On completion of the course student should be able to

- Prepare maintenance schedules and procedures with appropriate tools.
- Demonstrate the procedure and methods to repair and calibrate the engine.
- Analyze the causes and remedies for fault in transmission and drive line systems.
- Analyze the causes and remedies of steering and suspension systems.
- Analyze the causes and remedies of brake system.
- Demonstrate the procedure for wheel alignment and wheel balanced.

GECX117 FUNDAMENTALS OF DIGITAL IMAGE PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- Describe and explain basic principles of digital image processing
- Design and implement algorithms that perform basic image processing
- Design and implement algorithms for advanced image analysis
- Assess the performance of image processing algorithms and systems

PRE-REQUISITES:

- Basic knowledge of transforms in Mathematics

MODULE I DIGITAL IMAGE FUNDAMENTALS 8

Elements of Image Processing System, Fundamentals steps in Digital Image Processing, Image Sampling & Quantization, Spatial and Gray Level Resolution.

MODULE II COLOR IMAGE PROCESSING 8

Fundamental of color image processing, color models- RGB, CMY, HIS, Pseudo color image processing

MODULE III IMAGE ENHANCEMENT 7

Basic gray level Transformations, Histogram Processing, Spatial Filtering

MODULE IV IMAGE TRANSFORMS 7

2D-DFT, DCT, Haar Transform, Fundamentals of 2D-wavelet transform, sub-band coding

MODULE V IMAGE SEGMENTATION AND RESTORATION 8

Point, line and edge detection methods ,Image Segmentation and its types, Restoration: Noise model, Inverse filter and Wiener filter.

MODULE VI IMAGE COMPRESSION 7

Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Arithmetic coding, JPEG and MPEG Compression standards.

TOTAL HOURS 45

TEXT BOOKS

1. Gonzalez and Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2016.
2. Anil. K. Jain, "Fundamentals of Digital Image Processing"; 4th Edition, PHI, 2007

REFERENCES

1. Pratt William, "Digital Image Processing", John Wiley & Sons, 2007.
2. Arthur Weeks Jr., "Fundamentals of Digital Image Processing", PHI, 2006.

OUTCOMES:

On completion of the course, students will be able to

- Explain the fundamental concepts of digital image processing.
- Discuss about color image processing
- Recognize & apply various image enhancement techniques.
- Apply various transforms for image processing.
- Apply various techniques for image segmentation and restoration.
- Identify and use appropriate image compression techniques

Group II courses
(To be offered in VII Semester)

GECX201	GREEN DESIGN AND SUSTAINABILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge to face challenges, the technology poses for water, energy, and climate change by implementing sustainable design.

MODULE I CONCEPTS OF SUSTAINABLE DEVELOPMENT 7

Objectives of Sustainable Development - Need for sustainable development-Environment and development linkages - Globalisation and environment-Population, poverty and pollution- global, regional and local environment issues-Green house gases and climate change.

MODULE II SUSTAINABLE DEVELOPMENT OF SOCIO ECONOMIC SYSTEMS 8

Demographic dynamics of sustainability- Policies for socio economic development- Sustainable Development through trade- Economic growth-Action Plan for implementing sustainable development- Sustainable Energy and Agriculture.

MODULE III FRAME WORK FOR ACHIEVING SUSTAINBAILITY 7

Sustainability indicators- Hurdles to sustainability- Business and Industry – Science and Technology for Sustainable Development- Performance indicators of sustainability and assessment mechanism- Constraints and barriers of Sustainable Development.

MODULE IV GREEN BUILDINGS 8

Introduction to Green Building- Energy- Water- Materials and Resources - Sustainable Sites and Land Use - Indoor Environmental Quality- Life Cycle Assessment- Energy, water and materials efficiency.

MODULE V ENERGY CONSERVATION AND EFFICIENCY 7

Energy savings- Energy Audit- Requirements- Benefits of Energy conservation-Energy conservation measures for buildings- Energy wastage- impact to the environment.

MODULE VI GREEN BUILDINGS DESIGN 8

Elements of Green Buildings Design- Foundation, Electrical, Plumbing, flooring, Decking, roofing, insulation, wall coverings, windows, siding, doors and finishing, LEED certification for Green Buildings, Green Buildings for sustainability.

L – 45; Total Hours –45

TEXT BOOKS:

1. Kirby, J., Okeefe, P., and Timber lake, "Sustainable Development", Earthscan Publication, London, 1995.

REFERENCES:

1. Charles Kibert, J., "Sustainable Construction: Green Building Design and Delivery", 2nd Edition, John Wiley and sons, 2007.

OUTCOMES:

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

- Explain the relationship between sustainability and emergence of green building practices.
- Address the economic, environmental, and social concerns.

		L	T	P	C
GECX202	**APPROPRIATE TECHNOLOGY**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To impart students knowledge about the basics and applications of various appropriate technologies in the field of civil engineering.

MODULE I BASICS CONCEPTS 7

Back ground, Tools, Choices and Implications, Appropriate Technology Movement (an overview) - Basic design process, basic financial analysis-discounted cash flow, and energy fundamentals.

MODULE II APPROPRIATE TECHNOLOGY WITH REFERENCE TO BUILDING DESIGN 7

Appropriate Building Materials, Appropriate Energy Saving Techniques, Water Conservation (Indoor), Rain Water Harvesting.

MODULE III WATER, HEALTH AND SANITATION MANAGEMENT 7

Water Storage: Designing Dams and Pipelines, Appropriate Selection for Sanitation Technique, Sewerage, Communal Health and Waste Water Recycling.

MODULE IV WASTE MANAGEMENT 8

Types of Waste - Sources - Collections and On-Site Processing -Transferring Stations - Disposal Systems - Recycling.

MODULE V ENERGY EFFICIENT TECHNIQUES 8

Green building concepts-renewable energy sources- Solar – Steam and wind-Biofuels - Biogas – Electricity.

MODULE VI TECHNOLOGY POLICY 8

Government Policies- Energy Policy-Appropriate technology Development Centre-its function and responsibilities-Building policies-Case Studies.

L – 45; Total Hours –45

TEXT BOOKS:

1. Barrett Hazeltine and Christopher Bull, “Appropriate Technology: Tools Choices and Implications”, Academic Press, Orlando, USA, 1998.
2. Ken Darrow and Mike Saxenian, “Appropriate Technology Source Book : A Guide to Practical Books for Village and Small Community Technology”, Stanford, 1986.

REFERENCES:

1. Richard Heeks, “Technology and Developing Countries: Practical Applications Theoretical Issues”, 1995.
2. John Pickford, “The Worth of Water : Technical Briefs on Health, Water and Sanitation”, Intermediate Technology Publications, 1998.

OUTCOMES:

- At the end of the course, the students will be able to use suitable technologies for various conditions for sustainable development.

GECX203	ENGINEERING SYSTEM MODELLING AND SIMULATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the concepts, techniques, tools for modeling and simulation systems and environments through the use of computers.
- To study the various aspects of discrete dynamic, stochastic systems modeling and conducting experiments with those models on a computer.

MODULE I INTRODUCTION 6

Systems – Modelling – types – systems components – Steps in model building- Simulation Algorithms and Heuristics; Simulation Languages.

MODULE II RANDOM NUMBERS / VARIATES 7

Random numbers – methods of generation – random variates for standard distributions like uniform, exponential, Poisson, binomial, normal etc. – Testing of Random variates – Monte Carlo Simulation.

MODULE III MODELLING PROCESS 7

Primitive Models : Establishing relationships via physical laws; Establishing relationships via curve fitting; Parameters estimation problems; Elementary state transition models.

MODULE IV DESIGN OF SIMULATION EXPERIMENTS 9

Steps on Design of Simulation Experiments – Development of models using of Highlevel language for systems like Queuing, Inventory, Replacement, Production etc., – Model validation and verification, Output analysis.

MODULE V SIMULATION LANGUAGES 10

Need for simulation Languages – Comparisons & Selection of Languages – GPSSARENA- EXTEND – Study of any one of the languages.

MODULE VI CASE STUDIES USING SIMULATION LANGUAGES 6

L – 45; Total Hours –45

REFERENCES:

1. Law, A.M., & W.D. Kelton, "Simulation Modelling and Analysis", McGraw Hill, Singapore, 2000.
2. Harrel, C.R., et. al., "System Improvement Using Simulation", 3rd Edition, JMI Consulting Group and ProModel Corporation, 1995.
3. Harrel, C.R. & T. Kerim, "Simulation Made Easy, A Manager's Guide", IIE Press, 1995.
4. Geoffrey Gordon, "Systems Simulation", Prentice Hall, 2002.
5. David Kelton, Rondall P Sadowski, David T Sturrock, "Simulation with Arena", Mc Graw Hill, 2004.

OUTCOMES:

The student should be able to

- Model and simulate systems and environments through the use of computers.
- Conduct experiments with discrete dynamic, stochastic system models on a computer.

GECX204 VALUE ANALYSIS AND ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To get acquainted with value analysis and engineering tool for productivity improvement.
- To understand and analyze the theory and methodology of Value Engineering.

MODULE I VALUE ENGINEERING BASICS 8

Origin of Value Engineering, Meaning of value, Definition of Value Engineering and Value analysis, Difference between Value analysis and Value Engineering, Types of Value, function - Basic and Secondary functions, concept of cost and worth, creativity In Value Engineering.

MODULE II VALUE ENGINEERING JOB PLAN AND PROCESS 6

Seven phases of job plan, FAST Diagram as Value Engineering Tool, Behavioural and organizational aspects of Value Engineering, Ten principles of Value analysis, Benefits of Value Engineering.

MODULE III ORIENTATION AND INFORMATION PHASES 8

Launching Value Engineering project work - Objectives and Targets - VE Project work: a time-bound programme - Projects and Teams - Time Schedule - Co-ordination - Consultant. Technical data - Marketing related information - Competition profile - Cost data - Materials Management related information - Quality related information - Manufacturing data.

MODULE IV FUNCTION ANALYSIS AND CREATIVE PHASES 9

Objectives - Function definition - Classification of functions - Higher level functions – Function – Cost – Function – Worth - Value Gap - Value index - How to carry out Function Analysis? – Fast Diagraming - Cost Modelling.

Creativity - How to improve creativity of an individual? – How to promote creativity in the organisation? - Obstacles to Creativity - Mental road blocks - Creativity killer phrases. Positive thinking - Ideas stimulators - Creativity techniques - Brainstorming.

MODULE V EVALUATION, INVESTIGATION AND RECOMMENDATION 6

Paired comparison and Evaluation Matrix techniques - Criteria for selection of VE solutions. Design – Materials – Quality – Marketing – Manufacturing - Preview session. The report - presentation.

MODULE VI IMPLEMENTATION PHASE AND CASE STUDIES 8

Design department - Materials department - Production Planning & Control - Quality Control – Manufacturing – Marketing - Need for co-ordinated teams - The Action Plan. Value Engineering case studies.

L – 45; Total Hours –45

TEXT BOOKS:

1. Mudge, Arthur E. “Value Engineering- A systematic approach”, McGraw Hill, New York, 2000.
2. Kumar S, Singh R K and Jha J K (Ed), “Value Engineering”, Narosa Publishing House, 2005.

REFERENCES:

1. Park RJ, “Value Engineering: A Plan for Invention”, St.Lucie Press, New York, 1999.
2. Lawrence, D.M., “Techniques of Value Analysis and Engineering”, McGraw Hill 1988.
3. George, E.D., “Engineering Design: a Material and Processing Approach”, McGraw Hill, 1991.
4. Heller, D.E., “Value Management, Value Engineering and Cost Reduction”, Addison Wesley, 1988.

OUTCOMES:

- The student will be able to realize the value of products, processes and implement value analysis to achieve productivity improvement.

GECX205	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various safety measures to be taken in different industrial environments.

MODULE I SAFETY MANAGEMENT 7

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety. safety education and training.

MODULE II SAFETY IN MANUFACTURING 7

Safety in metal working-Machine guarding -Safety in welding and gas cutting - Safety in cold forming and hot working of metals -Safety in finishing, inspection and testing -Regulation.

MODULE III SAFETY IN CONSTRUCTION 8

General safety consideration in Excavation, foundation and utilities – Cordoning – Demolition – Dismantling –Clearing debris – Types of foundations – Open footings.

Safety in Erection and closing operation - Safety in typical civil structures – Dams-bridges-water Tanks-Retaining walls-Critical factors for failure-Regular Inspection and monitoring.

MODULE IV ELECTRICAL SAFETY 8

Electrical Hazards – Energy leakage – Clearance and insulation – Excess energy – Current surges – Electrical causes of fire and explosion – National electrical Safety code.

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance.

MODULE V SAFETY IN MATERIAL HANDLING 8

General safety consideration in material handling devices - Ropes, Chains,

Sling, Hoops, Clamps, Arresting gears – Prime movers.
Ergonomic consideration in material handling, design, installation, operation and maintenance of Conveying equipments, hoisting, traveling and slewing mechanisms.

Storage and Retrieval of common goods of shapes and sizes in a general store of a big industry.

MODULE VI SAFETY EDUCATION AND TRAINING 7

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

L – 45; Total Hours –45

REFERENCES:

1. Krishnan N.V, "Safety Management in Industry", Jaico Publishing House, Bombay, 1997.
2. Blake R.B., "Industrial Safety", Prentice Hall, Inc., New Jersey, 1973.
3. Fulman J.B., "Construction Safety, Security, and Loss Prevention", John Wiley and Sons, 1979.
4. Fordham Cooper W., "Electrical Safety Engineering", Butterworths, London, 1986.
5. Alexandrov M.P., "Material Handling Equipment", Mir Publishers, Moscow, 1981.

OUTCOMES:

Students would be able to

- Acquire knowledge on various safety Hazards.
- Carry out safety measures for different industrial environments.

GECX206 ADVANCED OPTIMIZATION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the various advanced optimization tools.
- To provide an understanding to deal with ill identified and fuzzy problems.

MODULE I INTRODUCTION 7

Review of conventional optimization techniques - limitations - limitation of exhaustive search - need for artificial intelligence - bio mimicking methods

MODULE II HEURISTICS METHODS 8

Introduction – Advanced methods of algorithm design: Greedy method, Backtracking method, Divide and Conquer method – Dynamic programming – Heuristics exploration algorithms – Greedy search - Local search – Hill climbing – Tabu search – Gradient search – Beam search – Simulated Annealing.

MODULE III GENETIC ALGORITHM 7

Introduction - Basics of GA – Population – Reproduction – Cross over – Mutation -genetic algorithms in search, optimization and machine learning-practical genetic algorithms.

MODULE IV ANT COLONY OPTIMIZATION 8

Introduction: Ant Colony Optimization – Meta-heuristic Optimization – History – The ACO Meta-heuristic – ACO Algorithms: Main ACO – Ant system – Ant colony system – Max-Min Ant system – Applications: Routing in telecommunication networks – Travelling salesmen – Graph Coloring – Advantages & Disadvantages

MODULE V FUZZY LOGIC AND ANN 8

Fuzzy logic, knowledge representation and inference mechanism – Fuzzy and expert control – standard Takagi-Sugeno mathematical characterizations – Design example – Biological foundations to intelligent systems: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks.

MODULE VI IMPLEMENTATIONS & APPLICATIONS 7

Reduction of size of an optimization problem – multilevel optimization – parallel processing – multi objective optimization – Job shop scheduling – Vehicle scheduling – Line balancing – Sensor integration.

L – 45; Total Hours –45

REFERENCES:

1. Singiresu S. Rao, “Engineering optimization – Theory and practices”, John Wiley and Sons, 1996.
2. Ravindran – Phillips –Solberg, “Operations Research – Principles and Practice, John Wiley and Sons, 1987.
3. Fredrick S.Hillier and G.J.Liberman, “Introduction to Operations Research”, McGraw Hill Inc. 1995.
4. Kalymanoy Deb, “Optimization for Engineering Design”, PHI, 2003
5. Christos H. Papadimitriou, Kenneth Steiglitz, Combinatorial Optimization, PHI 2006

OUTCOMES:

At the end of the course student will be able to

1. Formulate a real life situation as an optimization the problem.
2. Identify the appropriate solution methodology and provide a solution

GECX207 **MATLAB SIMULINK** **L T P C**

3 0 0 3

OBJECTIVES:

- Teach students how to mathematically model engineering systems
- Teach students how to use computer tools to solve the resulting mathematical models. The computer tool used is MATLAB and the focus will be on developing and solving models of problems encountered in engineering fields

MODULE I INTRODUCTION MATLAB DATA PRESENTATION

Vectors, Matrices -Vector/Matrix Operations & Manipulation- Functions vs scripts- Making clear and compelling plots-Solving systems of linear equations numerically and symbolically- Least squares regression -Curve fitting.

MODULE II MATLAB PLOT FUNCTION

Introduction- Plot Function – Animation- 3D Plots-Customizing Plots – Plot Applications- Saving &Painting Plots.

MODULE III ROOT FINDING AND COMPUTER REPRESENTATION OF NUMBERS

Linearization and solving non-linear systems of equations- The Newton-Rapson method- Integers and rational numbers in different bases- Floating point numbers- Round off and errors in basic arithmetic-Significant digits when reporting results

MODULE IV ORDINARY DIFFERENTIAL EQUATIONS

Numerical integration and solving 1st order, ordinary differential equations (Euler's method and Runge-Kutta)- Use of ODE function in MATLAB

MODULE V NON-LINEAR DIFFERENTIAL EQUATIONS

Converting 2nd order and higher ODEs to systems of 1st order ODEs- Solving systems of ODEs via Euler's method and Runge-Kutta)- Solving single and systems of non-linear differential equations by linearization-Use of the function

ODE in MATLAB to solve differential equations

MODULE VI INTRODUCTION OF SIMULINK

Simulink & its relations to MATLAB – Modeling a Electrical Circuit- Modeling a fourth order differential equations- Modeling the solution of three equations with three unknowns- Representing a model as a subsystem-Simulink demos.

L – 45; Total Hours –45

REFERENCES:

1. Griffiths D V and Smith I M, Numerical Methods for Engineers, Blackwell, 1991.
2. Laurene Fausett, Applied Numerical Analysis Using MATLAB, Pearson 2008.
3. Moin P, Fundamentals of Engineering Numerical Analysis, Cambridge University Press, 2001.
4. Wilson HB, Turcotte LH, Advanced mathematics and mechanics applications using MATLAB. CRC Press, 1997
5. Ke Chen, Peter Giblin and Alan Irving , Mathematical Exploration with MATLAB, Cambridge University Press, 1999.

OUTCOMES:

At the end of this unit students will be able to:

1. Use Matlab as a convenient tool for solving a broad range of practical problems in engineering from simple models to real examples.
2. Write programs using first principles without automatic use of built-in ones.
3. Write programs for solving linear and nonlinear systems, including those arising from boundary value problems and integral equations, and for root-finding and interpolation, including piecewise approximations.
4. Be fluent in exploring Matlab's capabilities, such as using matrices as the fundamental data-storage unit, array manipulation, control flow, script and function m-files, function handles, graphical output.
5. Make use of Maltab visual capabilities for all engineering applications.
6. An ability to identify, formulate, and solve engineering problems. This will be accomplished by using MATLAB to simulate the solution to various

problems in engineering fields

GECX208	EMBEDDED SYSTEMS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide a detailed overview of embedded system.
- To equip students with the software development skills necessary for practitioners in the embedded systems field.
- To understand entire software development lifecycle and examine the various issues involved in developing software for embedded systems.

MODULE I EMBEDDED SYSTEMS OVERVIEW 8

Introduction –Embedded Systems vs. General computing systems- Fundamental Components of embedded systems- Characteristics- Challenges-Examples- Embedded System design process.

MODULE II EMBEDDED COMPUTING PLATFORM 8

Overview of Processors and hardware units in an embedded system-CPU buses – Memory devices –Memory types- I/O devices – Designing with computing platforms- Consumer electronics architecture-Design example: Alarm clock.

MODULE III REAL TIME EMBEDDED SYSTEMS 8

Programming embedded systems in assembly and C – Real time systems – Hard and Soft real time systems- Need for RTOS in Embedded Systems- Multiple tasks and processes –Context switching-Scheduling policies- Interprocess communication and synchronization.

MODULE IV EMBEDDED SOFTWARE DEVELOPMENT PROCESS and TOOLS 8

Development process of an embedded system-software modules and tools for implementation of an embedded system- Integrated development environment- Host and target machines-cross compiler-cross assembler-Choosing right platform.

MODULE V PROGRAM MODELING IN EMBEDDED SYSTEMS 8

Program Models – Data Flow Graph model-control DFG model-Synchronous DFG model- Finite state machines- UML modeling – UML Diagrams.

MODULE VI EMBEDDED SYSTEMS APPLICATION 5

Application specific embedded system – case study: digital camera hardware and software architecture, embedded systems in automobile, embedded system for a smart card.

Total Hours –45

TEXT BOOKS:

1. Marilyn Wolf , "Computers as components", Elsevier 2012.
2. Shibu. K.V, "Introduction to Embedded Systems", Tata Mcgraw Hill,2009.
3. Rajkamal, "Embedded Systems Architecture, Programming and Design",1st Reprint,Tata McGraw-Hill, 2003
4. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons, 2002.

REFERENCES:

1. Sriram V Iyer and PankajGupta ,"Embedded Realtime Systems Programming "Tata McGraw-Hill,2008
2. Qing Li and Carolyn Yao," Real-Time Concepts for Embedded Systems", CMPBooks, 2003
3. David E.Simon, "An Embedded Software Primer", Pearson Education, 2003

OUTCOMES:

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

- Identify the suitable processor and peripherals in embedded applications
- Develop embedded programs in assembly and c
- Choose the right platform for designing an embedded system
- Explore different scheduling mechanism in rtos
- Design the program model for embedded applications.

- Analyze different domain specific applications in embedded systems.

GECX209 USABILITY ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

The objective of this course is

- To understand the emerging concept of usability, requirements gathering and analysis.
- To learn about human computer interaction with the help of interfaces that has high usability.

MODULE I INTRODUCTION 6

Cost Savings – Usability Now – Usability Slogans – Discount Usability Engineering – Usability – Definition – Example – Trade-offs – Categories – Interaction Design – Understanding & Conceptualizing Interaction – Cognitive Aspects.

MODULE II USER INTERFACES 8

Generation of User Interfaces – Batch Systems, Line Oriented Interfaces, Full Screen Interfaces, Graphical User Interfaces, Next Generation Interfaces, Long Term Trends – Usability Engineering Life Cycle – Interfaces – Data Gathering – Data Analysis Interpretation and Presentation.

MODULE III INTERACTION DESIGN 8

Process of Interaction Design - Establishing Requirements – Design,Prototyping and Construction - Evaluation and Framework.

MODULE IV USABILITY TESTING 8

Usability Heuristics – Simple and Natural Dialogue, Users' Language, Memory Load, Consistency, Feedback, Clearly Marked Exits, Shortcuts, Error Messages, Prevent Errors, Documentation, Heuristic Evaluation – Usability Testing - Test Goals and Test Plans, Getting Test Users, Choosing Experimenters, Ethical Aspects, Test Tasks, Stages of a Test, Performance Measurement, Thinking Aloud, Usability Laboratories.

MODULE V USABILITY ASSESSMENT METHODS 8

Observation, Questionnaires and Interviews, Focus Groups, Logging Actual Use, User Feedback, Usability Methods – Interface Standards - National, International and Vendor Standards, Producing Usable In-House Standards.

MODULE VI USER INTERFACES 7

International Graphical Interfaces, International Usability Engineering, Guidelines for Internationalization, Resource Separation, Multilocale Interfaces – Future Developments – Case Study.

L – 45; Total Hours –45

TEXT BOOKS:

1. Yvonne Rogers, Helen Sharp, Jenny Preece, "Interaction Design: Beyond Human - Computer Interaction", John Wiley & Sons, 3rd Edition, 2011 (Module I, II, III).
2. Jakob Nielsen, "Usability Engineering", Morgan Kaufmann Academic Press, 1994. (Module I – VI).

REFERENCES:

1. Ben Shneiderman, Plaisant, Cohen, Jacobs, "Designing the User Interface: Strategies for Effective Human Interaction", Pearson Education, 5th Edition, 2010.
2. Laura M. Leventhal, Julie A. Barnes, "Usability Engineering: Process, Products, and Examples", Pearson/Prentice Hall, 2008

OUTCOMES:

Students who complete this course will be able to

- build effective, flexible and robust user interfaces.
- translate system requirements into appropriate human/computer interaction sequences.
- choose mode, media and device for the application requirements.

GECX210 SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the various decision phases in a supply chain
- To be aware of the Supply Chain and its drivers
- To design Supply Chain Network
- To build a aggregate plan in supply chain
- To understand Sourcing Decisions in Supply Chain
- To comprehend the influence of Information technology in Supply Chain

MODULE I INTRODUCTION TO SUPPLY CHAIN 7

Understanding Supply Chain - Decision phases - Supply chain performance - Competitive and supply chain strategies - Achieving strategic fit - Expanding strategic scope

MODULE II SUPPLY CHAIN DRIVERS AND DESIGN 7

Drivers of supply chain performance – Designing distribution network - Network Design in the Supply Chain - Network design in Uncertain Environment

MODULE III AGGREGATE PLANNING AND MANAGING SUPPLY, DEMAND AND INVENTORY 8

Aggregate Planning in a Supply chain: role - Managing Supply - Managing Demand in Supply Chain – Cycle and Safety inventory in supply chain – Level of product availability.

MODULE IV MANAGING INVENTORY IN SUPPLY CHAIN 8

Managing Economies of Scale in a Supply Chain : Cycle Inventory- Managing uncertainty in a Supply Chain Safety Inventory- Determining optimal level of Product Availability

MODULE V SOURCING AND TRANSPORTATION 8

Sourcing decision in supply chain - Third and Fourth – Party Logistics providers - Supplier scoring and assessment - Transportation in a Supply Chain – Risk and Trade-offs in transportation design.

MODULE VI INFORMATION TECHNOLOGY IN A SUPPLY CHAIN 7

Information technology in a supply chain – CRM, ISCM, SRM in supply chain - Over view of recent trends in Supply Chain: e-SRM, e-LRM, e-SCM.

L – 45; Total Hours –45

REFERENCES:

1. Sunil Chopra and Peter Meindl, "Supply Chain Management-Strategy Planning and Operation", Pearson Education, 5th Indian Reprint, 2013.
2. Jananth Shah "Supply Chain Management – Text and Cases" Pearson Education, 2008.
3. Altekar Rahul V, "Supply Chain Management-Concept and Cases", Prentice Hall India, 2005.
4. Monczka et al., "Purchasing and Supply Chain Management", Thomson Learning, 2nd Edition, 2nd Reprint, 2002.

OUTCOMES:

- After taking up the course the student will be able to brighten his prospects of taking up a career on supply chain management.
- The student decision making capability specific to supply chain issues in an industry is improved.
- The student can plan a well defined execution of supply chain strategy in companies.
- The student will be able to design a optimal distribution network as per the demands of the industry.
- The student can also determine the most favorable transportation plan for a company.
- The student will also be able to bring in company from paper environment to paperless environment.

GECX211	**SYSTEMS ANALYSIS AND DESIGN**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To describe the phases of the systems development life cycle
- To teach the automated tools for system development
- To develop and evaluate system requirements.
- To explain the organizational issues in system implementation
- To teach the usability testing and electronic data interchange
- To elucidate the importance of System analysis and design in electronic commerce.

MODULE I FUNDAMENTALS OF SYSTEM DEVELOPMENT 8

System Concept – Characteristics – Elements of System – Types of System – Modern Approach to System Analysis and Design – System Development Life Cycle – Approaches to Improving Development – Tools for System Development – Succeeding as a System Analyst – Skills – Managing the Project.

MODULE II AUTOMATED TOOLS FOR SYSTEMS DEVELOPMENT 7

What is requirements determination? Fact finding techniques, Tools for documenting procedure and decision-CASE Tools-Need for CASE tools-Reverse engineering and reengineering- phases of the software life cycle-Ranking projects-Value Chain Analysis- Corporate Strategic Planning vs. Information Systems Planning.

MODULE III SYSTEM ANALYSIS 8

Determining System Requirements – Traditional Methods - Modern Methods – Radical Methods – Structuring System Requirements – Process Modeling – Data Flow Diagramming – Logic Modeling – Conceptual Data Modeling – E-R Modeling.

MODULE IV SYSTEM DESIGN 8

System Implementation – Software Application Testing – Installation – Documentation – Training and Support – Organizational Issues in Systems Implementation – Maintaining Information System – Conducting System Maintenance.

MODULE V USABILITY AND MEASURING USER SATISFACTION 7

Usability Testing-User satisfaction test- A tool for analyzing user satisfaction – Unified Modeling Language(UML)- Case study: System Design: Application in Human Resource-Financial Applications

MODULE VI SAD IN E-COMMERCE 7

Systems analysis and design in the era of electronic commerce: B2B, B2C and C2C e-commerce -advantages and disadvantages of e-commerce. E-commerce system architecture – physical networks, logical network, World Wide Web, web-services - HTML, XML - case studies-EI electronic data interchange: EDI standards - virtual private networks - XML and EDI

L – 45; Total Hours –45

REFERENCES:

1. Jeffrey A. Hoffer, Joey F. George, Joseph S. Valacich, “Modern Systems Analysis and Design”,Fifth Edition, Prentice Hall,March 2007.

2.Ned Kock, “Systems Analysis & Design Fundamentals” Sage South Asia, May 2008.

3. Joseph S. Valacich, Jeffrey A. Hoffer, Joey F. George, “Essentials Of System Analysis And Design” Prentice Hall , August 2005.

4. Rumbaugh et al, “Succeeding with Booch and Rambaugh Methods”, Addisson Wesley, second Edition, 1998.

5.Larman, C.,” Applying UML and Patterns. An introduction to Object-Oriented Analysis and Design”. Prentice-Hall PTR, 2002.

OUTCOMES:

- List the characteristics of the system and specify the approaches in the development of the system.
- Summarize the phases of the software life cycle
- Differentiate Corporate Strategic Planning and Information Systems Planning.

- Illustrate the system requirements through various modeling diagrams.
- Use tools and techniques for process and data modeling.
- Solve realistic systems analysis problems and perform user satisfaction test.

GECX212	ADVANCED MATERIALS	L	T	P	C
		3	1	0	4

OBJECTIVES:

To make the student conversant with

- Dielectric materials
- Magnetic materials
- Energy materials
- Nano materials
- Semi conductors
- Smart materials

MODULE I

Dielectric Materials- Polarization and Mechanism-Internal or local field-Clausius-Mossotti relation- Dielectric loss- Temperature and Frequency effect-Measurement of Dielectric constant and loss using Scherring bridge- electric break down- ferro, piezo, pyroelectric materials and its application.

MODULE II

Magnetic Materials- Terminology and classification of magnetic materials (Dia, Para, Ferro & Ferri) – Magnetic moments due to electrospin – Domain theory of Hysteresis – Heisenberg theory of Exchange Interaction (without derivation)-Structure and properties of Ferrites- Properties of Soft and Hard Magnetic Materials- Application: floppy disk, CD ROM, Magneto optical recording.

MODULE III

Energy Materials (Nuclear) - Introduction to nuclear materials- Materials for nuclear fuel in fission and fusion reactors, Fissile and fertile materials- Control & Construction Materials for Nuclear reactors, Moderators, Heat Exchangers-Radiation proof materials- Brief discussion of safety and radioactive waste disposal.

MODULE IV

Nano Materials- The nanosize range- classification of nanomaterials-processing of nanomaterials-properties of nanomaterials- mechanical, electrical, magnetic properties- other properties- carbon based nanomaterials- other nanomaterials and its application.

MODULE V

Semiconductors- The energy gap in solids-Extrinsic Semiconductors- Intrinsic Semiconductors- Hall Effect in semiconductors- Application of Hall Effect- Basic ideas of compound semiconductors -Semiconductor materials- Fabrication of Integrated Circuits- Some semiconductor Devices

MODULE VI

Smart materials- aerospace materials Ni and Co based super alloys, Special steels, Titanium alloys, Intermetallics, ceramics and their composites, New High strength material, Properties of Materials, Materials in Medical Applications, Stainless steel alloys,Cobalt based alloys, titanium based alloys, polymers

L – 45; Total Hours –45

REFERENCES:

1. Materials science and Engineering: A first course by V. RAGHAVAN, 6th ed., Eastern Economy edition,Prentice Hall of India,2015
2. Materials science and Engineering: An Introduction by William D. Callister Jr., 7th ed. John Wiley & Sons Inc. 2007
3. Material science by Dr.M.Arumugam, Anurasha agencies ,third revised edition ,2002

OUTCOMES:

Students will be able to know

- significance of dielectric materials
- types and applications of magnetic materials
- applications of nuclear materials for energy harvesting
- applications of nano materials
- significance of semi conductor devices
- applications of smart materials

GECX213	NATIONAL SERVICE SCHEME	L	T	P	C
		2	0	0	2

OBJECTIVES:

Primary Objective: Personality development through community service.

To achieve the above objective, the following should be adhered:

1. To provide an understanding about the aims, structure and programmes and activities of National Service scheme in terms of Nation Building
2. To develop certain basic skills for personality development through community development.
3. Understand the community in which they work and their relation
4. Identify the needs and problems of the community and involve them in problem-solving and
5. Practice national integration and social harmony.

MODULE I INTRODUCTION TO NSS 8

Orientation and structure of NSS,-Aims and Objectives of National Service Scheme-The history of NSS- Symbol and meaning- NSS hierarchy from national to college level – Role and responsibilities of various NSS functionaries

MODULE II PERSONALITY AND COMMUNITY DEVELOPMENT SKILLS 8

Importance of youth Leadership, Traits of Good Leadership and Personality Development. Role of youth in creating awareness through NSS Programmes on Health & Hygiene; Environmental Conservation and Enrichment for Sustainable Development; Sanitation and Swachh Bharat.

MODULE III UNDERSTANDING YOUTH 7

Definition and Profiles of youth categories, Youth Issues, Challenges and

Opportunities for Youth, Youth as agent of social change & Community Mobilization .Role of Youth in Nation Building. National Youth Policy.

MODULE IV SOCIAL HARMONY AND NATIONAL INTEGRATION 7

National Integration, Various obstacles in the way of National Integration; such as caste, religion, language and provisional problems etc. Role of youth in Peace building and conflict resolution- Globalization and its Economic Social Political and Cultural impacts.

L – 30; Total Hours –30

TEXT BOOKS:

1. National Service Scheme – A Youth Volunteers Programme for Under Graduate students as per UGC guidelines J.D.S.Panwar et al. Astral International. New Delhi.
2. National Service Scheme Revised Manual, 2006.Govt. of India. Ministry of Youth Affairs & Sports. New Delhi.
3. Social Problems in India, *Ram Ahuja.*

REFERENCES:

1. National Youth Policy-2014. Ministry of Youth Affairs & Sports. .Govt. of India

OUTCOMES:

On successful completion of this course-

- Students will have exposure to the the aims, structure and programmes and activities of National Service scheme in terms of Nation Building
- Students will be trained to skills for personality development through community development.
- Students will gain knowledge about national integration and social harmony.
- Students will be exposed to the role of youths in Nation building Students will gain

GECX214	AUTOMOTIVE POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To have a fair knowledge in automotive pollution control.
- To understand the concept of formation and control techniques of pollutants like UBHC, CO, NOx, particulate matter and smoke for both SI and CI engine will be taught to the students.
- To know about the instruments for measurement of pollutants
- To get introduced about emission standards

MODULE I EMISSION FROM AUTOMOBILES 8

Sources of Air Pollution. Various emissions from Automobiles — Formation — Effects of ollutants on environment and human beings. Emission control techniques – Modification of fuel, after treatment devices. Emission standards. Automotive waste management, old vehicle disposal, recycling, tyre recycling

MODULE II SI ENGINE EMISSIONS AND CONTROL 9

Emission formation in SI Engines- Carbon monoxide & Carbon di oxide - Unburned hydrocarbon, NOx, Smoke —Effects of design and operating variables on emission formation – controlling of pollutants - Catalytic converters, Charcoal Canister, Positive Crank case ventilation system, Secondary air injection, thermal reactor

MODULE III CI ENGINE EMISSION AND CONTROL 8

Formation of White, Blue, and Black Smokes, NOx, soot, Effect of Operating variables on Emission formation — Fumigation, Split injection, Catalytic Coating, EGR, Particulate Traps, SCR, Fuel additives — Cetane number Effect.

MODULE IV NOISE POLLUTION FROM AUTOMOBILES 8

Sources of Noise — Engine Noise, Transmission Noise, vehicle structural Noise, aerodynamics noise, Exhaust Noise. Noise reduction in Automobiles — Encapsulation technique for noise reduction —Silencer Design.

MODULE V TEST PROCEDURES 6

Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures — Chassis dynamometers - Seven mode and thirteen mode cycles for Emission Sampling.

MODULE VI EMISSION MEASUREMENTS 6

Emission analysers —NDIR, FID, Chemiluminesecent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

L – 45; Total Hours –45

TEXT BOOKS:

1. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2005.
2. Crouse and Anglin, 'Automotive Emission Control', McGraw Hill company., Newyork 1993.

REFERENCES:

1. G.P.Springer ad D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York. 1986.
2. D.J.Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', Anna Arbor Science Publication,1985.
3. L.Lberanek, 'Noise Reduction', Mcgrawhill Company., Newyork1993.
4. C.Duerson, 'Noise Abatment', Butterworths ltd., London1990.
5. A.Alexander, J.P.Barde, C.lomure and F.J. Langdan, 'Road traffic noise', Applied science publisher ltd., London,1987.

OUTCOMES:

On completion of the course student should be able to

- Identify the sources of emission from vehicles.
- Analyse the causes and effects of emissions.

- Analyse causes and effects of noise pollution
- Bring out solutions for control of emissions.
- Demonstrate the test procedures and emission norms.
- Select suitable instruments for measurement of emissions.

GECX215	MOTOR VEHICLE ACT, INSURANCE & POLICY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about basic act and regulation followed for road vehicle
- To learn about systematic steps involved to get licence and registration of motor vehicle
- To learn arbour various types of motor vehicle polices and insurances

MODULE I BASIC RULES FOR ROAD VEHICLE 8

Display and Use of Number Plates- Attachment of number plates- Number plates in horizontal position- Removal of number plates on transfer- Hours prescribed for lighted lamps- Mounting of lamps and reflectors- Multiple beam headlamps- Daytime running lamps- Auxiliary driving lamps- Parking lamps- Brakes- Stopping distances- Emergency or parking brakes- Horn- Muffler- Mirrors- Inspection of motor vehicles- Standards of safety and repair

MODULE II LICENSING OF DRIVERS OF MOTOR VEHICLES 8

Necessity of driving licence- Age limit in connection with driving of motor vehicle-Responsibility of owners of motor vehicles-Restriction on the holding of driving licence-Grant of learner's licence-Grant of driving licence-Addition to driving licence- Renewal of driving licence-Revocation of driving licence on grounds of disease or disability-Driving licence to drive motor vehicle belonging to the central government- power of court to disqualify- suspension of driving licence in certain cases- suspension or cancellation of driving licence on convection- Endorsement.

MODULE III REGISTRATION OF MOTOR VEHICLE 7

Necessity for registration – Registration Where and how to be made- Special provision for registration of motor vehicle of diplomatic officers-Temporary registration- Production of vehicle at the time of registration- Refusal of registration- renewal of certificate of registration- effectiveness in India of registration- Change of residence or place of business-transfer of ownership-Suspension of registration – cancellation of registration suspended under section 53- certificate of fitness of transport vehicle-cancellation of registration.

MODULE IV INSURANCE OF MOTOR VEHICLE 8

Necessity for insurance against third party – Requirements of policies and limits of liability- - Duty of insurers to satisfy judgements and awards against person insured in respect of third party risks-Duty to give information as to insurance-Settlement between insurers and insured persons- transfer of certificate of insurance-production of certain certificates, licences and permit in certain cases-Special provisions as to compensation in case of hit and run motor accident – Types of motor polices

MODULE V CONTROL OF TRANSPORT VEHICLES 7

Power to State Government to control road transport- Transport authorities-General provision as to applications for permits- Application for stage carriage permit- Procedure of Regional Transport Authority in considering application for stage carriage permit- Scheme for renting of motor cabs- Application for private service vehicle permit- Procedure in applying for and granting permits- Duration and renewal of permits- Transfer of permit- Replacement of vehicles-Temporary permits

MODULE VI OFFENCES AND PUNISHMENT 7

Driving without holding an effective driving licence- Driving by an under-aged person (Minor driving vehicle)- Holding of a driving licence permitting it to be used by other person.- Driving a vehicle at an excessive speed- Driving or permitting to drive a vehicle carrying excess load- Driving dangerously / its Abetment Driving an uninsured vehicle

Rider and pillion rider failing to wear protective head gear (Helmet) -Violation of Mandatory Signs -.e-challan and spot challan

L – 45; Total Hours –45

TEXT BOOKS:

1. The motor vehicle act 1988, Universal law publishing co.pvt ltd. Newdelhi 2011
2. A Commentary On The Motor Vehicles Act, 1988 by SUKHDEV AGGARWAL The Bright Law House, New Delhi

REFERENCES:

1. The Motor Vehicles Act, 1988 Along with Latest Case Law, Notifications & Table of Offences and Punishments Asia Law House; 15th edition (2014)
2. Assessment of Compensation in Accidents under Motor Vehicles Act by Karkara Delhi Law House (2013)

OUTCOMES:

On completion of the course students should be able to

- Explain the analysis of rules and regulations for road vehicles
- Analyze the procedure for getting driving license for vehicles at national and international level
- Analyze the procedure for registration of vehicles.
- Analyze the procedure for Insurance of vehicles and claims.
- Analyze the procedure for obtaining Government Permits and renewal
- Analyze the consequences of not following the rules and regulations

GECX216	**PRINCIPLES OF COMMUNICATION SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

To introduce the analog and digital modulation techniques.
To elaborate the working of communication receivers in the presence of noise.
To give an overview of various communication systems.

MODULE I LINEAR MODULATION 8

Baseband signals, Amplitude Modulation – Modulation Index, Power Transmitted, Double Side Band and Single Side Band AM, AM Modulators and AM Receivers, AM Radio systems, Frequency Division Multiplexing.

MODULE II ANGLE MODULATION 8

Frequency Modulation and Phase Modulation, Frequency deviation and modulation index, Bandwidth of FM, FM Modulators and FM receivers, FM Radio and FM Stereo Systems

MODULE III SAMPLING AND PULSE MODULATION 7

Sampling, Nyquist's Sampling Theorem, Pulse Modulations - PAM, PPM and PWM, Time Division Multiplexing, Bandwidth of TDM systems.

MODULE IV DIGITAL COMMUNICATION 7

Digital baseband data, Digital Modulations – ASK, FSK, PSK and QPSK. Digital Communication Transmitters and Receivers.

MODULE V NOISE 8

Sources of Noise, Thermal Noise, shot noise, White noise, Narrow band Noise, Effect of noise in communication, SNR, Receiver Noise Temperature and Noise Equivalent

Bandwidth.

MODULE VI COMMUNICATION SYSTEMS & NETWORK 7

FM Radio Systems, Cellular Mobile network, Satellite Communications, Optical Fiber Communication.

L – 45; T – 0; Total Hours – 45

TEXT BOOKS:

1. A. Bruce Carlson, Paul B. Crilly, “Communication Systems”, 5th Edition, McGraw Hill Int., 2011.
2. B.P. Lathi, Zhi Ding, Hari M. Gupta, “Modern Digital and Analog Communication Systems”, 4th Edition, Oxford University Press, 2017.

REFERENCES:

1. Herbert Taub, Donald L. Schilling, Goutam Saha, “Principles of Communication Systems” 4th Edition, McGraw Hill Int. 2013.
2. Simon Haykin, “An Introduction To Analog And Digital Communications”, 1st Edition, Wiley India, 2010.
3. Simon Haykin , “Communications Systems” 4th Edition, Wiley India, 2006.
4. Hwei P. Hsu, “Analog and Digital Communications” 3rd Edition,

OUTCOMES:

On completion of the course students will be able to

1. Identify various communication systems and the corresponding modulation schemes.
2. Predict the characteristics of various analog and digital modulation schemes.
3. Interpret the effect of noise and bandwidth in a communication systems
4. Apply the Nyquist criteria for a given baseband signals.
5. Evaluate the performance of communication receivers.
6. Demonstrate the applications of common communication systems.

GECX217	LEAN MANAGEMENT	L	T	P	C
		3	1	0	4

OBJECTIVES:

The objective of the Course to make the student know about

- the basics of lean production management,
- how Lean principles are applied to the Construction industry to improve the operation management and product development.

MODULE I **8**

lean production? – Introduction, background, and lean thinking. Importance of philosophy, strategy, culture, alignment, focus and systems view. Discussion of Toyota Production System.

MODULE II

Manufacturing systems – an overview of manufacturing strategies. Job shops, batch flow, and flexible manufacturing systems Flow production and lean production systems

MODULE III

Value stream mapping in process design and product development Waste reduction - lead time reduction

Process cycle time and value-added vs. non-value added activities Optimum lot sizing

MODULE IV

Lean production processes, approaches and techniques.—Importance of focusing upon flow. Tools -. Workplace organization – 5S. - Stability. - Just-In-Time – One piece flow – Pull. - . Cellular systems. - . Quick change and set-up reduction methods. f. Total productive maintenance. -. Poka-Yoke – mistake proofing, quality improvement. Standards. - . Leveling. - . Visual management. Just-in-time techniques – SMED and Takt Times - Standard work processes and line balancing

Poka-yoke and pull systems material handling reduction and facilities planning

MODULE V

Managing change in the lean organization Human resource management and the lean enterprise Employee involvement – Teams – Training – Supporting and encouraging involvement – Involving people in the change process -- communication -- Importance of culture. Startup of lean processes and examples of applications. Sustaining improvement and change, auditing, follow-up actions.

MODULE VI

The lean enterprise and supply chain management Costs and risks of lean initiatives - Measuring lean initiatives

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. The Toyota Way Fieldbook, Jeffrey Liker and David Meier, McGraw-Hill, 2006. Lean Production Simplified, Pascal Dennis, Productivity Press, 2007.
2. Womack, James P., and Daniel T. Jones. Lean Thinking. New York, NY: Simon and Schuster, 2003. ISBN: 0743249275.
3. Murman, Earll. Lean Enterprise Value. New York, NY: Palgrave Macmillan, 2002. ISBN: 0333976975.

REFERENCES:

1. Readings at http://www.leanconstruction.org/readings.htm
2. Hopp, W. J., and Spearman, M. L. (2011). Factory Physics, Third Edition, Waveland Press, Long Grove, Il. 720 pp.

OUTCOMES:

The student will be able to

- Describe the manufacturing approaches employed and the background and philosophy of lean production.
- Illustrate the concept of waste reduction
- Apply evaluation techniques that can be used in preparation for and use in learn production activities.
- Select the tools that can be used implementing lean production in

production operations.

- Discuss the importance of workplace organization, pull production, cellular arrangement and employee involvement, need for employee creativity
- Describe about the Methods for promoting success in implementing lean transformations

GECX218 GEOSPATIAL MODELING & ANALYSIS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To equip the students with fundamental representation and analysis of geospatial phenomena and provides foundations in methods and algorithms used in GIS analysis.
- To focus is on terrain modeling, geomorphometry, watershed analysis and introductory GIS-based modeling of landscape processes (water, sediment). The course includes analysis from lidar data, coastal change assessment and 3D visualization.

MODULE I INTRODUCTION TO GEOSPATIAL DATA 7

Mapping natural phenomena –Concept of continuous fields and discrete sampling – Units, projections, coordinate transformation – Georeferencing, geospatial formats, conversions, geospatial data abstraction library – Raster and vector representation, raster and vector conversions and resampling.

MODULE II DATA DISPLAY AND VISUALIZATION 7

Display of continuous and discrete data, use of color, shading, symbols, to extract the spatial pattern and relationships – 3D visualization: multiple surfaces and volumes, 3D vector objects – visualization for data analysis (lighting, scaling, transparency, cutting planes, animations) – view/create maps/post your data on-line (Google Earth/Maps, GPS visualizer)

MODULE III GEOSPATIAL ANALYSIS 7

Foundations for analysis of continuous and discrete phenomena – neighborhood operations and buffers – analysis and modeling with map algebra – cost surfaces and least cost path – spatial interpolation and approximation (gridding)

MODULE IV TERRAIN MODELING AND ANALYSIS 9

terrain and bathymetry mapping – mathematical and digital representations (point clouds, contour, raster, TIN) – DEM and DSM, working with multiple return lidar data – spatial interpolation of elevation data and topographic analysis, line of sight, view shed analysis – solar irradiation, photovoltaic energy potential, time series of elevation data, analysis of coastal change.

MODULE V FLOW TRACING, WATERSHED ANALYSIS AND LANDFORMS 8

Methods for flow routing and flow accumulation – Extraction of stream networks – Extraction of watershed boundaries and building watershed hierarchies – feature extraction, types of landforms.

MODULE VI MODELING OF GEOSPATIAL PROCESSES 7

Model formulation, input data processing – introduction to GIS-based hydrologic, erosion and environmental modeling – Geocomputational methods, including agent-based modeling, artificial neural networks and evolutionary computing.

L – 45; T – 0; Total Hours –45

TEXT BOOKS:

7. Hassan A, Karimi (2017), *Geospatial Data Science Techniques and Applications*, CRS Press & Co.
8. Sudipto Banerjee, Bradley P, Carlin, Alan E. Gelfand (2014), *Hierarchical Modeling and Analysis for Spatial Data*, CRS Press & Co.

REFERENCES:

1. Maguire, D., M. Batty, and M. Goodchild. 2015. GIS, Spatial analysis, and modeling. ESRI Press (G70.212 .G584 2005)
2. Zeiler, M. 2010. Modeling Our World: The ESRI Guide to Geodatabase Design. Second Ed. ESRI Press, Redlands, California

OUTCOMES:

On successful completion of this course,

- Students will be able to apply the basic concepts of Conceptualize models as representations of real life systems with inputs, outputs, and processes.
- Students will have gained knowledge in spatial tools to make simulations and predictions of real life phenomena.
- Students will have synthesized knowledge about Apply, integrate, and develop

models with geospatial data through a GIS.

- Students will have an overview of Evaluate models in terms of accuracy, sensitivity, and uncertainty.
- Students will have Use of a system-based approach for problem solving, with an emphasis on sustainability.