Sri

SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

West Tambaram, Chennai - 44

www.sairam.edu.in

Approved by AICTE, New Delhi
Affiliated to Anna University

REGULATIONS 2020

Academic Year 2020-21 onwards

AUTONOMOUS

OPEN ELECTIVES

Sairam INSTITUTIONS

VISION 2025

PEOPLE + PROCESS + PURPOSE = SUCCESS

At Sairam, we realize that the higher education sector is under significant pressure to adapt to the changing needs of the future. Institutions need to become more operationally efficient and effective, improve student outcomes, increase access to higher education, recruit and retain top faculty and researchers, and more.

Effective transformation in these areas requires an organization-wide strategic approach that seeks to improve and enhance organizational models, operating processes, technology, leadership, and talent models. We have adopted a 3Ps model of aligning People, Process and Purpose with the vision of the organization.

Inspiring PEOPLE

Sairam RAISE

Improving PROCESS

Sairam EOMS

Instilling PURPOSE

Sairam SDG ACTION PROGRAM

OPEN ELECTIVES

INDEX

OPEN ELECTIVES
AICTE - UHV

20HSMC501 SDG NO. 4&9	UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY	L	T	P	C
		2	1	0	3

OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

SYLLABUS:

The course has 28 lectures and 14 practice sessions in 5 modules:

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

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

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

UNIT II UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF!

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensureSanyam and Health.

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

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

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

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

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

18. Understanding the harmony in the Nature
19. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self- regulation in nature
20. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
21. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS

22. Natural acceptance of human values
23. Definitiveness of Ethical Human Conduct
24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people- friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
26. Case studies of typical holistic technologies, management models and production systems
27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
28. Sum up.

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

TEXT BOOK:

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

REFERENCES:

1. AICTE Model Curriculum in Humanities, Social Science and Management Courses (UG Engineering & Technology)Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

COURSE OUTCOMES

By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow it up by

a) Faculty-student or mentor-mentee programs throughout their time with the institution

b) Higher level courses on human values in every aspect of living. E.g. as a professional

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OPEN ELECTIVES

I - VIII SEMESTER
AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

DEPARTMENT OF ENGLISH

S. NO	COURSE CODE	COURSE TITLE	CONTACT HOURS	WEEK HOURS			CREDITS
				L	T	P	C
1	20ENOE901	Basic Japanese	3	3	0	0	3
2	20ENOE902	Fundamental German	3	3	0	0	3
3	20ENOE903	Basic Chinese	3	3	0	0	3
4	20ENOE904	Literature ,Culture and Media	3	3	0	0	3
5	20ENOE905	Advanced Grammar and Literary Forms	3	3	0	0	3
6	20ENOE906	Interpersonal Skills and Leadership qualities	3	3	0	0	3
7	20ENOE907	Stress Management	3	3	0	0	3
8	20ENOE907	English For Competitive Examinations	3	3	0	0	3

OPEN ELECTIVES

20ENOE901 SDG NO. 4	BASIC JAPANESE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To help the learners understand the Japanese alphabets like: Kanji (Chinese Pictograms) and Kana (Katakana and Hiragana) scripts
- To encourage the learners to focus on conversational skills and basic training in sentence construction
- To help the learners prepare for better future and professional advancement
- To actively participate in listening and reading techniques
- To help the learners to qualify the Japanese Language Proficiency Test (JLPT N5 (first level of qualifying Japanese language)

UNIT I INTRODUCTION 9

Introduction to Japanese scripts and particles – Introduce oneself – Interrogative words – Demonstrative pronouns and adjectives – Time – Hobbies

UNIT II GRAMMAR AND VOCABULARY 9

Conversation with Time expressions – Simple verbs – Negative form of verb – Locational Nouns – Simple conversation on phone – Conjunctions – Volitional form of verb

UNIT III ADJECTIVES AND FORMS 9

Types of Adjectives: 'i' and 'na' adjectives – Negative form of adjectives – Plain form of verbs – Negative form of verbs – Expressions like: giving or receiving things, gifts etc

UNIT IV PROVERBS, EXPRESSIONS AND JAPANESE CULTURE 9

Potential form of verbs – Proverbs and Expressions – Expressing intent or purpose – Examples from Japanese way of life

UNIT V LANGUAGE DEVELOPMENT 9

Permission and seeking approval – Basic Kanji scripts – Filling out simple forms – Conditional form of verb – Read simple conversation – Write simple sentences

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Yamamoto, N. "Shin Nihongo no kiso I (Romanized edition)" Association for Overseas Technical Scholars (AOTS), 3A Corp, June, 1990.
2. "Minna no Nihongo", 3 A Network, Goyal Publishers.

REFERENCES:

1. Mizutani O. and Mizutani N., "Introduction to Modern Japanese", Japan Times, November, 1992.
2. Nishimo A., "250 Essential Kanji for Everyday Use, 2nd revised edition, Tuttle Publishing, January, 2004.
3. "Japanese for Busy People, 3rd edition", Association for Japanese Language Teaching, Kodansha Tokyo Japan Kodansha International, November, 2011.

WEB REFERENCES:

1. http://www.nptelvideos.com/course.php?id=604
2. https://swayam.gov.in/nd1_noc19_hs52/preview

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3522/introduction-to-japanese-language-and-culture
2. http://engineeringvideolectures.com/course/604

OUTCOMES: At the end of the course, learners will be able to

1. Understand the Japanese culture and their festivals
2. Write Kana scripts and 125 Kanji scripts
3. Possess knowledge in basic grammar and write correct sentence structures
4. Read longer texts and develop skimming and scanning techniques
5. Speak simple sentences using conjunctions and fillers by engaging in active communication

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	3	2	2	-	2	3	-	-
CO2	-	-	-	-	-	-	3	2	2	3	-	-	-	-
CO3	-	-	-	-	-	-	-	2	2	3	2	3	-	-
CO4	-	-	-	-	-	3	-	3	2	2	-	2	-	-
CO5	-	-	-	-	-	-	2	2	2	3	-	-	-	-

20ENOE902 SDG NO. 4	FUNDAMENTAL GERMAN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To help the learners to understand and articulate German in real life contexts
- To make the learners to grasp the basic sentence structure
- To build a good foundational vocabulary in German
- To encourage the learners for better career progression
- To create basic orientation towards Germany

UNIT I INTRODUCTION **9**

Introduction to German Language – Introduce oneself- Hobbies, The Week, Numbers, Months, Reading the clock, Seasons-Alphabets in German-Pronunciation-Phrases-Daily life expressions.

UNIT II GRAMMAR AND VOCABULARY **9**

My apartment, rooms, furniture, colors -W questions- Personal pronouns-Simple Sentence-Tenses in German-Idioms-Articles-Plural- Definite and Indefinite articles negation - kein and nicht imperative-the verbs to have and to be.

UNIT III GERMAN SYNTAX **9**

Food, drink, family / groceries and meals / Grammar: the accusative-prepositions am, um, von.bis modal verbs, Possessive articles.

UNIT IV GERMAN CULTURE AND LIFESTYLE **9**

Everyday life-telling time-making appointment-German Culture- Leisure activity- celebrations-clothes– Profession-Grammar: separable verbs- past tense of to have and to be.

UNIT V LANGUAGE FOCUS **9**

Holiday-Weather-Contacts, Writing letters - Grammar: Changing preposition-dative –Perfect Tense- Verb Conjugation.

TOTAL: 45 PERIODS

TEXT BOOKS

1. DaF leicht A1.1 (Combined Half Edition) Textbook Series for College/Adult Learners:Text/Workbook + DVD-ROM; Klett(Ernst) Verlag, Stuttgart Publisher; May, 2014.
2. DaF kompakt neu in 3 Banden: Kurs- und Ubungsbuch A1 + MP3-CD Klett (Ernst) Verlag,Stuttgart Publisher: April, 2016.
3. Studio D A1(set of 3 books), Goyal Publishers, Pvt. Ltd.

REFERENCES

1. Edward Swick M A., "Learning German Book: Speak, write, and understand basic German in no time", The Everything; Second edition, November, 2009.
2. Arnold Leitner., German Made Simple: Learn to Speak and Understand German Quickly and Easily, Three Rivers Press, Revised Edition May, 2006.
3. Waltraud Coles. and Bill Dodd, Reading German: A Course Book and Reference Grammar, Oxford University Press, U.S.A.; 1 edition, December, 1997.
4. Agundez Diego. A., German Made Easy: Learn German in an Easy and Systematic Way with CD, Goodwill publishing House, New Delhi, revised edition July, 2018.

WEB REFERENCES

1. https://www.udemy.com/topic/german-language/
2. https://swayam.gov.in/nd1_noc19_hs51/preview

ONLINE RESOURCES

1. https://www.actilingua.com/en/german-language-course-content/online-german-with-sisi/
2. https://germanwithlaura.com/german-word-order/

OUTCOMES: At the end of the course, learners will be able to

1 Gain primary knowledge about the German culture and their lifestyle
2. Listen to the daily life expressions
3. Communicate basic sentences with proper Grammar
4. Read the fundamental content and simple German Language Texts
5. Write basic sentence structure and letters in German

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	-	1	1	-	-	3	-	-
CO2	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO3	-	-	-	-	-	-	2	-	1	3	-	3	-	-
CO4	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO5	-	-	-	-	-	-	-	-	1	3	-	3	-	-

20ENOE903 SDG NO. 4	BASIC CHINESE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enhance the listening, speaking, reading and writing skills of the learners
- To build the learners' communicative competency in oral and aural skills
- To help the learners understand and articulate Chinese language in real life contexts
- To enable the learners to communicate verbally in Chinese language within given situations
- To encourage the learners for better career progression

UNIT I INTRODUCTION **9**

Introduction to Chinese language -Basic Vocabulary—how to say hi, ask names, nationalities, greetings Sentence Patterns— Authentic (daily-used) expressions Vs. Textbook expressions of greetings Activity--"I live in the global village" Cultural Note--Chinese Names (formation + history)

UNIT II NONVERBAL COMMUNICATION **9**

Warm-up activity—how to count 1-100 in Chinese (with hand-gesture expressions) Basic expressions in asking time -Basic expressions in asking price- Cultural note— (1) semantic meaning of numbers in Chinese culture (2) bargaining cultures in China

UNIT III CHINESE SYNTAX **9**

Basic vocabulary—means of transportation; directions; taxi language - Sentence patterns—asking ways; communicating with taxi drivers (drive slowly, drive fast, turn left/right, stop, etc.) Activity— role play; Cultural note—road names in China, road designing ideas in China and directions

UNIT IV CULTURE AND LIFESTYLE **9**

Basic vocabulary—fruit and vegetables, meats: Sentence patterns—buying food, asking price, ordering food, making reservations: Activity— role play, Cultural Note—Chinese people consider "Food is the first happiness"; eight types of Chinese food; Chinese food, philosophy and Taoism.

UNIT V LANGUAGE FOCUS **9**

Warm-up activity—introducing the formation of Chinese character -Basic vocabulary—family members, measure word for people, professions; Sentence patterns—introduce family members and professions Activity—family album; Cultural note—different family concepts

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Alber, Dave. "Chinese English: English for Chinese Speakers" March, 2014.
2. Mtthews Alison & Matthews Laurence, "Learning Chinese Characters". HSK Level A. Tuttle publishing. 2007.

WEB REFERENCES:

1. https://sites.uni.edu/becker/chinese2.html
2. https://www.omniglot.com/links/chinese.htm
3. https://www.chineseboost.com/blog/10-best-free-resources-learn-chinese/

ONLINE RESOURCES:

1. https://www.iwillteachyoualanguage.com/resources/mandarin-chinese-resources
2. https://www.udemy.com/topic/chinese-language/free/

OUTCOMES:

At the end of the course learners will be able to

1. Understand the basic knowledge of Chinese language
2. Demonstrate their Chinese language skills to conduct conversations in daily life, including greetings, buying products, transportation and business
3. Read simple Chinese language texts and interpret
4. Communicate and write with proper grammar
5. Apply and illustrate simple sets of Chinese language and communication skills in various professional spheres

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	2	1	2	3	-	3	-	-
CO2	-	-	-	-	-	-	-	-	1	3	-	2	-	-
CO3	-	-	-	-	-	3	2	-	1	3	-	3	-	-
CO4	-	-	-	-	-	-	-	-	1	3	-	2	-	-
CO5	-	-	-	-	-	3	2	-	1	3	1	2	-	-

20ENOE904 SDG NO. 4	MASS COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce learners to the principles and practices of mass communication
- To help the learners observe different forms of communication and information through mass media
- To appreciate the potential and the scope of various communication processes
- To gain an insight into the nature and structure of reporting and editing news for the print and electronic media
- To encourage the learners to use different styles and techniques in writing

UNIT I PRINCIPLES OF MASS MEDIA

Nature and process of human communication - functions of communication – verbal and non-verbal communication - intra- personal - small group – public

and mass communication – Media systems and theories – Mass media – public opinion and democracy.

UNIT II PRINT MEDIA **9**

Evolution of media - growth and development of print media in India - before and after emergency - news - definition – values – types –purpose and style of writing - role of a reporter - ethics of reporting news - editorial column - letter to the editor -advertising in print media

UNIT III CINEMA **9**

Birth of Cinema - development of cinema in India - types – impact of cinema - ethics of cinema- elements of film language - Type of shots - time and relations between shots - montage and discontinuity - film appreciation

UNIT IV TELEVISION **9**

Development of television in India - types of programs – newscast –interview - entertainment - soap opera - advertisement - satellite TV channels - ethics of telecasting.

UNIT V MULTIMEDIA **9**

New media - history and evolution of the internet - emergence of new media - online media - social networking - podcast - basics of web writing.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Keval J Kumar. "Mass Communication in India". Jaico Publishing House, Mumbai, 2008.
2. Griffin, E. "A first look at communication theory". McGraw Hill: New York, NY, 2009.

REFERENCES:

1. Mehta, D. S. Mass communication and Journalism in India. Allied Publishers.
2. Pearce, K.J. Media and Mass Communication Theories. In Encyclopedia of Communication Theory (p. 624-628). Sage Publications ,2009.
3. Hartley, J.: "Mass communication", in O'Sullivan; Fiske (eds): Key Concepts in Communication and Cultural Studies, Routledge, 1997.
4. Mackay, H.; O'Sullivan T.: The Media Reader: Continuity and Transformation, Sage Publications, 1999.
5. McQuail, D.: McQuail's "Mass Communication Theory", (fifth edition) Sage Publications, 2005.

WEB RESOURCES:

1, https://courses.lumenlearning.com/suny-introductionto communication/chapter/defining-mass-communication/
2. https://www.quora.com/What-are-some-examples-of-mass-communication-and-their-uses
3. https://www.docsity.com/en/subjects/mass-communication/

ONLINE RESOURCES:

1. https://www.udemy.com/course/communication-crash-course-for-beginners/
2. https://www.coursera.org/learn/media-ethics-governance

COURSE OUTCOMES:

At the end of the course learners will be able to

1. Recognize different attributes of communication and apply them in the field of journalism
2. Analyze different types of news and categorize them according to the need of media production
3. Recall and reproduce English language effectively in media communication, especially in different kinds of news writing
4. Appreciate films with an understanding of film making and editing techniques
5. Use multiple media skills, concepts, terminologies, formats and trends

CO – PO, PSO MAPPING:

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

20EN0E905 SDG NO. 4	INTERPERSONAL AND LEADERSHIP SKILLS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Build interpersonal skills
- Learn active listening and responding skills
- Develop skills to communicate clearly
- Enhance presentation and take part in group discussions/interviews
- Understand the importance of leadership skills and implement etiquettes in workplace and in society

UNIT- I LISTENING SKILLS **9**

Listening as a key skill- its importance-barriers to active listening-listen to a process information-give information-simple conversation- being an active listener- giving verbal feedback-listen to formal and informal talk- to follow and respond to explanations, directions and instructions in academic and business contexts

UNIT- II SPEAKING SKILLS **9**

Speaking- stress patterns in English- intonation patterns- barriers in speaking- give personal information – ask for personal information-improving pronunciation-converse with reasonable accuracy over a wide range of topics- participating informal and informal conversation-delivering informal talk-greet-respond to greetings- invite and offer- accept and decline

UNIT – III GROUP DISCUSSION AND INTERVIEW SKILLS **9**

Managing anxiety and fear – building self-esteem – self assessment – body language: gesture, posture and facial expressions – verbal and non-verbal communication – group discussion -characteristics of GD, subject knowledge, team management skills – individual contribution & consistency – presentation skills- how to make PPT and body language during presentation – Interview skills- interview etiquettes, handling situations and answering skills

UNIT- IV LEADERSHIP SKILLS **9**

Leader - Introduction and skills- vision and mission- roles - responsibilities-leadership styles- autocratic, democratic - bureaucratic-motivating others-organizational skills- team building- decision making- public speaking-inspiring others- leading by example

UNIT -V LEADERSHIP TRAITS **9**

Traits of a leader-time management- giving support- mentoring and counselling- appraisal-feedback-handling conflicts- motivation- internal and external motivation- professional etiquette- importance of work ethics- problems in the absence of work ethics

TOTAL : 45 PERIODS.

TEXT BOOKS:

1. Brooks, Margret. Skills for Success. Listening and Speaking; Level 4; Oxford University Press, Oxford:2011
2. Peter, Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw Hill. 2012. Print.
3. Johnson, D.W. "Reaching out – Interpersonal Effectiveness and Self Actualization". 6th ed. Boston: Allyn and Bacon, 1997.

REFERENCES:

1. Sherfield, R. M.; Montgomery, R.J. and Moody, P, G. Developing Soft Skills. 4th ed. New Delhi: Pearson, 2010.
2. Robbins, S. P. and Hunsaker, Phillip, L. "Training in Interpersonal skills". Tips for managing people at work. 5th ed. New Delhi: PHI Learning, 2009.
3. John, Seely The Oxford guide to writing and speaking. Oxford U P, 1998, Delhi.
4. Pease, Allan. "Body Language: How to Read Others Thoughts by their Gestures". Suda Publications. New Delhi, 1998.
5. De Bono, Edward. "Serious Creativity". Re print. Harper Business, 1993.

WEB REFERENCES:

1 http://interpersonalskillsonline.com/
2. https://www.edx.org/learn/leadership
3. https://www.classcentral.com/tag/interpersonal-skills

ONLINE RESOURSES

1. https://freevideolectures.com/course/4120/nptel-interpersonal-skills
2. https://swayam.gov.in/nd2_arp19_ap69/preview
3. https://www.udemy.com/course/communication-skills-at-workplace/
4. https://www.udemy.com/course/practical-leadership/

OUTCOMES:

At the end of the course the learners will be able to:

1. Understand the nature of interpersonal communication.
2. Apply the conceptual understanding of communication into everyday practice
3. Make use of techniques for self-awareness and self-development.
4. Understand the importance of team work and time management
5. Apply leadership skills effectively

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	1	-	-	2	3	3	-	2	-	-
CO2	-	-	-	-	-	-	-	2	3	3	-	2	-	-
CO3	-	-	-	-	-	1	1	2	3	3	-	1	-	-
CO4	-	-	-	-	-	-	-	2	3	3	-	2	-	-
CO5	-	-	-	-	-	1	2	2	3	3	3	2	-	-

20EN0E906 SDG NO. 4	ADVANCED WRITING SKILLS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enhance learners' skills in reading and writing
- To develop the proficiency of the students in written communication
- To help the students to integrate form, meaning and use in academic discourse settings
- To reinforce the theory and practice of writing as a recursive process among learners
- To enable the learners, understand the elements of creative writing

UNIT I ESSAY WRITING **9**

Essay and its types i) narrative ii) descriptive iii) expository and iv) Persuasive essays - paragraph writing

UNIT II EMAIL/ REPORT WRITING **9**

Writing E-mails – formal/ informal letters – resume writing - writing reports – the introduction of a report – types of report - proposal writing – blogs

UNIT III REVIEW WRITING **9**

Write a review of a book – review of a movie – prose writing - i) descriptive writing ii) argumentative writing iii) subjective writing

UNIT IV LIFE WRITING **9**

Writing reviews of articles / columns / novels – biography and autobiographical writing – dialogue writing - travel writing

UNIT V CREATIVE WRITING **9**

Creative writing – writing on a topic of one's own interest – writing a poem / short story /incident description – content creation

TOTAL: 45 PERIODS

TEXT BOOKS

1. Williams, Phil. Advanced Writing Skills for Students of English. Rumian Publishing, 2018.
2. O'Brien, Terry. Modern Writing Skills. Rupa Publications India, 2011.

REFERENCES

1. Taylor, Shirley. Model Business Letters, Emails and Other Business Documents. 7th Ed. Pearson Education Limited, 2015.
2. Paul. D. S. Advanced Writing Skills: Success in 20 Minutes a Day. Goodwill Publishing House. 2016.
3. Anderson, Linda. Creative Writing: A Workbook with Readings. 1st Edition. Routledge, New York. 2006.

WEB REFERENCES

1. https://www.writersdigest.com/be-inspired/websites-for-writers-writing-creativity
2. https://oxfordsummercourses.com/articles/what-is-creative-writing/

ONLINE RESOURCES

1. https://oeru.org/oeru-partners/oer-foundation/writing-for-business-success/
2. https://www.coursera.org/learn/advanced-writing
3. https://www.edx.org/microbachelors/asux-professional-writing-microbachelors-program

OUTCOMES

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

1. Understand the functions of essays and reports
2. Use writing as a tool for exploration and reflection in addressing problems, exposition and persuasion
3. Adapt to different types of write-ups
4. Apply revising and editing techniques to their own writings
5. Inculcate the skills needed to write impressively and emphatically

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	1	3	2	-	-	-	-
CO2	-	-	-	-	2	-	-	-	2	3	1	1	-	-
CO3	-	-	-	-	-	1	2	-	3	3	-	2	-	-
CO4	-	-	-	-	-	1	2	-	3	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	-	-	-

20ENOE907 SDG NO. 4	STRESS MANAGEMENT IN THE TECHNO SAVVY AND CORPORATE CULTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To comprehend psychological and physiological effects of stress
- To acquire personal strengths for achieving one's goals
- To understand the importance of time management and techniques to overcome stress
- To develop new strategies to regulate stress
- To recognize the impact of stress on psychological, emotional and cognitive processes

UNIT I UNDERSTANDING THE NATURE OF STRESS 9

Definition of stress- types of stress- origin and body systems- importance of stress management- symptoms of stress -sources – physical, emotional, interpersonal and cognitive -impacts of stress- personal responsibility in stress management

UNIT II PROBLEM SOLVING AND TIME MANAGEMENT 9

Principles for teaching problem solving methods-researches, analysis, decision making, dependability-ways to enhance problem solving skills effectively- strategies for better time management- importance of time management skills-the psychology of time management-determine the value of one's vision and mission

UNIT III STRESS AND COPING APPLICATION IN CORPORATE ENVIRONMENT AND CONTEXT: EMOTIONAL INTELLIGENCE 9

Connection between social support and stress –types of social support-working in teams and being techno cultured -recognizing the role of communication and relationships in managing stress and in academic and work performance-emotional intelligence

UNIT IV THE SCIENCE OF STRESS 9

Human fight or flight response to stress-physiological changes associated with the stress response-role of stress in disease-stress affects body system

UNIT V STRATEGIES OF STRESS MANAGEMENT AND PREVENTION 9

Challenging stressful thinking-psychological and spiritual relaxations methods-physical methods of stress reduction-college and occupational stress-stress and conflicts in relationship

TOTAL: 45 PERIODS

TEXTBOOKS

1. Kottler, J.A& D.D, "Stress Management and Prevention": Application to daily life (2nd Ed) London and Newyork.; Routledge, 2011.
2. Olpin. M. & Hesson. Stress Management for Life: A Research-based experiential approaches. 4th Ed. Wadsworth Publishing. 2015.

REFERENCES

1. Lee. K Reset: Make the Most of Our Stress: Your 24x7 Plan for Wellbeing. Universe Publishing. 2014.
2. Jerrold S. Greenberg, Dr. Comprehensive Stress Management. 14th Ed. Mcgraw Hill. 2016.
3. Goleman Daniel, "Emotional Intelligence". Bloomsbury Publishing India Pvt. Ltd., January, 1995.

WEB REFERENCES

1. https://www.webmd.com/balance/stress-management/stress-symptoms-effects_of-stress-on-the-body#2
2. https://managementhelp.org/personalproductivity/time-stress-management.htm

ONLINE RESOURCES

1. http://www.mindtools.com/smpage.html.
2. https://experiencelife.com/article/the-science-of-stress/

OUTCOMES

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

1. Understand the role of situation and manage to regulate stress
2. Examine the techniques and implementation of stress management in personal and professional arenas
3. Recognize the role or impact of stress on psychological, emotional and cognitive processes
4. Identify the key dimensions of time management
5. Develop the capacity for critical thinking and self-awareness to reduce stress

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	-	-	-	3	-	2	-	-
CO2	-	-	-	-	-	1	3	-	-	-	-	2	-	-
CO3	-	-	-	-	-	3	-	-	-	1	-	2	-	-
CO4	-	-	-	-	-	1	-	2	-	-	-	3	-	-
CO5	-	-	-	-	-	1	-	-	-	-	-	2	-	-

20ENOE908 SDG NO. 4	ENGLISH FOR COMPETITIVE EXAMINATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defense) and the international level (GRE, TOEFL, IELTS)
- To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests
- To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing
- To build critical analytical abilities
- To inculcate the habit of adding new words and use them in daily conversation and writing

UNIT I VOCABULARY DEVELOPMENT 9

Orientation on different formats of competitive exams - vocabulary – verbal ability – verbal reasoning - exploring the world of words – essential words – meaning and their usage – synonyms - antonyms – word substitution – word analogy – idioms and phrases – commonly confused words – spellings – word expansion – new words in use

UNIT II GRAMMAR RULES 9

Grammar – sentence improvement –sentence completion – rearranging phrases into sentences – error identification –tenses – adjectives – adverbs – subject-verb agreement – voice –clauses – speech patterns - reading newspapers and magazines for content- social issue - environment issue - polity issue - women empowerment - general awareness - online quiz

UNIT III READING COMPREHENSION 9

Reading - specific information and detail – identifying main and supporting ideas – speed reading techniques – improving global reading skills – linking ideas – summarizing – understanding argument – identifying opinion/attitude and making inferences - critical reading

UNIT IV LISTENING AND SPEAKING ACTIVITIES 9

Listening and speaking – contextual listening – listening to instructions – listening for specific information – identifying detail, main ideas – following signpost words – stress, rhythm and intonation - speaking to respond and elicit ideas – guided speaking – opening phrases – interactive communication – dysfluency -sentence stress – speaking on a topic – giving opinions – giving

an oral presentation – telling a story or a personal anecdote – talking about oneself - utterance – speech acts- brainstorming ideas – group discussion

UNIT V EFFECTIVE WRITING 9

Writing – pre-writing techniques – mind map - describing pictures and facts - paragraph structure – organizing points – rhetoric writing – improving an answer – drafting, writing and developing an argument – focus on cohesion – using cohesive devices –analytic writing – structure and types of essays – structure of drafts, letters, memos, emails – Statements of purpose – content and style

TOTAL: 45 PERIODS

TEXTBOOKS

1. R. P. Bhatnagar - General English for Competitive Examinations. Macmillan India Limited, 2009.
2. Pillai, Radhakrishnan. G. English Grammar and Composition. Emerald Publishers, 2002.
3. Gupta. S. C. General English for All Competitive Examinations. Arihant Publications, 2016.

REFERENCES

1. Agarwal R.S. A Modern Approach to Verbal & Non-Verbal Reasoning (2 Colour Edition) Paperback – 1 January 2018.
2. Bhatnagar, R P. English for Competitive Examinations. January 2017.
3. Educational Testing Service - The Official Guide to the GRE Revised General Test, Tata McGraw Hill, 2010.
4. R Rajagopalan, General English for Competitive Examinations, McGraw Hill Education (India) Private Limited, 2008.

WEB REFERENCES

1. https://www.examsbook.com/general-english-questions-and-answers-for-competitiveexam
2. https://learnenglish.britishcouncil.org/
3. https://www.edudose.com/gk/

OUTCOMES

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

1. Expand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with better emphasis
2. Identify errors with precision and write with clarity and coherence

3. Speak and write in English with appropriate grammatical structure and usage
4. Understand the importance of task fulfillment and the usage of task-appropriate vocabulary
5. Apprehend the pattern of English questions for competitive examination

CO-PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	1	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	1	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	1	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	1	3	-	2	-	-

Sri SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

Affiliated to Anna University & Approved by AICTE, New Delhi

OPEN ELECTIVES

I - VIII SEMESTER
AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

DEPARTMENT OF MATHS

S. NO	COURSE CODE	COURSE TITLE	CONTACT HOURS	WEEK HOURS			CREDITS
				L	T	P	C
1	20MAOE901	Advanced Linear Algebra	3	3	0	0	3
2	20MAOE902	Operations Research	3	3	0	0	3
3	20MAOE903	Optimization Techniques	3	3	0	0	3
4	20MAOE904	Graph Theory and its Applications	3	3	0	0	3
5	20MAOE905	Probability and Statistics	3	3	0	0	3
6	20MAOE906	Algebra and Number Theory	3	3	0	0	3
7	20MAOE907	Statistics and R Programming	3	3	0	0	3
8	20MAOE908	Mathematical Finance	3	3	0	0	3
9	20MAOE909	Discrete Mathematical Structures	3	3	0	0	3
10	20MAOE910	Numerical Methods	3	3	0	0	3
11	20MAOE911	Cryptography and Number theory	3	3	0	0	3
12	20MAOE912	Cellular Automata	3	3	0	0	3

OPEN ELECTIVES

20MAOE901 SDG NO. 4	ADVANCED LINEAR ALGEBRA	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concepts of Vector Spaces.
- To represent the linear transformation as a matrix and to obtain a necessary and sufficient condition for diagonalizability of a linear operator.
- To introduce the idea of distance or length in to vector spaces via inner product space structure and use Gram-Schmidt Orthogonalization process to find an orthonormal bases.
- To seek conditions that guarantees that the inner product space has an orthonormal basis of Eigen vectors.
- To use matrix operation techniques to find generalized Eigenvectors and pseudo inverse of a matrix.

UNIT I VECTOR SPACES 12

Vector Spaces-Subspaces-Linear Combination and system of linear equations-Linear Dependence and Linear Independence of Vectors-Bases and Dimensions.

UNIT II LINEAR TRANSFORMATIONS 12

Linear Transformations-Range and Null Space-Dimension Theorem-Matrix representation of a Linear Transformation-Eigen Values and Eigen Vectors-Positive definite matrices - Diagonalizability.

UNIT III INNER PRODUCT SPACE 12

Inner Product Spaces - orthogonality - projections- Gram Schmidt Orthogonalization Process - Least Square Approximation.

UNIT IV OPERATORS ON INNER PRODUCT SPACE 12

Adjoint of a linear operator - Normal and self-adjoint operators - The Spectral Theorem - Positive operators - Isometries.

UNIT V MATRIX OPERATIONS 12

Eigenvalues using QR transformations - QR factorization - Generalized eigenvectors - Canonical forms - Singular value decomposition and applications - Pseudo inverse - Toeplitz matrices and some applications.

TEXT BOOKS:

1. Linear Algebra, 4th Edition, Stephen H. Friedberg, Arnold J. Insel and Lawrence E. Spence (Units - I, II, III).
2. Linear Algebra Done Right, 2nd Edition, Sheldon Axler (Unit - IV).
3. Schaum's outline of Theory and Problems of Matrix Operations, Richard Bronson (Unit - V).

REFERENCE BOOKS:

1. Linear Algebra, 2nd Edition, Kenneth Hoffman and Ray Kunze.
2. Elementary Linear Algebra, 11th Edition, Howard Anton and Chris Rorres.
3. Linear Algebra and its applications, 4th Edition, Gilbert Strang.
4. Linear Algebra, 2nd Edition, R. Bronson and G. B. Costa.
5. Linear Algebra and Its Applications , 3rd Updated Edition, David C. Lay.

OUTCOMES:

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

1 Identify the vector spaces and find its basis and dimension.

2 Find the matrix of the linear transformation and test the diagonalizability of a linear operator.

3 Use Gram Schmidt Orthogonalization process to convert the given subset of an inner product space to an orthonormal basis.

4 Find the condition for the inner product space to have an orthonormal basis of eigenvectors.

5 Use appropriate matrix operation techniques to find Eigen values, generalized Eigen vectors and pseudo inverse of a given matrix.

CO - PO MAPPING

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

20MAOE902 SDG NO. 4	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To appropriately formulate various OR models and apply optimization techniques and algorithms to solve these problems.

UNIT I LINEAR PROGRAMMING 9

Introduction, Mathematical formulation of LPP – graphical solution – simplex method – duality – Sensitivity analysis

UNIT II TRANSPORTATION, ASSIGNMENT AND NETWORK FLOW MODELS 9

Transportation Model – Assignment Model – Travelling salesman problem – post optimality analysis – Shortest route problem: Dijkstra's Algorithm – Maximal flow problem.

UNIT III DECISION THEORY AND PROJECT SCHEDULING 9

Decision trees – Game theory – two person zero sum – mixed strategies – $2xn$ and mx^2 games.

Project scheduling: CPM and PERT - crashing networks and cost considerations – resource levelling and resource smoothening.

UNIT IV SEQUENCING AND INVENTORY MODELS 9

Sequencing model - 2 machines n jobs, m machines n jobs - n jobs 2 machines.

Inventory model - deterministic and probabilistic models

UNIT V QUEUEING AND SIMULATION MODELS 9

Queuing models – poison arrival and exponential service times – single & multi-server models.

Simulation: Monte Carlo simulation - simple problems.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Wagner, H. M., "Principles of Operations Research with Applications to Managerial Decisions", 2nd edition, Prentice Hall, New Delhi, 1998.
2. Taha H. A., "Operations Research: An Introduction", 9th Edition, Prentice Hall, New Delhi, 2010.

REFERENCE BOOKS:

1. Hadley G., "Linear Programming", Narosa Publishing House, New Delhi, 2002.
2. Dantzig G. B. and Thapa M. N., "Linear Programming: 2 : Theory and Extensions", 3rd Edition, Springer Series inOperations Research, New York, 2003.
3. Ravindra A., Phillips D. T. and Solberg J. J., "Operations Research - Principles and Practice", John Wiley & Sons, 2005.
4. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, "Linear Programming and Network Flows", 4th Edition, John Wiley and Sons, 2010.
5. Frederick S. Hillier andGerald J. Lieberman, "Introduction to Operation Research", Tata McGraw-Hill, 2nd Edition,2000.
6. Budnick F. S., McLeavey D. and Mojena R., "Principles of Operations Research for Management", 2nd Edition, Richard D. Irwin, Inc., Illinois, 1988.
7. Kasene H. S. andKumar K. D., "Introductory Operations Research", Springer (India) Pvt. Ltd., 2004.
8. Panneerselvam R., "Operations Research", 2nd Edition, PHI Learning Pvt. Ltd., 2006.
9. Swarup K., Gupta P. K. and Manmohan, "Operations Research", Sultan Chand & Sons, 2010.
10. S. D. Sharma, "Operations Research: Theory, Methods & Applications", Kedarnath Ramnath & Co., 2002.

WEB REFERENCES:

1. https://www.cs.toronto.edu/~stacho/public/IEOR4004-notes1.pdf
2. http://www.maths.adelaide.edu.au/matthew.roughan/notes/OORII/03lecture_notes.html
3. faculty.psau.edu.sa › filedownload › doc-6-pdf-14b14198b6e26157b..

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/111/105/111105100/
2. https://nptel.ac.in/courses/112/106/112106134/
3. https://freevideolectures.com/course/2678/advanced-operations-research
4. https://www.nptel.ac.in/courses/111/105/111105039/

COURSE OUTCOMES:

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

1. Formulate real-world problems as a linear programming model and solve using graphical or simplex method, explain the relationship between a linear program and its dual and perform sensitivity analysis to identify the change in the objective function as the input data change.
2. Find solutions to transportation, assignment and network flow problems using standard optimization technique algorithms.
3. Obtain optimal decisions using graphical approach namely decision tree, solve two-person zero-sum games using graphical and LP methods and critically analyze the project schedule and the cost-time trade-offs in the context of a project network.
4. Determine the optimal allocation of jobs to machines by minimizing total elapsed time for the problems of multiple jobs and machines in a production line and understand the various selective inventory control techniques and its applications.
5. Understand and compute quantitative metrics of performance for queueing systems and use Monte-Carlo simulation techniques to solve OR problems.

CO - PO MAPPING

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

20MAOE903 SDG NO. 4	OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems.
- To apply the mathematical results and numerical techniques of optimization theory to concrete Engineering problems.

UNIT I CLASSICAL OPTIMIZATION TECHNIQUES 9

Introduction to optimization, engineering applications of optimization, formulation of structural optimization problems as programming problems, single variable optimization – Multivariable optimization with no constraints – Multivariable optimization with equality constraints – solution by direct substitution, solution by the method of constrained variation and solution by the method of Lagrange multipliers.

UNIT II LINEAR PROGRAMMING 9

Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems (without proof) –simplex algorithm for solving LPP.

Integer Programming Problem: Introduction - Gomory's cutting plane algorithm for solving all integer and mixed integer programming problems.

UNIT III UNCONSTRAINED NON LINEAR PROGRAMMING 9

One dimensional minimization methods: Fibonacci method and quadratic interpolation method.

Unconstrained optimization techniques – Univariate method, Gradient of a function – Cauchy's steepest descent method – Newton's method – Conjugate gradient (Fletcher-Reeves) method.

UNIT IV DYNAMIC PROGRAMMING 9

Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution – examples illustrating the tabular method of solution.

UNIT V NETWORK FLOW METHODS 9

Shortest path model – Dijkstra's Algorithm, Floyd's Algorithm – minimum spanning tree problem – PRIM algorithm – Maximal Flow Problem algorithm.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. S. S. Rao, "Engineering Optimization, Theory and Practice",4th edition, New Age International Pvt. Ltd., 2012.
2. A. D. Belegundu, T. R. Chandrupatla, "Optimization Concepts and Applications in Engineering",2nd Edition, Cambridge University Press, 2011.
3. A. H. Taha, "Operations Research: An Introduction", 9th Edition, Prentice Hall, New Delhi, 2010.

REFERENCE BOOKS:

1. R. Fletcher, "Practical Optimization", 2nd Edition, John Wiley & Sons, New York, 1987.
2. K. Deb, "Optimization for Engineering Design: Algorithms and Examples", 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.
3. J. Arora,"Introduction to Optimum Design", 3rd Edition, Elsevier Inc., 2012.
4. Edwin K. P. Chong and Stanislaw H. Zak, "An introduction to Optimization", 2nd Edition, John Wiley & Sons, Inc., 2001
5. J. C. Pant, "Introduction to optimization: Operations Research", Jain Brothers,2004.
6. A. Ravindran, K. M. Ragsdell and G. V. Reklaitis, "Engineering Optimization: Methods and Applications", 2nd Edition, John Wiley, 2006.
7. Ronald L.Rardin, "Optimization in Operation Research", Pearson Education Pvt. Ltd. New Delhi, 2005.
8. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, "Linear Programming and Network Flows", 4th Edition, John Wiley and Sons, 2010.
9. Swarup K., Gupta P. K. and Manmohan, "Operations Research", Sultan Chand & Sons, 2010.
10. K. V. Mittal and C. Mohan, "Optimization Methods in Operations Research and Systems Analysis', 4th Edition, New Age International Publishers, 2016.

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/Mathematical optimization
2. https://ocw.mit.edu/courses/sloan-school-of-management/15-093j-optimization-methods-fall-2009/lecture-notes/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/111/105/111105100/
2. https://nptel.ac.in/courses/112/106/112106134/
3. https://www.nptel.ac.in/courses/111/105/111105039/
4. http://www.nptelvideos.in/2012/11/numerical-optimization.html

COURSE OUTCOMES:

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

1. Formulate the optimization problem, with and without constraints, by using design variables and find the optimal solution using classical optimization techniques.

2. Solve LPP and IPP using the simplex and Gomory's cutting plane algorithms respectively.
3. Demonstrate knowledge and understanding of nonlinear programming models and their solution algorithms.
4. Comprehend the Dynamic Programming model and its applications in industry.
5. Develop mathematical models associated with network flows and find the solution using standard algorithms.

CO - PO MAPPING

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

20MAOE904 SDG NO. 4	**GRAPH THEORY AND ITS APPLICATIONS**	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Aims to cover basic concepts of graph theory.
- Be familiar with theorems and results in graph theory.

UNIT 1 INTRODUCTION **9**

Graphs – Introduction – Isomorphism – Sub graphs – Walks, Paths, Circuits –Connectedness – Components – Euler graphs – Hamiltonian paths and circuits – Trees – Properties of trees – Distance and centers in tree – Rooted and binary trees.

UNIT 2 TREES, CONNECTIVITY& PLANARITY **9**

Spanning trees – Fundamental circuits – Spanning trees in a weighted graph – cut sets – Properties of cut set – All cut sets – Fundamental circuits and cut sets – Connectivity and Separability – 1-Isomorphism – 2-Isomorphism – Combinational and geometric graphs – Planar graphs – Different representation of a planargraph.

UNIT 3 MATRICES, COLOURING & COVERING **9**

Incidence matrix - Submatrices - Circuit Matrix - Fundamental circuit matrix - Cutset, Path, Adjacency Matrix - Chromatic number – Chromatic partitioning – Chromatic polynomial – Matching – Covering – Four color problem

UNIT 4 DIRECTED GRAPH **9**

Directed graphs – Types of directed graphs – Digraphs and binary relations – Directed paths and connectedness – Eulergraphs – Trees with Directed edges – Matrices of Digraphs.

UNIT 5 GENERATING FUNCTIONS & RECURRENCE RELATIONS **9**

Generating functions - Partitions of integers - Exponential generating function – Summation operator - Recurrence relations - First order and second order – Non-homogeneous recurrence relations - Method of generating functions.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Narsingh Deo, "Graph Theory: With Application to Engineering and Computer Science", Prentice Hall of India,2003. (Unit I – IV)
2. Grimaldi R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", Addison Wesley,1994. (Unit V)

REFERENCES:

1. Rosen K.H., "Discrete Mathematics and Its Applications", Mc Graw Hill,2007.
2. Jonathan L. Gross and Jay Yellen, Graph Theory and its Applications, CRC Press, New York, 2006.
3. Bondy J.A. and Murty U.S.R., Graph Theory, Springer, London, 2008.
4. Douglas B West, Graph Theory, Prentice Hall, New Delhi, 2009.

WEB REFERENCES:

1. https://nptel.ac.in/courses/111106050/
2. https://nptel.ac.in/courses/106104170/
3. http://www.leda-tutorial.org/en/unofficial/ch05.html

ONLINE RESOURCES:

1. https://swayam.gov.in/nd1_noc20_ma05/preview
2. https://dzone.com/articles/the-top-13-resources-for-understanding-graph-theor

OUTCOMES:

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

1. Recognize the basic structure of a graph and its associated varieties and constituents, including trees.
2 Identify various substructures of trees and investigate the planarity of graphs.
3 Understand the concepts of Coloring, Chromatic partitioning, matching, and covering, directed graphs and types, binary relations and Euler graphs.
4 Understand the concepts of digraphs and its various terminologies.
5. Add to his/her knowledge the concepts of partition of integers, summation operator and solve recurrence relations using generating functions.

CO - PO MAPPING

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

20MAOE905 SDG NO. 4	PROBABILITY AND STATISTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays important roles in the field of agriculture and statistical quality control.

UNIT I PROBABILITY AND RANDOM VARIABLES 9

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 9

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS 9

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS 9

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2 x 2 factorial design.

UNIT V STATISTICAL QUALITY CONTROL `9

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition,2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition,2007.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences||, Cengage Learning, New Delhi, 8th Edition, 2014.
2. Papoulis, A. and Unnikrishna pillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi,2010.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier,2004.

4. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition,2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition,2007.

WEB REFERENCES:

1. https://nptel.ac.in/courses/111105041/
2. https://nptel.ac.in/courses/111106112/
3. https://swayam.gov.in/nd2_cec20_ma01/preview

ONLINE RESOURCES:

1 https://freevideolectures.com/course/4941/nptel-probability-statistics
2 https://cosmolearning.org/courses/introduction-probability-statistics/video-lectures/

OUTCOMES:

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

1. Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
2. Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
3. Apply the concept of testing of hypothesis for small and large samples in real life problems.
4. Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
5. Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

CO- PO MAPPING :

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

20MAOE906 SDG NO. 4	ALGEBRA AND NUMBER THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems
- To introduce and apply the concepts of rings, finite fields and polynomials
- To understand the basic concepts in number theory
- To examine the key questions in the Theory of Numbers
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

UNIT I GROUPS 9

Groups: Definition – Properties – Homomorphism – Isomorphism – Cyclic groups – Cosets – Lagrange's theorem – Normal Subgroups.

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UNIT II RINGS, FINITE FIELDS AND POLYNOMIALS 9

Rings- Definition –Sub rings - Integral domain– Filed – Integer modulo n – Ring homomorphism. Polynomial rings – irreducible polynomials over finite fields – Factorization of polynomials over finite fields.

UNIT III DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS 9

Division algorithm – base-b representation – Number pattern - prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM.

UNIT IV DIOPHANTINE EQUATIONS AND CONGRUENCES 9

Linear Diophantine equation - Congruence's –Linear Congruence's- Applications: Divisibility tests- Modular exponentiation –Chinese remainders theorem-2X2 linear systems - discrete logarithm problem

UNIT V CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS 9

Wilson Theorem- Fermat's little theorem – Euler's theorem- Euler's Phi function – Euler's totient function – Tau and Sigma functions.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Grimaldi, R.P and Ramana, B.V., "Discrete and combinatorial Mathematics", Pearson Education, 5 th Edition, New Delhi,2007.

2. Koshy, T., "Elementary Number Theory with Applications", Elsevier Publications, New Delhi, 2002

REFERENCES:

1. Lidl, R. and Pitz,G, "Applied abstract Algebra", Springer Verlag, New Delhi, Second Edition, 2006
2. Niven,I., Zukerman.H.S., and Montgomery, H.l., " An Introduction to Theory of Numbers:. John Wiley and Sons, Singapore, 2004
3. San Ling and Chaoping Xing, —Coding Theory – A first Course||, Cambridge Publications, Cambridge, 2004

WEB REFERENCES:

1. https://ocw.mit.edu/courses/mathematics/18-781-theory-of-numbers-spring-2012/
2. https://math.dartmouth.edu/research/algebra-and-number-theory/
3. https://web.stanford.edu/~aaronlan/assets/finite-fields.pdf

ONLINE RESOURCES:

1. https://nptel.ac.in/courses.html
2. https://www.coursera.org/learn/number theory-cryptography
3. https://swayam.gov.in/nd1_noc19_ma25/

CO, PO MAPPING

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

20MAOE907 SDG NO. 4	STATISTICS AND R PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To master the basics of R Programming in R Studio.
- To write user defined functions in R in an efficient way.
- To perform data exploration via graphics.
- To perform and implement basic statistical procedures such as tests and analyses.
- To fit some basic types of statistical models.

UNIT I INTRODUCTION TO R PROGRAMMING 9

Introduction, How to run R, R Sessions and Functions, Basic Math, Variables, Data Types, Vectors. Advanced Data Structures: Data Frames, Lists, Matrices, Arrays and Classes.

UNIT II R PROGRAMMING STRUCTURES 9

Control Statements, Loops, - if-else, Looping Over Non vector Sets, Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding whether to explicitly call return- Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion, A Quick sort Implementation-Extended Example: A Binary Search Tree.

UNIT III FUNCTIONS AND GRAPHICS IN R 12

Doing Math and Simulation in R, Math Function, Functions for Statistical Distribution, Sorting. Extended Examples: Calculating Probability-Cumulative Sums and Products- Calculus: Minima and Maxima, Linear Algebra: Operation on Vectors and Matrices, Vector cross Product- Finding Stationary Distribution of Markov chains, Set Operations. Input / output: Accessing the Keyboard and Monitor, Reading and writing files.

Graphics, Creating Graphs, The Workhorse of R Base Graphics, the plot () Function –Customizing Graphs, Saving Graphs to Files.

UNIT IV PROBABILITY DISTRIBUTIONS AND TESTS OF SIGNIFICANCE 15

Probability Distributions: Uniform, Binomial, Poisson, Exponential and Normal distributions, Basic Statistics, Correlation and Covariance, Hypothesis testing (parametric): t- test, Hypothesis testing (non-parametric): Wilcoxon signed rank test, Mann-Whitney test, Run test, Kolmogorov-Smirnov test, ANOVA (one-way and two-way).

UNIT V STATISTICAL MODELS **15**

Linear Models: Simple Linear Regression, Multiple Regressions, Logistic regression, Non-linear Model: Splines, Forecasting Model: Time Series analysis, Decision Model: Random forests.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. The Art of R Programming, Norman Matloff, Cengage Learning.
2. R for Everyone, Lander, Pearson
3. Probability and Statistics for Engineers (4th Edition), I. R. Miller, J. E. Freund and R. Johnson.
4. Introduction to Probability Models, S. M. Ross, Academic Press, N.Y.
5. The Analysis of Time Series: An Introduction, Chris Chatfield.

REFERENCES:

1. R Cookbook, PaulTeetor, Oreilly.
2. An Introduction to Statistical Learning with Applications in R, G. James,D. Witten, T. Hastie, R.Tibshirani, Springer Texts in Statistics.
3. R in Action,Rob Kabacoff, Manning.
4. A first course in Probability, S. M. Ross, Prentice Hall.
5. Introduction to the Theory of Statistics, A. M. Mood, F. A. Graybill and D.C. Boes.
6. Introduction to Linear Regression Analysis, D. C. Montgomery and E. Peck.
7. Statistical Programming in R, K.G. Srinivasa, S. M. Siddesh, Chetan Shetty, B. J. Sowmya, Oxford University Press.
8. Fundamentals of Mathematical Statistics, S. C. Gupta and V. K. Kapoor.

WEB REFERENCES:

1. https://nptel.ac.in/courses/111104100/
2. https://nptel.ac.in/courses/111104098/
3. https://nptel.ac.in/courses/111105091/
4. https://nptel.ac.in/courses/111105041/

ONLINE RESOURCES:

1. https://www.nptel.ac.in/courses/110107113/
2. https://nptel.ac.in/courses/103106123/

OUTCOMES:

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

1 List motivation for learning a programming language.

2 Access online resources for R and import new function packages into the R workspace.

3 Import, review, manipulate and summarize data-sets in R.

4 Explore data-sets to create hypotheses which can be tested and identify appropriate statistical tools.

5 Perform appropriate statistical tests using R Create and edit visualizations.

CO-PO MAPPING

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

20MAOE908 SDG NO. 4	MATHEMATICAL FINANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The main objective of this course is to introduce the financial mathematics and its applications to marketing.

UNIT I FINANCIAL MATHEMATICS 6

Introduction to financial markets, financial instruments, bonds, stocks and financial derivatives.

UNIT II RISK FREE ASSETS 9

Time value of money, Simple interest, periodic compounding, streams of payments, continuous compounding. Money market: zero coupon bonds, coupon bonds, money market account.

UNIT III FORWARD AND FUTURE CONTRACTS 12

Forward contract, forward price formula, value of a forward contract, futures contract, futures pricing.

UNIT IV PORTFOLIO MANAGEMENT **6**

Risk and return, expected return - standard deviation as risk measure, two securities, risk and expected return on a portfolio.

UNIT V OPTION PRICING **12**

Definition and preliminaries, behavior of option prices with respect to variables, pay-off curves, single and multi period binomial lattice models for option pricing, pricing - American options: a binomial lattice model, Black-Scholes formula.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. M. Capinski and T. Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, Springer, 2005.
2. S. Chandra, S. Dharmaraja, Aparna Mehra and R. Khemchandani, Financial Mathematics – An Introduction, Narosa Publishing House, New Delhi, 2013.

REFERENCES:

1. J. C. Hull, Options, Futures and Other Derivatives, 8th Ed., Pearson India/Prentice Hall, 2011.
2. J. Cvitanic and F. Zapatero, Introduction to the Economics and Mathematics of Financial Markets, Prentice-Hall of India, 2007.
3. A.O. Petters and X. Dong, An Introduction to Mathematical Finance with Applications, Springer, 2016.
4. David G. Luenberger, Investment Science, Oxford University Press, Delhi, 1998.
5. Frank J. Fabozzi, Bond markets, analysis, and strategies, 9th Ed., Pearson
6. Sheldon M Ross, An elementary introduction to Mathematical Finance, Cambridge University Press, New York, 2011.
7. M. J. Alhabeeb, Mathematical Finance, John Wiley and Sons, Inc., 2012.
8. Donald G. Saari, Mathematics of Finance: An Intuitive Introduction, Springer.
9. R. Brown and P. Zima, Schaum's Outline of Mathematics of Finance, 2nd Ed., McGraw-Hill Education-Europe, 2011.
10. S. Roman, Introduction to the Mathematics of Finance: From Risk Management to Options Pricing, Springer India, 2004.

WEB REFERENCES:

1. https://nptel.ac.in/courses/111/103/111103126/
2. https://ocw.mit.edu/courses/mathematics/18-s096-topics-in-mathematics-with-applications-in-finance-fall-2013/lecture-notes/

ONLINE RESOURCES:

1. http://www.math.snu.ac.kr/~trutnau/finance22015.pdf
2. http://www.math.ntu.edu.tw/~chern/notes/finance.pdf
3. https://people.richland.edu/james/lecture/m170/

OUTCOMES:

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

1. Optimise and plan the day to day financial affairs.
2. Apply different valuation models to evaluate fixed income securities, stocks, and how to use different derivative securities to manage their investment risks.
3. Assess and manage the forward price risk and volatility of various financial assets.
4. Describe asset allocation models across various asset classes depending on individual risk appetite.
5. Demonstrate an understanding of various attributes that is considered for option pricing model on which the premium is ascertained.

CO - PO MAPPING

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

20MAOE909 SDG NO. 4	DISCRETE MATHEMATICAL STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of Logic, Rules of inference and Quantifiers.
- To learn the concepts of Mathematical induction, Permutation and Combination.
- To develop Graph Algorithms by using the concepts of Graphs
- To impart the knowledge on Groups, Rings and Fields.
- To learn the basic concepts of Boolean Algebra and Lattices.

UNIT I LOGICS AND PROOFS 12

Basic Connectives – Truth Tables – Logical Equivalence: The Laws of Logic, Logical Implication – Rules of Inference – The use of Quantifiers – Proof Techniques: Some Terminology – Proof Methods and Strategies – Forward Proof – Proof by Contradiction .

UNIT II COMBINATORICS 12

The Principles of Mathematical Induction-The Well-Ordering Principle – Recursive definition – Basic counting techniques – Inclusion and exclusion , Pigeonhole principle – Permutation – Combination.

UNIT III GRAPHS 12

Graphs and their properties – Degree, Connectivity, Path, Cycle – Sub Graph – Isomorphism – Eulerian and Hamiltonian Walks.

UNIT IV ALGEBRAIC STRUCTURES 12

Algebraic Structures with One Binary Operation – Groups – Subgroups – Normal subgroups – Algebraic Structures with two Binary Operation: Definition and Examples of Rings and Fields.

UNIT V BOOLEAN ALGEBRA AND LATTICES 12

Partial ordering – Posets – Lattices as posets – Properties of lattices - Lattices as algebraic systems – Sub lattices – Boolean algebra.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications: with Combinatorics and Graph Theory,7th Edition, Tata McGraw –Hill Education Pvt. Ltd., 2015..
2. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure with Applications to Computer Science", McGraw-Hill Education (India) Edition 1997.

REFERENCES:

1. Susanna S. Epp, Discrete Mathematics with Applications, 4th edition, Brooks/Cole, Cengage Learning, 2010.
2. Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press, 2002.
3. Seymour Lipschutz, MarcLipson, Discrete Mathematics, Schaum's Outlines Series, 3rd edition, McGraw-Hill Education, 2009.
4. C. L. Liu and D. P. Mohapatra, Elements of Discrete Mathematics: A Computer Oriented Approach, 4th Edition, Tata McGraw –Hill Education Pvt. Ltd, 2012.

WEB REFERENCES

1. https://web.stanford.edu/class/cs103x/cs103x-notes.pdf
2. https://www.cs.cornell.edu/~rafael/discmath.pdf
3. http://home.iitk.ac.in/~arlal/book/mth202.pdf

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=h_9WjWENWV8&list=PL3o9D4Dl2FJ9q0_gtFXPh_H4POI5dK0yG
2. https://www.youtube.com/watch?v=xlUFkMKSB3Y&list=PL0862D1A947252D20
3. https://www.youtube.com/watch?v=4LlTmsfDS4Y&list=PLEAYkSg4uSQ2Wfc_l4QEZUSRdx2ZcFziO&index=13
4. https://www.youtube.com/watch?v=jBsEKyx6Rj0&list=PLwdnzlV3ogoVxVxCTlI45pDVM1aoYoMHf
5. https://www.youtube.com/watch?v=rdXw7Ps9vxc&list=PLHXZ9OQGMqxersk8fUxiUMSIx0DBqsKZS

OUTCOMES:

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

1 For a given logic sentence express it in terms of predicates, quantifiers, and logical connectives.

2 For a given a problem, derive the solution using deductive logic and prove the solution based on logical inference

3 For a given a mathematical problem, classify its algebraic structure

4 Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra

5 Develop the given problem as graph networks and solve with techniques of graph theory.

CO- PO MAPPING

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

20MAOE910 SDG NO. 4	NUMERICAL METHODS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which play an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9

Solution of algebraic and transcendental equations - Fixed point iteration method — Newton Raphson method - Solution of linear system of equations - Gauss elimination method — Pivoting - Gauss Jordan method — Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT II INTERPOLATION AND APPROXIMATION 9

Interpolation with unequal intervals - Lagrange's interpolation — Newton's divided difference interpolation — Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule — Romberg's Method - Two point and three point Gaussian quadrature formulae — Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9

Single step methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order equations - Multi step methods - Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9

Finite difference methods for solving second order two - point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain — One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods — One dimensional wave equation by explicit method.

TOTAL: 45 PERIODS

TEXTBOOKS :

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9'h Edition, Cengage Learning,2016.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi,2015.

REFERENCES :

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi,2007.
2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi,2006.
3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall,1992.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3'd Edition, New Delhi,2007.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd,5th Edition, 2015.

WEB REFERENCES:

1. https://www.udemy.com/course/programming-numerical-methods-in python
2. https://www.coursera.org/learn/intro-to-numerical-analysis
3. https://ocw.mit.edu/courses/mathematics/18-335j-introduction-to-numerical-methods
4. https://swayam.gov.in/nd1_noc19_ma21/preview
5. https://www.mooc-list.com/tags/numerical-methods

ONLINE RESOURCES:

1. https://www.quora.com/How-do-I-become-a-data-scientist
2. https://global.oup.com/uk/orc/biosciences/maths/reed/01student/numerical_tutorials/

OUTCOMES:

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

- Understand the basic concepts and techniques of solving algebraic and transcendental equations.
- Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
- Apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	2	0	1	2	0	1	0	3
CO2	3	3	1	3	2	0	1	2	0	1	0	3
CO3	3	3	0	3	1	0	1	1	0	1	0	3
CO4	3	3	0	1	2	0	1	2	0	1	0	3
CO5	3	3	0	1	2	0	1	1	0	1	0	3

20MAOE911 SDG NO. 4	CRYPTOGRAPHY AND NUMBER THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce and apply the concepts of rings, finite fields and polynomials.
- To comprehend the basic concepts of number theory.
- To provide knowledge of classical theorem in Number theory.
- To provide an introduction to some basic techniques of cryptography.
- To give an integrated approach to number theory abstract algebra, and cryptography provide a firm basis for further reading and study in the subject.

UNIT I RINGS AND FINITE FIELDS 9

Rings- Definition –Sub rings-Integral domain– Filed – Integer modulo n – Ring homomorphism. Polynomial rings – irreducible polynomials over finite fields – Factorization of polynomials over finite fields.

UNIT II DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS 9

.Division algorithm – base-b representation – number patterns - prime and composite numbers – test of primality-Pseudo primes – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM.

UNIT III CONGRUENCES AND CLASSICAL THEOREM 9

Linear Diophantine equation - Congruence's –Linear Congruence's-Applications: Divisibility tests- Modular exponentiation –Chinese remainders theorem-2X2 linear systems- discrete logarithm problem - Wilson Theorem-Fermat's little theorem – Euler's theorem- Euler's Phi function – Euler's totient function

UNIT IV CRYTOGRAPHY 9

Foundations of Cryptography- Some simple cryptosystems- product cryptosystem-cryptanalysis – Enciphering matrices –Public key-Affine ciphers – Exponential ciphers – The RSA Cryptosystem –Knapsack ciphers

UNIT V FACTORIZING AND ELLIPICTIC CURVES

Fermat Factorization and factor bases-The continued fraction method-The quadratic sieve methods-Elliptic curves-Basic facts- Elliptic curve cryptosystems- Elliptic curve primarily test-Elliptic curve factorization 9

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Koshy, T., "Elementary Number Theory with Applications", Elsevier Publications, New Delhi, 2002
2. Neil Koblitz., "A course in Number theory and Cryptography", Springer-Verlag, Second edition

REFERENCES:

1. Grimaldi, R.P and Ramana, B.V., "Discrete and combinatorial Mathematics", Pearson Education, 5 th Edition, New Delhi,2007
2. Lidl, R. and Pitz,G, "Applied abstract Algebra", Springer Verlag, New Delhi, Second Edition, 2006
3. Joseph. A. Gallian, "Contemporary Abstract Algebra" Narosa Publishing House, Bengaluru , Fourth Edition

4. Niven,I., Zukerman.H.S., and Montgomery, H.l., " An Introduction to Theory of Numbers". John Wiley and Sons, Singapore, 2004

WEB REFERENCES:

1. https://www.classcentral.com/course/number-theory-cryptography-9210
2. https://www.commonlounge.com/discussion/20f56c5cfff24d5d87f8a583505bb122
3. https://web.stanford.edu/~aaronlan/assets/finite-fields.pdf

ONLINE RESOURCES:

1. https://nptel.ac.in/courses.html
2. https://www.coursera.org/learn/crypto
3. https://swayam.gov.in/nd1_noc19_ma25/

OUTCOMES:

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

1 Apply the basic notions of Groups rings, fields and finite fields which will then be used to solve related problems.

2 Demonstrate accurate and efficient use of advanced algebraic techniques.

3 Demonstrate their mastery by solving non-trivial problems related to the concepts, and by proving simple theorems about the statement proven by the text.

4 Apply different cryptographic operations of public key cryptography

5 Understand factorization and various Elliptic curves

CO - PO MAPPING

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

20MAOE912 SDG NO. 4	CELLULAR AUTOMATA	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the basic concept of Cellular automata.
- Analyze how simple rules can lead to phenomenally complex and behaviors
- Acquire insights into relationship among formal languages, formal grammars and automata.
- Examine the behavior of stochastic and Monte-carlo dynamics
- Expose to concept of quantum cellular automata & reaction diffusion systems.

UNIT I INTRODUCTION 9

Introduction-History of CA &Computation -Powerful Computation Engines-Discrete Dynamical System Simulators-Mathematical Preliminaries -Set Theory-Information Theory - Graph Theory- Groups, Rings and Fields-Abstract Automata-One Dimensional and Two Dimensional CA.

UNIT II PHENOMENOLOGICAL STUDIES OF CELLULAR AUTOMATA 9

One-dimensionalSystems-Space-TimePatterns-BehavioralClasses-DifferencePatterns-Blocking Transformations- General Properties of Elementary CA-Local Properties-GlobalProperties-A Small Sampling of Rules–Rule 22 and30-Critical-LikeBehavior-Particle-Like Behavior for Space Time Pattern-Reversible Rules-Parameterizing the Space of CA Rules.

UNIT III CELLULAR AUTOMATA AND LANGUAGE THEORY 9

Regular Languages- Finite Automata- Context Free Languages- Push Down Automata-CA Rule - Finite state Transition Graph- Regular Language Complexity -Entropy-Power Spectra of Regular Languages- Numerical Estimates- Li's Algorithm for Generating Power Spectra–Reversible Computations.

UNIT IV PROBABILISTIC CELLULAR AUTOMATA 9

Critical Phenomena- A Heuristic Discussion-BoltzmannDistribution-Free Energy-Stochastic Dynamics-Monte Carlo Dynamics-CriticalExponents- Ising Model, General-One DimensionalIsing Model-Mean Field Approximation-Spin Glasses.

UNIT V QUANTUM CELLULAR AUTOMATA 9

Quantum Cellular Automata-Introduction- General Properties-A Conservation Law –k=2 systems, k=3 systems- Reaction Diffusion Systems-The Belousov- Zhabotinskii Reaction-Greenberg-Hastings Model - Hodgepodge Rule- Applications to Immunology- Random Boolean Networks.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Andrew Ilachinski "Cellular Automata A Discrete Universe|| - World scientific publishing company private limited, 2002.
2. Bastien Chopard, Michel Droz, —Cellular Automata Modeling of Physical Systems, Cambridge University Press, 2009
3. Andrew Adamatzky —Game of Life Cellular Automata||- Springer; 1st Edition, 2010

REFERENCES:

1. Hopcroft J.E., Motwani R. and Ullman J.D, "Introduction to Automata Theory, Languages and Computations", Second Edition, Pearson Education, 2008.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112106134/
2. https://www.youtube.com/watch?v=2SIqrz7NtR0

ONLINE RESOURCES:

1. https://files.wolframcdn.com/pub/www.stephenwolfram.com/pdf/cellular-automata-and-complexity-collected papers.pdf?5db8f077951d5e4ef6fbad86daf24214146552f3ae141ac21f7cf2aef767799678b244ec4070f219c19860ab58d8271a
2. https://www.whitman.edu/Documents/Academics/Mathematics/andrewgw.pdf

OUTCOMES

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

1 Understand the close theoretical relationship between computer science and other disciplines particularly Mathematics and Physics

2 Understand universal computation from a mathematical point of view, and how very simple cellular automata rules can reproduce computers as powerful as a super computer.

3 Cellular Automata ideas can be used in Computer Processors, Cryptography, Artificial Intelligence, etc.

CO- PO MAPPING

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

Sri SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

Affiliated to Anna University & Approved by AICTE, New Delhi

OPEN ELECTIVES

I - VIII SEMESTER
AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

DEPARTMENT OF PHYSICS

S. NO	COURSE CODE	COURSE TITLE	CONTACT HOURS	WEEK HOURS			CREDITS
				L	T	P	C
1	20PHOE901	Fundamentals of Nanoelectronics	3	3	0	0	3
2	20PHOE902	Fibre Optics and Laser Engineering	3	3	0	0	3
3	20PHOE903	Fundamentals of MEMS and Nanoscience (for ICE & E&I)	3	3	0	0	3
4	20PHOE904	Introduction to Nanoscience & Nanotechnology	3	3	0	0	3
5	20PHOE905	Quantum Information and Computing	3	3	0	0	3
6	20PHOE906	Nano and Quantum Electronics	3	3	0	0	3
7	20PHOE 907	Medical and Plasma Physics	3	3	0	0	3
8	20PHOE908	Structural Analysis & Materials Characterization	3	3	0	0	3
9	20PHOE909	Nuclear and Particle Physics	3	3	0	0	3
10	20PHOE910	Biophysics & Instrumentation	3	3	0	0	3
11	20PHOE911	Acoustics for Engineering	3	3	0	0	3
12	20PHOE912	Non-Linear Dynamics	3	3	0	0	3

OPEN ELECTIVES

20PHOE901 SDG NO. 4	FUNDAMENTALS OF NANOELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce and educate the basics of nanotechnology, microelectronics, mesoscopic physics and quantum structures, principles of carbon nanotubes, graphene, various characterization of nanostructures and their applications.

UNIT I NANOSCIENCE, SEMICONDUCTOR AND CARBON NANOTUBES **9**

Introduction to nanotechnology, Impacts, Limitations of conventional microelectronics, Trends in microelectronics and optoelectronic - Materials for nano electronics - Semiconductors - Crystal lattices: Bonding in crystals - Electron energy bands - Semiconductor hetero structures - Lattice-matched and pseudomorphic hetero structures - Inorganic-organic hetero structures - Carbon nanomaterials: nanotubes and fullerenes.

UNIT II FABRICATION TECHNIQUES **9**

Growth, fabrication of nanostructures - Introduction to methods of fabrication of nano-layers, different approaches, physical vapor deposition, chemical vapor deposition - Molecular Beam Epitaxy, Ion Implantation - Fabrication of nano particle - balls milling, laser ablation, reduction methods, sol gel, self assembly, precipitation of quantum dots.

UNIT III PROPERTIES AND INSTRUMENTATION TECHNIQUES **9**

Dielectrics - Ferroelectrics - Electronic Properties and Quantum Effects - Magneto-electronics - Magnetism and Magneto-transport in Layered Structures -Organic Molecules - Electronic Structures, Properties, and Reactions-Neurons - Principle of operation of Scanning Tunneling Microscope, Atomic Force Microscope, Scanning Electron microscope, Specimen interaction - Transmission Electron Microscope - X-Ray Diffraction analysis, PL & UV Spectroscopy - Particle size analyzer.

UNIT IV NANO STRUCTURE DEVICES **9**

Electron transport in semiconductors and nanostructures - Time and length scales of the electrons in solids - Statistics of the electrons in solids and nanostructures - Density of states of electrons in nanostructures - Electron transport in nanostructures - Electrons in traditional low-dimensional

structures - Electrons in quantum wells - Electrons in quantum wires - Electrons in quantum dots- Nanostructure devices - Resonant-tunneling diodes - Field-effect transistors - Single-electron-transfer devices - Potential-effect transistors - Nano-electromechanical system.

UNIT V LOGIC DEVICES AND QUANTUM PHYSICS APPLICATIONS 9

Logic devices - Silicon MOSFETs - Ferroelectric Field Effect Transistors - Quantum Transport Devices, based on resonant tunneling - Single electron devices for Logic applications - Superconductor electronics - quantum computing using superconductors - Carbon nanotubes for data processing - Molecular electronics - Quantum well laser, Quantum dot LED, Quantum dot laser, Quantum well optical modulator, Quantum well subband photo-detectors.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. B.K.Kaushik, "Nanoelectronics-Devices, Circuits and Systems", Elsevier Publications, Edition, 2018.
2. T.Pradeep, "Nano: The Essentials - Understanding NanoScience and Nanotechnology" Tata McGraw Hill, Paperback Edition, 2017.
3. W.George. Hanson, "Fundamentals of NanoElectronics", Pearson Education, 2009.
4. M.Mathews and K.Venkatesan, "A textbook of Quantum Mechanics", Tata Hill McGraw Hill Publishing Company Ltd, 2010.
5. P.Charles. Poole Jr and J.Frank. Owens, "Introduction to Nanotechnology", WileyIndia (P) Ltd., 2004.

REFERENCES:

1. Hassan Raza, "Nanoelectronics Fundamentals-Materials,Devices and Systems", Springer International Publishing,Switzerland AG, 2019.
2. M. Lindsay, "Introduction to NanoScience and Technology" SOUP (2009).
3. SupriyoDatta, "Lessons from Nanoelectronics: A New Perspective on Transport", World Scientific, 2012.
4. Korkin, Anatoli; Rosei, Federico (Eds.), "Nano electronics and photonics", Springer, 2008.
5. Karl Goser, Peter Glösekötter, Jan Dienstuhl, "Nano Electronics and Nano Systems: From Transistors to Molecular and Quantum Devices", Springer, 2004.
6. Jaap Hoekstra, "Introduction to NanoElectronic Single-Electron Circuit Design", Pan Stanford Publishing, 2010.

7. W. Ranier, "Nano Electronics and Information Technology", John Wiley & Sons, 2012.

OUTCOMES:

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

1. Recite nanotechnology, microelectronics, mesoscopic physics and quantum dots.
2. Attempt synthesis of carbon nanotubes and graphene using CVD, MBE techniques and laser ablation.
3. Characterize the nanostructures, using SEM, TEM and AFM, XRD, PL & UV spectroscopy.
4. Interpret basic principles in quantum wells, super lattices and parallel transport.
5. Demonstrate the principles of nanoelectronic devices, Coulomb blockade effect, SET, quantum dot laser.

CO - PO MAPPING

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

20PHOE902 SDG NO. 4	FIBER OPTICS AND LASER INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the basic concepts of optical fiber and their properties.
- To provide adequate knowledge about the industrial applications of optical fibers.
- To familiarize the Laser fundamentals.
- To enhance the knowledge about industrial application of lasers.
- To render the knowledge of holography and medical applications of lasers.

UNIT I OPTICAL FIBERS AND THEIR PROPERTIES 9

Construction of optical fiber cable: Guiding mechanism in optical fiber and basic component of optical fiber communication - Principles of light propagation through a fiber: Total internal reflection, Acceptance angle (θa), Numerical aperture and Skew mode - Different types of fibers and their properties: Single and multimode fibers and Step index and graded index fiber characteristics: Mechanical characteristics and Transmission Characteristics - Absorption Losses - Scattering losses - Dispersion - Connectors and splices - Fiber termination - Optical sources: Light Emitting Diode (LED) - Optical detectors: PIN Diode.

UNIT II INDUSTRI APPLICATION OF OPTICAL FIBERS 9

Fiber optic sensors: Types of fiber optics sensor, Intrinsic sensor - Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fiber Optic Sensor and Displacement sensor (Extrinsic Sensor) - Fiber optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflectometers, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques - Different types of modulators: Electro - optic modulator (EOM) - Interferometric method of measurement of length - Moire fringes - Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT III LASER FUNDAMENTALS 9

Fundamental characteristics of lasers - Three Level Laser, Quasi Three and four level lasers - Properties of laser: Monochromaticity, Coherence, Divergence and Directionality and Brightness - Laser modes - Resonator configuration - Q-switching and mode locking - Cavity damping - Types of lasers - Gas lasers - CO2 Laser, solid state Lasers - Nd-YAG Laser - dye lasers.

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9

Laser for measurement of length, velocity, acceleration, current, voltage and Atmospheric Effect: Types of LIDAR, Construction and Working, and LIDAR Applications - Material processing: Laser instrumentation for material processing, Powder Feeder, Laser Heating, Laser Welding, Laser Melting, Conduction Limited Melting and Key Hole Melting - Laser trimming of material: Process Of Laser Trimming, Types Of Trim, Construction and Working Advantages - Material Removal and vaporization: Process Of Material Removal.

UNIT V HOLOGRAM AND MEDICAL APPLICATIONS 9

Holography: Basic Principle, Holography vs. photography, Principle Of

hologram recording, Condition for recording a Hologram, Reconstructing and viewing the holographic image- Holography for non-destructive testing - Holographic components - Medical applications of Nd:YAG laser - Laser-tissue Interactions - Photochemical reactions, Thermalisation, collisional relaxation, Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynecology and oncology.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. J.M. Senior, "Optical Fibre Communication - Principles and Practice", Pearson Education India, 2009.
2. J. Wilson and J.F.B. Hawkes, "Introduction to Opto Electronics", Prentice Hall of India, 2001.
3. Eric Udd, B.William, and Spillman, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists", John Wiley & Sons, 2011.
4. Orazio Svelto, "Principles of Lasers", 5th edition, Springer, 2017.
5. Govind Agarwal, "Nonlinear Fiber Optics",Academic Press, 5th Edition, 2012.

REFERENCES:

1. Renk and F.Karl, "Basics of Laser Physics", Springer-Verlag, 2nd Edition, 2017.
2. T.K.Gangopadhyay,P.Kirubakar,M.K.Mandal,CRC Press, 2019.
3. G.Keiser., "Optical Fiber Communication", McGraw-Hill, 3rd Edition, 2000.
4. K.Thyagarajan and A.K.Ghatak, "Laser Fundamentals and Applications", Springer, 2nd Edition, 2011.
5. John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in 2008.
6. John and Harry, "Industrial Lasers and their Application", McGraw-Hill, 2002.
7. Frank Trager, "Handbook of Lasers and Optics", Springer, 2019.

WEB REFERENCES:

1 http://nptel.ac.in/courses/117101002

2 https://swayam.gov.in/ndl_noc20_ph07/preview

OUTCOMES:

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

1. Elaborate the principle, transmission, dispersion and attenuation characteristics of optical fibers.

2. Apply the gained knowledge on optical fibers for its use as communication medium and as sensor as well which have important applications in production, manufacturing, industrial and biomedical applications.
3. Understand laser theory and laser generation system.
4. Apply laser theory for the selection of lasers for a specific industrial and medical application.
5. Develop the industrial application of Holography and medical applications of Lasers.

CO - PO MAPPING

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

20PHOE903 SDG NO. 3, 11,12	MEMS AND NANO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the MEMS and NEMS technologies, their advancements and applications

UNIT I INTRODUCTION AND SCALING 9

MEMS and Microsystems - development of MEMS technology- MEMS future and applications, Microsystems and microelectronics - MEMS challenges - scaling - scaling in geometry, rigid body dynamics, electrostatic forces, electromagnetic forces, electricity, fluid mechanics, heat transfer.

UNIT II MATERIALS FOR MEMS 9

Introduction - substrates and wafer- silicon substrate - crystal structure, miller indices, properties - silicon compounds - silicon dioxide, silicon carbide, silicon nitride, polycrystalline silicon- gallium arsenide - quartz- piezoelectric crystals - polymers - polymers for MEMS, conductive polymers.

UNIT III FABRICATION PROCESS **9**

Physical Vapour Deposition (PVD) - evaporation, sputtering - Chemical Vapour Deposition (CVD) - Etching process - Wet chemical etching, plasma etching, Ion milling - patterning - lithography, lift off process - wafer bonding - silicon fusion bonding, anodic bonding - annealing- chemical mechanical polishing - doping - diffusion, Implant.

UNIT IV MEMS TECHNOLOGIES AND PACKAGING **9**

Bulk micromachining - Isotropic and anisotropic etching, wet etchants, etch stop, dry etching, comparison of wet and dry etching - surface micromachining - Introduction, process, associated problems - LIGA Process and electroplating - Integration of electronics and MEMS technology- packaging - post fabrication process, package selection, die attach, Wire bond and Sealing.

UNIT V NEMS TECHNIQUES AND APPLICATIONS **9**

Introduction to NEMS and its architecture - carbon nanotube electronics - modeling - introduction, analysis and simulation - simulation of Actuators, FET, Pressure transducer - applications and future challenges.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. Sergey Edward Lyshevski, Nano and Micro Electromechanical systems, fundamentals of nano and micro engineering- second edition CRC press, New york Washington DC 2018.
2. Gatzen, Hans,Saile "Micro –Nano Fabrication", Springer, 2015
3. Tai Ran Hsu, "MEMS and Microsystems, Design, Manufacture and Nanoscale Engineering", John Wiley & Sons, New Jersey. 2008.
4. James J Allen, "Micro Electro Mechanical System Design" CRC Press-Taylor & Francis, New York, 2005.

REFERENCES:

1. Ki Bang Lee, Principles of microelectromechanical systems, A John Wiley & Sons inc, Publications, IEEE press 2011.
2. Vikas Choudhary and Krzysztof Iniewski, MEMS fundamental Technology and applications. Taylor and Francis Group CRC press, 2013.
3. Ananthasuresh G. K., Vinoy. K.J., Gopalakrishnan.S, "Micro and Smart Systems", Wiley India Pvt Ltd, New Delhi, 2012.
4. Vijay K. Varadan, Vinoy. K.J., Gopalakrishnan.S, "Smart Material Systems and MEMS: Design and Development Methodologies", John Wiley & Sons, New York, 2011.

OUTCOMES:

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

1. Elaborate the MEMs technology and their challenges.
2. Identify the suitable materials for MEMs fabrications.
3. Demonstrate various synthesis techniques involved in MEMs constructions.
4. Apply the gained knowledge to MEMs packing advancements.
5. Develop the industrial application of MEMs technology.

CO - PO MAPPING

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

20PHOE904 SDG NO. 4	INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce knowledge on the basics of Nanoscience and Technology.
- To learn about the preparation techniques and various types of nanomaterials.
- To analyze the different characterization techniques.

UNIT I INTRODUCTION **9**

Introduction to Nanoscience and Technology - Implications for Physics, Chemistry, Biology and Engineering - Nanostructured materials - Classification - nanoparticles - quantum dots - nanowires - nano thin films - Size effect - Quantum effect - Quantum confinement of electrons in nanostructured materials – Quantum confinement in 3D, 2D, 1D and zero dimensional structures - Properties of nanostructures.

UNIT II PREPARATION TECHNIQUES 9

Top-down and bottom-up synthesis method - Co-precipitation - Self assembly - Mechanical milling – Ultrasonication - Sol-gel - Laser ablation - Electro deposition - Physical vapor deposition (PVD) - Chemical vapour deposition (CVD) - Spray pyrolysis - Sputtering - Molecular beam epitaxy - Atomic layer epitaxy.

UNIT III CARBON NANOTUBES AND METAL OXIDES 9

Nanoforms of carbon - Buckminster fullerene - Graphene - Carbon nanotubes (CNTs) - Types - Single wall carbon nanotubes (SWCNT) - Multiwall carbon nanotubes (MWCNT) - Properties and applications of CNTs. Nano metal oxides – ZnO, TiO2, MgO, ZrO2, Al2O3, NiO. Nano Ferrites - Functionalization and applications

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique - Crystallite size analysis using Scherrer formula – Scanning Electron Microscopy (SEM) - Transmission Electron Microscopy (TEM) with high-resolution imaging (HRTEM) - Particle size measurement using DLS and HRTEM – Surface analysis techniques - Atomic Force Microscopy (AFM) and Scanning Probe Microscopy (SPM) – Electron Spectroscopy for Chemical Analysis (ESCA) - Nanomechanical characterization – Nanoindentation.

UNIT V APPLICATIONS OF NANOTECHNOLOGY 9

Nanoinfo Tech: Information storage – nanocomputer, molecular switch, super chip, nanocrystal – Nano-biotechnology: nanoprobes in medical diagnostics and biotechnology -Nano medicines – Targeted drug delivery – Bioimaging – Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS) – Nanosensors – Nano crystalline materials for bacterial inhibition – Nanomaterials in supercapacitor and dye sensitized solar cell applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ajit D Keldar, Daniel J C Herr, James G. Ryan, “Nanoscience and Nanoengineering: Advances and applications, CRC Press, 2017.
2. Hobart Hurd Willard, Lynne Lionel Merritt, John Aurie Dean, Frank A Settle “Instrumental methods of Analysis , CBS publishers and distributors, New Delhi, 8th edition, 2016.
3. C. Wolf Edward “ Nanophysics and Nanotechnology”, Wiley VCH, 2015.
4. B. Rogers, J. Adams, S. Pennathur, “Nanotechnology understanding small systems”, CRC Press 2014.

5. A.S. Edelstein & R.C. Cammearata, "Nanomaterials: Synthesis, properties and applications" Institute of Physics Publishing, Bristol and Philadelphia, 2012.

REFERENCES:

1. Emmanuel Craig, "An introduction to preparation, synthesis and applications", Imperial College Press, 2019.
2. Nils, Petersen, "Foundations for Nanoscience and Nanotechnology", CRC Press, 2017.
3. Wandelt & Klaus, "Surface and Interface science", Wiley VCH, 2016.
4. T. Pradeep, "A text book of Nanoscience and Nanotechnology", Tata McGraw Hill Education Pvt. Ltd., 2012.
5. K. Barriham & D.D. Vvedensky, "Low dimensional semiconductor structures: fundamental and device applications", Cambridge University Press, 2012.

OUTCOMES:

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

1. Elaborate the nanoscience, nanotechnology and various kinds of nanomaterials.
2. Prepare nanomaterials by various synthesis methods.
3. Identify the application of carbon nanotubes, metal oxides, ferrites and their potential engineering applications.
4. Characterize the nanomaterials through various techniques.
5. Apply the different nanostructured materials for interdisciplinary applications

CO - PO MAPPING

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

20PHOE905 SDG NO. 4	THE PHYSICS OF QUANTUM COMPUTING AND INFORMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the fundamentals of quantum physics, basics of quantum computing algorithms and error corrections.

UNIT I QUANTUM PHYSICS AND COMPUTATION 9

Overview of traditional computing – Church-Turing thesis – circuit model of computation – reversible computation – quantum physics – quantum physics and computation – Dirac notation and Hilbert Spaces – dual vectors – operators – the spectral theorem – functions of operators – tensor products – Schmidt decomposition theorem.

UNIT II QUBITS AND QUANTUM MODEL OF COMPUTATION 9

State of a quantum system – time evolution of a closed system – composite systems – measurement – mixed states and general quantum operations – quantum circuit model – quantum gates – universal sets of quantum gates – unitary transformations – quantum circuits

UNIT III QUANTUM ALGORITHMS–I. 9

Superdense coding – quantum teleportation – applications of teleportation – probabilistic versus quantum algorithms – phase kick-back – the Deutsch algorithm – the Deutsch- Jozsa algorithm – Simon's algorithm – Quantum phase estimation and quantum Fourier Transform – eigenvalue estimation

UNIT IV QUANTUM ALGORITHMS – II. 9

Order-finding problem – eigenvalue estimation approach to order finding – Shor's algorithm for order finding – finding discrete logarithms – hidden subgroups – Grover's quantum search algorithm – amplitude amplification – quantum amplitude estimation – quantum counting – searching without knowing the success probability.

UNIT V QUANTUM COMPUTATIONAL COMPLEXITY AND ERROR CORRECTION 9

Computational complexity – black-box model – lower bounds for searching – general black-box lower bounds – polynomial method – block sensitivity – adversary methods – classical error correction – classical three-bit code – fault tolerance – quantum error correction – three- and nine-qubit quantum codes – fault-tolerant quantum computation.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. M.A. Nielsen and I.L.Chuang, " Quantum Computation and Quantum Information", Cambridge University press, 2013.
2. Eric R Johnston, Nic Harrigan and Mercedes Gimenosegovia, "Programming Quantum Computers: Essential algorithms and code samples", O'Reilly Media, 2019.
3. Chris Bernhardt, "Quantum computing for everyone", The MIT press, 2019.
4. Eleanor Rieffel and Wolfgang Polak, Quantum computing A Gentle introduction, MIT Press, 2011.
5. P. Kaye, R. Laflamme, and M. Mosca, "An introduction to Quantum Computing", Oxford University Press, 2007.

REFERENCES:

1. Jack D. Hidary, "Quantum computing, An applied approach", Springer 2019.
2. Bera, Rajendra K, "The amazing world of Quantum computing", Springer, 2019.
3. Scherer, Wolfgang, "Mathematics of Quantum Computing", Springer, 2019.
4. Eleanor G. Riffle and Wolfgang H. Polka, "Quantum Computing: A Gentle Introduction"- The MIT Press – 2014.
5. Vladimir Silva, "Practical Quantum computing for developers", Apress, 2018.
6. Riley Tipton Perry," Quantum computing from the Ground", WP world scientific, 2012.

ONLINE SOURCES:

1. https://www.cs.umd.edu/~amchilds/teaching/w13/qic823.html 2 2. 2. 2.
2. https://www.cse.iitk.ac.in/users/rmittal/prev_course/s16/course_s16.php
3. www.ibm.com/cloud/computing.

OUTCOMES:

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

1. Interpret the principles of quantum physics and computation.
2. Elaborate the principles of qubits and the quantum model of computation.
3. Apply the fundamental principles of quantum algorithms for Quantum phase estimation and quantum Fourier Transform.

4. Write the quantum algorithms for order finding.
5. Execute the basics of quantum computational complexity and error correction.

CO- PO MAPPING :

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

20PHOE906 SDG NO. 4	NANO AND QUANTUM ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge on nanoelectronics and quantum transport devices

UNIT I FUNDAMENTALS OF NANOELECTRONICS 9

Introduction to nanotechnology and nanoelectronics - Impacts - Limitations of conventional microelectronics - Mesoscopic physics - Trends in microelectronics and optoelectronics - Characteristic lengths in mesoscopic systems - Quantum mechanical coherence - Low dimensional structures - Density of states and dimensionality - Quantum wells - basic properties of two dimensional semiconductor nano structures - Square quantum wells of finite depth - Parabolic and triangular quantum wells - Quantum wires and quantum dots.

UNIT II FABRICATION AND MEASUREMENT OF NANOSTRUCTURES 9

Fabrication of nanomaterials - different approaches - Fabrication of nano-layers - Physical Vapour Deposition - Chemical Vapour Deposition - Epitaxy - Molecular Beam Epitaxy - Preparation of nanoparticle - balls milling - laser ablation - reduction methods - sol gel - self assembly - precipitation of quantum dots - Characterization techniques for nanomaterials - STM - AFM - SEM - TEM.

UNIT III NANOELECTRONIC DEVICES **9**

Tunneling through a potential barrier - Potential energy profiles for material interfaces - Metal-insulator and metal-semiconductor junctions - Metal-insulator-metal junctions - Heterojunctions - Quantum well - modulation doped quantum wells - multiple quantum wells - Quantum Hall effect - Applications of tunneling - Field emission gate - oxide tunneling - Hot electron effects in MOSFETs - Double barrier tunneling - Resonant tunneling diode.

UNIT IV QUANTUM DEVICES **9**

Coulomb blockade effect - Tunnel junction excited by a current source - Single electron transistor, ballistic transport - Quantum resistance and conductance - CNT transistors - Quantum well laser - Quantum dot laser - Quantum well optical modulator - Quantum well sub band photo detectors - Infrared detector - principle of NEMS - Transport of spin, spintronics devices and applications.

UNIT V MOLECULAR NANOELECTRONICS **9**

An atomistic view of electrical resistance - Schrodinger equation and self consistent field - Band Structure - Level broadening - Coherent transport - Non- coherent transport in molecular electronics devices - Optical molecular memories - Random access memory - Molecular devices and logic switches - Organic material based rectifying diode switches - OLEDs - Molecular wires and molecular circuits.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. George W. Hanson, "Fundamentals of Nanoelectronics", Prentice Hall, 2009.
2. Edward L. Wolf, "Quantum Nanoelectronics", John Wiley & Sons, 2015.
3. Pradeep, "Nano the Essentials-Understanding Nano Science and Nanotechnology," McGraw Hill, Paperback Edition, 2017.
4. Chattopadhyay and Banerjee, "Introduction to Nanoscience & Technology", PHI, 2009.
5. R.Kelsall, I.W. Hamley, M.Geoghegan, Nanoscale Science and Technology, John Wiley & Sons, 2005.

REFERENCES:

1. Hazzan Raza, "Nanoelectronics Fundamentals - Materials, Devices and Systems", Springer, 2019.
2. Fahrner W. R., "Nanotechnology and Nanoelectronics", Springer, 2009.
3. Rainer Waser, "Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices", Wiley-VCH, 2012.

4. Goser K., "Nanoelectronics and Nano systems", Springer, 2013.
5. Supriyo Dutta, "Quantum Transport- Atom to Transistor", Cambridge, 2013.
6. Vijaykumar Arora, "Nanoelectronics", CRC Press, 2018.

OUTCOMES:

At the end of the coursework, the students should be able to:

1. Interpret the fundamental of science and quantum mechanical effects associated with low dimensional semiconductors.
2. Illustrate nano level fabrication of particles and layers and their characterization.
3. Correlate the concept of quantum level transport and tunneling in similar structured nano devices.
4. Analyze nanoscale devices like SET, QW laser, CNT Transistors, and so on.
5. Demonstrate molecular electronics.

CO, PO - PSO MAPPING

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

20PHOE907 SDG NO. 4	MEDICAL AND PLASMA PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the complete non-ionizing radiations including light and its effect in human body
- To understand the principles of ultrasound radiation and its applications in medicine.
- To explore the Diagnostic and Therapeutic applications Lasers.
- To know about the Uses of Spectroscopic Techniques in the medical field.
- To learn the concept of Plasma and its application in the medical field.

UNIT I NON-IONIZING RADIATION AND ITS MEDICAL APPLICATIONS9

Introduction to EM waves - Tissue as a leaky dielectric - Relaxation processes: Debye model, Cole-Cole model - Overview of non-ionizing radiation effects - Low Frequency Effects - Higher frequency effects - Physics of light - Measurement of light and its unit - limits of vision and color vision an overview - Applications of ultraviolet in medicine, Thermograph.

UNIT II ULTRASOUND IN MEDICINE 9

Ultrasound fundamentals - Generation of ultrasound (Ultrasound Transducer) - Interaction of Ultrasound with matter: Cavitations, Reflection, Transmission - Scanning systems – Artifacts – Ultrasound - Doppler- Double Doppler shift - Clinical Applications - Ultrasonography.

UNIT III LASERS IN DIAGNOSIS AND THERAPY 9

Introduction about the lasers, Generation of lasers and its types, Trace Elements detection - laser-induced fluorescence studies - cancer diagnosis - lasers in endoscopy - photo radiation therapy of tumors - lasers in laparoscopy - lasers in trapping of cells and genetic engineering - bio simulation.

UNIT IV OPTICAL SPECTROSCOPY IN MEDICINE 9

Optical characteristics of biomolecules from the point of spectroscopy - principles of UV - Visible absorption - IR and FTIR absorption - Raman and Fluorescence spectroscopy - application with regard to characterization of bio molecules - blood oxygen, glucose measurements, monitoring drug concentration, cancer diagnosis.

UNIT V PLASMA & MEDICAL APPLICATIONS 9

Fundamentals of plasma and methods for its generation - processing, Gas discharge processes, dc discharge, Rf discharge, capacitive and inductively, coupled plasma systems theory and description of different plasma production systems - Cold plasma application - Indirect (Plasma Jet), Direct Methods (Dielectric Barrier Discharge (DBD), Applications of Cold Atmospheric Pressure Plasma (CAP), Decontamination in Dentistry, Enhancement of Blood Coagulation, Surface coating of Implants, Plastic surgery, Treatment of Skin diseases, Degradation of Toxins, Non-Thermal Plasma sterilization of Living And Non-Living Surfaces, In activation of Micro organism by Plasma.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. B H Brown, R H Smallwood, D C Barber, P V Law ford and D R Hose, “Medical Physics and Biomedical Engineering”, CRC Press ,2017.
2. K.Thayalan, "Basic Radiological Physics", Jaypee Brothers Medical Publishers, 2017.
3. Markolf H Niemz, “Laser-Tissue Interactions Fundamentals and Applications”, Springer-Verlag Berlin Heidelberg, New York, 2019.
4. Sadhan M.Musa,"Computational Optical Biomedical Spectroscopy and Imaging", CRC Press; 1 edition (January 28, 2015)
5. Baranska, Malgorzata,"Optical Spectroscopy and Computational Methods in Biology and Medicine ", Springer ,2014.
6. Nandkumar N “Plasma-The Fourth State of Matter” Int. J Sci Technol. Res 2014.
7. M. Laroussi, M. G. Kong , G. Morfill , W. Stolz,"Plasma Medicine: Applications of Low-Temperature Gas Plasmas in Medicine and Biology",Cambridge University Press; 1 edition (24 May 2012).

REFERENCES:

1. Faiz.M. Khan, John.P. Gibbons, "The Physics of Radiation therapy", Wolter Mouser,Lippincott Williams and wilkins, 2020.
2. John Christopher Draper, "A Text Book of Medical Physics", Forgotten Books, 2018.
3. Zhihua Qi, Robert D. Wissman, "Radiologic Physics: The Essentials", Wolters Kluwer,2020.
4. Yusuf Tutar,"Plasma Medicine Concepts and Clinical Applications", Intechopen,May 16th 2018.
5. Alexander Friedman, Gary Friedman, " Plasma Medicine", John Wiley & Sons Ltd,January 2013.

JOURNAL REFRENCES:

1. Fridman, G.; Peddinghaus, M.; Balasubramanian, M.; Ayan, H.; Fridman, A.; Gutsol, A.; Brooks, A. Blood coagulation and living tissue sterilization by floating-electrode dielectric barrier discharge in air. Plasma Chem. Plasma Process. 2006, 26, 425.
2. De Geyter N, Morent R, Nonthermal plasma sterilization of living and nonliving surfaces. Annu Rev Biomed Eng. 2012; 14: 255-274.
3. Sakudo, A.; Shintani, H. Sterilization and Disinfection by Plasma: Sterilization Mechanisms, Biological and Medical Applications (Medical Devices and Equipment); Nova Science Publishers: New York, NY, USA, 2010

4. Plasma medicine—current state of research and medical application K-D Weltmann and Th von Woedtke 3 November 2016.
5. Plasma medicine - Current state of research and medical application
   - January 2017 - Plasma Physics and Controlled Fusion 59(1):014031
   - K-D Weltmann,Th von Woedtke.

OUTCOMES:

At the end of the coursework, the students should be able to:

1. Analyze the low frequency and high frequency effects of non-ionizing radiation and physics of light.
2. Define various clinical applications based on ultrasound waves.
3. Elaborate the diagnostic and therapeutic applications of lasers.
4, Illustrate the medical applications of optical spectroscopy.
5. Narrate the plasma fundamentals and its applications in the medical field.

CO-PO MAPPING

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

20PHOE908 SDG NO. 4	STRUCTURAL ANALYSIS OF MATERIALS AND CHARACTERIZATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce how to grow, analysis the structure and properties of new crystalline materials.

UNIT I CRYSTAL AND PREPARATION TECHNIQUES 9

Introduction – crystalline, amorphous single, poly crystalline- unit cells, Miller indices, Symmetry elements – Euler formula - rotation symmetry- translation symmetry- glide symmetry, crystal symmetry, lattice symmetry space group symmetry, point group symmetry Laue symmetry, Patterson symmetry, space group.

UNIT II STRUCTURAL ANALYSIS 9

X-ray Scattering techniques: powder method, Laue method - electron scattering, atomic scattering and unit cell scattering - inverse lattice - Wigner seitz cell and Brillouin zone. Indexing of XRD patterns - lattice parameter - X-ray powder diffractometer - Indexing of powder diffraction patterns - XRD peak analysis - Limitations of powder method - Single crystal diffractometers.

UNIT III ELEMENTAL MOLECULAR AND MORPHOLOGY ANALYSIS 9

X-ray photoelectron spectroscopy (XPS), Auger Electron Spectroscopy - Electron Probe Micro Analysis (EPMA) - Application of DTA, TGA, TMA and DSC - Science of Imaging and diffraction - Difference between transmission electron microscope and scanning electron microscopy - AFM and STM with their merits.

UNIT IV INFRARED, DIELECTRIC AND OPTICAL STUDIES 9

Dielectric behaviour: Capacitance - Types of polarization - Frequency dependence of dielectric constant. Spectroscopic methods: FTIR (IR, Raman), and mass spectrometry - Optical microscopy techniques including polarized light and phase contrast.

UNIT V MAGNETIC PROPERTIES OF SOLIDS 9

Magnetometers: M-H loop, temperature dependent magnetization, time dependent magnetization - Measurements using AC susceptibility - Magneto-optical Kerr effect - Nuclear Magnetic Resonance - Electron Spin Resonance.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. Sharma and Surendra Kumar, Handbook of Material characterization, Springer, 2018.
2. David.G.Rethwisch and William Callister, "Material Science and Engineering", Wiley, 2020.
3. D.B Cullity Franklin,"Elements of X-ray Diffraction", Classics Trade Press, 2018.

REFERENCE BOOKS:

1. Rohit P. Prasankumar, Anboinette J.Taylor,"Optical techniques for Solid State MaterialCharacterization",CRC Press, 2016.
2. Richard A.Dunlap,"Novel microstructure for solids", Morgan & Claypool Publishers, 2018.
3. P.K.Palanisamy, "Material Science", Scitech,2017.
4. Ramiro perez Campos, Antonio Contreras cuevas, Rodrigo A.Esparza Munoz,"Characterization of Meals and Alloys", Springer,2018.
5. Joseph C Woicik, "Hard X-ray Photoelectron Spectroscopy" S

ONLINE SOURCES:

1 https://www.ccdc.cam.ac.uk/solutions/csd-system/components/mercury/

2 https://www.iucr.org/resources/other-directories/software.

3 https://www.chem.purdue.edu/xray/software.html.

OUTCOMES:

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

1. Knowledge of how to prepare new engineering materials.
2. Test the prepared material fits with standard and reliable product.
3. Analysis the effect of elements, molecule and surface morphology in the properties of materials
4. Identify the electric, optical, mechanical nature of material for suitable applications.
5. Figure out the magnetic nature of the materials.

CO - PO MAPPING

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

20PHOE909 SDG NO. 4	NUCLEAR AND PARTICLE PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge about the modern particle physics, incorporating the description of the fundamental particles and their interaction using relevant theory.

UNIT I PROPERTIES OF NUCLEUS AND NUCLEAR MODEL 9

Quantum properties of Nucleon states: Nuclear energy levels – Nuclear angular momentum, parity, isospin, statistics, nuclear, magnetic dipole moment – Nuclear models: Liquid drop model – Bohr wheeler theory of nuclear fission – Shell model – Prediction of shell model – Collective nuclear model.

UNIT II NUCLEAR REACTION AND NUCLEAR DECAY 9

Types of Nuclear reactions and energetic of Nuclear reaction - Conservation laws – Nuclear reaction kinematics – Expression for Q value, Nuclear decay, Alpha decay – Geiger Nuttal laws – Gamow's theory – Neutrino hypothesis – Fermi theory of beta decay – selection rules – Gamma decay – selection rules – Internal conversion.

UNIT III ELEMENTARY PARTICLE 9

Classification of elementary particles – particle interaction – Conservation laws – Leptons – Hadrons – Pion – muons – mesons – hyperon - strange particles – CPT theorem – Quark model – Elementary particle symmetries - SU(2) & SU(3) symmetry – Weak and Strong interaction.

UNIT IV THE STANDARD MODEL 9

Experimental and theoretical aspects of modern particle physics in terms of

fundamental matter particles (Quarks and Leptons) and the gauge bosons (Photon, W±Z bosons, gluons) The standard model (SM): Gauge theory of electro weak and strong interaction, QCD – QCD correction, Feynman diagram and rules in QED, Experimental verification of SM.

UNIT V BEYOND THE STANDARD MODEL 9

Limitation of Standard model – Higgs Boson, Neutrinos, Dark matter and energy – Beyond the standard model - (BSM) -Grand Unified theory – Supersymmetry models - Theories of Everything: Super symmetry, String theory – Extra dimension - Axion – Cosmology.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. P.Feynman and S.Weinberg, " Elementary Particles and the Laws of Physics", Cambridge University Press, 2014.
2. Schwartz, D. Mathew "Quantum field theory and Standard model" Cambridge University press, 2013
3. Dine, Michael, "Supersymmetry and String theory: Beyond the standard model", Cambridge University press, 2016.
4. A. Bettini, "Introduction to Elementary particle Physics", Cambridge University press, 2018
5. Michael E. Perskin, "Concept of Elementary particle physics", Oxford university press, 2019.

REFERENCES:

1. T.William Donnelly, Joseph A. Formaggio, Richard G. Milner, Bernd Surrow., " Foundation of Nuclear and Particle physics", Cambridge University Press, 2017.
2. J Michael E Peskin, Daniel V.Schroeder," An introduction to Quantum field theory", CRC press, 2018.
3. P.Griffiths, "Introduction to Elementary particles", Wiley – VCH, 2010.
4. Joy Moody, " Advances in Particle physics", Willford Press, 2019.
5. Brain R Martin, Graham Shaw, "Nuclear and Particle Physics, An introduction" Wiley, 2019.
6. Gordon Kane, "Modern Elementary Particle Physics", Cambridge University Press, 2018.
7. Paul Langacker, "The standard model & Beyond", CRC Press, 2020

OUTCOMES:

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

1. Elaborate the fundamental properties of nucleus and the nuclear models such as liquid drop model, shell model and collective model.
2. Explicate the various nuclear reactions, conservation laws and Nuclear decay.
3. Explain the elementary particle interaction using relevant theory.
4. Analyze modern particle physics using the standard model and its experimental verification.
5. Apply the Beyond the standard model to explain various concepts like Higgs Boson, Neutrinos, Dark matter and Dark energy.

CO- PO MAPPING

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

20PHOE910 SDG NO. 4	BIOPHYSICS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce fundamentals of biophysics and basic principles in imaging techniques and the life assisting therapeutic devices
- To educate the communication mechanics of proteins in a biomedical system and measurement of certain important electrical and non electrical parameters

UNIT I MOLECULAR INTERACTIONS 9

Basic thermodynamics: Concept of entropy, enthalpy, free energy change, heat capacity. Forces involved in biomolecular interactions with examples: Configuration vs. conformation - Van der Waals interactions - Electrostatic interactions - Stacking interactions - Hydrogen bond and hydrophobic effect.

UNIT II MEDICAL IMAGING TECHNIQUES 9

Physical aspects of medical imaging - LASER beam in biology & medicine - fundamentals of laser physics, medical lasers (Carbon Dioxide Laser, Nd: YAG Laser,), applications of lasers in therapy and diagnosis - photothermal effects - photochemical effects - Principle, instrumental set up, procedure and medical utility of X-ray imaging - Xeroradiography - Fluoroscopy - Computer Tomography Scan - Magnetic Resonance Imaging

UNIT III PROTEIN DYNAMICS 9

Protein folding: Marginal stability of proteins - thermodynamic and kinetic basis of protein folding, protein folding problem (Levintha's paradox) and role of molecular chaperones in cellular protein folding - basics of molecular and chemical chaperones - protein misfolding and aggregation - diseases associated with protein misfolding.

UNIT IV NUCLEAR MEDICINE 9

In vitro & in vivo imaging using radioisotopes, blood volume determinations by isotopic method - radioiodine diagnosis & therapy in thyroid disorders - Principle, method and applications of radio immunoassay, organ scans - thyroid, liver, brain, bone, renal imaging, cardiac imaging - PET scan - nuclear medicine for therapy - radio-pharmaceuticals-concept, production & use.

UNIT V BIOMEDICAL INSTRUMENTATION 9

Basic concepts in medical instrumentation - basic sensors-principles, transducers, amplifiers - measurement of blood pressure, blood volume ,blood flow - respiratory measurements - cardiac output measurements - patient monitoring equipment - audiometers, cardiac pacemakers - surgical diathermy - physiotherapic equipment - hemodialysis machine - automated drug delivery systems - ICU and operation theater equipment - blood bank instrumentation.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. Shulika.O et al., "Advanced Lasers", Springer, 2015.
2. N.Arumugam, V.Kumaresan,"Biophysics and Bioinstrumentation", Saras Publications,2015.
3. Andreas Maier etal, "Medical Imaging Systems",Springer,2018.
4. DuccioVolterrani,"Nuclear Medicine Textbook: Methodology and clinical applications"Springer, 2017.

REFERENCES:

1. Dennis R.Livesay, "Protein Dynamics: Methods and protocols",Humana Press, 2016.
2. Leslie Cromwell, Fred J.Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Pearson Education, 2015.
3. David R. Gaskell, David E. Laughlin, , "Introduction to the thermodynamics of Materials",CRC press,2017.
4. Amitabhachattopadhyay,"Membrane Organization and dynamics", Springer, 2017.
5. Thayala kuppusamy,"Basic Radiological physics", Jaypee Brothers Medical publishers,2017.

OUTCOMES :

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

1. Illustrate the physics behind the biomolecular interactions
2. Apply the obtained knowledge on diagnosis and neuro imaging using scanning techniques
3. Demonstrate the functioning of protein.
4. Understand the use of nuclear medicine and imaging using radioisotopes.
5. Analyze instrumentation systems and their applications.

CO - PO MAPPING

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

20PHOE911 SDG NO. 5	ACOUSTICS FOR ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce knowledge on basics of waves and oscillations
- To learn about production and applications of ultrasonic waves
- To understand the acoustics of building

UNIT I WAVES AND OSCILLATION 9

Simple harmonic motion - Free, Damped, Forced vibrations and Resonance - Fourier's Theorem - Application to saw tooth wave and square wave - Intensity & loudness of sound - Decibels - Intensity levels - Noise pollution.

UNIT II ACOUSTIC WAVE EQUATION 9

Equation of state - Equation of continuity - Euler's equation - Linearized wave equation - Speed of sound in fluids - Harmonic plane waves - Energy density - Acoustic intensity - Specific acoustic impedance - Spherical waves - Decibel scales.

UNIT III ABSORPTION AND ATTENUATION 9

Complex sound speed - Absorption in liquids - Attenuation and scattering - Cavities and waveguides: Resonance in pipes - Open-ended pipes - Standing waves - Absorption in pipes - Pipes with drivers.

UNIT IV RESONATORS AND FILTERS 9

Helmholtz resonator - Acoustic impedance (radiation impedance and mechanical impedance) - Waves in a pipe - Acoustic filters. Ultrasonics: Production of ultrasonic waves - Piezoelectric crystal method - Magnetostriction method - Properties. Medical applications of ultrasound: Diagnostic imaging -Thermal therapy.

UNIT V ACOUSTICS OF BUILDINGS 9

Reverberation and time of reverberation - Absorption coefficient – Sabine's formula - Measurement of reverberation time - Acoustic aspects of halls and auditoriums.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. J.H. Ginsberg, "Acoustics-A text book for Engineers and Physicist", Springer Publishing Company, 2018.
2. Dimitrios G. Aggelis, "Acoustics and Elastic Waves: Recent trends in Science and Engineering", Mdpi,2017.
3. S.W.Rienstra, A.Hirschberg, "An Introduction to Acoustics", IWDE-9206, 2019.
4. Rossing and Thomas (Editors) 'Springer Handbook of Acoustics' Springer Nature; 2nd ed., 2014.
5. Tor Erik Vigran, "Building Acoustics", T & F Books UK, 2008.

REFERENCE BOOKS:

1. Marc Asselineau.,"Building Acoustics", CRC Press, 2015.
2. Charles E.Speaks, "Introduction to sound: Acoustic for the Hearing and Speech", Plural Publishing, 2017.
3. S.L. Kakani., "Waves and Oscillations and Acoustics", CBS Publications, 2017.
4. Brij Lal & N. Subramaniam, "Fundamentals of Acoustics", 1997.
5. M.Ghosh, D. Bhattacharya , "A textbook of Oscillations Waves and Acoustics", S.Chand Publishing, 2016.

OUTCOMES:

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

1. Illustrate the basic concepts of waves and oscillations.
2. Formulate the acoustic wave equations for real-time problems.
3. Demonstrate the attenuation during sound propagation.
4. Narrate the functions of resonators and filters and production and application of ultrasonic waves.
5. Apply the knowledge of acoustics of buildings in real-time applications.

CO - PO MAPPING

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

20PHOE912 SDG NO. 4	NONLINEAR DYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The objective of this course is to enable learners to understand the fundamental Knowledge about linear and nonlinear dynamics with applications. It takes an instinctive approach with emphasis on geometric thinking in computational and analytical
- To correlate the theoretical principles with applications and makes extensive use of demonstration software

UNIT I INTRODUCTION TO NONLINEAR DYNAMICS 9

Linear and nonlinear forces- mathematical implication of nonlinearity-Working definitions of nonlinearity.-Linear oscillators and predictability-damped and driven nonlinear oscillators-nonlinear oscillation and bifurcations.

UNIT II VARIOUS SYSTEMS 9

Qualitative features: Autonomous and non autonomous systems: Dynamical system as coupled first order differential equations-equilibrium points-Phase-space/phase plane and phase trajectories.

Classification of equilibrium points: Two dimensional case with examples-limit cycle motion-periodic attracters-Poincare- Bendixsons theorem-Higher dimensional system-Lorentz equations

UNIT III BIFURCATIONS AND CHAOS 9

Bifurcation theory – Local and global bifurcations - Three dimensional autonomous systems and chaos, Lyapunov exponents -– Torus – quasi-periodic attractor – Poincaré map – Period doubling cascades – Feigenbaum number – characterization – Homoclinic orbits, heteroclinic orbits – Strange attractor and strange non-chaotic attractor

UNIT IV FINITE DIMENSIONAL INTEGRABLE NONLINEAR DYNAMICAL SYSTEM 9

The notion of integrability-complete integrability-complex analytic integrability-How to detect integrability: Painleve

UNIT V SOLITON AND COMPLETE INTEGRABILITY 9

Nonlinear dispersive system- conoidal and solitary waves-The Scott Russel phenomenon and K-dv equation-fermi-pasta-Ulam numerical experiment-K-

dv equation-numerical experiment of Zabusky and Kruskal-Birth of solitons-Miura transformation and linerarization of K-dv equation: Lax pair- Inverse scattering transform method-Explicit soliton solution-Hirota's bilinearisation method.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. Stevan H.Strogatz "Non linear dynamics and chaos" 2 nd Edition, 2007.
2. Robert C.Hilborn "Chaos and Non linear dynamics An introduction for scientists and engineers" 2001.
3. E.A.Jackson: perspectives of nonlinear dynamics and II Cambridge Univ. Press, revised Edition.(1992)
4. R.L Devaney: An introduction to chaotic dynamical system, westview press,(2003) Hao Bai-lin chaos, world scientific publishing co.Pvt Ltd. Singapore , 2nd edition, CRC Press. 2003.

REFERENCE BOOKS:

1. M. Lakshmanan and S. Rajasekar, Nonlinear Dynamics: Integrability Chaos and Patterns Springer-Verlag, Berlin, 2003.
2. C. Misbah, Complex Dynamics and Morphogenesis: An Introduction to Nonlinear Science, Springer, 2017.
3. S. Wolfram, A New Kind of Science, Wolfram Media Inc., 2002
4. H. G. Schuster, Deterministic Chaos: An Introduction, Wiley-VCH, 2005
5. A. Fuchs, Nonlinear Dynamics in Complex Systems: Theory and Applications for the Life- , Neuro- and Natural Sciences, Springer, 2013.
6. S. H. Strogatz, Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering, II Edition, CRC Press, 2014.

OUTCOMES:

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

1. Discussion on the linear and nonlinear resonances and resonance in driven and damped nonlinear oscillators.
2. Apply the dynamic concept in various dimensional structural system
3. Discussion on the linear stability analysis and the illustration of basic bifurcations with suitable example.
4. Give a detailed theory of finite dimensional integrable nonlinear systems
5. Analysis the Nonlinear dispersive system and soliton theory used in various aspects.

CO- PO MAPPING

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

Sri
SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

Affiliated to Anna University & Approved by AICTE, New Delhi

OPEN ELECTIVES

I - VIII SEMESTER
AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

DEPARTMENT OF CHEMISTRY

S. NO	COURSE CODE	COURSE TITLE	CONTACT HOURS	WEEK HOURS			CREDITS
				L	T	P	C
1	20CYOE901	Advanced Engineering Chemistry	3	3	0	0	3
2	20CYOE902	Fundamentals of Nanochemistry	3	3	0	0	3
3	20CYOE903	Principles of Food Preservation	3	3	0	0	3
4	20CYOE904	Fundamentals of Nutrition	3	3	0	0	3
5	20CYOE905	Air Pollution and Control Engineering	3	3	0	0	3
6	20CYOE906	Bio Chemistry	3	3	0	0	3
7	20CYOE907	Green Technology	3	3	0	0	3
8	20CYOE908	Water and Waste Water Treatment	3	3	0	0	3
9	20CYOE909	Analytical Methods and Instrumentation Engineering	3	3	0	0	3
10	20CYOE910	Fuel Cell Chemistry	3	3	0	0	3
11	20CYOE911	Introduction to Bioenergy and Biofuels	3	3	0	0	3
12	20CYOE912	Corrosion Science and Engineering	3	3	0	0	3
13	20CYOE913	Waste Management and Recycling Technology	3	3	0	0	3
14	20CYOE914	Environmental Toxicology	3	3	0	0	3

OPEN ELECTIVES

20CYOE901 SDG NO. 6, 8, 9	ADVANCED ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop skills with basics of polymer chemistry.
- To learn the principles of electrochemical reactions, redox reactions in corrosion of materials and methods for corrosion prevention and protection of materials.
- To acquaint with concepts of photophysical and photochemical processes and spectroscopy.
- To acquire sound knowledge of the second law of thermodynamics and its applications..
- To understand the basics of nanomaterials, their properties and applications.

UNIT I POLYMERS AND SPECIALITY POLYMER 9

Polymers – Types of polymerization – degree of polymerization – plastics and types – mechanism of polymerization (free radical mechanism) properties of polymers - Tg and tacticity – compounding of plastics – fabrication of plastics – Blow and extrusion mouldings. Speciality polymers-conducting polymers: polyacetylene, polyaniline, synthesis, mechanism of conduction – applications of conducting polymers. Biodegradable polymers: requirements, factors affecting degradation – PLA– preparation, properties –applications.

UNIT II ELECTROCHEMISTRY, CORROSION AND PROTECTIVE COATINGS 9

Electrode potential – Nernst equation, numerical problems – Emf series, applications, electrochemical cells, galvanic cells, electrolytic concentration cells – Emf measurement problems. Corrosion: dry & wet corrosion – mechanism, factors affecting corrosion - corrosion control, material selection and design aspects – corrosion protection – sacrificial anode and impressed current methods. Protective coatings: Metallic coatings – electroplating of Cu - electroless plating of Ni. Organic coatings: Paints - constituents and function, special paints – water repellent, heat resistant and luminous paints.

UNIT III PHOTOCHEMISTRY & ANALYTICAL TECHNIQUES 9

Photochemistry: Laws of photochemistry - Grothuss–Draper law, Stark–Einstein law and Beer–Lambert's Law. Quantum efficiency – determination - photophysical processes (Jablonski diagram) -

photosensitization - chemiluminescence and bioluminescence. Analytical techniques: IR, UV – principle, instrumentation and applications. Thermal analysis: TGA & DTA - principle, instrumentation and applications. Chromatography: Basic principles of column & TLC – principles and applications.

UNIT IV THERMODYNAMICS 9

Terminology of thermodynamics – First law: Heat and Work Macroscopic and microscopic understanding of temperature (zero-th law), internal energy, heat and work – Conversion of internal energy into work and heat (first law) – microscopic understanding of heat and work – Joule's coefficient, Joule-Thomson effect – Second law of thermodynamics: Entropy –entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function- Helmholtz and Gibbs free energy functions (problems); criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius – Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore (problems).

UNIT V NANOCHEMISTRY 9

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties (surface to volume ratio, melting point, optical and electrical). Nanoparticles, nanocluster, nanorod, nanotube (CNT: SWNT and MWNT) and nanowire, synthesis - precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation, sol-gel process and applications (electronic and biomedical). Fullerenes: Types - C60 - preparation, properties and applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.
2. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013
3. B.Sivasankar , "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd.,2012.

REFERENCES:

1. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015.
2. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015.

3. B. K. Sharma, "Engineering Chemistry", Krishna Prakashan Media (P) Ltd, Meerut, 2012.

OUTCOMES:

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

- Develop knowledge on polymer chemistry, to produce sustainable biodegradable plastics.
- Illustrate the corrosion concepts and its preventive measures.
- Apply analytical techniques to characterise materials to be used in the engineering works.
- Use the thermodynamic concepts to achieve useful work in the operating systems.
- Acquire knowledge about the synthesis and emerging applications of nanomaterials in different engineering fields.

CO - PO MAPPING

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

20CYOE902 SDG NO. 8, 9	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the introduction about nano materials, their importance and their dimensions.
- To study about the synthetic methods of nano materials.
- To develop skills about the structure, function and application of nano materials.
- To acquire knowledge about different analytical techniques for nanomaterials.
- To illustrate the application nano materials in medical, electronic and engineering fields.

UNIT I INTRODUCTION **8**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires ultra-thinfilms-multi layered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION **9**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS **12**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arcgrowth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications. Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nano alumina, CaO, AgTiO2, Ferrites, Nano clays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

UNIT IV CHARACTERIZATION TECHNIQUES **9**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques, AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

UNIT V APPLICATIONS **7**

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechnology: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targeted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sun barrier products - In Photostat, printing, solar cell, battery.

TOTAL : 45 PERIODS

TEXT BOOKS :

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.

2. N John Dinardo, "Nanoscale Characterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

OUTCOMES: ·

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

- acquire knowledge about the nanomaterials types, dimensions and their properties.
- develop the different approaches in the synthesis of nano materials.
- become familiar about the structure, functions and the applications of nano materials.
- know about the different analytical techniques with respect to the dimension of the nanomaterials.·
- illustrate the application nano materials in medical, electronic and engineering fields.

CO - PO MAPPING

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

20CYOE903 SDG NO. 3, 11,12	PRINCIPLES OF FOOD PRESERVATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the students to the need of Food Preservation.
- To explain the methods of food handling and storage.
- To attain the knowledge about the newer thermal methods of food preservation.
- To illustrate the various drying methods involved in the storage of food.
- To summarise detailed study of food processing and technology subjects.

UNIT I FOOD PRESERVATION AND ITS IMPORTANCE 9

Introduction: Food safety and food poisoning – reasons for food poisoning and its effects. Deterioration and spoilage of processed foods; Shelf life of food products; Types of food based on its perishability. Food Preservation: principles, importance, and methods of preservation.

UNIT II METHODS OF FOOD HANDLING AND STORAGE 9

Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods. retort pouch packing, aseptic packaging.

UNIT III THERMAL METHODS 9

Newer methods of thermal processing; batch and continuous; In container sterilization- canning; application of infra-red microwaves; ohmic heating; control of water activity; preservation by concentration and dehydration; osmotic methods

UNIT IV DRYING PROCESS FOR TYPICAL FOODS 9

Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychrometric chart, freezing and cold storage.freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages.

UNIT V NON-THERMAL METHODS 9

Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation,

curing, pickling, smoking, membrane technology. Hurdle technology,

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Karnal, Marcus and D.B. Lund "Physical Principles of Food Preservation". Rutledge, 2003.
2. S.J.VanGarde and Woodburn. M "Food Preservation and Safety Principles and Practice".Surbhi Publications, 2001.
3. B.Sivasankar, "Food Processing & Preservation", Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications, 2005.

REFERENCES:

1. Rahman, M. Shafiur. "Handbook of Food Preservation". Marcel & Dekker, 2006.
2. Zeuthen, Peter and Bogh-Sarensen, Leif. "Food Preservation Techniques". CRC / Wood Head Publishing, 2003.
3. S.Ranganna, "Handbook of Canning and Aseptic Packaging". Tata McGraw-Hill, 2000.

OUTCOMES:

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

1 Study about the importance of food preservation.
2 Explain about the various methods of food processing and storage.
3 Provide the impact of thermal methods in food preservation.
4 Organize the need of drying methods.
5 Acquire knowledge about non thermal methods in food processing and preservation.

CO - PO MAPPING

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

20CYOE904 SDG NO. 4	FUNDAMENTALS OF NUTRITION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop the knowledge of students in the basic area of Food Chemistry.
- To illustrate the anatomy and physiology of digestion in GIT.
- To interpret the similarities and complexities of the chemical components in foods.
- To recognise the importance of consuming balanced diet to overcome diseases.
- To demonstrate the bioavailability of the nutrients to maintain the BMI and food processing.

UNIT I OVERVIEW OF NUTRITION **9**

Definition, six classes of nutrients, calculating energy values from food, using the RDA, nutritional status, nutritional requirement, malnutrition, nutritional assessment of individuals and populations, dietary recommendations, Balanced diet planning: Diet planning principles, dietary guidelines; food groups, exchange lists, personal diet analysis;

UNIT II DIGESTION **9**

Digestion, Absorption and Transport: Anatomy and physiology of the digestive tract, mechanical and chemical digestion, absorption of nutrients.

UNIT III CARBOHYDRATES **9**

Glycemic and Non-glycemic carbohydrates, blood glucose regulation, recommendations of sugar intake for health, health effects of fiber and starch intake, Artificial sweeteners; Importance of blood sugar regulation, Dietary recommendations for NIDDM and IDDM

UNIT IV PROTEINS & LIPIDS **9**

Proteins; Food enzymes ; Texturized proteins; Food sources, functional role and uses in foods. Review of structure, composition & nomenclature of fats. Non-glyceride components in fats & oils; Fat replacements; Food sources, functional role and uses in foods. Health effects and recommended intakes of lipids. Recommended intakes of proteins, Deficiency- short term and long term effects.

UNIT V METABOLISM, ENERGY BALANCE AND BODY COMPOSITION **9**

Energy Balance; body weight and body composition; health implications;

obesity, BMR and BMI calculations; Weight Control: Fat cell development; hunger, satiety and satiation; dangers of unsafe weight loss schemes; treatment of obesity; attitudes and behaviours toward weight control. Food and Pharmaceutical grades; toxicities, deficiencies, factors affecting bioavailability, Stability under food processing conditions.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. H.K.Chopra and P.S. Panesar. " Food Chemistry". Narosa, 2010.
2. V. A.Vaclavik and E. W.Christian "Essentials of Food Science". II Edition, Kluwer- Academic, Springer, 2003.
3. Mann, Jim and Stewart Truswell "Essentials of Human Nutrition". 3rd Edition. Oxford University Press, 2007.
4. Gibney, J.Michael al., "Introduction to Human Nutrition". 2nd Edition. Blackwell,2009.
5. Gropper, Sareen S. and Jack L.Smith "Advanced Nutrition and Human Metabolism". 5th Edition. Wadsworth Pub etlishing, 2008.

REFERENCES:

1. C.Gopalan, B.V. Rama Sastri, and S.C. Balasubramanian, "Nutritive Value of Indian Foods". NIN, ICMR, 2004.
2. S.Damodaran, K.L. Parkin and O.R. Fennema. "Fennema‟s Food Chemistry". 4th Edition, CRC Press, 2008
3. H.D.Belitz, W Grosch and P.Schieberle, "Food Chemistry", 3rd Rev. Edition, Springer- Verlag, 2004.
4. P.Walstra, " Physical Chemistry of Foods". Marcel Dekker Inc. 2003.
5. Owusu-Apenten, Richard. "Introduction to Food Chemistry". CRC Press, 2005.

OUTCOMES:

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

1 generate the importance of food chemistry.
2 apprehend the mechanical and chemical digestion taking place in GIT.
3 expand knowledge about the nutrients, sources and their functions.
4 conquer the malnutrition and deficiency diseases.
5 Illustrate the importance to consumption of nutritious food to maintain the body composition.

CO - PO MAPPING

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

20CYOE905 SDG NO. 3,11,13	AIR POLLUTION AND CONTROL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop knowledge about the ambient air quality
- To illustrate effects of meteorology on air pollution and wind profiles.
- To recognize the control measures to overcome the particulate contaminants.
- To pertain the preventive measures for gaseous contaminants.
- To expand the knowledge on the principle and design of control of Indoor air pollutants.

UNIT I INTRODUCTION 7

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards.

UNIT II METEOROLOGY 6

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.

UNIT III CONTROL OF PARTICULATE CONTAMINANTS 11

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle - Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators.

UNIT IV CONTROL OF GASEOUS CONTAMINANTS 11

Factors affecting Selection of Control Equipment – Working principle - absorption, Adsorption, condensation, Incineration, Bio filters – Process control and Monitoring.

UNIT V INDOOR AIR QUALITY MANAGEMENT 10

Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness- Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science + science media LLC,2004.
2. Noel de Nevers, "Air Pollution Control Engineering", Waveland press,Inc 2017.
3. Y.Anjaneyulu, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India 2002.

REFERENCES:

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
2. Arthur C. Stern, "Air Pollution (Vol.I – Vol.VIII)", Academic Press, 2006.
3. Wayne T.Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc, 2000.
4. M.N Rao and HVN Rao, "Air Pollution",Tata Mcgraw Hill Publishing Company limited,2007.
5. C.S.Rao, "Environmental Pollution Control Engineering",New Age International(P) Limited Publishers,2006.

OUTCOMES:

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

1 Perceptive of the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management

2 Identify, formulate and solve air and noise pollution problems

3 Design stacks and particulate air pollution control devices to meet applicable standards.

4 Select appropriate pollution control equipments.

5 Ensure quality, control and preventive measures.

CO- PO MAPPING :

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

20CYOE906 SDG NO. 3, 12	**BIO CHEMISTRY**	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the structural and functional properties of carbohydrates, proteins, lipids and nucleic acids
- To discuss the impairments in metabolism of the above, including inborn errors of metabolism.
- To recognize about the chemical nature of hormones and their roles in the metabolism.
- To recognize the importance of biochemical analysis.

UNIT I BIOLOGICAL PRINCIPLE 8

Composition & properties of the cell membrane, membrane transports, permeability Coefficient & partition coefficient, body fluids, electrolytes, acid-base balance, blood viscosity and Newtonian nature, colloids, filtration, diffusion, osmosis, dialysis, ultrafiltration, ultracentrifugation, cellular fractionation, electrophoresis, radioimmunoassay, Photochemical reaction, law of photochemistry, fluorescence and phosphorescence.

UNIT II MACROMOLECULES 10

Classification and functions of carbohydrates, glycolysis, TCA cycle, Blood Sugar analysis and glucose tolerance test, Classification and functions of proteins, architecture of proteins, Classification of amino acids, Oxidative and nonoxidative deamination, transamination, decarboxylation, urea cycle, Purification/separation of proteins, Classification and functions of lipids, biosynthesis of long chain fatty acids, oxidation and degradation of fatty acids.

UNIT III ENZYMES **9**

Chemical Nature, General Properties, Spectrophotometric measurement of enzymes, Isolation techniques, Diagnostic enzymes. Hormones: Chemical Nature, Properties of hormones, Hormonal Assay and their Significance.

UNIT IV METABOLIC DISORDER **9**

Diabetes mellitus, Diabetic ketoacidosis, lactose intolerance, Glycogen storage disorders, Lipid storage disorders, obesity, atherosclerosis, Plasma proteins in health and disease, Inborn error of amino acid metabolism, Disorders associated with abnormalities in the metabolism of bilirubin – Jaundice.

UNIT V ANALYTICAL TEST METHODS **9**

Liver Function tests, Renal Function Tests, Blood gas Analysis, Measurement of Electrolytes. Their abnormal and Normal Values and Conditions. Biochemistry of Urine and Stools testing.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Keith Wilson & John Walker, "Practical Biochemistry - Principles & Techniques", Oxford University Press, 2009.
2. MD Rafi, "Text book of biochemistry for Medical Student", Second Edition, University Press, 2014.
3. W. Rodwell, David Bender, M.Kathleen Botham, J.Peter Kennelly, P. Anthony Weil Harper, "Review of biochemistry", 30 th Edition, LANGE Medical Publications, 2015.
4. Trevor palmer and Philip L Bonner "Enzymes: Biochemistry, Biotechnology, Clinical Chemistry", 2 nd Edition, Woodhead Publishing, 2009.

REFERENCES:

1. David L. Nelson & Michael M.Cox, W. H. FreemanLehninger, " Principles of Biochemistry", Fourth Edition - by; 4 edition,April 23, 2004.
2. Donald J. Voet , G.Judith. Voet & Charlotte W. Pratt., " Fundamentals of Biochemistry: Life at the Molecular Level", Wiley; 2 edition, March 31, 2005.
3. Pamela.C.Champe & Richard.A.Harvey, Lippincott, " Biochemistry Lippincott" Illustrated Reviews, 6 th Edition, LWW publishers, 2013.

OUTCOMES:

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

1 Elucidate the fundamentals of biochemistry

2 Illustrate the classification, structures and properties of carbohydrates, lipid, protein and amino acid.

3 Demonstrate about the mechanism of actions of enzymes and co-enzymes, clinical importance of enzymes, hormonal assay and significance.

4 Develop knowledge about the metabolic disorders and remedial measures.

5 Recognize the different biochemical analytical methods to maintain health.

CO, PO MAPPING

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

20CYOE907 SDG NO. 9,12	GREEN TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To apply the principles of Energy efficient technologies.
- To develop knowledge on the methods of reducing CO2 levels in atmosphere.
- To extend knowledge of the importance of life cycle assessment
- To learn the importance of green fuels and its impact on environment.

UNIT I INTRODUCTION TO GREEN TECHNOLOGY & CLEANER PRODUCTION (CP) 9

Introduction To Green Technology: Definition- Importance – Historical evolution – advantages and disadvantages of green technologies-factors affecting green technologies- Role of Industry, Government and Institutions – Industrial Ecology – role of industrial ecology in green technology.

Cleaner Production (CP): Definition – Importance – Historical evolution – Principles of Cleaner Production–Benefits–Promotion – Barriers – Role of Industry, Government and Institutions – clean development mechanism, reuse, recovery, recycle, raw material substitution-Wealth from waste, case studies.

UNIT II CLEANER PRODUCTION PROJECT DEVELOPMENT AND IMPLEMENTATION 9

Overview of CP Assessment Steps and Skills, Process Flow Diagram, Material Balance, CP Option Generation – Technical and Environmental Feasibility analysis – Economic valuation of alternatives – Total Cost Analysis – CP Financing – Preparing a Program Plan – Measuring Progress- ISO 14000.

UNIT III POLLUTION PREVENTION AND CLEANER PRODUCTION 9

Awareness Plan– Waste audit – Environmental Statement, carbon credit, carbon sequestration, carbon trading, Life Cycle Assessment – Elements of LCA – Life Cycle Costing – Eco Labelling.

UNIT IV AVAILABILITY AND NEED OF CONVENTIONAL ENERGY RESOURCES 9

Major environmental problems related to the conventional energy resources, future possibilities of energy need and availability. Non-conventional energy sources: Solar Energy-solar energy conversion technologies and devices, their principles, working and application.

UNIT V GREEN FUELS 9

Definition-benefits and challenges – comparison of green fuels with conventional fossil fuels with reference to environmental, economical and social impacts- public policies and market-driven initiatives. Biomass energy: Concept of biomass energy utilization, types of biomass energy, conversion processes, Wind Energy, energy conversion technologies, their principles, equipment and suitability in Indian context; tidal and geothermal energy.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Paul L Bishop, " Pollution Prevention: Fundamentals and Practice" , McGraw Hill International, 2000.
2. S.P.Sukhatme, "Solar Energy".

REFERENCES:

1. World Bank Group , World Bank and UNEP, Washington D.C., "Pollution Prevention and Abatement Handbook – Towards Cleaner Production", 1998.
2. Prasad Modak, C.Visvanathan and Mandar Parasnis, " Cleaner Production Audit", 1995.
3. "Environmental System Reviews No.38", Asian Institute of Technology, Bangkok
4. M.W.M. Bewik , "Handbook of Organic Waste Conversion".
5. J.O.Bokris, " Energy, The Solar Hydrogen Alternative".
6. G.D.Rai , "Non-conventional Energy Sources".
7. Y. H.Kiang , "Waste Energy Utilization Technology".

OUTCOMES:

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

1 enlist different concepts of green technologies in a project
2 recognize the principles of Energy efficient technologies
3 estimate the carbon credits of various activities
4 identify the importance of life cycle assessment
5 recognize the benefits of green fuels with respect to sustainable development.

CO-PO MAPPING

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

20CYOE908 SDG NO. 6, 11	WATER AND WASTE WATER TREATMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the student conversant with the water treatment methods including adsorption and oxidation process.
- To provide basic understanding about the requirements of water and its preliminary treatment.
- To acquire knowledge about the conventional treatment methods.
- To recognize about the industrial waste water treatment methods.

UNIT I WATER QUALITY AND PRELIMINARY TREATMENT 9

Water Quality-physical- chemical and biological parameters of water- water quality requirement - potable water standards -wastewater effluent standards -water quality indices. Water purification systems in natural systems- physical processes-chemical processes and biological processes primary, secondary and tertiary treatment-Unit operations-unit processes. Mixing, clarification - sedimentation; Types; aeration and gas transfer – coagulation and flocculation, coagulation processes - stability of colloids - destabilization of colloids- transport of colloidal particles, clariflocculation.

UNIT II INDUSTRIAL WATER TREATMENT 9

Filtration – size and shape characteristics of filtering media – sand filters hydraulics of filtration – design considerations – radial, upflow, high rate and multimedia filters, pressure filter. Water softening – lime soda, zeolite and demineralization processes – industrial water treatment for boilers.

UNIT III CONVENTIONAL TREATMENT METHODS 9

Taste and odour control – adsorption – activated carbon treatment – removal of color – iron and manganese removal – aeration, oxidation, ion exchange and other methods – effects of fluorides – fluoridation and defluoridation –desalination - corrosion prevention and control – factors influencing corrosion – Langelier index – corrosion control measures.

UNIT IV WASTEWATER TREATMENT 9

Wastewater treatment – pre and primary treatment – equalization neutralization – screening and grid removal – sedimentation – oil separation gas stripping of volatile organics – biological oxidation – lagoons and stabilization basins – aerated lagoons – activated sludge process – trickling filtration – anaerobic decomposition.

UNIT V ADSORPTION AND OXIDATION PROCESSES **9**

Chemical process – adsorption – theory of adsorption – ion exchange process – chemical oxidation – advanced oxidation process – sludge handling and disposal – miscellaneous treatment processes.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Metcalf and Eddy, "Wastewater Engineering", 4th ed., McGraw Hill Higher Edu., 2002.
2. W. Wesley Eckenfelder, Jr., "Industrial Water Pollution Control", 2nd Edn., McGraw Hill Inc., 1989.

REFERENCES:

1. S.P. Mahajan, "Pollution control in process industries", 27th Ed. Tata McGraw Hill Publishing Company Ltd., 2012.
2. M. Lancaster, "Green Chemistry: An Introductory Text", 2nd edition, RSC publishing, 2010.
3. C.S. Rao, "Environmental Pollution Control Engineering", New Age International, 2007.

OUTCOMES:

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

1 Develop knowledge about the adsorption and oxidation process happening in the waste water treatment process.

2 Elaborate the idea about various methods available for water treatment.

3 Carryout the necessity of water and acquire knowledge of preliminary treatment.

4 Extend knowledge about the industrial waste water treatment and safe disposal of treated water.

5 Recognize the methods to dispose the sludge effectively.

CO - PO MAPPING

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

20CYOE909 SDG NO. 8,11,12	ANALYTICAL METHODS AND INSTRUMENTATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To demonstrate the electromagnetic radiation properties and its instrumental applications.
- To recognize the interaction of infrared radiations with the molecules using instrumentation.
- To develop knowledge about proton, carbon shifts and the determination of molecular mass of compounds.
- To enlist the separation methods to know the purity of substances/compounds.
- To find the suitable electrochemical analytical methods.

UNIT I SPECTROMETRY **9**

Properties of electromagnetic radiation- wave properties – components of optical instruments– Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Applications.

UNIT II MOLECULAR SPECTROSCOPY **9**

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence –Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT III NMR AND MASS SPECTROMETRY **9**

Theory of NMR –– chemical shift- NMR-spectrometers – applications of 1H and 13C NMR- Molecular mass spectra – ion sources. Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values – instrumentation.

UNIT IV SEPARATION METHODS **9**

General description of chromatography – Band broadening and optimization of column performance Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography- principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY 9

Electrochemical cells- Electrode potential cell potentials – potentiometry-reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry – Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probe microscopes – AFM and STM.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. D.A.Skoog, F. James Holler and Stanky, R.Crouch "Instrumental Methods of Analysis".Cengage Learning , 2007.
2. Willard, Hobart, etal., "Instrumental Methods of Analysis". VIIth Edition, CBS, 1986.
3. Braun, D Robert. "Introduction to Instrumental Analysis". Pharma Book Syndicate, 1987.
4. G.W. Ewing, "Instrumental Methods of Chemical Analysis", Vth Edition, McGraw-Hill, 1985.

REFERENCES:

1. B.K.Sharma, "Instrumental Methods of Chemical Analysis: Analytical Chemistry" Goel Publishing House, 1972.
2. Haven, C Mary., etal., "Laboratory Instrumentation ". IVth Edition, John Wiley, 1995.

OUTCOMES:

On the successful completion of this course students should be able to

1 Acquire knowledge about the electromagnetic interaction with the materials.

2 Demonstrate the instrumentation and analytical technique of IR spectrophotometer.

3 Recognize the nuclear magnetic interaction and estimation of mass of the compounds.

4 Do the separation of compounds using suitable chromatographic technique.

5 Adopt suitable electrochemical technique and surface phenomena technique for compounds identification.

CO- PO MAPPING

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

20CYOE910 SDG NO. 7,8,9,11,12	FUEL CELL CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To create awareness about alternate clean fuel available.
- To familiarize the students with the concepts and chemistry of fuel cell.
- To develop the fuel cell characterization techniques.
- To recognize the life time of fuel cell.
- To demonstrate the applications of fuel cells

UNIT I INTRODUCTION **9**

Overview of fuel cells: Low and high temperature fuel cells; Fuel cell thermodynamics - heat, work potentials, prediction of reversible voltage, fuel cell efficiency.

UNIT II FUEL CELL KINETICS **9**

Fuel cell reaction kinetics - electrode kinetics, overvoltage, Tafel equation, charge transfer reaction, exchange currents, electro catalysis - design, activation kinetics, Fuel cell charge and mass transport - flow field, transport in electrode and electrolyte.

UNIT III CHARACTERIZATION TECHNIQUES **9**

Fuel cell characterization - in-situ and ex-situ characterization techniques, i-V curve, frequency response analysis; Fuel cell modelling and system integration: - 1D model – analytical solution and CFD models.

UNIT IV RENEWABLE SOURCES **9**

Balance of plant; Hydrogen production from renewable sources and storage; safety issues, cost expectation and life cycle analysis of fuel cells.

UNIT V APPLICATIONS OF FUEL CELL **9**

Fuel cell power plants: fuel processor, fuel cell power section (fuel cell stack), power conditioner; automotive applications, portable applications

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Gregor Hoogers, "Fuel Cell Technology Handbook", CRC Press, 2003.
2. R.P. O'Hayre,S. Cha, W. Colella, F.B. Prinz, "Fuel Cell Fundamentals", Wiley, 2006.
3. A. J.Bard, L. R. Faulkner, "Electrochemical Methods", Wiley, 2004.

REFERENCES:

1. S. Basu, "Fuel Cell Science and Technology", Springer, 2007.
2. H. Liu, "Principles of Fuel Cells", Taylor & Francis, 2006.

OUTCOMES:

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

1 Aware of the alternate energy sources and its importance .
2 Develop the concepts of fuel cell chemistry.
3 Thorough knowledge of fuel cell characterization.
4 Recognize the fuel cell as renewable source of energy.
5 Recognize the applications of fuel cell in various areas.

CO - PO MAPPING

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

20CYOE911 SDG NO. 3,7,11	INTRODUCTION TO BIOENERGY AND BIOFUELS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enlist the biofuels and biobased products concepts.
- To recognize the evolution of biofuels.
- To demonstrate the chemistry of biofuel conversion.
- To apprehend the pros and cons of biofuels.
- To establish the sustainability of biofuels.

UNIT I CONCEPTS **9**

Biopower, Bioheat, Biofuel, advanced liquid fuels, drop-in fuels, biobased products

UNIT II FEEDSTOCKS **9**

Harvested Feedstocks: First generation biofuels, Second generation biofuels, third generation biofuels. Residue Feedstocks: Agricultural wastes, forestry wastes, farm waste, organic components of residential, commercial, institutional and industrial waste.

UNIT III CONVERSION TECHNOLOGIES **9**

Biorefinery concept – biorefineries and end products, Biochemical conversion – hydrolysis, enzyme and acid hydrolysis, fermentation, anaerobic digestion and trans-esterification, Thermochemical conversion – Combustion, Gasification, Pyrolysis, other thermochemical conversion technologies. Scaling up of emerging technologies.

UNIT IV BIOFUELS **9**

Pros and cons of Biofuels, Algal biofuels, Cyanobacteria and producers of biofuels, Jatropha as biodiesel producer, Bioethanol, Biomethane, biohydrogen, biobutanol, metabolic engineering of fuel molecules, Engineering aspects of biofuels, Economics of biofuels.

UNIT V SUSTAINABILITY & RESILIENCE **9**

Environmental Sustainability, bioenergy sustainability, emissions of biomass to power generation applications, emissions from biofuels. ILUC issues, Carbon footprint, Advanced low carbon fuels.

TOTAL :45 PERIODS

TEXTBOOKS:

1. C Robert Brown, "Biorenewable Resources – Engineering new products", Blackwell Publishing Professional, 2003.
2. Wim Soetaert and Erik Vandamme (Editors) , "Biofuels", Wiley., 2009.
3. Donald Klass, "Biomass for Renewable Energy, Fuels and Chemicals", Academic press., 1998.

REFERENCES:

1. C.Vaughn Nelson and L.Kenneth Starcher, "Introduction to Bioenergy".
2. Anju Dahiya, "Bioenergy: Biomass to Biofuels".
3. Yebo Li and Samir Kumar Khanal, "Bioenergy: Principles and Applications".
4. D Judy Wall and S Caroline Harwood, "Bioenergy".
5. Ted Weyland, "Bioenergy: Sustainable Perspectives".

OUTCOMES:

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

1 Perceptive of bioenergy concepts.
2 Realize about the feed stocks importance.
3 Comprehend the chemistry in the conversion of bioenergy.
4 Enlist the various biofuels.
5 Develop the sustainable application of biofuels.

CO - PO MAPPING

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

20CYOE912 SDG NO. 9,11,12	CORROSION SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To recognize the fundamental aspects of electrochemistry and materials science relevant to corrosion phenomena.
- To know the various types of corrosion.
- To identify practices for the prevention and remediation of corrosion.
- To learn about the immersion corrosion and corrosion inhibitors.
- To attain knowledge about the corrosion monitoring methods.

UNIT I BASIC ASPECTS OF CORROSION 9

Introduction, classification, economics, emf series, Galvanic series. Corrosion theories: derivation of potential – current relationships of activation controlled and diffusion controlled corrosion processes. Potential – pH diagrams Fe-H2O system, application and limitations. Passivation-definition, anodic passivation theory of passivation.

UNIT II FORMS OF CORROSION 9

Definition, factors and control methods of various forms of corrosion: uniform, galvanic, pitting, inter granular, crevice, dezincification, stress corrosion, corrosion fatigue, hydrogen embrittlement.

UNIT III ATMOSPHERIC CORROSION AND PROTECTIVE COATINGS 9

Atmospheric corrosion – classification, factors influencing atmospheric corrosion, temporary corrosion preventive methods ; organic coating – surface preparation, natural, synthetic resin, paint formulation and applications. Paint testing and evaluation.

UNIT IV IMMERSION CORROSION AND ELECTROCHEMICAL PROTECTION 9

Corrosion in immersed condition: effect of dissolved gases, salts, pH, temperature and flow rates on corrosion; marine corrosion. Underground corrosion – corrosion process in the soil, factors influencing soil corrosion, Biological corrosion definition, mechanism of biological corrosion control of bio corrosion. Electrochemical methods of protection theory of cathodic protection, design of cathodic protection, sacrificial anodes, impressed current anodes, anodic protection. Corrosion inhibitors for acidic, neutral and alkaline media, cooling water system - boiler water system. Corrosion resistant alloys.

UNIT V CORROSION MONITORING **9**

Laboratory corrosion tests, accelerated chemical tests for studying different forms of corrosion. Electrochemical methods of corrosion rate measurements by Gravimetric, Tafel polarization, linear polarization, cyclic polarization, impedance spectroscopy, harmonics and NDT techniques- ultrasonics, radiography eddy current.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.N.Banerjee, "An Introduction to Corrosion Science and Corrosion Inhibition", Oxonian Press, P.Ltd., New Delhi, 1985.
2. Zaki Ahmad, "Principles of Corrosion Engineering & Corrosion Control", Butterworth Heinemann, London, 2006.

REFERENCES:

1. E.E. Stansbury, R.A. Buchanan, "Fundamentals of electrochemical corrosion", ASM International, 2000.
2. M.G.Fontana & N.D. Greene, "Corrosion Engineering", III Edition, McGraw Hill, New York, 1978.

OUTCOMES:

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

1 express the causes and the mechanisms of various types of corrosion.
2 build up various modes of environmentally assisted cracking.
3 recognize the importance of application of protective coatings.
4 analyze the significance of corrosion inhibitors.
5 attain knowledge about various corrosion monitoring methods.

CO- PO MAPPING

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

20CYOE913 SDG NO. 8,9,11	WASTE MANAGEMENT AND RECYCLING TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students conversant with the types, sources, generation, storage, collection, transport, processing and disposal of municipal solid waste.
- To learn about the management of waste.
- To know the various processing methods involved in the waste management.
- To recognize the safe disposal of waste.

UNIT I SOURCES AND CHARACTERISTICS 9

Sources and types of municipal solid wastes- Public health and environmental impacts of improper disposal of solid wastes- sampling and characterization of wastes - factors affecting waste generation rate and characteristics - Elements of integrated solid waste management – Requirements and salient features of Solid waste management rules (2016) –- Role of public and NGO‟s- Public Private participation – Elements of Municipal Solid Waste Management Plan.

UNIT II SOURCE REDUCTION, WASTE STORAGE AND RECYCLING 8

Waste Management Hierarchy - Reduction, Reuse and Recycling - source reduction of waste – On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health and economic aspects of open storage – case studies under Indian conditions – Recycling of Plastics and Construction/Demolition wastes.

UNIT III COLLECTION AND TRANSFER OF WASTES 8

Methods of Residential and commercial waste collection – Collection vehicles – Manpower – Collection routes – Analysis of waste collection systems; Transfer stations –location, operation and maintenance; options under Indian conditions – Field problems- solving.

UNIT IV PROCESSING OF WASTES 12

Objectives of waste processing – Physical Processing techniques and Equipment; Resource recovery from solid waste composting and biomethanation; Thermal processing options – case studies under Indian conditions.

UNIT V WASTE DISPOSAL **8**

Land disposal of solid waste- Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Landfill bioreactor – Dumpsite Rehabilitation.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. A.William Worrell, P. Aarne Vesilind , "Solid Waste Engineering", Cengage Learning, 2012.
2. John Pitchel , "Waste Management Practices-Municipal, Hazardous and industrial" – CRC Press, Taylor and Francis, New York, 2014.

REFERENCES:

1. CPHEEO, "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation" , Government of India, New Delhi 2014.
2. George Tchobanoglous and FrankKreith, "Handbook of Solid waste management", McGraw Hill, New York, 2002.

OUTCOMES:

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

1 The nature and characteristics of municipal solid wastes and the regulatory requirements regarding municipal solid waste management.

2 Reduction, reuse and recycling of waste, ability to plan and design systems for storage, collection, transport, processing and disposal of municipal solid waste.

3 The issues on solid waste management from an integrated and holistic perspective, as well as in the local and international context.

4 Design and operation of sanitary landfill.

5 The achievement of sustainable and safe environment.

CO- PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	2	2	-	-	-	-	2
CO2	2	2	1	-	-	2	2	2	-	-	-	2
CO3	2	1	1	-	-	1	2	-	-	-	-	2
CO4	2	2	2	2	2	2	2	-	1	-	1	1
CO5	2	1	2	2	0	2	2	-	1	-	1	1

20CYOE914 SDG NO. 3,11,12	ENVIRONMENTAL TOXICOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop knowledge on toxicology, risk assessment and remediation.
- To learn about xenobiotics.
- To know the industrial toxic substrates.
- To create awareness about assessing and mitigating environmental disorders.
- To extend knowledge of risk assessment through case studies.

UNIT I BIOCHEMICAL TOXICOLOGY **10**

Toxicants, Distribution, Metabolism of toxicants, sites of action, classification of toxicity – acute and sub-acute toxicity bioassay, Factors influencing toxicity, Elimination of toxicants, Methods of toxicity testing – Evaluation - statistical assessment, sediment toxicity, Bio- chemical markers/indicators, Toxicokinetics, Bioconcentration, Bio-accumulation and Biomagnification in the environment.

UNIT II GENETIC TOXICOLOGY **10**

Xenobiotics – Chemical carcinogenesis – Genotoxicity assays – Neurotoxicity, Skin toxicity, Immunotoxicity. Renal toxicity, Endocrine disruptors, hormones, receptors.

UNIT III INDUSTRIAL TOXICOLOGY **9**

Toxicity of monomers, solvents, intermediates, products – toxic substrates – Metals and other inorganic Chemicals, Organic Compounds – Persistent chemicals.

UNIT IV RISK ASSESSMENT AND REMEDIATION **9**

Procedures for assessing the risk – Risk measurement and Mitigation of environmental disorders – Factors in risk assessment.

UNIT V CASE STUDIES IN RISK ASSESSMENT **7**

Pharmaceutical, Petroleum, Carbide industry, Textile and Leather Industry Case study.

TOTAL:45 PERIODS

TEXT BOOKS:

1. C. H.Walker et al., "Principles of Ecotoxicology", Taylor and Francis, Inc, ISBN 074803557, 1996.
2. D.G.Crosby, "Environmental Toxicology and Chemistry", Oxford University Press, New York,1998.
3. B.Ballantyne,T. M.Marrs and T. Syversen, "General and Applied Toxicology" 2nd ed. MacMillan Reference Ltd, 1999.

REFERENCES:

1. A.Hodgson, "A text book of Modern Toxicology", John Wiley and Sons, Inc.NJ. 2004.
2. E.Hodson and R.C. Smart, "Introduction to Biochemical toxicology", Wiley Interscience, New York, 2001.

OUTCOMES:

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

1 Develop knowledge about Toxicology.
2 Recognize the genetic toxicity and its effects.
3 Interpret the toxicity of chemicals from industrial effluents.
4 Illustrate the risk measurement and reclamation.
5 Analyse the risk assessment case studies related to the industries.

CO- PO MAPPING

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

Sri SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

Affiliated to Anna University & Approved by AICTE, New Delhi

OPEN ELECTIVES

I - VIII SEMESTER
AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

B.TECH. DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

S. NO	COURSE CODE	COURSE TITLE	CONTACT HOURS	WEEK HOURS			CREDITS
				L	T	P	C
1	20AIOE901	Basics of Bioinformatics	3	3	0	0	3
2	20AIOE902	Mobile Robot	3	3	0	0	3
3	20AIOE903	Bio Inspired Learning	3	3	0	0	3
4	20AIOE904	Exploratory Data Analysis	3	3	0	0	3
5	20AIOE905	Computer Vision from 3D Reconstruction to Recognition	3	3	0	0	3
6	20AIOE906	Robotic Simulation	3	3	0	0	3
7	20AIOE907	Full Stack Development	3	3	0	0	3
8	20AIOE908	Cognitive Science and Analytics	3	3	0	0	3
9	20AIOE909	Speech Processing and Analytics	3	3	0	0	3
10	20AIOE910	Health Care Analytics	3	3	0	0	3

OPEN ELECTIVES

20AIOE901 SDG NO. 4&9	BASICS OF BIOINFORMATICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Exposed to the need for Bioinformatics technologies
- Be familiar with the modeling techniques
- Learn microarray analysis
- Exposed to Pattern Matching and Visualization

UNIT I INTRODUCTION **9**

Need for Bioinformatics technologies – Overview of Bioinformatics technologies Structural bioinformatics – Data format and processing – Secondary resources and applications – Role of Structural bioinformatics - Biological Data Integration System.

UNIT II DATA WAREHOUSING AND DATA MINING IN BIOINFORMATICS **9**

Bioinformatics data – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture and applications in bioinformatics.

UNIT III MODELING FOR BIOINFORMATICS **9**

Hidden Markov modelling for biological data analysis – Sequence identification –Sequence classification – multiple alignment generation – Comparative modelling –Protein modelling – genomic modelling – Probabilistic modelling – Bayesian networks – Boolean networks - Molecular modelling – Computer programs for molecular modelling.

UNIT IV PATTERN MATCHING AND VISUALIZATION **9**

Gene regulation – motif recognition – motif detection – strategies for motif detection – Visualization – Fractal analysis – DNA walk models – one dimension – two dimension – higher dimension – Game representation of biological sequences – DNA, Protein, Amino acid sequences.

UNIT V MICROARRAY ANALYSIS **9**

Microarray technology for genome expression study – image analysis for data extraction – preprocessing – segmentation – gridding – spot extraction – normalization, filtering – cluster analysis – gene network analysis – Compared

Evaluation of Scientific Data Management Systems – Cost Matrix – Evaluation model - Benchmark – Trade-offs.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Yi-Ping Phoebe Chen (Ed), "Bioinformatics Technologies", First Indian Reprint, Springer Verlag, 2007.

REFERENCES:

1. Bryan Bergeron, "BioInformatics Computing", Second Edition, Pearson Education, 2003.
2. Arthur M Lesk, "Introduction to Bioinformatics", Second Edition, Oxford University Press, 2005.

ONLINE RESOURCES:

1. https://www.hsls.pitt.edu/obrc/

WEB REFERENCE:

1. https://libguides.wpi.edu/c.php?g=355423&p=2396195

OUTCOMES:

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

1. Understand the concepts of bioinformatics, Data format and Processing. (K2)
2. Interpret Data Warehousing and Data Mining concepts in Bioinformatics. (K3)
3. Develop Hidden Markov Model for Data Analytics. (K3)
4. Build Bayesian Network and Boolean Model for Bioinformatics. (K3)
5. Perform Pattern Matching and Visualization Process on DNA Models. (K2)
6. Develop an evolution model for scientific Data management system. (K3)

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	3	-	1	-	-	-	-	3	3	2	2
CO2	3	3	3	1	2	1	-	-	-	-	3	3	2	2
CO3	3	3	2	1	3	1	-	-	-	-	3	3	2	2
CO4	3	3	2	1	3	1	-	-	-	-	3	3	2	2
CO5	3	3	2	1	1	3	1	-	-	-	3	3	2	2
CO6	3	3	2	1	1	3	1	-	-	-	3	3	2	2

20AIOE902 SDG NO. 4	MOBILE ROBOT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To familiarize the students with mobile robots, basic methods for achieving mobility and autonomy
- Present various aspects of design, fabrication, motion planning, and control of intelligent mobile robotic systems
- Give students an opportunity to design and fabricate a mobile robotic platform and program it to apply learned theoretical concepts in practice

UNIT I - INTRODUCTION TO MOBILE ROBOTS 9

Introduction to Mobile robots - Locomotion, Classification - Legged, Wheeled, Aerial. Key issues in locomotion. Mobile Robot Kinematics - Kinematic model-Forward Kinematic model, Representing position, Wheel kinematic constraints. Motion control.

UNIT II CONTROL OF MOBILE ROBOTS 9

Control theory - Control design basics, Cruise-Controllers, Performance Objectives. Simple robot – State space model, Linearization, LTI system, stability. PID control, basic control algorithms

UNIT III PERCEPTION **9**

Sensors for mobile robots – Classification, performance, uncertainty in sensors, wheel sensor, heading sensor, accelerometers, inertial measurement, motion sensor, range sensors. Vision sensor- Basics of computer vision, image

processing techniques, feature extraction – image, range data location recognition.

UNIT IV LOCALIZATION **9**

Major challenges, localization based navigation. Belief representation, map representation, probabilistic Map. Examples of localization systems. Autonomous map building

UNIT V PLANNING AND NAVIGATION **9**

Planning and Reaction- Path Planning – graph search, D* algorithm, Potential field. Obstacle avoidance – bug algorithm, histogram, curvature velocity techniques. Navigation architecture. Case studies

TOTAL: 45 PERIODS

REFERENCES

1. Siciliano. et al, "Robotics: Modelling, Planning and Control", 3rd Edition, Springer, 2009.
2. Choset. et al, "Principles of Robot Motion: Theory, Algorithm & Implementations", MIT Press, 2005.
3. Thrun, Burgard, Fox, "Probabilistic Robotics", MIT Press, 2005.
4. Siegwart, Nourbakhsh, "Introduction to Autonomous Mobile Robots", MIT Press, 2004. 5. Siciliano, Khatib, Eds, "Handbook of Robotics", Springer, 2008.

WEB REFERENCES

1. http://www.galileo.org/robotics/
2. http://www.learnaboutrobots.com/
3. http://www.roboanalyzer.com/
4. http://timobrien.tech/projects/mars-rover/

COURSE OUTCOMES

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

1. Explain the Design and kinematic modeling of mobile robots (K2)
2. Understand the basic control algorithms involved in mobile robots (K3)
3. Explain Various sensors used for perception (K3)
4. Use an algorithm to plan the localization and mapping path of robot (K3)
5. Analyze various algorithms in path planning and navigation (K2)
6 Describe the applications and current trend in field and service robot (K2)

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2		1	-	-	-	-	3	3	3	2
CO2	3	3	3	1	2	1	-	-	-	-	3	3	2	2
CO3	3	3	2	1	3	1	-	-	-	-	3	3	1	1
CO4	3	3	2	1	3	1	-	-	-	-	3	3	3	2
CO5	3	3	2	1	1	3	1	-	-	-	3	3	2	2
CO6	3	3	2	1	3	1	-	-	-	-	3	3	2	2

20AIOE903 SDG NO. 4	BIO INSPIRED COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Learn bio-inspired theorem and algorithms
- To Understand random walk and simulated annealing
- To Learn genetic algorithm and differential evolution
- To Learn swarm optimization and ant colony for feature selection
- To understand bio-inspired application in image processing

UNIT I INTRODUCTION 9

Introduction to algorithm - Newton ' s method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Metaheuristics -Analysis of Algorithms -Nature Inspired Algorithms -Parameter tuning and parameter control.

UNIT II RANDOM WALK AND ANNEALING 9

Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle Strategy-Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunnelling.

UNIT III GENETIC ALGORITHMS AND DIFFERENTIAL EVOLUTION 9

Introduction to genetic algorithms and - role of genetic operators - choice of parameters - GA variants - schema theorem - convergence analysis - introduction to differential evolution - variants - choice of parameters - convergence analysis - implementation.

UNIT IV SWARM OPTIMIZATION AND FIREFLY ALGORITHM 9

Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - variants- Ant colony optimization toward feature selection.

UNIT V APPLICATION IN IMAGE PROCESSING 9

Bio-Inspired Computation and its Applications in Image Processing: An Overview - Fine- Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Threshold Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search.

TOTAL : 45PERIODS

TEXT BOOK:

1. Eiben, A. E., Smith, James E, "Introduction to Evolutionary Computing", Springer 2015.
2. Xin-She Yang, Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing", Elsevier 2016

REFERENCES:

1. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013
2. Xin-She Yang, "Nature Ispired Optimization Algorithm, Elsevier First Edition 2014
3. Yang, Cui, XIao, Gandomi, Karamanoglu, "Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013

WEB REFERENCES:

1. https://programsandcourses.anu.edu.au/course/comp8420

ONLINE RESOURCES:

1. https://cbmm.mit.edu/education/courses/bio-inspired-intelligence

OUTCOMES:

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

1. Implement and apply bio-inspired algorithms (K3)
2. Explain random walk and simulated annealing (K2)

3. Implement and apply genetic algorithms (K3)
4. Explain swarm intelligence and ant colony for feature selection (K2)
5. Apply bio-inspired techniques in image processing. (K3)
6 Apply Image processing on deep belief tuning networks. (K3)

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	3	-	1	-	-	-	-	3	3	2	2
CO2	3	3	3	1	2	1	-	-	-	-	3	3	2	2
CO3	3	3	2	1	3	1	-	-	-	-	3	3	2	2
CO4	3	3	2	1	3	1	-	-	-	-	3	3	2	2
CO5	3	3	2	1	1	3	1	-	-	-	3	3	2	2
CO6	3	3	2	1	1	3	1	-	-	-	3	3	2	2

20AIOE904 SDG NO. 4	EXPLORATORY DATA ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explore and analyze a data set.
- Determine a predictive model is a feasible analytical tool for business challenges.
- Data set variables and the relationship among them.
- Concept and the outcomes expected of data mining.

UNIT I INTRODUCTION **9**

Introduction to Data Science and Class Logistics/Overview, Statistical Inference and Exploratory Data Analysis, Principles of Data Management, SQL for Data Science: SQL Basics, SQL Joins and aggregates, Grouping and query evaluation, SQL Sub-queries, Key Principles of RDBMS

UNIT II DATA MODELS **9**

Data Models, Data Warehousing, OLAP, Data Storage and Indexing, Query Optimization and Cost Estimation, Data log, E/R Diagrams and Constraints, Design Theory, BCNF

UNIT III DATA MANAGEMENT SOLUTION FOR ENTERPRISE APPLICATIONS **9**

Data Management Solutions for Enterprise Applications: Introduction to Transactions, Transaction Implementations, Transaction Model, Database Concurrency Control Protocols, Transaction Failures and Recovery, Database Recovery Protocols.

UNIT IV PARALLEL DATABASES **9**

Parallel Databases: Introduction to NoSQL database, Apache Cassandra, MongoDB, Apache Hive

UNIT V DATA MANAGEMENT SOLUTION FOR INTERNET APPLICATIONS **9**

Data Management Solution for Internet Applications: Google's Application Stack: Chubby Lock Service, Bigtable Data Store, and Google File System; Yahoo's key-value store: PNUTS; Amazon's key-value store: Dynamo.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Database Systems: the Complete Handbook, by Hector Garcia-Molina, Jennifer Widom, and Jeffrey Ullman. Second edition.
2. Fundamentals of database systems by Elsmasri and Navathe
3. Seven NoSQL Databases in a Week: Get up and running with the fundamentals, By Xun (Brian) Wu, Sudarshan Kadambi, Devram Kandhare, Aaron Ploetz, Packt Publishers

REFERENCE BOOKS/RESOURCES:

1. Database management systems by Raghu Ramakrishnan and Johannes Gehrke.
2. Foundations of database systems by Abiteboul, Hull and Vianu
3. "Transactional Information Systems" by Gerhard WEIKUM and Gottfried VOSSEN, publisher Morgan Kaufmann.
4. Programming Hive: Data Warehouse and Query Language for Hadoop by Edward Capriolo, Dean Wampler, Jason Rutherglen, O'Reilly
5. https://ai.google/research/pubs/pub27897
6. Fay Chang, Jeffrey Dean, Sanjay Ghemawat, Wilson C. Hsieh, Deborah A. Wallach Mike Burrows, Tushar Chandra, Andrew Fikes, Robert E. Gruber, Bigtable: A Distributed Storage System for Structured Data, Google, Inc. OSDI 2006
7. Brian F. Cooper et al., " PNUTS: Yahoo!'s hosted data serving platform", Journal Proceedings of the VLDB Endowment VLDB Endowment Hompage archive Volume 1 Issue 2, August 2008 Pages 1277- 1288

8. Giuseppe DeCandia et al., "Dynamo: Amazon's Highly Available Key-value Store", Proceeding SOSP '07 Proceedings of twenty-first ACM SIGOPS symposium on Operating systems principles, Pages 205- 220 Stevenson, Washington, USA — October 14 - 17, 2007

WEB REFERENCES:

1. https://www.coursera.org/learn/exploratory-data-analysis
2. https://www.coursera.org/lecture/data-analysis-with-python/exploratory-data-analysis-iNeWs

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/110106064
2. https://analyticsindiamag.com/8-online-courses-for-exploratory-data-analysis/

OUTCOMES:

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

1. Understand how to perform exploratory data analysis on different data types. (K1)
2. Apply the principles of data modeling using entity relationship and develop a good database design. (K2)
3. Interpret the need of database processing and learn techniques for controlling the consequences of concurrent data access. (K2)
4. Discuss NoSQL database systems and manipulate the data associated with it. (K3)
5. Analyse the components of any data-intensive application infrastructure (K2)
6. Describe applicability of different data analysis and visualization models techniques to solve real world problems (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	2	2	3	3	3	3	3	-	-	3
CO2	3	2	-	3	3	3	2	2	2	2	3	-	-	2
CO3	3	2	-	2	2	2	2	1	3	3	3	1	1	2
CO4	3	2	-	2	3	3	2	2	2	3	2	-	3	3
CO5	3	3	-	3	2	2	2	1	3	3	2	1	2	2
CO6	3	2	-	3	3	2	2	1	2	3	3	1	2	3

20AIOE905 SDG NO. 4	COMPUTER VISION FROM 3D RECONSTRUCTION TO RECOGNITION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Learn basic principles of image formation, image processing algorithms and different algorithms for 3D reconstruction and recognition from single or multiple images (video).
- Applications to 3D modeling, video analysis, video surveillance, object recognition and vision based control will be discussed.
- Acquire a general background in issues related to real-world perception, image processing, object and scene recognition and multi-view geometry

UNIT I INTRODUCTION 9

Introduction to computer vision: Examples and applications. - Notations and definitions: 3D Euclidean space, Cartesian coordinate frames and homogeneous coordinates. - Image formation: Projective geometry, Camera models, Pinhole camera model - Recovering 3D from images: Visual cues, perception of objects and scenes. Shape from X.

UNIT II OBJECT PERCEPTION AND RECOGNITION 9

Fundamentals of objects perception and recognition. Categorization - The Marr paradigm and scene reconstruction, Model-based vision. Gestalt cues. Other paradigms for image analysis: bottom-up, top-down, neural network, feedback. - Pixels, lines, boundaries, regions, and object representations. "Low-level", "intermediate level", and "high-level" vision. - Object recognition model-based methods. Appearance-based methods. Invariant features. - From scenes to objects, emergent features, scene categorization. The importance of the context.

UNIT III RECOVERING 3D CONSTRUCTION 9

Recovering 3D from stereovision & Multiview: Introduction to Mutli-view Geometry, Stereovision - Two view geometry: Epipolar geometry, 3D reconstruction ambiguities - Computation of the Essential Matrix and Fundamental Matrix (linear methods, iterative methods, robust methods), Structure computation, Rectification methods - Camera Geometry and Single View Geometry, Calibration and auto-calibration in Stereovision.

UNIT IV DEPTH ESTIMATION 9

Depth from Triangulation, Two-View Geometry, N-View Geometry, Depth estimation and 3D reconstruction. - Primitive description from lines, edges, corners, interest points. Correlation methods, energy minimization methods - Recovering camera and geometry up to ambiguity (affine approximation,

Algebraic methods, Factorization methods).

UNIT V MULTI VIEW GEOMETRY **9**

Shape from stereovision & N-views, Shape from Motion. Multi-view geometry: computational models, auto-calibration - Introduction of Motion Field, Optical Flow. Motion Analysis. Motion detection - Deep learning and neural networks - based methods for computer vision.

TOTAL: 45 PERIODS

TEXT BOOK

1. An invitation to 3D vision, From Images to Geometric Models, Ma Y., Soatto S., Kosecka J. and Sastry S.S. Springer, 2004.
2. Computer Vision: Algorithms and Applications, Richard Szeliski, Springer, 2010.

REFERENCE BOOK

1. Multiple view geometry in computer vision, R. Hartley et A. Zisserman, vol. 2., Cambridge Univ Press, 2000
2. Computer Vision: Models, Learning, and Inference, Simon J.D. Prince, Cambridge University Press, 2012.
3. Programming Computer Vision with Python, Jan Erik Solem, 2012

OUTCOMES:

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

1. Identify basic concepts, terminology, theories, models and methods in the field of computer vision.(K1)
2. Describe known principles of human visual system .(K2)
3. Describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition. .(K2)
4. Assess which methods to use for solving a given problem, and Analyze the accuracy of the methods Skills.(K3)
5. Perform visual object recognition and motion recognition tasks and Understand the applications such as vision-based modeling and interaction.(K2)
6. Develop and apply computer vision techniques for solving practical problems.(K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	1	-	-	-	-	3	3	2	3
CO2	3	2	3	2	2	1	-	-	-	-	3	3	3	2
CO3	3	2	2	2	3	1	-	-	-	-	3	3	2	2
CO4	3	2	2	1	3	1	-	-	-	-	3	3	2	3
CO5	3	2	2	2	1	3	1	-	-	-	3	3	1	2
CO6	3	2	2	2	1	3	1	-	-	-	3	3	2	3

20AIOE906 SDG NO. 4 & 8	ROBOTIC SIMULATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To analyse the automated system online.
- To learn a simulation package
- Graphic animation sequences for robot movement.
- Velocity, acceleration analysis of joint and linkages

UNIT I INTRODUCTION **9**

Robotics systems, Robot movements, Quality of simulation, types of simulation, Robot applications, Robotics simulation displays. Simulation notation, Auto lisp functions. Features, Command syntax, writing design functions.

UNIT II ROBOTIC PRINCIPLES **9**

Straight lines, Angles and optimal moves circular interpolation, Robotic functions Geometrical commands, Edit commands. Selecting robot views, standard Robot part, using the parts in a simulation.

UNIT III ROBOTICS SIMULATION **9**

Simulation packages, Loading the simulation, Simulation editors, delay, Resume commands. Slide commands, program flow control. Robot motion control, Analysis of robot elements, Robotic linkages.

UNIT IV ROBOTIC MOTION **9**

Solids construction, Solid animation. Types of motion, velocity and

acceleration, Types of simulation motion Harmonic motion, parabolic motion, uniform motion velocity and acceleration analysis for robots.

UNIT V ROBOT DESIGN **9**

Linkages, Types, Transmission elements Flexible connectors, pulley-and-Belt drives, variable speed transmission. Design of Robot for particular applications – A case study.

TOTAL :45 PERIODS

TEXT BOOK

1. Daniel L. Ryan, "Robotics Simulation", CRC Press Inc., 1994.
2. Richard D. Klafter, Thomas. A, Chri Elewski, Michael Negin, "Robotics Engineering an Integrated Approach", Phi Learning., 2009.

REFERENCES

1. Robert J. Schilling, "Fundamentals of Robotics Analysis and Control", PHI Learning., 2009.
2. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, "Industrial Robotics, Technology Programming and Applications", McGraw Hill, 2012.
3. Francis N. Nagy, Andras Siegler, "Engineering foundation of Robotics", Prentice Hall Inc., 1987.
4. Robert J. Schilling, "Fundamentals of Robotics Analysis and Control", PHI Learning, 2009.
5. Tsuneo Yohikwa, "Foundations of Robotics Analysis and Control", the MIT Press, 2003.
6. John J. Craig, "Introduction to Robotics Mechanics and Control", Third Edition, Pearson, 2008.
7. Bijay K. Ghosh, Ning XI, Tarn .T.J, "Control in Robotics and Automation Sensor – Based integration", Academic Press, 1999.
8. Carl D. crane III and Joseph Duffy, "Kinematic Analysis of Robot manipulation", Cambridge University press, 2008.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112108093
2. https://onlinecourses.nptel.ac.in/noc21_me44/preview

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112107289
2. https://onlinecourses.nptel.ac.in/noc21_me108/

Outcomes:

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

1 Understand the techniques for solving optimization problems. (K1)

2 Identify and Understand the basics of Classical Optimization Algorithm. (K2)

3 Analyze some specific problems of scheduling jobs on one machine, two or three machine using sequencing techniques. (K2)

4 Interpret the potential solution and frames the better solution for optimization of genetic algorithm (K3)

5 Analyze the adaptation of TS to the optimization of continuous function to solve various combinatorial optimization problems. (K2)

6 Analyze and design the complex systems. (K2)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	3	2	2	3	3	2	3	-	-	3
CO2	3	2	-	3	3	3	2	2	3	3	3	-	-	2
CO3	3	2	-	2	3	3	3	1	3	3	3	1	1	3
CO4	3	2	-	2	3	2	2	2	3	3	2	-	3	3
CO5	3	3	-	3	3	3	3	2	3	2	3	1	2	2
CO6	3	2	-	3	3	2	2	1	2	3	3	1	2	3

20AIOE907 SDG NO. 4 & 9	FULL STACK DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the core concepts of both the frontend and backend programming
- Apply intermediate and advanced web development practices.
- Implement basic JavaScript.
- Develop a fully functioning website and deploy on a web server.
- To get familiar with the latest web development technologies.

UNIT I HTML5, CSS AND JAVASCRIPT 9

HTML: Tags – structuring document – web page –Make it Prettier with CSS–Loading background images –Organizing files. JavaScript – Variables–Controlling HTML and CSS–Organizing JavaScript code

UNIT II SERVER SIDE – NODE.JS **9**

Server–Side Action: Node and NPM – JavaScript Runtimes and Building Servers – Node Installation – NPM – NPM Commands – Initializing a New NPM/Node Project – Adding Dependencies – Semantic Versioning – Node Web Server – Advanced Node and NPM: package.json – other commands – Node: Standard Modules

UNIT III CLIENT–SIDE – REACT **9**

Client–Side Adventures: React – History – Components – Props – Memory State – Style – Advanced React – JSX – Compile JSX – Put It All Together– Default Props – Typing Props – Component Lifecycle

UNIT IV TYPESCRIPT AND WEBPACK **9**

TypeScript : Jumping into the Deep End – Configuring TypeScript Compilation – Types : String – Number – Boolean – Arrays – Tuples –Enums– Function – Object –Null, Void, and Undefined – Custom Type Aliases – Union Types – TypeScript - ES6 Features –Advanced TypeScript : Interfaces – Namespaces and Modules – Decorators – Third– Party Libraries – Debugging TypeScript Apps–Webpack : Bundle, and How Do I Make One–Webpack in detail – Getting Started with Webpack– Using Modules – Wither TypeScript

UNIT V APPLICATION DEPLOYMENT **9**

MailBagServer: Basic Requirements – Setting Up the Project – Starting Point: main.ts–ServerInfo.ts– Time to Send the Mail – Time to Get the Mail – Reach Out and Touch Someone – NoSQL–NeDB– Testing–MailBagClient: Basic Requirements – Setting Up the Project – Starting Point: index.html –Redux: main.tsx – Configuration – Worker for All Seasons – Cavalcade of Components.Docker– Containers and Containerization – Installing Docker– Key Docker Commands – Creating Your Own Image – Deploying to Docker Hub – Wrapping Up MailBag

TOTAL: 45 PERIODS

TEXT BOOK

1. Frank Zammetti, “Modern Full–Stack Development” , Apress, 2020
2. B Rex van der Spuy “Foundation Game Design with HTML5 and JavaScript” Apress / friends of ED,2012

REFERENCE BOOK

1. W. P. Petersen, P. Arbenz, “Introduction to Parallel Computing”, Oxford University Press, 2004
2. Paweł Czarnul, “Parallel Programming for Modern High-Performance Computing “, CRC Press, 2018

3. Cyrus Dasadia, Amol Nayak, “MongoDB Cookbook”, Packt Publishing, 2016
4. Krasimir Tsonev, “Node.js by Example”, Packt Publishing, 2015

EXTENSIVE READING:

1. https://nodejs.org/en/
2. https://www.typescriptlang.org/
3. https://www.mongodb.com/
4. https://www.w3schools.com/react

OUTCOMES:

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

1 Construct front end application using HTML5/CSS (K3)
2 Create JavaScript based web application (K2)
3 To develop a web pages based on Node JS and jQuery Mobile based responsive web application (K2)
4 Develop a dynamic user interface using the React framework, Typescript and Webpack (K3)
5 Describe development environments and their purpose (K2)
6 Implement web application and deployment from the scratch that includes Front-end, Backend and Data-exchange technologies (K2)

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	2	-	-	-	2	3	-	-	3
CO2	3	3	3	3	3	3	-	-	-	3	3	-	-	2
CO3	3	3	3	2	3	3	-	-	-	3	3	1	1	3
CO4	3	3	2	2	3	2	-	-	-	3	2	-	3	3
CO5	3	3	3	3	3	3	-	-	-	2	3	1	2	2
CO6	3	2	2	3	3	2	-	-	-	3	3	1	2	3

20AIOE908 SDG NO. 4&9	COGNITIVE SCIENCE AND ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain cognitive computing and design principles.
- To distinguish between NLP and cognitive computing.
- To apply advanced analytics to cognitive computing.
- To discuss application of cognitive computing in business.
- To illustrate various applications of cognitive computing.

UNIT I FOUNDATION & DESIGN PRINCIPLES 9

Foundation of Cognitive Computing: cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition. Design Principles for Cognitive Systems: Components of a cognitive system, building the corpus, bringing data into cognitive system, machine learning, hypotheses generation and scoring, presentation and visualization services.

UNIT II NLP IN COGNITIVE SYSTEM 9

Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system, semantic web, Applying Natural language technologies to Business problems. Representing knowledge in Taxonomies and Ontologies: Representing knowledge, Defining Taxonomies and Ontologies, knowledge representation, models for knowledge representation, implementation considerations.

UNIT III BIG DATA Vs COGNITIVE COMPUTING 9

Relationship between Big Data and Cognitive Computing: Dealing with human-generated data, defining big data, architectural foundation, analytical data warehouses, Hadoop, data in motion and streaming data, integration of big data with traditional data. Applying Advanced Analytics to cognitive computing: Advanced analytics is on a path to cognitive computing, Key capabilities in advanced analytics, Using advanced analytics to create value, Impact of open source tools on advanced analytics.

UNIT IV COGNITIVE COMPUTING IN BUSINESS 9

The Business Implications of Cognitive Computing: Preparing for change, advantages of new disruptive models, knowledge meaning to business, difference with a cognitive systems approach, meshing data together differently, using business knowledge to plan for the future, answering

business questions in new ways, building business specific solutions, making cognitive computing a reality, cognitive application changing the market- IBM Watson as a cognitive system.

UNIT V APPLICATIONS **9**

The process of building a cognitive application: Emerging cognitive platform, defining the objective, defining the domain, understanding the intended users and their attributes, questions and exploring insights, training and testing- Building a cognitive health care application- Smarter Cities-Cognitive Computing in Government.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Judith H Hurwitz, Marcia Kaufman, Adrian Bowles, "Cognitive computing and Big Data Analytics" , Wiley, 2015.
2. Vijay Raghvan, Venu Govindaraju, C.R. Rao, Cognitive Computing: Theory and Applications", by Elsevier publications, North Holland Publication, 1st Edition, 2016.

REFERENCES:

1. Bernadette Sharp (Author), Florence Sedes (Author), WieslawLubaszewski (Author), Cognitive Approach to Natural Language Processing Hardcover, First Edition May 2017.
2. Arun Kumar Sangaiah, Arunkumar Thangavelu, et al., Cognitive Computing for Big Data Systems Over IoT: Frameworks, Tools and Applications: Lecture Notes on Data Engineering and Communications Technologies 1st edition 2018
3. Min Chen and Kai Hwang, Big-Data Analytics for Cloud, IoT and Cognitive Computing Wiley Publication, 1st Edition, 2017.
4. Mallick, Pradeep Kumar, Borah, Samarjeet," Emerging Trends and Applications in Cognitive Computing", IGI Global Publishers, 2019.

WEB REFERENCES:

1. https://www.coursera.org/learn/philosophy-cognitive-sciences
2. https://www.coursera.org/lecture/introduction-to-ai/cognitive-computing-perception-learning-reasoning-UBtrp

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/109104126
2. https://onlinecourses.nptel.ac.in/noc21_hs105/preview

OUTCOMES:

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

1 Understand the cognitive computing and design principles (K2)
2 Discuss the cognitive computing and NLP analytic capabilities. (K2)
3 Apply advanced analytics to cognitive computing (K2)
4 Discuss application of cognitive computing in business. (K3)
5 Illustrate various applications of cognitive computing. (K2)
6 Learn and understand the learning model and apply reasoning methodology to appropriate real world applications (K2)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	3	3	3	3	3	2	3	3	-	-	3
CO2	3	2	-	3	3	3	2	2	3	2	2	-	-	2
CO3	3	2	-	2	3	2	2	2	3	3	3	1	1	2
CO4	3	2	-	2	3	3	2	3	2	3	2	-	2	3
CO5	3	3	-	2	3	2	2	2	2	3	2	1	2	3
CO6	3	2	2	3	3	2	-	-	-	3	3	1	2	3

20AIOE909 SDG NO. 4,9	SPEECH PROCESSING AND ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the need for morphological processing and their representation
- To know about the various techniques used for speech synthesis and recognition
- To appreciate the syntax analysis and parsing that is essential for natural language processing
- To learn about the various representations of semantics and discourse
- To have knowledge about the applications of natural language processing

UNIT I SPEECH PROCESSING **9**

Phonetics –Articulatory Phonetics -Phonological Categories -Acoustic Phonetics and Signals - Speech Synthesis –Text Normalization –Phonetic and Acoustic Analysis -Diphone Waveform synthesis –Evaluation-Automatic

Speech Recognition –Architecture -Hidden Markov Model to Speech -MFCC vectors -Acoustic Likelihood Computation -Evaluation. Triphones – Discriminative Training -Modeling Variation. Computational Phonology-Finite-State Phonology –Computational Optimality Theory -Syllabification -Learning Phonology and Morphology

UNIT II SPEECH ANALYSIS **9**

Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths

UNIT III SPEECH MODELING **9**

Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

UNIT IV SPEECH RECOGNITION **9**

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary 95 continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word units; Applications and present status.

UNIT V SPEECH SYNTHESIS **9**

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

TOTAL: 45 PERIODS

TEXT BOOK

1. Jurafsky and Martin, “Speech and Language Processing”, Pearson Prentice Hall, Second Edition, 2008.
2. Lawrence Rabinerand Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003

REFERENCES

1. Steven W. Smith, “The Scientist and Engineer’s Guide to Digital Signal Processing”, California Technical Publishing.
2. Thomas F Quatieri, “Discrete-Time Speech Signal Processing –

Principles and Practice", Pearson Education.
3. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons, 1999.
4. Ben gold and Nelson Morgan, "Speech and audio signal processing", processing and perception of speech and music, Wiley- India Edition, 2006 Edition.
5. Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press

OUTCOMES:

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

1 Identify the different linguistic components of natural language (K2)
2 Design a morphological analyzer for a given natural language (K3)
3 Decide on the appropriate parsing techniques necessary for a given language and application (K3)
4 Design new tagset and a tagger for a given natural language (K4)
5 Design applications involving natural language (K2)
6 Understand the speech production and perception process. (K2)

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	3	3	3	3	3	2	3	3	-	-	3
CO2	3	2	-	3	3	3	2	2	3	2	2	-	-	2
CO3	3	2	-	2	3	2	2	2	3	3	3	1	1	2
CO4	3	2	-	2	3	3	2	3	2	3	2	-	2	3
CO5	3	3	-	2	3	2	2	2	2	3	2	1	2	3
CO6	3	2	-	3	3	2	3	1	2	3	3	1	2	3

20AIOE910 SDG NO. 4&9	HEALTHCARE ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the health data formats, health care policy and standards
- Learn the significance and need of data analysis and data visualization
- Understand the health data management frameworks
- Learn the use of machine learning and deep learning algorithms in healthcare
- Apply healthcare analytics for critical care applications

UNIT I INTRODUCTION TO HEALTHCARE ANALYSIS 9

Overview - History of Healthcare Analysis Parameters on medical care systems- Health care policy- Standardized code sets – Data Formats – Machine Learning Foundations: Tree Like reasoning, Probabilistic reasoning and Bayes Theorem, Weighted sum approach.

UNIT II ANALYTICS ON MACHINE LEARNING 9

Machine Learning Pipeline – Pre-processing –Visualization – Feature Selection – Training model parameter – Evaluation model:Sensitivity,Specificity,PPV ,NPV, FPR ,Accuracy , ROC , Precision Recall Curves , Valued target variables –Python: Variables and types, Data Structures and containers , Pandas Data Frame :Operations – Scikit –Learn : Pre-processing , Feature Selection.

UNIT III HEALTH CARE MANAGEMENT 9

IOT- Smart Sensors – Migration of Healthcare Relational database to NoSQL Cloud Database – Decision Support System – Matrix block Cipher System – Semantic Framework Analysis – Histogram bin Shifting and Rc6 Encryption – Clinical Prediction Models – Visual Analytics for Healthcare.

UNIT IV HEALTHCARE AND DEEP LEARNING 9

Introduction on Deep Learning – DFF network CNN- RNN for Sequences – Biomedical Image and Signal Analysis – Natural Language Processing and Data Mining for Clinical Data – Mobile Imaging and Analytics – Clinical Decision Support System.

UNIT V CASE STUDIES 9

Predicting Mortality for cardiology Practice –Smart Ambulance System using IOT –Hospital Acquired Conditions (HAC) program- Healthcare and Emerging Technologies – ECG Data Analysis.

TOTAL:45 PERIODS

TEXT BOOKS :

1. Chandan K.Reddy, Charu C. Aggarwal, "Health Care data Analysis", First edition, CRC, 2015.
2. Vikas Kumar, "Health Care Analysis Made Simple", Packt Publishing, 2018.

REFERENCES :

1. Nilanjan Dey, Amira Ashour , Simon James Fong, Chintan Bhatl, "Health Care Data Analysis and Management, First Edition, Academic Press, 2018.
2. Hui Jang, Eva K.Lee, "HealthCare Analysis : From Data to Knowledge to Healthcare Improvement", First Edition, Wiley, 2016.
3. Kulkarni ,Siarry, Singh ,Abraham, Zhang, Zomaya , Baki, "Big Data Analytics in HealthCare", Springer, 2020.

WEB REFERENCES:

1. https://www.ksm.edu.in/pgdm-healthcare-analytics
2. https://www.coursera.org/courses?query=healthcare%20analytics

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/109107190
2. https://nptel.ac.in/courses/110104095

OUTCOMES:

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

1 Describe the changing context of healthcare services, including the trend value-based healthcare systems and the role of data (K1)

2 Design data models that integrate patient data from multiple sources to create comprehensive, patient-centered views of data and Know how to find, download/extract, clean, and do descriptive analyses on a variety of healthcare datasets. (K2)

3 Understand conceptual and practical issues related to the collection, sharing, and structuring of healthcare data (K1)

4 Understand concepts related to healthcare data innovation, "Big Data" analytics, descriptive data analytics, and predictive data analytics (K2)

5 Understand current barriers in healthcare management and how data analytics can provide potential solutions to improve quality, lower cost, and advance outcomes(K2)

6 Use machine learning and deep learning algorithms for health data analysis and Evaluate the need of healthcare data analysis in e-healthcare, telemedicine and other critical care applications (K3)

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	3	2	2	3	3	3	3	-	-	3
CO2	3	2	-	3	3	3	2	2	2	2	3	-	-	2
CO3	3	2	-	2	3	2	3	1	3	3	3	1	1	3
CO4	3	2	-	2	3	3	2	2	2	3	2	-	3	3
CO5	3	3	-	3	3	2	3	1	3	3	2	1	2	2
CO6	3	2	-	2	3	2	2	2	3	3	3	1	1	2

Sri
SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

Affiliated to Anna University & Approved by AICTE, New Delhi

OPEN ELECTIVES

I - VIII SEMESTER
AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

B.E. DEPARTMENT OF CIVIL ENGINEERING

S. NO	COURSE CODE	COURSE TITLE	CONTACT HOURS	WEEK HOURS			CREDITS
				L	T	P	C
1	20CEOE901	Environmental Nanotechnology	3	3	0	0	3
2	20CEOE902	Human Nutrition & Health	3	3	0	0	3
3	20CEOE903	Disaster Management and Mitigation	3	3	0	0	3
4	20CEOE904	Air Pollution & Control Engineering	3	3	0	0	3
5	20CEOE905	Water Resources Systems Engineering	3	3	0	0	3
6	20CEOE906	Transportation Planning and Systems	3	3	0	0	3
7	20CEOE907	Urban Planning and Development	3	3	0	0	3
8	20CEOE908	Geographic Information System	3	3	0	0	3
9	20CEOE909	Climate Change & its Impact	3	3	0	0	3
10	20CEOE910	Building Design & Vastu	3	3	0	0	3

OPEN ELECTIVES

20CEOE901 SDG NO. 4	ENVIRONMENTAL NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To assess health effects due to nanoparticle exposure
- To manage the risks caused by nano particles in the environment
- To educate scientifically the need of sustainable nanotechnology
- To emphasize the significance of risk assessment for environmental safety

UNIT I ASSESSING NANO TECHNOLOGY HEALTH 9

Nanomaterials: The Current State of Nanotechnology Application - Nano technology Risks – Risk Analysis – Hazard Identification - Exposure Asses sment for Nanomaterials – Risk Characterization – Risk Management -Best Practices for Nanomaterials in the Workplace – Safety Research - Needs for Engineered Nanoscale Materials

UNIT II RISK ASSESSMENT AND ENVIRONMENTAL PROTECTION 9

Context for Technological Risk - Need for Risk Assessment for Nano technology-Adaptive Risk Assessment for Nanomaterials-Origins and Development of Risk Assessment-Risk Assessment Used in Environmental Decision Making - Issues in Applying the Four Steps of Risk Assessment to Nanotechnology - Hazard Assessment – Exposure Assessment - Dose - Response Evaluation

UNIT III SUSTAINABLE NANO TECHNOLOGY DEVELOPMENT 9

Necessity of Risk Assessment in Nanotechnology – The Pace of Nanotechnology Development and the Paucity of Information - Potential for Wide Dispersion in the Environment Amid Uncertainty-Few Standards or Guidelines – Environmental Risk Issues - Carbon Nano tubes –Defining the Toxic Dose - Environmentally Friendly Nanotechnology -Life Cycle Analysis for Sustainable Nanotechnology

UNIT IV HUMAN HEALTH, TOXICOLOGY, AND NANOTECHNOLOGICAL RISK 9

Mechanisms of Toxicity-Types of Toxicological Studies–Pulmonary Toxicity Studies-Gastrointestinal Toxicity-In Vitro Studies–Dermal- In Vitro Toxicity Studies

UNIT V ENVIRONMENTAL RISKS **9**

Antimicrobial Properties of Nanoscale Silver – Bucky balls, Titanium Di oxide (TiO2) - Short - Term Toxicity Tests – Daphnia LC50 Assays - Stu dies of Nanomaterial Toxicity to Fish - Bucky balls and Bass - TiO2 in Arsenic - Field Studies - Environmental Exposures -Nanoscale Zero valent Iron

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jo Ann Shatkin "Nanotechnology - Health and Environmental risks". CRC Press. Taylor and Francis Group 2008
2. David A. Wright, Pamela Welbourn " Environmental Toxicology "Cambridge's University Press, 2002

REFERENCES:

1. Whitacre David. M, "Reviews of Environmental Contamination and Toxicology".Volume223, Springer, 2013
2. Lorris G. Cockerham, BarbaraS.Shane"Basic Environmental Toxicology" CRC Press 1994

WEB REFERENCES:

1. https://www.understandingnano.com/environmental-nano technology.html
2. https://www.accessengineeringlibrary.com/content/book/ 9780071477505
3. www.nptel.ac.in

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/118104008/
2. https://ocw.mit.edu/courses/mechanical-engineering/2-57-nano-to-macro-transport-processes-spring-2012/video-lectures/lecture-1-intro-to-nanotechnology-nanoscale-transport-phenomena/

OUTCOMES:

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

1. Explain the current status of nanotechnology, application and Risk analysis with concept of nanomaterial
2. Discuss the risk assessment in nanotechnology and environmental protection
3. Illustrate the SUSTAINABLE NANOTECHNOLOGY DEVELOPMENT and standard guidelines

4. Explain the various concepts of TOXICOLOGY, AND NANO TECHNOLOGICAL RISK
5. Understand Environmental risk due to nanotechnology, Field Studies and Environmental Exposures in detail

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	2	-	-	2	-
CO2	-	3	3	2	-	-	-	3	2	-	3	-	3	2
CO3	3	3	2	-	-	-	-	-	-	-	3	-	3	2
CO4	3	3	3	-	2	-	2	3	-	2	3	2	-	-
CO5	2	3	2	3	-	1	2	-	3	2	-	-	2	2

20CEOE902 SDG NO. 4	HUMAN NUTRITION & HEALTH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand about Composition of foods
- Know about nutrients metabolites and dietary evaluation.
- Calculate energy value of foods

UNIT I INTRODUCTION TO NUTRITION 9

Classification of nutrition, RDA for nutrients, Digestion and absorption and metabolism of foods.

UNIT II MAJOR AND MICRO NUTRIENTS 9

Carbohydrates ,Proteins, Fat, Vitamins and Minerals- Classification with respect to nutrition aspects, functions and sources.

UNIT III FOOD AS ENERGY 9

Forms of energy, Energy value of foods, estimation of energy requirement for humans.

UNIT IV TYPES OF DIET 9

Balanced diet, Modified diet, planning for balanced diet

UNIT V NUTRITIONAL FOODS **9**

Health specific nutrition, nutritive value of fast foods, nutritional evaluation of foods, nutritional labeling

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Sunetra Roday, "Food science and Nutrition". Oxford Publishers 2007.
2. Sri Lakshmi, B. Food Science, New Age International (P)Ltd Publishing House , New Delhi 2007
3. Srilakshmi . B , Human Nutrition , New Age International Publishers ,2010
4. ShakuntalaManay ,N. and N.ShadakSharaswamy , Foods, Facts and Principles, New Age International Publishers, New Delhi, 2nd Edition, 2007

REFERENCES:

1. Norman N. Potter, Joseph H. Hotchkiss. "Food science". Springer Publications 1988.
2. Potter, N .M., Food Science, The AVI Publishing Company, Inc, West Port Connecticut, USA, 2007
3. Garrow, J.S., James, PT. And Ralph. A., Human Nutrition and Dietetics, ChurchillLiving Stone10th edition 2000.
4. Mahan,K.L., and StumphS. E. Krause Food, Nutrition and Diet therapy,W.B.SaundersCompany,10th edition2004.

WEB REFERENCES:

1. https://libraryguides.mcgill.ca/c.php?g=346138&p=2332864
2. https://onlinelibrary.wiley.com/journal/1365277x
3. https://www.britannica.com/science/human-nutrition
4. https://www.who.int/nutrition/en/

ONLINE RESOURCES:

1. https://youtu.be/CpMeB0TObHA
2. https://youtu.be/-dmJSLNgjxo

OUTCOMES:

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

1. The role of nutrition in growth and health through the life cycle.
2. Provide an overview of the major macro and micronutrients relevant to human health.
3. Discuss the scientific rationale for defining nutritional requirements in healthy individuals and populations

4. The role of diet in the development of chronic diseases, such as cardiovascular disease, cancer, diabetes, etc.
5. The rationale for the development of dietary guidelines and of nutrition policies

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	3	2	2	3	2	-	2	-	-
CO2	-	2	-	1	3	2	-	-	-	-	-	-	-	-
CO3	1	-	3	-	-	3	-	-	2	2	3	-	3	3
CO4	-	2	2	3	-	3	2	2	-	1	2	-	-	-
CO5	1	-	2	-	2	2	2	1	-	-	1	2	2	-

20CEOE903 SDG NO. 4,13,15	DISASTER MANAGEMENT & MITIGATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake- holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423

2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES:

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

WEB REFERENCES:

1. https://nptel.ac.in/courses/105104183/
2. https://www.researchgate.net/publication/277327554_Introduction_to_Disaster_Management
3. http://www.pitt.edu/~super1/disasters/disasters.htm
4. https://www.brainkart.com/article/Disaster-Management,-Mitigation-and-Prevention_1171/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/4255/nptel-natural-hazards-part/6
2. https://swayam.gov.in/nd2_cec19_hs20/preview
3. https://freevideolectures.com/course/4318/nptel-urban-governance-development-management-ugdm/40
4. https://nidm.gov.in/videos.asp

OUTCOMES:

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

1. Differentiate the types of disasters, causes and their impact on environment and society
2. Assess vulnerability and various methods of risk reduction measures as well as mitigation.
3. Understand the interrelationship between between vulnerability, disasters, disaster prevention.
4. Draw the hazard and vulnerability profile of India
5. Draw the Scenarios in the Indian context, Disaster damage assessment and management.

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	3	3	-	1	-	1	-	-
CO2	3	2	3	-	-	2	-	-	3	2	2	1	1	1
CO3	3	2	3	-	2	1	-	-	1	2	-	1	1	-
CO4	2	2	3	3	2	2	-	-	1	2	2	1	-	1
CO5	2	2	3	3	2	2	-	-	3	2	2	1	1	2

20CEOE904 SDG NO. 4&13	AIR POLLUTION AND CONTROL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on the principle
- To design of control of Indoor/ particulate / Gaseous air pollutant and its emerging trends.

UNIT I AIR QUALITY **9**

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility – Ambient Air Quality and Emission standards – Ambient and stack sampling and Analysis of Particulate and Gaseous Pollutants.

UNIT II ATMOSPHERIC DISPERSION OF AIR POLLUTANT **8**

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns-Atmospheric Diffusion Theories–Dispersion models, Plume rise.

UNIT III CONTROL OF PARTICULATE CONTAMINANTS **9**

Gas Particle Interaction – Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations- Factors affecting Selection of Control Equipment.

UNIT IV CONTROL OF GASEOUS CONTAMINANTS 10

Working principle, Design and performance equations of absorption , Adsorption , condensation , Incineration , Bio scrubbers , Bio filters – Process control and Monitoring -Operational Considerations - Factors affecting Selection of Control Equipment – CO_2 capturing.

UNIT V INDOOR AIR QUALITY MANAGEMENT 9

Sources types and control of indoor air pollutants , sick building syndrome types – Sources and Effects of Noise Pollution – Measurement – Standards – Control and Preventive measures.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Lawrence K. Wang, Norman C. Pareira, Yung TseHung, Air Pollution Control Engineering, Tokyo, 2004.
2. Noel de Nevers, Air Pollution Control Engineering, McGrawHill,NewYork, 1995
3. Anjaneyulu.Y,"AirPollutionandControlTechnologies", Allied Publishers(P)Ltd, India 2002.
4. M.N Rao and HVN Rao, Air Pollution,Tata Mcgraw Hill Publishing Company limited, 2007.

REFERENCES:

1. David H.F. Liu, Bela G. Liptak ,, Air Pollution",LweisPublishers, 2000
2. Arthur C.Stern, ,,Air Pollution(Vol.I–Vol.VIII)", Academic Press, 2006
3. WayneT.Davis,,, Air Pollution Engineering Manual", John Wiley & Sons, Inc.,2000

WEB REFERENCES:

1. https://onlinelibrary.wiley.com/doi/10.1002/0471238961.01091823151206.a01.pub3
2. https://nptel.ac.in/courses
3. https://www.britannica.com/technology/air-pollution-control

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105104099/
2. https://www.open.edu/openlearn/science-maths-technology/engineering-technology/air-pollution
3. https://www.slideshare.net/mobile/gauravhtandon1/indoor-air-quality-32772998

OUTCOMES:

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

1. Understand the chemistry of atmosphere, characterize the air pollutants, know the effects of air pollution, identify the criteria air pollutants and know about NAAQS
2. Apply the knowledge of mathematics, science and engineering fundamentals to understand the concept of meteorology, air pollution dispersion and Gaussian Plume dispersion model
3. Select suitable method and design the particulate pollutant control equipment
4. Select appropriate method for control of gaseous pollutant by due consideration of sources of emission
5. Understand the source of indoor air pollution, effects and control methods as well as to identify the source of noise, and select suitable method for measuring and control of noise pollution.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	3	1	2	2	1	2	3	2	3	1	3
CO2	3	2	1	2	1	3	2	1	2	3	2	3	1	2
CO3	3	2	3	2	2	2	2	2	2	3	1	2	2	3
CO4	3	3	3	2	2	2	3	2	3	3	1	2	3	3
CO5	3	2	3	3	1	2	2	2	2	3	1	2	2	2

CEOE905 SDG NO. 4,6,7,9,11	WATER RESOURCES SYSTEMS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the student to the concept of Mathematical approaches for managing the water resources system and apply to operate a water resource system optimally.

UNIT I SYSTEM APPROACH **9**

Definition, classification, and characteristics of systems-Philosophy of modelling– Goals and Objectives– Basics of system analysis concept –steps in systems engineering.

UNIT II LINEAR PROGRAMMING **9**

Introduction to Operation research-Linear programming Problem Formulation- graphical solution Simplex method–Sensitivity analysis - application to operation of single purpose reservoir

UNIT III DYNAMIC PROGRAMMING **9**

Bellman's optimality criteria, problem formulation and solutions– Water Allocation for three states (user), forward and Backward Recursion technique sin Dynamic Programming-Shortest pipe line route problem - Application to reservoirs capacity expansion

UNIT IV SIMULATION **9**

Basic principles and concepts–Monte Carlo techniques–Model development–Input sand outputs– Single and multipurpose reservoir simulation models –Deterministic simulation –Rule Curve development for reservoir

UNIT V ADVANCED OPTIMIZATION TECHNIQUES **9**

Integer and parametric linear programming– Goal programming types–Applications to reservoir release optimization – application of evolutionary algorithms like Genetic algorithm, Particle swarm, Simulated Annealing to reservoir release optimization.

TOTAL: 45PERIODS

TEXTBOOKS

1. Vedula,S., and Majumdar, P.P. Water Resources Systems–Modeling Techniques and Analysis Tata McGrawHill, NewDelhi, Fifthreprint, 2010.
2. Bhave PR,WaterResourcesSystems, NarosaPublishers,2011

REFERENCES:

1. Gupta, P.K., and Man Mohan, "Problems in Operations Research", (Methods and Solutions),Sultan Chand and Sons, NewDelhi,1995.
2. Chaturvedi,M.C., "Water Resources Systems Planning and Management", TataMcGraw Hill,NewDelhi,1997.
3. Taha,H.A., "Operations Research",McMillanPublicationCo., New York, 1995.
4. Hiller, F.S., and Liebermann, G.J., "Operations Research", CBS Publications and Distributions, NewDelhi, 1992.

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1. https://nptel.ac.in/content/syllabus_pdf/105108081.pdf
2. http://cwc.gov.in/sites/default/files/pin-2772017uploaded_1.pdf
3. http://nitrr.ac.in/downloads/syl_new/CIVIL/

ONLINE RESOURCES:

1. https://portals.iucn.org/library/efiles/documents/2002-011.pdf
2. https://www.icevirtuallibrary.com/doi/10.1680/jwama.15.00018

OUTCOMES: Students will be to

1. Define the economic aspects and analysis of water resources systems for comprehensive and integrated planning of a water resources project.
2. Apply the concept of linear programming for optimization of water resources problem
3. Explain the concept of dynamic programming and apply in water resource system.
4. Develop the simulation model based on deterministic and stochastic simulation for reservoir operating policy
5. Apply advance optimization techniques like goal programming, heuristic algorithm in the field of water resources planning and management.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	2	-	-	-	-	3	2	2
CO2	3	2	-	-	-	3	-	3	-	-	2	2	2	3
CO3	3	3	2	-	2	2	-	2	-	-	3	2	1	3
CO4	3	3	3	-	3	3	-	3	-	2	2	3	3	3
CO5	3	3	3	3	3	3	-	3	2	-	3	3	3	3

CEOE906 SDG NO. 2,3,4,7, 9,11,12&13	TRANSPORTATION PLANNING AND SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Key principles governing transportation planning, investment, operations and maintenance. It introduces the macroeconomic concepts central to transportation systems.
- To find specific transportation mode, by using the various modes to apply the theoretical and analytical concepts presented in the lectures and readings.
- Application to transportation systems includes congestion pricing, technological change, resource allocation, market structure and regulation, revenue forecasting, public and private transportation finance.
- To give an exposure on overview of the principles of the bus and rail transportation planning and evaluation of the transportation projects.

UNIT I STUDY AREA AND SURVEYS 10

Importanceofplanningandintegratedtransportfacilitiesinurbanareas–Deline ationofstudy area and zoning–Conducting various surveys–Travelpatterns, transport facilities and planning parameters.

UNIT II MODES 7

Basics of trip generation– Trip distribution– Trip assignment and modal split models–Validation of the model.

UNIT III PLAN PREPARATION AND EVALUATION 8

Preparation of alternative plans–Evaluation techniques– Economic and financial evaluation– Environment Impact Assessment (EIA)–CaseStudies.

UNIT IV BUS TRANSPORTATION 10

Characteristics and bus transportation in urban areas–Fare policy –Route planning– Planning of terminals–Breakevenpointanditsrelevance.

UNIT V RAIL TRANSPORTATION 10

Characteristics of suburban, IRT and RRT systems– Planning of rail terminals – Fare policy – Unified traffic and transport authority.

TOTAL:45PERIODS

TEXT BOOKS:

1. Michael J.Bruton, Introduction to Transportation Planning, Hutchinson, London,1995.

2. Kadiyali.L.R., Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 2008.

REFERENCES:

1. John W. Dickey, Metropolitan Transportation Planning, Tata McGraw Hill Publishing Company Ltd., NewDelhi,1990.
2. C. JotinKhisty, KentLall, and Transportation Engineering: An Introduction, PrenticeHall,1998
3. Juande Dios Ort zar and Luis G.Willumsen, Modelling Transport, JohnWiley&Sons2001
4. Chennai Comprehensive Traffic Study, Chennai Metropolitan Development Authority, 2007.

WEB REFERENCES:

1. https://wisconsindot.gov/Pages/projects/data-plan/plan-res/default.aspx
2. https://ops.fhwa.dot.gov/plan4ops/focus_areas/planning_prog.htm
3. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-221j-transportation-systems-fall-2004/lecture-notes/
4. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-225j-transportation-flow-systems-fall-2002/
5. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-201j-transportation-systems-analysis-demand-and-economics-fall-2008/index.html
6. https://nptel.ac.in/courses/105107067/
7. https://nptel.ac.in/courses/105/104/105104098/
8. https://nptel.ac.in/courses/105/101/105101087/
9. https://cosmolearning.org/courses/urban-transportation-planning/video-lectures/
10. https://www.ite.org/
11. https://www.itdp.org/our-work/public-transport/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/105/105105107/
2. https://nptel.ac.in/courses/105/107/105107123/
3. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-258j-public-transportation-systems-spring-2017/class-videos/

OUTCOMES:

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

1. Understand the concepts and surveys adopted in Transportation planning
2. Knowledge on modelling of trip generation assigning and distribution techniques in transportation system.
3. Planning and evaluating transportation projects through various case studies.
4. Knowledge on planning of bus transportation system in urban areas.
5. Planning of various rail transportation and fare policies adopted.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	2	-	3	-	1	-	-	3	1
CO2	-	-	3	-	2	2	-	-	-	1	-	2	3	2
CO3	2	3	3	2	3	-	-	-	3	2	3	3	2	3
CO4	2	3	2	2	2	-	-	3	3	3	-	-	2	3
CO5	-	2	1	1	-	-	1	3	3	1	3	3	3	1

20CEOE907 SDG NO. 4,11,15	URBAN PLANNING AND DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To prepare the students to develop a holistic view of the city as a basis for designing the city/city components
- To contribute to a clearer understanding of cities, particularly of Indian cities
- To address the various urban design issues facing the city
- To study norms and aspects of land use planning policies and survey techniques.
- to provide the students an overview and understanding of the History of Town Planning Politics and policy making in modern cities

UNIT I BASIC ISSUES 8

Definition of Human settlement, Urban area, Town, City, Urbanisation, Suburbanisation, Urban sprawl, Peri-urban areas, Central Business District (CBD), Classification of urban areas – Trend of Urbanisation at International, National, Regional and State level.

UNIT II PLANNING PROCESS 8

Principles of Planning – Types and Level of Plan, Stages in Planning Process – Goals, Objectives, Delineation of Planning Areas, Surveys and Questionnaire Design.

UNIT III DEVELOPMENT PLANS, PLAN FORMULATION AND EVALUATION 10

Scope and Content of Regional Plan, Master Plan, Detailed Development Plan, Development Control Rules, Transfer of Development Rights , Special Economic Zones- Development of small town and smart cities-case studies

UNIT IV PLANNING AND DESIGN OF URBAN DEVELOPMENT PROJECTS 9

Site Analysis, Layout Design, Planning Standards, Project Formulation – Evaluation, Plan Implementation, Constraints and Implementation, Financing of Urban Development Projects.

UNIT V LEGISLATION, DEVELOPMENT AND MANAGEMENT OF URBAN SYSTEM 10

Town and Country Planning Act, Land Acquisition and Resettlement Act etc., Urban Planning Standards and Regulations, Involvement of Public, Private, NGO, CBO and Beneficiaries.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Goel, S.L Urban Development and Management, Deep and Deep publications, New Delhi 2002
2. George Chadwick, A Systems view of planning, Pergamon press, Oxford 1978
3. Singh V.B, Revitalised Urban Administration in India, Kalpaz publication, Delhi, 2001
4. Edwin S.Mills and Charles M.Becker, Studies in Urban development, A World Bank publication, 1986

REFERENCES:

1. Tamil Nadu Town and Country Planning Act 1971, Government of Tamil Nadu, Chennai

2. Goel S.L., Urban Development and Management, Deep and Deep Publications, New Delhi,2002
3. Thooyavan, K.R., Human Settlements – A Planning Guide to Beginners, M.A Publications, Chennai, 2005
4. CMDA, Second Master Plan for Chennai, Chennai 2008

WEB REFERENCES:

1. https://nptel.ac.in/content/storage2/courses/109104047/pdf/lecture42.pdf
2. https://swayam.gov.in/nd2_cec20_ar01/preview
3. http://www.iitb.ac.in/newacadhome/MUDEbrouchure28032019.pdf

ONLINE RESOURCES:

1. https://www.planetizen.com/news/2019/01/102491
2. https://www.ted.com/topics/urban+planning

OUTCOMES:

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

1. Understand the basic concepts in urban planning and development.
2. Knowledge on principles of planning, surveys and analysis. in developing an urban area.
3. Knowledge on development of regional, master plan and norms for development of smart cities.
4. Planning of standards, implanting and financing of Urban projects.
5. Understand the norms, legal aspects and stakeholder's role in planning an urban area.

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	2	-	-	3	-	3	-	-	3	3
CO2	3	3	3	3	2	-	-	-	3	-	-	-	3	-
CO3	3	1	2	-	-	2	-	3	-	2	-	3	3	-
CO4	-	1	2	3	-	2	-	3	3	-	3	3	2	2
CO5	-	-	-	-	-	-	1	3	3	3	-	-	-	3

20CEEL908 SDG NO. 4,9,11	GEOGRAPHIC INFORMATION SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the fundamentals and components of Geographic Information System
- To provide details of spatial data structures and input, management and output processes.

UNIT I INTRODUCTION TO MAPS AND GIS 9

Maps – Definition – Scale - Types of Maps – Elements of Map – Projection – purpose - types – Coordinate Systems: Geographic, Rectangular and Polar – Transformations - types and application – GIS: Introduction - History – Components – Applications of GIS - Popular GIS software – Open source GIS software

UNIT II DBMS AND GIS DATA MODEL 9

Database Management system – function – types – advantages - Entity Relationship Model - Normalization - GIS Data Model - Introduction - Data Encoding - Vector Data Structure - Raster Data structure – Network Data Structure - Comparison of Vector and Raster Data Structure – ODBC

UNIT III GIS DATA INPUT 9

Sources for GIS Data - Vector Data Input – Georeferencing – Topology – Topological Relationship - Raster Data Input – Errors in input – Data Editing – Linking Attribute Data – Raster File Formats – Vector File Formats – Raster to Vector and Vector to Raster Conversion - OGC standards.

UNIT IV GIS DATA ANALYSIS 9

Introduction to spatial analysis - Raster Data Spatial Analysis: Local, Neighbourhood, Zonal Operations - Vector Operations and Analysis: Topological and Non-topological operations - Network Analysis – DEM – Surface Analysis

UNIT V GIS OUTPUT DESIGN AND PRESENTATION 9

Introduction - Spatial and Non-spatial Data presentation - Map layout – Charts, Graphs and Multimedia output – Elements of Spatial Data Quality – Meta Data - Introduction to Web GIS – Applications in Civil Engineering

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jonathan Campbell and Michael Shin, Essentials of Geographic Information Systems, 2011, Saylor Foundation, ISBN: 9781453321966
2. Michael N. DeMers, Fundamentals of Geographic Information Systems, 4th Edition, 2009, Wiley, ISBN: 9780470129067
3. Ian Heywood, Sarah Cornelius, Steve Carver, An Introduction to Geographical Information Systems, 4th Edition, 2011, Prentice Hall, ISBN: 9780273722595
4. Longley, P. A., Goodchild, M. F., Maguire, D. J., and Rhind, D. W., Geographical Information Systems: Principles, Techniques, Management and Applications, 2nd Edition, 2005, John Wiley & Sons, ISBN: 9780471735458
5. Kang-tsung Chang, "Introduction to Geographic Information Systems", 9th Edition, 2019, McGraw-Hill Book Company, ISBN: 9781259929649

REFERENCES:

1. Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind, Geographic Information Science and Systems, 4th Edition , 2015, Wiley, ISBN: 9781118676950
2. David Smith, Understanding GIS - An ArcGIS Pro Project Workbook, 4th Edition, 2018, Environmental Systems Research, ISBN: 9781589485266

WEB REFERENCES:

1. https://www.esri.com/en-us/what-is-gis/overview
2. https://bhuvan.nrsc.gov.in/bhuvan_links.php
3. https://nptel.ac.in/courses/105/102/105102015/
4. https://researchguides.dartmouth.edu/gis/internet
5. https://www.cdc.gov/gis/index.htm

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/107/105107155/
2. http://www.gisresources.com/resource-box/

OUTCOMES:

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

1. Understand the fundamentals of maps, their characteristics and GIS, its components
2. Appreciate various spatial data models and their advantages
3. Produce a error free GIS database for civil engineering applications

4. Apply various spatial analysis tools for deriving GIS based outcome
5. Present the spatial information along with quality assessment for applications

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	2	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	1	-	-	-	-	-
CO3	-	-	1	-	-	-	-	-	-	-	1	-	-	2
CO4	-	3	-	-	3	-	-	-	-	-	1	-	-	-
CO5	-	3	1	-	3	2	1	1	-	2	-	-	1	2

20CEOE909 SDG NO. 4,13	CLIMATE CHANGE & ITS IMPACT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of weather and climate
- To have an insight on Atmospheric dynamics and transport of heat
- To develop simple climate models and evaluate climate changes using models

UNIT I BASICS OF WEATHER AND CLIMATE 9

Shallow film of Air– stratified & disturbed atmosphere – law – atmosphere Engine. Observation of parameters: Temperature – Humidity – Wind - Pressure – precipitation-surface – networks. Constitution of atmosphere: well stirred atmosphere – process around turbopause – in dry air – ozone – carbon Dioxide – Sulphur Dioxide– Aerosol - water. Evolution of Atmosphere. State of atmosphere: Air temperature – pressure – hydrostatic – Chemistry – Distribution – circulation

UNIT II ATMOSPHERIC DYNAMICS 9

Atmosphere dynamics: law – isobaric heating and cooling – adiabatic lapse rates – equation of motion - solving and forecasting. Forces – Relative and absolute acceleration – Earth's rotation coriolis on sphere – full equation of motion – Geostrophy;- Thermal winds –departures – small- scale motion. Radiation, convection and advections: sun & solar radiation – energy balance

– terrestrial radiation and the atmosphere – Green house effect- Global warming - Global budget – radiative fluxes - heat transport. Atmosphere and ocean systems convecting & advecting heat. Surface and boundary layer – smaller scale weather system – larger scale weather system.

UNIT III GLOBAL CLIMATE 9

Components and phenomena in the climate system: Time and space scales – interaction and parameterization problem. Gradients of Radiative forcing and energy transports by atmosphere and ocean – atmospheric circulation – latitude structure of the circulation - latitude – longitude dependence of climate features. Ocean circulation: latitude – longitude dependence of climate features – ocean vertical structure – ocean thermohaline circulation – land surface processes – carbon cycle.

UNIT IV CLIMATE SYSTEM PROCESSES 9

Conservation of motion: Force – coriolis - pressure gradient- velocity equations – Application – geotropic wind – pressure co-ordinates. Equation of State – atmosphere – ocean. Application: thermal circulation – sea level rise. Temperature equation: Ocean – air – Application – decay of sea surface temperature. Continuity equation: ocean – atmosphere. Application: coastal upwelling – equatorial upwelling – conservation of warm water mass. Moisture and salinity equation: conservation of mass – moisture. Source & sinks – latent heat. Moist processes – saturation – convection – Wave processes in atmosphere and ocean.

UNIT V CLIMATE CHANGE MODELS 9

Constructing a climate model – climate system modeling – climate simulation and drift – Evaluation of climate model simulation – regional (RCM) – global (GCM) – Global average response to warming – climate change observed to date.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Private limited 2007.
2. Adaptation and mitigation of climate change-Scientific Technical Analysis. Cambridge University Press ,Cambridge,2006.
3. Atmospheric Science, J.M. Wallace and P.V. Hobbs, Elsevier / Academic Press 2006.
4. Jan C. van Dam, Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge university press ,2003.
5. Fundamentals of weather and climate (2nd Edition) Robin Moilveen (2010), Oxford University Press.

6. Climate change and climate modeling, J. David Neelin (2011) Cambridge University press.

WEB REFERENCES:

1. https://climate.nasa.gov/effects/
2. https://nptel.ac.in/courses/119/102/119102007/
3. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/102104068/lec34.pdf
4. https://serc.carleton.edu/integrate/teaching_materials/index.html
5. http://cliveg.bu.edu/courses/gg101spring05/L32-Lecture-Notes.pdf

ONLINE RESOURCES:

1. https://swayam.gov.in/nd1_noc19_ge23/preview
2. https://www.coursera.org/learn/global-warming
3. https://sdgacademy.org/course/climate-change-the-science-and-global-impact/

OUTCOMES:

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

1. The concepts of weather and climate
2. The principles of Atmospheric dynamics and transport of heat and air mass
3. The develop simple models to predict climate change
4. To know the concept of mitigation measures against global warming
5. To develop the Climate Change Model

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	3	2	3	2	2	1	2	2	1
CO2	3	2	3	2	2	3	2	3	2	2	1	2	2	1
CO3	1	3	3	3	2	3	2	3	2	2	2	2	2	2
CO4	1	2	3	2	2	3	3	3	2	3	2	3	2	2
CO5	3	3	3	3	2	3	2	2	3	3	1	3	2	3

20CEOE910 SDG NO. 4,9,11	BUILDING DESIGN AND VASTU	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The objective of this course is enable the student to understand the principles of GreenBuilding, Global assessment and certification methods and the concept of Sustainability.

UNIT I INTRODUCTION OF GREEN BUILDING 9

Concept of green building, History of green building, Need of green building in present scenario, Importance of green building Merits and demerits, Classification of green building, Assessment methods Global assessment and certification, Local assessment, LEED India GRIHA (Green Rating for Integrated Habitat Assessment)

UNIT II PRINCIPLES AND ELEMENTS OF DESIGN OF GREEN BUILDING 9

Sustainability: concept and reality - Climate responsive process of design: Climatic zones, design sequence, shelter or form, land form, vegetation, water bodies, street widths, open spaces, ground character, plan form, orientation, roof form - Shading devices and their effect

UNIT III THERMAL INDICES 9

Thermal comfort inside the building: Factors affecting, indices, cooling and heating requirement, Heat transmission through building sections, thermal performance of building sections, simple calculation for U value and insulation thickness - Day lighting - Ventilation

UNIT IV ENERGY CONSERVATION 9

3 R's for water conservation, rain water harvesting, low flow fixtures, grey water recycling Material conservation: concept of embodied energy, low energy materials, sustainable materials, alternative materials Concept of carbon emission and its reduction.

UNIT V VASTU CONCEPT 9

History, scientific approach, importance of shapes size and direction, vastu of a plot, elements ofvastu for selecting a plot, vastu of a residence, vastu of existing building.

TOTAL 45 PERIODS

TEXT BOOKS:

1. Climate responsive architecture(A design hand book for energy efficient buildings),Arvind Krishnana, Simos Yannas, NickBaker, SVSzokolay, McGrawhill Education, Seventh reprint.2013
2. Renewable Energy and Environment-A Policy Analysis for India, H.Ravindranath, K UshaRao,

REFERENCE BOOKS:

1. Standards/Guidelines Handbook on functional requirements of buildings (SP41), BIS, New Delhi, 1987
2. Energy Conservation building code (ECBC), Bureau of energy efficiency, 2011

WEB REFERENCES:

1. https://theconstructor.org/building/elements-of-green-building/
2. https://www.livevaastu.com/articles/article-460/vastu-for-shapes-and-sizes

ONLINE RESOURCES:

1. https://freevideolectures.com/course/
2. https://www.wbdg.org/resources/green-building-standards-and-certification-systems

OUTCOMES:

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

1. Know the importance and need of Green Building.
2. Study the principle elements of Green Building.
3. Know about thermal comfort inside the Building.
4. Understand the Recycling of materials and conservation
5. Know the importance of shapes size and direction.

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	1	1	2	3	-	-	1	2	3	2
CO2	3	3	3	-	2	2	2	3	-	-	2	2	3	2
CO3	2	2	3	-	3	2	2	2	-	3	3	2	3	2
CO4	2	2	2	-	3	3	2	3	-	3	2	3	3	2
CO5	2	2	2	3	3	3	2	3	3	3	2	3	3	2

Sri
SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

Affiliated to Anna University & Approved by AICTE, New Delhi

OPEN ELECTIVES

I - VIII SEMESTER
AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

B.E. DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

S. NO	COURSE CODE	COURSE TITLE	CONTACT HOURS	WEEK HOURS			CREDITS
				L	T	P	C
1	20CSOE901	Database Concepts	3	3	0	0	3
2	20CSOE902	Software Engineering Practices	3	3	0	0	3
3	20CSOE903	Data Structures and Algorithms	3	3	0	0	3
4	20CSOE904	Network Security	3	3	0	0	3
5	20CSOE905	Software Testing Techniques	3	3	0	0	3
6	20CSOE906	Networking Essentials	3	3	0	0	3
7	20CSOE907	Introduction to Cloud Computing	3	3	0	0	3
8	20CSOE908	Internet of Things	3	3	0	0	3
9	20CSOE909	Robotic Process Automation	3	3	0	0	3
10	20CSOE910	Soft Computing Methodologies	3	3	0	0	3

OPEN ELECTIVES

20CSOE901 SDG NO. 4&9	DATABASE CONCEPTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the fundamentals of Database Management Systems.
- To make the students understand the relational model.
- To familiarize the students with ER diagrams and SQL
- To make the students to understand the fundamentals of Transaction Processing and Query Processing.
- To familiarize the students with the different types of Databases and security issues

UNIT I INTRODUCTION TO DBMS 10

File Systems Organization – Sequential, Pointer, Indexed, Direct – Purpose of Database System- Database System Terminologies-Database characteristics-Data models – Types of data models – Components of DBMS- Relational Algebra. LOGICAL DATABASE DESIGN: Relational DBMS – Codd's Rule – Entity-Relationship model – Extended ER Normalization – Functional Dependencies, Anomaly- 1NF to 5NF- Domain Key Normal Form – De-Normalization

UNIT II SQL & QUERY OPTIMIZATION 8

SQL Standards – Data types – Database Objects- DDL-DML-DCL-TCL-Embedded SQL-Static Vs Dynamic SQL – QUERY OPTIMIZATION: Query Processing and Optimization – Heuristics and Cost Estimates in Query Optimization.

UNIT III TRANSACTION PROCESSING AND CONCURRENCY CONTROL 8

Introduction-Properties of Transaction- Serializability- Concurrency Control – Locking Mechanisms- Two Phase Commit Protocol-Dead lock.

UNIT IV TRENDS IN DATABASE TECHNOLOGY 10

Overview of Physical Storage Media – Magnetic Disks – RAID – Tertiary storage – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Introduction to Distributed Databases- Client server technology- Multidimensional and Parallel databases- Spatial and multimedia databases- Mobile and web databases- Data Warehouse-Mining- Data marts.

UNIT V ADVANCED TOPICS **9**

DATABASE SECURITY: Data Classification-Threats and risks – Database access Control – Types of Privileges –Cryptography- Statistical Databases.- Distributed Databases-Architecture-Transaction Processing-Data Warehousing and Mining-Classification-Association rules-Clustering-Information Retrieval- Relevance ranking-Crawling and Indexing the Web-Object Oriented Databases-XML Databases.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", Fifth Edition, Pearson Education, 2008.

REFERENCES:

1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, "Database System Concepts", Sixth Edition, Tata Mc Graw Hill, 2011.
2. C.J.Date, A.Kannan and S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
3. Atul Kahate, "Introduction to Database Management Systems", Pearson Education, New Delhi, 2006.
4. Alexis Leon and Mathews Leon, "Database Management Systems", Vikas Publishing House Private Limited, New Delhi, 2003.
5. Raghu Ramakrishnan, "Database Management Systems", Fourth Edition, Tata Mc Graw Hill, 2010.
6. G.K.Gupta, "Database Management Systems", Tata Mc Graw Hill, 2011.
7. Rob Cornell, "Database Systems Design and Implementation", Cengage Learning, 2011.

WEB REFERENCES:

1. http://www.nptelvideos.in/2012/11/database-management-system.html
2. https://www.classcentral.com/course/swayam-database-management-system-9914
3. https://swayam.gov.in/nd1_noc19_cs46/preview

ONLINE RESOURCES:

1. https://www.w3schools.in/sql/database-concepts/
2. https://beginnersbook.com/2015/04/dbms-tutorial/
3. https://www.tutorialspoint.com/sql/sql-rdbms-concepts.htm

OUTCOMES:

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

1. Design Databases for applications.
2. Use the Relational model, ER diagrams.
3. Apply concurrency control and recovery mechanisms for practical problems.
4. Design the Query Processor and Transaction Processor.
5. Apply security concepts to databases.

CO - PO, PSO MAPPING

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

20CSOE902 SDG NO. 4	SOFTWARE ENGINEERING PRACTICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the phases in a Software Project
- To understand fundamental concepts of Requirements engineering and Analysis Modeling.
- To understand the various Software Design Methodologies
- To learn various Testing and Maintenance measures

UNIT I SOFTWARE PROCESS AND AGILE DEVELOPMENT 9

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models –Introduction to Agility-Agile process-Extreme programming-XP Process.

UNIT II REQUIREMENTS ANALYSIS AND SPECIFICATION 9

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement

Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management - Classical analysis: Structured system Analysis, Petri Nets- Data Dictionary.

UNIT III SOFTWARE DESIGN 9

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design - Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNIT IV TESTING AND MAINTENANCE 9

Software testing fundamentals-Internal and external views of testing-White box testing - Basis path testing-Control Structure testing-Black box testing-Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing and Debugging –Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering.

UNIT V PROJECT MANAGEMENT 9

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan-CASE TOOLS.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Seventh Edition, Mc Graw-Hill International Edition, 2010.
2. Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education Asia, 2011

REFERENCES:

1. Rajib Mall, "Fundamentals of Software Engineering", Third Edition, PHI Learning Private Limited, 2009.
2. Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.
3. Kelkar S.A., "Software Engineering", Prentice Hall of India Pvt. Ltd, 2007.
4. Stephen R. Schach, "Software Engineering", Tata McGraw-Hill Publishing Company Limited,2007.

WEB REFERENCES:

1. https://sceweb.sce.uhcl.edu/helm/ROLE-Tester/ myfiles/ Module2/ 03_TST170_S01_Engineering.pdf
2. http://softenfirm.com/software-engineering-practice/
3. https://blog.k2datascience.com/software-engineering-fundamentals-best-practices-b5105d155c6d

OUTCOMES:

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

1. Identify the key activities in managing a software project and Compare different process models.
2. Concepts of requirements engineering and Analysis Modeling.
3. Apply systematic procedure for software design and deployment.
4. Compare and contrast the various testing and maintenance.
5. Manage project schedule, estimate project cost and effort required.

CO- PO, PSO MAPPING:

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

20CSOE903 SDG NO. 4	DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart the basic concepts of data structures and algorithms.
- To understand concepts about searching and sorting techniques.
- To understand basic concepts about stacks, queues, lists trees and graphs.
- To enable them to write algorithms for solving problems with the help of fundamental data structures.
- To analyze the various sorting algorithms.

UNIT I BASIC TERMINOLOGIES 9

Elementary Data Organizations - Data Structure Operations: insertion, deletion, traversal etc. - Analysis of an Algorithm - Asymptotic Notations - Time-Space trade off- Searching - Linear Search and Binary Search Techniques- their complexity analysis.

UNIT II ADT STACK AND ITS OPERATIONS 9

Algorithms and their complexity analysis - Applications of Stacks: Expression Conversion and Evaluation – corresponding algorithms and complexity analysis - ADT queue - Types of Queue: Simple Queue, Circular Queue, Priority Queue- Operations on different type of Queues - algorithms and their analysis.

UNIT III LINKED LISTS 9

Singly Linked Lists-Representation in Memory-Algorithms of several operations-Traversing, Searching, Insertion into, Deletion from Linked list; Linked representation of Stack and Queue- Header nodes-Doubly linked list: Operations on it and algorithmic analysis-Circular Linked Lists- all operations - their algorithms and the complexity analysis.

UNIT IV TREES 9

Basic Tree Terminologies- Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree- Tree operations on each of the trees and their algorithms with complexity analysis- Applications of Binary Trees-B Tree, B+ Tree: definitions - algorithms and analysis.

UNIT V SORTING AND HASHING 9

Objectives and properties of different Sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort- Performance and Comparison among all the methods- Hashing- Graph: Basic Terminologies and Representations- Graph search - Traversal algorithms and complexity analysis

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures", Illustrated Edition, Computer Science Press, 1983.
2. Mark Allen Weiss, "Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition, Addison-Wesley Publishing Company, 4th Edition, 2014

REFERENCES:

1. RS Salaria, "Data Structures", Khanna Publishing House, 5th edition, 2017.
2. Yashwant Kanetkar, "Data Structures through C", BPB Publications, 2nd edition, 2009.
3. RB Patel, "Expert Data Structures with C++", Khanna Publications, 2nd edition, 2012.

WEB REFERENCES:

1. https://www.coursera.org/specializations/data-structures-algorithms
2. https://www.codechef.com/certification/data-structures-and-algorithms/prepare
3. https://www.programiz.com/dsa

OUTCOMES:

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

1. Implement abstract data types for linear data structures.
2. Apply the different linear and non-linear data structures to problem solutions.
3. Analyze the algorithms to determine the time and computation complexity and justify the correctness.
4. Implement a given Search problem (Linear Search and Binary Search).
5. Critically analyze the various sorting algorithms.

CO – PO, PSO MAPPING

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

20CSOE904 SDG NO. 4	NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn network security and classical encryption techniques
- To know application and wireless network
- To get exposure on system level security
- To provide knowledge on security in mobile and IoT
- To understand fundamental knowledge on email and web security

UNIT I INTRODUCTION **9**

Security Goals- Attacks- Services- Mechanism- Techniques-Substitution and Transposition ciphers- Stream and Block chippers-Data Encryption Standard – Advanced Encryption Standard (AES)

UNIT II WIRELESS NETWORK SECURITY **9**

Wireless Security – Mobile Device Security -Wireless LAN Overview - Wireless LAN Security - Wireless Application Protocol Overview - Wireless Transport Layer Security - WAP End-To-End Security

UNIT III SYSTEM LEVEL SECURITY **9**

Authentication applications – Kerberos – X.509 Authentication services-Intrusion detection – password management - Viruses and related Threats – Counter measures - Firewall Design Principles Trusted Systems

UNIT IV SECURITY IN MOBILE AND IoT **9**

Security - Threats To SDN – NFV Security Attack Surfaces – Cloud Security – Security Issues – Risks – Data Protection – Security As A Service – Addressing Cloud Security -IOT Security – Vulnerability Patching – Security Framework.

UNIT V E-MAIL & WEB SECURITY **9**

E-mail Security: Security Services for E-mail-Attacks possible through E-mail – Establishing keys privacy-Authentication of the source-Message Integrity-Non-Repudiation-Pretty Good Privacy-S/MIME.

Web Security: SSL/TLS Basic Protocol-Computing the Keys- Client Authentication-PKI as deployed by SSL Attacks fixed in v3-Secure Electronic Transaction (SET).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" Publisher: Addison-Wesley 2015.
2. Behrouz A Forouzan, "Cryptography and Network Security", McGraw-Hill Education, 2011.
3. William Stallings, "Network Security Essentials: Applications and Standards", Prentice Hall India, 4th Edition.
4. William Stallings, "Cryptography and Network Security – Principles and Practices"- Pearson / Prentice Hall of India- Fourth Edition- 2006
5. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security", Prentice Hall of India, 2002.

REFERENCES:

1. Man Young Rhee, "Internet Security: Cryptographic Principles, Algorithms and Protocols", Wiley Publications, 2003.
2. Charles Pfleeger, "Security in Computing", 4th Edition, Prentice Hall of India, 2006.
3. Ulysess Black, "Internet Security Protocols", Pearson Education Asia, 2000.
4. Charlie Kaufman and Radia Perlman, Mike Speciner, "Network Security", Second Edition, Private Communication in Public World", PHI 2002
5. Bruce Schneier and Neils Ferguson, "Practical Cryptography", First Edition, Wiley Dreamtech India Pvt Ltd, 2003.
6. Douglas R Simson "Cryptography – Theory and Practice", First Edition, CRC Press, 1995.
7. Jyrki T. J. Penttinen , "Wireless Communications Security: Solutions for the Internet of Things", John Wiley & Sons,2016

WEB REFERENCES:

1. https://nptel.ac.in/courses/106105031/
2. https://swayam.gov.in/nd1_noc20_cs21/preview

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3027/cryptography-and-network-security

OUTCOMES:

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

1. Compare various classical encryption technique
2. Apply a number of different wireless security to a given concept
3. Analyze and validate system level security

4. Identify the security services in mobile and IoT devices
5. Implement real-world security services in terms of email and web

CO – PO, PSO MAPPING:

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

20CSOE905 SDG NO. 4	SOFTWARE TESTING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the criteria for test cases.
- To learn the design of test cases.
- To understand test management and test automation techniques.
- To apply test metrics and measurements.
- To design ,verify and validate the test plan

UNIT I INTRODUCTION 9

Testing as an Engineering Activity – Testing as a Process – Testing Maturity Model- Testing axioms – Basic definitions – Software Testing Principles – The Tester's Role in a Software Development Organization – Origins of Defects – Cost of defects – Defect Classes – The Defect Repository and Test Design –Defect Examples- Developer/Tester Support of Developing a Defect Repository.

UNIT II TEST CASE DESIGN STRATEGIES 9

Test case Design Strategies – Using Black Box Approach to Test Case Design – Boundary Value Analysis – Equivalence Class Partitioning – State based testing – Cause-effect graphing – Compatibility testing – user documentation testing – domain testing - Random Testing – Requirements based testing – Using White Box Approach to Test design – Test Adequacy Criteria – static testing vs.

structural testing – code functional testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – code complexity testing – Additional White box testing approaches- Evaluating Test Adequacy Criteria.

UNIT III LEVELS OF TESTING **9**

The need for Levels of Testing – Unit Test – Unit Test Planning – Designing the Unit Tests – The Test Harness – Running the Unit tests and Recording results – Integration tests – Designing Integration Tests – Integration Test Planning – Scenario testing – Defect bash elimination System Testing – Acceptance testing – Performance testing – Regression Testing – Internationalization testing – Ad-hoc testing – Alpha, Beta Tests – Testing OO systems – Usability and Accessibility testing – Configuration testing –Compatibility testing – Testing the documentation – Website testing.

UNIT IV TEST MANAGEMENT **9**

People and organizational issues in testing – Organization structures for testing teams – testing services – Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – test management – test process – Reporting Test Results – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group- The Structure of Testing Group- The Technical Training Program.

UNIT V TEST AUTOMATION **9**

Software test automation – skills needed for automation – scope of automation – design and architecture for automation – requirements for a test tool – challenges in automation – Test metrics and measurements – project, progress and productivity metrics.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", Pearson Education, 2006.
2. Ron Patton, Software Testing", Second Edition, Sams Publishing, Pearson Education, 2007. AU Library.com

REFERENCES:

1. Ilene Burnstein, "Practical Software Testing, Springer International Edition, 2003.
2. Edward Kit, "Software Testing in the Real World – Improving the Process", Pearson Education, 1995.
3. Boris Beizer, "Software Testing Techniques" – 2nd Edition, Van Nostrand Reinhold, New York, 1990.

4. Aditya P. Mathur, "Foundations of Software Testing Fundamental Algorithms and Techniques", Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

WEB REFERENCES:

1. https://www.softwaretestinghelp.com/types-of-software-testing/
2. https://www.guru99.com/software-testing-techniques.html
3. http://softwaretestingfundamentals.com/software-testing-methods/
4. https://www.cs.cmu.edu/~luluo/Courses/17939Report.pdf

OUTCOMES:

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

1. Design test cases suitable for a software development for different domains.
2. Prepare test planning based on the document. Identify suitable tests to be carried out.
3. Explain the various level of testing.
4. Design test plans and test cases.
5. Validate a test plan.

CO – PO, PSO MAPPING:

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

20CSOE906 SDG NO. 4 & 8	NETWORKING ESSENTIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the division of network functionalities into layers.
- Be familiar with the components required to build different types of networks
- Be exposed to the required functionality at each layer
- Learn the flow control and congestion control algorithms
- To learn the functions of network layer and the various routing protocols.

UNIT I FUNDAMENTALS & LINK LAYER 9

Building a network – Requirements – Layering and protocols – Internet Architecture – Network software – Performance ; Link layer Services – Framing – Error Detection – Flow control

UNIT II MEDIA ACCESS & INTERNETWORKING 9

Media access control – Ethernet (802.3) – Wireless LANs – 802.11 – Bluetooth – Switching and bridging – Basic Internetworking (IP, CIDR, ARP, DHCP, ICMP)

UNIT III ROUTING 9

Routing (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM), Unicast Routing Algorithms

UNIT IV TRANSPORT LAYER 9

Overview of Transport layer – UDP – Reliable byte stream (TCP) – Connection management – Flow control – Retransmission – TCP Congestion control – Congestion avoidance (DECbit, RED) – QoS – Application requirements

UNIT V APPLICATION LAYER 9

Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS – SNMP, Telnet –SSH

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.
2. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.

REFERENCES:

1. James F. Kurose, Keith W. Ross, "Computer Networking – A Top-Down Approach Featuring the Internet", Fifth Edition, Pearson Education, 2009.
2. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2010.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach",McGraw Hill Publisher, 2011.
4. Behrouz A. Forouzan, "Data communication and Networking", Fourth Edition, Tata McGraw – Hill, 2011.

WEB REFERENCES:

1. https://swayam.gov.in/nd2_cec19_cs07/preview
2. https://nptel.ac.in/courses/106105081/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/2276/computer-networks
2. 2.https://www.youtube.com/watch?v=g8iY36onLeM&list=PLWPirh4EWFpHJrW1D9UB24wsbM3zx7QMx

OUTCOMES:

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

1. Identify the components required to build different types of networks
2. Choose the required functionality at each layer for given application
3. Identify solution for each functionality at each layer
4. Trace the flow of information from one node to another node in the network
5. Design protocols for various functions in the network and understand the working of various application layer protocols

CO – PO, PSO MAPPING:

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

20CSOE907 SDG NO. 4 & 9	INTRODUCTION TO CLOUD COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept of cloud computing.
- To appreciate the evolution of cloud from the existing technologies.
- To have knowledge on the various issues in cloud computing.
- To be familiar with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.

UNIT I INTRODUCTION 9

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

UNIT II CLOUD ENABLING TECHNOLOGIES 10

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support and Disaster Recovery.

UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE 8

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

UNIT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 10

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.

UNIT V CLOUD TECHNOLOGIES AND ADVANCEMENTS 8

Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine –– Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management and Security", CRC Press, 2017.

REFERENCES:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach", Tata McGraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)", O'Reilly, 2009.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/105/106105167/
2. https://swayam.gov.in/nd1_noc20_cs20/preview

ONLINE RESOURCES:

1. https://www.ubuntupit.com/best-cloud-computing-books-available-online/
2. https://azure.microsoft.com/en-in/overview/what-is-cloud computing/
3. https://www.simplilearn.com/what-is-cloud-computing-article

OUTCOMES:

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

1. To articulate the main concepts, key technologies, strengths and limitations of cloud computing.
2. To explain enabling technologies that help in the development of cloud.
3. To make use of cloud computing architecture to solve design challenges.
4. To explain the core issues of cloud computing such as resource management and security.
5. To install and use current cloud technologies.

CO – PO, PSO MAPPING

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

20CSOE908 SDG NO. 4&9	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

UNIT I INTRODUCTION TO IoT **9**

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II IoT PROTOCOLS **9**

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT

UNIT III DESIGN AND DEVELOPMENT **9**

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE

programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

UNIT IV DATA ANALYTICS AND SUPPORTING SERVICES 9

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG

UNIT V CASE STUDIES/INDUSTRIAL APPLICATIONS 9

Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – GridBlocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

TOTAL: 45 PERIODS

TEXT BOOK:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”, Cisco Press, 2017.

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
2. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.
3. 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.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
5. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/105/106105166/
2. https://nptel.ac.in/courses/106/105/106105195/

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1. https://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=6488907

2. https://www.sciencedirect.com/science/article/pii/S000768131 5000373
3. https://www.springer.com/gp/book/9783319697147
4. https://www.arduino.cc/
5. https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet

OUTCOMES:

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

1. Explain the concept of IoT.
2. Analyze various protocols for IoT.
3. Design an PoC of an IoT system using Raspberry Pi/Arduino
4. Apply data analytics and use cloud offerings related to IoT.
5. Analyze applications of IoT in real time scenario.

CO-PO, PSO MAPPING:

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

20CSOE909 SDG NO. 4,9	ROBOTIC PROCESS AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To study the use of various types of End of Sensors.
- To impart knowledge in Robot Kinematics and Programming.
- To learn Robot safety issues and economics.

UNIT I FUNDAMENTALS OF ROBOT **6**

Robot - Definition - 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-Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III SENSORS AND MACHINE VISION 12

Requirements of a Sensor, Principles and Applications of the following types of Sensors-Position Sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors , Binary Sensors, Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 13

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems - Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effectors commands and Simple Programs.

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 5

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2003.2. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGrawHill, 2001.

REFERENCES:

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
2. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 1994.
3. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
5. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.
6. Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2008.
7. Surender Kumar, "Industrial Robots and Computer Integrated Manufacturing", Oxford and IBH Publishing Co. Pvt. Ltd., 1991.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108108111/
2. https://swayamg.ov.in/nd1_noc19_me74/preview

ONLINE RESOURCES:

1. https://www.classcentral.com/subject/robotics
2. https://www.futurelearn/courses/making-robots-move

OUTCOMES:

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

1. Understand the functions of the basic components of a Robot
2. List the various types of End of Effectors and Sensors
3. Identify the use of various types of End of Sensors
4. Knowledge in Robot Kinematics and Programming.
5. Explain the implementation and Robot safety issues and economics.

CO- PO, PSO MAPPING

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

20CSOE910 SDG NO. 4&9	SOFT COMPUTING METHODOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Classify the various soft computing frame works
- Be familiar with the design of neural networks, fuzzy logic and fuzzy systems
- Learn mathematical background for optimized genetic programming
- Be exposed to neuro-fuzzy hybrid systems and its applications

UNIT I INTRODUCTION TO SOFT COMPUTING 9

Soft Computing Constituents-From Conventional AI To Computational Intelligence- Artificial Neural Network: Introduction, Characteristics- Evolution Of Neural Networks - Basic Models - Important Technologies - Applications. Fuzzy Logic: Introduction - Crisp Sets- Fuzzy Sets - Crisp Relations And Fuzzy Relations: Cartesian Product Of Relation - Classical Relation, Fuzzy Relations, Tolerance And Equivalence Relations. Genetic Algorithm-Introduction - Biological Background - Traditional Optimization And Search Techniques – Genetic Basic Concepts.

UNIT II NEURAL NETWORKS 9

Mcculloch-Pitts Neuron - Linear Separability - Hebb Network - Supervised Learning Network: Perceptron Networks - Adaptive Linear Neuron, Multiple Adaptive Linear Neuron, BPN, RBF - Associative Memory Network: Auto-Associative Memory Network, Hetero-Associative Memory Network, Hopfield Networks, Iterative Auto Associative Memory Network – Unsupervised Learning Networks: Kohonen Self-Organizing Feature Maps, LVQ – CP Networks, ART Network.

UNIT III FUZZY LOGIC 9

Membership Functions: Features, Fuzzification, Methods Of Membership Value Assignments- Defuzzification: Lambda Cuts - Methods - Fuzzy Arithmetic And Fuzzy Measures: Fuzzy Arithmetic - Extension Principle - Fuzzy Measures - Measures Of Fuzziness -Fuzzy Integrals - Fuzzy Rule Base And Approximate Reasoning : Truth Values And Tables, Fuzzy Propositions, Formation Of Rules-Decomposition Of Rules, Aggregation Of Fuzzy Rules, Fuzzy Reasoning-Fuzzy Inference Systems Overview Of Fuzzy Expert System-Fuzzy Decision Making.

UNIT IV GENETIC ALGORITHM 9

Genetic Algorithm- Operators – Encoding Scheme – Fitness Evaluation –Crossover - Mutation – Classification Of Gnetic Algorithms- Genetic Programming – Advances In GA .

UNIT V HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS 9

Neuro-Fuzzy Hybrid Systems - Genetic Neuro Hybrid Systems - Genetic Fuzzy Hybrid And Fuzzy Genetic Hybrid Systems - Simplified Fuzzy ARTMAP - Applications: A Fusion Approach Of Multispectral Images With SAR, Optimization Of Traveling Salesman Problem Using Genetic Algorithm Approach, Soft Computing Based Hybrid Fuzzy Controllers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd, 2011
2. J.S.R.Jang, C.T. Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI / Pearson Education, 2004

REFERENCES:

1. S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.
2. George J. Klir, Ute St. Clair, Bo Yuan, “Fuzzy Set Theory: Foundations and Applications” Prentice Hall, 1997.
3. David E. Goldberg, “Genetic Algorithm in Search Optimization and Machine Learning” Pearson Education India, 2013.
4. James A. Freeman, David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India, 1991.
5. Simon Haykin, “Neural Networks Comprehensive Foundation” Second Edition, Pearson Education, 2005.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106105173/

ONLINE RESOURCES:

1. https://towardsdatascience.com/understanding-neural-networks-19020b758230

OUTCOMES:

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

1. Apply various soft computing concepts for practical applications
2. Choose and design suitable neural network for real time problems
3. Use fuzzy rules and reasoning to develop decision making and expert system
4. Explain the importance of optimization techniques and genetic programming
5. Review the various hybrid soft computing techniques and apply in real time problems

CO- PO, PSO MAPPING

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

Sri
SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

Affiliated to Anna University & Approved by AICTE, New Delhi

OPEN ELECTIVES

I - VIII SEMESTER
AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
1	20EC OE 901	Digital Electronics	3	0	0	3	3
2	20EC OE 902	Basic of Biomedical Instrumentation	3	0	0	3	3
3	20EC OE 903	Sensor Networks	3	0	0	3	3
4	20EC OE 904	Wireless Networks	3	0	0	3	3
5	20EC OE 905	Fuzzy Logic	3	0	0	3	3
6	20EC OE 906	Industrial IOT	3	0	0	3	3
7	20EC OE 907	Industrial Nanotechnology	3	0	0	3	3
8	20EC OE 908	Control Systems	3	0	0	3	3
9	20EC OE 909	Microprocessor &Microcontrollers	3	0	0	3	3
10	20EC OE 910	Computer Networks	3	0	0	3	3

OPEN ELECTIVES

20ECOE901 SDG NO. 4,9	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions
- To introduce the methods for simplifying Boolean expressions
- To outline the formal procedures for the design of combinational circuits and sequential circuits
- To implement combinational and sequential circuits using Verilog HDL

UNIT I PRINCIPLES OF COMBINATIONAL LOGIC 9

Review of Boolean Algebra; Definition of Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3, 4 and 5 variables; Incompletely specified functions (Don't care terms). Simplifying max – term equations; Quine -McClusky minimization technique; Reduced Prime Implicant tables, Map entered variables

UNIT II COMBINATIONAL LOGIC DESIGN 9

Half Adders, Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder multiplexers and demultiplexers - implementation of combinational circuits using multiplexers - magnitude comparator. Encoder, Priority Encoder-Decoder, Driver and Multiplexed Display.

UNIT III SEQUENTIAL CIRCUITS 9

Basic Bistable element, Latches, SR latch, Application of SR latch, A Switch debouncer. The gated SR and D Latch, The Master-Slave Flip-Flops, Triggering, SR, D, T and JK flip flop. Characteristic equations, Registers, Counters-Binary Ripple Counter, Synchronous Binary counters, Counters based on Shift Registers, Design of a Synchronous counters, Design of a Synchronous Mod-N counters

UNIT IV SEQUENTIAL DESIGN 9

Design of synchronous sequential circuit- Mealy and Moore models, State machine notation, synchronous sequential circuit analysis and design. Construction of state Diagrams, Design of asynchronous sequential circuit.

UNIT V HDL **9**

Introduction, A brief history of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, Simulation and synthesis, Brief comparison of VHDL and Verilog. Implementation of Combinational circuits and Sequential circuits in Verilog.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, —Digital Design, 5th Edition, Pearson, 2014
2. S. Salivahanan, S. Arivazhagan, "Digital Circuits and Design", Oxford Press India, 2018 (5th Edition)
3. R P Jain, "Modern Digital Electronics", McGraw Hill India, 2009(4th Edition)

REFERENCES:

1. Charles H.Roth. —Fundamentals of Logic Design, 6th Edition, Thomson Learning, 2013
2. Thomas L. Floyd, —Digital Fundamentals, 10th Edition, Pearson Education Inc, 2011
3. Digital Logic Applications and Design John M Yarbrough Cengage Learning 2011
4. Digital Principles and Design Donald D Givone McGraw Hill Education 1 st Edition, 2002
5. A. Anand Kumar —Fundamentals of Digital Circuits, 4th Edition, PHI Learning Private Limited, 2016
6. Soumitra Kumar Mandal — Digital Electronics, McGraw Hill Education Private Limited, 2016
7. Donald P Leach, Albert Paul Malvino and Goutam Saha - Digital Principles and Applications – McGraw Hill, India – 2014(8th Edition – SIE)
8. Samir Palnitkar, "Verilog HDL", Pearson India, 2015(2nd Edition), ISBN: 9780132599702

WEB REFERENCES:

1. http://nptel.ac.in/courses/117106086/1
2. http://web.iitd.ac.in/~shouri/eel201/lectures.php
3. https://www.allaboutcircuits.com/textbook/digital/
4. http://nptel.ac.in/courses/117103064/

ONLINE RESOURCES:

1. https://www.adelaide.edu.au/course-outlines/108280/1/sem-2/ - University of Adelaide
2. http://jjackson.eng.ua.edu/courses/ece480/- The University of Alabama
3. http://www.ee.ic.ac.uk/pcheung/teaching/ee2_digital/index.html - Imperial College London

OUTCOMES:

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

1 Utilize Boolean algebra and K-map as tool and the knowledge of number systems and codes, to simplify and design logic circuits

2 Analyze logic processes and implement logical operations using combinational logic circuits.

3 Design Combinational Circuits from the description of a logical function

4 Design Synchronous and Asynchronous Sequential Circuits from the description of a logical function

5 Perform high-level HDL simulations and design combinational and sequential digital circuits in Verilog

CO - PO, PSO MAPPING

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

20ECOE902 SDG NO. 3,4	BASICS OF BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Illustrate origin of bio potentials and its propagations
- To understand the different types of electrodes and its placement for various recordings
- To design bio amplifier for various physiological recordings
- To learn the different measurement techniques for non-physiological parameters
- To Summarize different biochemical measurements.

UNIT I BIOPOTENTIAL ELECTRODES 9

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, Contact impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - motion artifacts, measurement with two electrodes.

UNIT II BIOPOTENTIAL MEASUREMENTS 9

Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system, Principles of vector cardiography.EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. Recording of ERG, EOG and EGG.

UNIT III SIGNAL CONDITIONAL CIRCUITS 9

Analog Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier., Power line interference, Right leg driven ECG amplifier, Band pass filtering.

UNIT IV MEASUREMENT OF NON-ELECRICAL PARAMETERS 9

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

UNIT V BIOCHEMICAL MEASUREMENT AND BIOSENSORS 9

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors, Blood gas analyzers - colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description) – Bio Sensors – Principles – amperometric and voltometric techniques.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Leslie Cromwell, —Biomedical Instrumentation and measurement||, 2nd edition, Prentice hall of India, New Delhi, 2015.

REFERENCES:

1. John G. Webster, —Medical Instrumentation Application and Design||, 4th edition, Wiley India Pvt Ltd,New Delhi, 2015
2. Joseph J. Carr and John M. Brown, —Introduction to Biomedical Equipment Technology||, Pearson Education, 2004.
3. Myer Kutz, —Standard Handbook of Biomedical Engineering and Design||, McGraw Hill Publisher, 2003.
4. Khandpur R.S, —Handbook of Biomedical Instrumentation||, 3rd edition, Tata McGraw-Hill New Delhi, 2014

WEB REFERENCES:

1. https://nptel.ac.in/courses/108105101/
2. https://swayam.gov.in/nd1_noc20_ee41/preview
3. https://en.wikipedia.org/wiki/Bioinstrumentation

ONLINE RESOURCES:

1. https://biomedikal.in/2009/12/lecture-notes-on-biomedical-instrumentation/

OUTCOMES:

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

1 Differentiate different bio potentials and its propagations
2 Illustrate different electrode placement for various physiological recordings
3 Design bio amplifier for various physiological recordings.
4 Explain various technique for non-electrical physiological measurements
5 Demonstrate different biochemical measurement techniques.

CO – PO, PSO MAPPING

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

20ECOE903 SDG NO. 4,9,11,15	SENSOR NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Learn Sensor Network fundamentals and Node architecture
- To understand the physical layer design
- To describe MAC protocols and time synchronization algorithms
- To understand the various routing protocols, localization algorithms used for sensor network.
- Have an exposure to sensor network programming and Internet of Things

UNIT I NODE ARCHITECTURE 9

Introduction to sensor network – Application – Difference between Adhoc and Sensor Network - Node architecture - Hardware components overview - Energy consumption of Sensor nodes - Operating Systems and Execution Environment - some examples of Sensor nodes

UNIT II NETWORK ARCHITECTURE 9

Sensor Network Scenarios – Optimization goals- Design Principles –Gateway Concepts–Wireless Channel fundamentals - Physical layer and transceiver design considerations in Wireless Sensor Network

UNIT III MAC PROTOCOLS & TIME SYNCHRONIZATION 9

Fundamentals of MAC Protocols – Low duty cycle protocols – Contention based Protocols – schedule based protocols – IEEE 802.15.4 MAC – Address and name management in wireless sensor network. Need for time synchronization

UNIT IV LOCALIZATION & ROUTING PROTOCOLS 9

Properties of localization and positioning procedures – Range based Localization – Range free Localization Routing Metrics – Data Centric Routing– Proactive Routing - On Demand Routing – Hierarchical Routing – QoS based Routing Protocols

UNIT V SENSOR NETWORK PROGRAMMING and IoT 9

Challenges in sensor network programming – Node Centric programming – Dynamic programming – Sensor Network Simulators - Internet of Things (IoT): overview, Applications, potential & challenges, and architecture.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
3. WaltenegusDargie and Christian Poellabauer, “Fundamentals of Wireless Sensor Networks – Theory and Practice”, John Wiley and Sons, First edition, 2010.
4. C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education - 2008.

REFERENCES:

1. Kazem Sohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks Technology, Protocols, And Applications”, John Wiley, 2007
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

WEB REFERENCES:

1. https://www.sciencedirect.com/topics/computer-science/wireless-sensor-networks
2. https://www.elprocus.com/architecture-of-wireless-sensor-network-and-applications/

ONLINE RESOURCES:

1. https://www.digimat.in/nptel/courses/video/106105160/L01.html

OUTCOMES:

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

1 Describe Wireless Sensor Network Architecture and its Applications.
2 Explain the physical layer design
3 Compare the various MAC protocols and illustrate time synchronization algorithms
4 Distinguish various routing protocols, localization algorithms used for sensor network
5 Be familiar with the sensor network programming and Internet of Things

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	0	3	0	1	0	0	0	0	3	3
CO2	3	3	3	1	2	1	0	0	0	0	3	3
CO3	3	3	2	1	3	1	0	0	0	0	3	3
CO4	3	3	2	1	3	1	0	0	0	0	3	3
CO5	3	3	2	1	1	3	1	0	0	0	3	3

20ECOE904 SDG NO. 4,9	WIRELESS NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept of Wireless networks, protocol stack and standards.
- To understand and analyse the network layer solutions for Wireless networks
- To study about fundamentals of 3G Services, its protocols and applications.
- To have in depth knowledge on internetworking of WLAN and WWAN
- To learn about evolution of 4G Networks, its architecture and applications

UNIT I WIRELESS LAN **9**

Introduction-WLAN technologies: - IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee.

UNIT II MOBILE NETWORK LAYER **9**

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol

UNIT III 3G OVERVIEW **9**

Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3GPP Architecture, User equipment, CDMA2000 overview-Radio and Network components, Network structure, Radio Network, TD-CDMA, TD – SCDMA

UNIT IV INTERNETWORKING BETWEEN WLANS AND WWANS 9

Internetworking objectives and requirements, Schemes to connect WLANS and 3G Networks, Session Mobility, Internetworking Architecture for WLAN and GPRS, System Description.

UNIT V 4G & BEYOND 9

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jochen Schiller, "Mobile Communications", 2nd Edition, Pearson Education, 2012.
2. Vijay Garg, "Wireless Communications and Networking", 1st Edition, Elsevier 2007.

REFERENCES:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", 2nd Edition, Academic Press, 2008
2. Anurag Kumar, D.Manjunath, Joy kuri, "Wireless Networking", 1st Edition, Elsevier, 2011.
3. Simon Haykin , Michael Moher, David Koilpillai, "Modern Wireless Communications", 1st Edition, Pearson Education, 2013.

.

WEB REFERENCES:

1. https://youtu.be/Eu_mTZxPofl

ONLINE RESOURCES:

1. https://pervasive.aau.at/BR/teaching/sn/wh1_2.pdf
2. http://tools.ietf.org/html/draft-ietf-core-coap-18
3. http://3gpp.org/about-3gpp

OUTCOMES:

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

1 Understand the concept about Wireless networks, protocol stack and standards

2 Understand and analyse the network layer solutions for Wireless networks

3 Know about fundamentals of 3G Services, its protocols and applications

4 Have in depth knowledge on internetworking of WLAN and WWAN
5 Learn about evolution of 4G Networks, its architecture and applications

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	3	2	2	1	-	2	1	2	3	1
CO2	3	2	2	2	3	3	2	1	-	2	1	3	3	1
CO3	3	3	2	3	3	1	2	1	-	2	1	3	3	1
CO4	3	3	3	2	3	1	2	2	-	2	1	3	3	1
CO5	3	3	3	2	3	1	2	1	-	2	1	3	3	1

20ECOE905 SDG NO. 3,4,9	FUZZY LOGIC	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Impact knowledge on Crisp set and fuzzy set.
- To understand features of membership function and fuzzy relations.
- To apply the fuzzy logic based classifications techniques.

UNIT I INTRODUCTION TO CLASSICAL AND FUZZY SET 9

Introduction – Classical set – Operation, Property and Mapping, Fuzzy Sets – Operations, Properties and alternate methods of fuzzy set operations, Relations-Crisp, Fuzzy relations

UNIT II FUZZIFICATION, DEFUZZIFICATION AND MEMBERSHIP FUNCTION 9

Features of the Membership Function, Various forms, Fuzzification, Defuzzification to crisp sets, λ-Cuts for Fuzzy relations, Defuzzification to Scalars.

UNIT III LOGIC AND FUZZY SYSTEMS 9

Logic-Classical Logic, Fuzzy Logic, Approximate Reasoning, Other Forms of the Implication Operation, Fuzzy Systems-Natural Language, Linguistic Hedges, Fuzzy Rule-Based Systems, Graphical Techniques of Inference.

UNIT IV FUZZY DECISION MAKING **9**

Fuzzy Synthetic Evaluation, Fuzzy Ordering, Preference and consensus, Multiobjective Decision Making, Fuzzy Bayesian Decision Method, Decision Making under Fuzzy States and Fuzzy Actions.

UNIT V FUZZY CLASSIFICATION **9**

Classification by Equivalence Relations - Crisp Relations, Fuzzy Relations. Cluster Analysis, Cluster Validity, c-Means Clustering - Hard c-Means (HCM), Fuzzy c-Means (FCM). Classification Metric, Hardening the Fuzzy c-Partition, Similarity Relations from Clustering.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Timothy J.Ross, "Fuzzy logic with Engineering Applications", McGraw Hill, 2017 .
2. Klir G, Yuan B. Fuzzy sets and fuzzy logic. New Jersey: Prentice hall; 1995 Jan.
3. Sugeno, M., Asai, K. and Terano, T., 1992. Fuzzy systems theory and its applications. Tokyo Institute of Technology.

REFERENCES:

1. Turunen, E. and Turunen, E., 1999. Mathematics behind fuzzy logic (pp. 136-137). Heidelberg: Physica-Verlag.
2. Zadeh, L.A., Klir, G.J. and Yuan, B., 1996. Fuzzy sets, fuzzy logic, and fuzzy systems: selected papers (Vol. 6). World Scientific.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108104157/
2. https://www.slideshare.net/sajidqaxi/fuzzy-logic-and-neural-networks
3. https://nptel.ac.in/courses/111102130/

ONLINE RESOURCES:

1. https://youtu.be/IZWTduVCrf8
2. https://www.slideshare.net/ehamzei/fuzzy-set

OUTCOMES:

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

1 Understand the principles behind Fuzzy logic and Fuzzy set.

2 Understand membership function of fuzzy sets

3 Apply fuzzy logic system using rule based and graph theory techniques.
4 Analyze the data by applying decision making techniques.
5 Analyze the data by applying Fuzzy based classification technique.

CO – PO, PSO MAPPING

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

20ECOE906 SDG NO. 3,4,11,15	INDUSTRIAL IoT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Introduce how IoT has become a game changer in the new economy where the customers are looking for integrated value
- Bring the IoT perspective in thinking and building solutions
- Introduce the tools and techniques that enable IoT solution and Security aspects

UNIT I INTRODUCTION 9

Introduction to IOT, What is IIOT? IOT Vs. IIOT, History of IIOT, Components of IIOT -Sensors, Interface, Networks, People &Process, Hype cycle, IOT Market, Trends& future Real life examples, Key terms – IOT Platform, Interfaces, API, clouds, Data Management Analytics, Mining &Manipulation; Role of IIOT in Manufacturing Processes Use of IIOT in plant maintenance practices, Sustainability through Business excellence tools Challenges & Benefits in implementing IIOT

UNIT II ARCHITECTURES 9

Overview of IOT components ;Various Architectures of IOT and IIOT, Advantages & disadvantages, Industrial Internet - Reference Architecture;

IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN,WSN network design for IOT

UNIT III SENSOR AND INTERFACING **9**

Introduction to sensors, Transducers, Classification, Roles of sensors in IIOT , Various types of sensors , Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet , Current, M2M etc

UNIT IV PROTOCOLS AND CLOUD **9**

Need of protocols; Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Z wave, Bacnet, BLE,Modbus, SPI , I2C, IIOT protocols –COAP, MQTT,6lowpan, lwm2m, AMPQ IIOT cloud platforms : Overview of cots cloud platforms, predix, thingworks, azure etc. Data analytics, cloud services, Business models: Saas, Paas, Iaas.

UNIT V PRIVACY, SECURITY AND GOVERNANCE **9**

Introduction to web security, Conventional web technology and relationship with IIOT, Vulnerabilities of IoT, Privacy, Security requirements, Threat analysis, Trust, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, Non-repudiation and availability, Security model for IoT, Network security techniques Management aspects of cyber security.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications 2. Bernd Scholz-Reiter, Florian
2. Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer

REFERENCES:

1. Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Willy Publications
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications
3. Inside the Internet of Things (IoT), Deloitte University Press
4. Internet of Things- From Research and Innovation to Market Deployment;By Ovidiu & Peter; River Publishers Series

5. Five thoughts from the Father of the Internet of Things; by By Phil Wainewright – Kevin Ashton
6. How Protocol Conversion Addresses IIoT Challenges: White Paper By RedLion.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106105195/
2. https://freevideolectures.com/course/4231/nptel-introduction-industry-industrial-internet-things

ONLINE RESOURCES:

1. https://www.coursera.org/lecture/digital-thread-implementation/the-industrial-internet-of-things-iiot-za9wH
2. https://swayam.gov.in/nd1_noc20_cs24/preview

OUTCOMES:

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

1 Describe IOT, IIOT
2 Understand, design and develop the real life IoT applications using off the shelf hardware and software
3 Understand various IoT Layers and their relative importance
4 Study various IoT platforms and Security
5 Realize the importance of Data Analytics in IoT

CO – PO, PSO MAPPING

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

20ECOE907 SDG NO. 3,4,7,15	INDUSTRIAL NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To elucidate on advantages of nanotechnology based applications in industries.
- To provide instances of contemporary industrial applications of nanotechnology
- To provide an overview of future technological advancements and increasing role of nanotechnology in industries

UNIT I NANOTECHNOLOGY IN ELECTRICAL AND ELECTRONICS INDUSTRY **9**

Advantages of nano electrical and electronic devices – Electronic circuit chips – Nanosensors and actuators, Optical switches – Diodes and Nano-wire transistors - Memory storage – Lighting and displays – Filters (IR blocking) – Quantum computers – Energy devices – Medical diagnosis – Conductive additives - Lead-free solder – Nanocoatings –EMI shielding.

UNIT II NANOTECHNOLOGY IN DEFENCE **9**

Military applications of Nanotechnology - Artificial intelligence materials - Propulsion – Vehicles - Propellants and Explosives – Camouflage distributed sensors - Amour protection - Conventional weapons - Soldier systems - Implanted systems, Body manipulation - Autonomous systems - Mini-/Micro robots - Bio-technical hybrids - Small satellites and Space launchers - Nuclear weapons - Chemical weapons - Biological weapons - Chemical/Biological protection.

UNIT III NANOTECHNOLOGY IN AGRICULTURE **9**

Precision farming, Smart delivery system – Nanofertilizers: Nanourea and mixed fertilizers, Nanofertigation - Nanopesticides, Nanoseed Science.

UNIT IV NANOTECHNOLOGY IN FOOD TECHNOLOGY **9**

Nanotechnology in Food industry – Nanopackaging for enhanced shelf life - Smart/Intelligent packaging - Food processing and food safety and bio-security – Electrochemical sensors for food analysis and contaminant detection.

UNIT V NANOTECHNOLOGY IN ENVIRONMENTAL AND HEALTH EFFECTS **9**

Environmental pollutants in air, water, soil, hazardous and toxic wastes -

Application of Nanotechnology in remediation of pollution in Industrial and waste water treatment – Drinking water and Air/Gas purifications - The challenge to occupational health and hygiene, toxicity of nanoparticles, effects of inhaled nanosized particles, skin exposure to nanoparticles, impact of CNTs on respiratory systems, hazards and risks of exposure to nanoparticles, monitoring nanoparticles in work place and sensors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. D. P. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead publication, London, 2006.
2. J. Altmann, Routledge, Military Nanotechnology: Potential Applications and Preventive Arms Control, Taylor and Francis Group, 2006. 31
3. Kuzma and Peter VerHage, Nanotechnology in agriculture and food production, Woodrow Wilson International Center, (2006).
4. Lynn J. Frewer, Willehm Norde, R. H. Fischer and W. H. Kampers, Nanotechnology in the Agri-food sector, Wiley-VCH Verlag, (2011).
5. P. J. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead Publishing Limited, Cambridge, (2007).
6. Chaudry, L.Castle and R. Watkins Nanotechnologies in Food, RSC Publications, 2010.
7. W.N.Chang, Nanofibers Fabrication, Performance and Applications, Nova Science Publishers Inc., (2009).

REFERENCES:

1. Y-W. Mai,Polymer Nano composites, Woodhead publishing, (2006).
2. Udo H. Brinker, Jean-Luc Mieusset (Eds.), Molecular Encapsulation: Organic Reactions in Constrained Systems,Wiley Publishers (2010).
3. Nanocomposites Science and Technology - P. M. Ajayan, L.S. Schadler, P. V. Braun.

WEB REFERENCES:

1. https://nptel.ac.in/courses/113/106/113106093/
2. https://nptel.ac.in/courses/102/104/102104069/
3. https://nptel.ac.in/courses/102/107/102107058/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3471/nano-structured-materials-synthesis-properties-self-assembly-and-applications
2. https://www.coursera.org/learn/nanotechnology1

OUTCOMES:

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

- Elucidate food quality, safety and security of agricultural product, packaging and distribution, nanomaterials for food applications
- Learn harmful effects of nanoparticles
- Define intermolecular as well as hydrophilic and hydrophobic interactions, soluble polymers, self assembly in plant cells.
- understand need of nanotechnology in health care
- Be introduced to recent advancements in nano medicine.

CO – PO, PSO MAPPING

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

20ECOE908 SDG NO. 4 & 9	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Describe the Modeling of Electrical & Mechanical systems & representation of systems.
- Test the time domain analysis of control systems required for stability analysis.
- Test the frequency domain analysis.
- Examine the stability analysis of control systems.
- Inspect and explore the systems in state variable analysis.

UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION 9

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory- Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models.

UNIT II TIME RESPONSE ANALYSIS 9

Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI,PID control systems.

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS 9

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot - Polar Plot- Nyquist plots.

UNIT IV CONCEPTS OF STABILITY ANALYSIS 9

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.

UNIT V CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS 9

State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations

TOTAL: 45 PERIODS

TEXT BOOKS:

1. M.Gopal, "Control System–Principles and Design", Tata McGraw Hill, 4th Edition, 2012.

REFERENCES:

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, Fifth Edition, 2007.
2. K.Ogata, "Modern Control Engineering", 5th Edition, PHI, 2012.
3. S.K.Bhattacharya, "Control System Engineering", 3rd Edition, Pearson, 2013.
4. Benjamin.C.Kuo, "Automatic Control Systems", Prentice Hall of India, 7th Edition, 1995

WEB REFERENCES:

1. https://nptel.ac.in/courses/108106098/
2. https://nptel.ac.in/courses/108101037/

ONLINE RESOURCES:

1. https://lecturenotes.in/notes/15854-note-for-control-system-engineering-cse-by-amity-kumar
2. https://lecturenotes.in/notes/23763-note-for-control-system-engineering-cse-by-suman-kumar-acharya

OUTCOMES:

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

1 Identify the various control system components and their representations.
2 Analyze the various time domain parameters.
3 Analysis the various frequency response plots and its system.
4 Apply the concepts of various system stability criterions.
5 Design various transfer functions of control system using state variable models.

CO – PO, PSO MAPPING

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

20ECOE909 SDG NO. 4 & 11	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the Architecture of 8086 microprocessor
- To learn the design aspects of I/O and Memory Interfacing circuits
- To interface microprocessors with supporting chips
- To study the Architecture of PIC microcontroller
- To design a microcontroller based system

UNIT I THE 8086 MICROPROCESSOR 9

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming –

Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II 8086 SYSTEM BUS STRUCTURE 9

8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

UNIT III I/O INTERFACING 9

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

UNIT IV PIC MICROCONTROLLER 9

Architecture – memory organization – addressing modes – PIC programming in C –I/O port, Data Conversion, Timer programming, Timers – Interrupts, I/O ports- I2C bus-A/D converter-UART- -ADC, DAC and Sensor Interfacing.

UNIT V SYSTEM DESIGN – CASE STUDY 9

Interfacing LCD Display – Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control – Controlling DC/ AC appliances – Measurement of frequency - Stand alone Data Acquisition System.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Yu-Cheng Liu, Glenn A.Gibson, —Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design||, Second Edition, Prentice Hall of India, 2007.
2. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ' PIC Microcontroller and Embedded Systems using Assembly and C for PIC18', Pearson Education 2008

REFERENCES:

1. DoughlasV.Hall, —Microprocessors and Interfacing, Programming and Hardware,TMH,2012 2
2. A.K.Ray, K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3 rd edition, Tata McGrawHill, 2012.
3. Muhammad Ali Mazidi, Sarmad Naimi ,SepehrNaimi' AVR Microcontroller and Embedded Systems using Assembly and C", Pearson Education 2014

4. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, 'The 8051 Microcontroller and Embedded Systems' Prentice Hall, 2005. 5. John Iovine, 'PIC Microcontroller Project Book', McGraw Hill 2000
5. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, 'The 8051 Microcontroller and Embedded Systems' Prentice Hall, 2005.
6. John Iovine, 'PIC Microcontroller Project Book ', McGraw Hill 2000.
7. Senthil Kumar, Saravanan, Jeevanathan, "Microprocessor & Microcontrollers" , Oxford, 2013.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ee42/preview
2. https://nptel.ac.in/courses/108105102/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3018/microprocessors-and-microcontrollers
2. http://www.satishkashyap.com/2012/02/video-lectures-on-microprocessors-and.html

OUTCOMES:

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

1 Explain the architecture of 8086 microprocessor and its programming concepts.
2 Design the memory interfacing circuits
3 Design and interface IO circuits
4 Explain the architecture of PIC Microcontroller and its programming concepts.
5 Design Embedded systems

CO – PO, PSO MAPPING

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

20ECOE910 SDG NO. 4	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the protocol layering and physical level communication.
- To analyze the performance of a network.
- To understand the various components required to build different networks.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the transport layer.

UNIT I INTRODUCTION AND PHYSICAL LAYER 9

Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.

.

UNIT II DATA-LINK LAYER & MEDIA ACCESS 9

Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP - Media Access Control - Wired LANs: Ethernet - Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.

UNIT III NETWORK LAYER 9

Network Layer Services – Packet switching – Performance – IPV4 Addresses – Forwarding of IP Packets - Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.

UNIT IV TRANSPORT LAYER 9

Introduction – Transport Layer Protocols – Services – Port Numbers- User Datagram Protocol – Transmission Control Protocol – SCTP.

UNIT V APPLICATION LAYER 9

WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH,

2013.

REFERENCES:

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.

WEB REFERENCES:

1. https://swayam.gov.in/nd2_cec19_cs07/preview
2. https://nptel.ac.in/courses/106105081/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/2276/computer-networks
2. https://www.youtube.com/watch?v=g8iY36onLeM&list=PLWPirh4EWFpHJrW1D9UB24wsbM3zx7QMx

OUTCOMES:

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

1. Understand the basic layers and its functions in computer networks.
2. Evaluate the performance of a network.
3. Understand the basics of how data flows from one node to another.
4. Analyze and design routing algorithms.
5. Illustrate various application layer protocols.

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	3	2	2	1	2	1	-	1	3	2
CO2	3	3	2	-	-	-	1	-	-	-	-	-	2	1
CO3	3	3	2	-	1	-	1	1	-	1	-	1	3	1
CO4	3	3	2	-	-	-	1	1	-	1	-	-	2	2
CO5	3	3	2	-	1	-	2	2	-	1	-	1	3	2

Sri
SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

Affiliated to Anna University & Approved by AICTE, New Delhi

OPEN ELECTIVES

I - VIII SEMESTER
AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

B.E. DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

S. NO	COURSE CODE	COURSE TITLE	CONTACT HOURS	WEEK HOURS			CREDITS
				L	T	P	C
1	20EE OE 901	Principles of Wind energy system	3	3	0	0	3
2	20EE OE 902	Introduction to MEMS Design	3	3	0	0	3
3	20EE OE 903	Basics of Energy Storage Technologies	3	3	0	0	3
4	20EE OE 904	Basic Concepts of SMPS and UPS	3	3	0	0	3
5	20EE OE 905	Solar energy appliances	3	3	0	0	3
6	20EE OE 906	Introduction to renewable energy systems	3	3	0	0	3
7	20EE OE 907	Fundamentals of power electronics	3	3	0	0	3
8	20EE OE 908	Introduction to Microcontroller	3	3	0	0	3
9	20EE OE 909	Fundamentals of Smart Grid	3	3	0	0	3
10	20EE OE 910	Basics of Programmable Logic Controllers	3	3	0	0	3

OPEN ELECTIVES

20EEOE901 SDG NO: 4,7	PRINCIPLES OF WIND ENERGY SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concepts of wind energyand process of wind measurement techniques.
- To know the concepts of wind energy conversionand machines used in wind energy.
- To give the brief knowledge about power generation and hybrid system.

UNIT I BASICS OF WIND **9**

Introduction - Causes of wind - Types of Winds - Planetary or Permanent Winds -Trade Winds-Local & Regional Wind System - Meteorology of Wind: Global Circulation - Forces influencing Wind- Pressure Gradient Force &Coriolis Force - Power in the Wind.

UNIT II WIND MEASUREMENT TECHNIQUES **9**

Measurement & Instrumentation - Wind Data Presentation - Power Law Index, Betz Constant, Terrain value - Wind data Characterization - Mean Wind Speed - Wind Speed Distribution - Wind Turbulence Characteristics : Short-termfluctuations & Long-term fluctuations - Wind Direction Distribution - Wind Shear.

UNIT III WIND ENERGY CONVERSION **9**

Wind Mill - Basic Components of Wind Mill Conversion System - Types of Wind Mills – Based on:Application - Wind Flow Direction - Tower Type & Height – Roto – Controls – Axis - Number & Types of Blades – Speed - Inventor & Make - Development of Wind Turbine - Wind Turbine Terminology Power & Torque co-efficient - Co-efficient of Performance – Efficiency.

UNIT IV GENERATORS USED IN WIND TURBINE **9**

Generator : Basics - D.C. Generator - Induction Generator - Construction & Principle of Operation - Development of Equivalent circuit - Power equation - Voltage control of self-excited generators - Grid connected single & double output generators - Synchronous Generators - Construction & Principle of operation - Salient pole synchronous machines.

UNIT V POWER GENERATION & HYBRID SYSTEM 9

Wind Energy Conversion System - Fixed Speed Drive Scheme - Variable Speed Drive Scheme - Diesel Power Generation - Photovoltaic Power Generation - Hybrid System Models - Wind – Diesel Hybrid System - Wind – Photovoltaic Hybrid System - Diesel – Photovoltaic Hybrid System - Wind – Photovoltaic – Diesel Hybrid System - Battery Banks and Power Converters.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. E. I. Wakil "Power Plant Technology", McGraw Hill Publishers, New York,2014.
2. S.N. Bhadra, D. Kastha and S. Banerjee, Wind Electrical Systems, Oxford Univ Press 2005.

REFERENCES:

1. G. D. Rai "Non-Conventional Energy Sources", Khanna Publishers, New Delhi,1988.
2. J.F. Manwell, J.G. McGowan and A.L. Rogers Wind Energy Explained,John Willy & Sons 2003.
3. A report by the EWEA The Economics of Wind Energy, March 2009
4. Paul Gipe, Wind Power for Home and Business, Chelsea Green Publishing Company, Vermont, Totnes, England, 1993.

WEB RESOURCES:

1. https://www.coursera.org/lecture/wind-energy/wind-energy-technology-concepts-5F0pp
2. http://web.mit.edu/windenergy/windweek/Presentations/Wind%20Energy%20101.pdf

ONLINE RESOURCES:

1. https://www.awea.org/wind-101/basics-of-wind-energy
2. https://www.nrel.gov/research/re-wind.html

OUTCOMES:

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

1. Acquire knowledge onwind energy
2. Acquire knowledge onwind measurement techniques.
3. Acquire knowledge onwind mill energy conversion
4. Acquire knowledge onwind turbine
5. Acquire knowledge on hybrid systems

CO - PO MAPPING

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

20EEOE902 SDG NO: 4,7	MEMS DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce different MEMS materialsand their properties, and MEMS technology
- To study the different fabrication process and application areas in MEMS technology.
- To introduce the fundamental working principles of different micro sensors and actuators.

UNIT I INTRODUCTION **9**

Intrinsic Characteristics of Micro systems – Macro and micro Sensors and Actuators –Scaling laws - Silicon based MEMS processes, Packaging and Integration, MEMS Materials

UNIT II MICROMACHINING **9**

Bulk Micromanufacturing - Surface micromachining, LIGA processes, Polymer MEMS fabricationprocess, General Principles in nanofabrication and Nanoproducts

UNIT III SENSORS AND ACTUATORS – I **9**

Electrostatic sensors – Parallel plate capacitors – Applications – Micro motors – Inter digitated Fingercapacitor – Comb drive devices – Thermal Sensing and Actuation – Thermal expansion– Thermalcouples – Thermal resistors – Applications – Microfluidics for sensing and actuation applications.

UNIT IV SENSORS AND ACTUATORS - II **9**

Piezo resistive sensors – Piezo resistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensorsPiezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications toInertia, Acoustic, Tactile and Flow sensors.

UNIT V APPLICATIONS **9**

Application to Acceleration, Pressure, Flow, Inertial sensors - Optical MEMS – Bio MEMS – RF MEMS – NEMS devices.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Chang Liu, "Foundations of MEMS", Pearson Education Inc
2. Tai Ran Hsu, "MEMS and Micro systems Design and Manufacture" Tata McGraw Hill, NewDelhi, 2006.

REFERENCES:

1. Gregory T. Kovacs "Micro machined Transducers Source Book", McGraw-Hill High Education, 1998.
2. M.H.Bao, "Micromechanical Transducers: Pressure sensors, Accelerometers and Gyroscopes", Elsevier, Newyork, 2000.
3. Marc Madou, "Fundamentals of Microfabrication", CRC press 1997.
4. Stephen D. Senturia," Micro system Design", Kluwer Academic Publishers,2001

WEB RESOURCES:

1. http://www.memsnet.org/news/
2. https://www.mems-exchange.org/MEMS/what-is.html

ONLINE RESOURCES:

1. https://www.edx.org/course/micro-and-nanofabrication-mems
2. https://engineering.purdue.edu/online/courses/fundamentals-mems

OUTCOMES:

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

1. Understanding the material properties and the significance of MEMS .
2. Knowledge delivery on micromachining and micro fabrication.
3. Applying the concepts of MEMS to design the sensors and actuators.
4. Applying the fabrication mechanism for MEMS sensor and actuators.
5. Able to identify the right MEMS device against the applications.

CO- PO MAPPING:

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

20EEOE903 SDG NO. 4, 7	BASICS OF ENERGY STORAGE TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide an insight into the various modes of energy storage
- To impart knowledge on construction, working principle and performance analysis of electrochemical, electric and thermal storage systems
- To identify the applications for renewable energy systems.

UNIT I STORAGE: INTRODUCTION AND CHANGES 9

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

UNIT II ENERGY STORAGE MODES 9

Potential energy, Pumped hydro storage; KE and Compressed gas system: Flywheel storage, compressed air energy storage; Electrical and magnetic energy storage: Capacitors, electromagnets; Chemical Energy storage: Thermo-chemical, photo-chemical, bio-chemical, Superconducting Magnet Energy Storage (SMES) systems.

UNIT III ELECTROCHEMICAL ENERGY STORAGE SYSTEMS 9

Batteries- primary, secondary, Lithium; Solid-state and molten solvent batteries; Lead acid batteries; Nickel Cadmium batteries; Advanced batteries, Role of carbon nano-tubes in electrodes.

UNIT IV ELECTRIC ENERGY STORAGE SYSTEMS 9

Capacitor and Batteries: Comparison and application; Super capacitor:

Electrochemical Double Layer Capacitor (EDLC), principle of working, structure, performance and application, role of activated carbon and carbon nano-tube

UNIT V APPLICATION OF ENERGY STORAGES 9

Areas of Application of Energy Storage: Waste heat recovery, Solar energy storage, Green house heating, Power plant applications, Drying and heating for process industries, energy storage in automotive applications in hybrid and electric vehicles.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ibrahim Dincer and Mark A Rosen, "Thermal Energy Storage Systems and Applications", John Wiley and Sons 2011.
2. Ru-shiliu, Leizhang, Xueliang sun, "Electrochemical technologies for energy storage and conversion", Wiley Publications, 2012.
3. Doughty Liaw, Narayan and Srinivasan, "Batteries for Renewable Energy Storage", The Electrochemical Society, NewJersy,2010.

REFERENCES:

1. James Larminie and Andrew Dicks, "Fuel cell systems Explained", Wiley Publications, 2003.
2. Yves Brunet., "Energy storage", Wiley publications,2013.
3. Luisa F.Cabeza., "Advances in thermal energy storage systems", Woodhead publications 2014.

WEB RESOURCES:

1. www.enegrystorage.org/technologies
2. https://www.eesi.org/papers/view/energy-storage-2019
3. https://www.geni.org/globalenergy/research/energy-storage-technologies/Energy-Storage-Technologies.pdf
4. https://www.renewableenergyworld.com/
5. https://www.forbes.com/

OUTCOMES:

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

1. Explore the historical changes and provide solution for environmental and sustainability issues.
2. Identify various means of energy storage and demonstrate knowledge on energy storage modes

3. Demonstrate knowledge on the storage behavior in electro chemical systems and identify the parameters affecting their performance.
4. Demonstrate an understanding of electrical energy storage systems and evaluate their performance parameters
5. Able to categorize the energy storage devices to different application

CO – PO MAPPING

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

20EE0E904 SDG NO. 4,7	BASICS CONCEPTS OF SMPS AND UPS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Modern power electronic converters and its applications in electric power utility.
- Resonant converters and UPS.
- PWM techniques for DC-AC converters

UNIT I DC-DC CONVERTERS AND APPLICATIONS **9**

Principles of step down and step up converters -Applications: Hybrid Electric Vehicle (HEV),Renewable Energy System.

UNIT II SWITCHED MODE POWER CONVERTERS **9**

Analysis of fly back, Forward, Push pull, Half bridge and full bridge converters-control circuits and PWM techniques.

UNIT III SOFT SWITCHING CONVERTERS **9**

Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- Series and parallel Resonant inverters- Voltage control- SMPS Using Resonant Circuit

UNIT IV DC-AC CONVERTERS **9**

Single phase and three phase inverters, control using various (sine PWM, SVPWM and PSPWM) techniques, Multilevel inverters-Concepts - Applications.

UNIT V POWER CONDITIONERS, UPS & FILTERS **9**

Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications .

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Muhhamad H. Rashid, "Power Electronics:Circuits,Devices and Applications" Pearson,4th Edition,2014.
2. Slobodan Cuk, Power Electronics: Advanced Topics and Design, TESLAco, 2015.

REFERENCES:

1. Philip T Krein, " Elements of Power Electronics", Oxford University Press
2. Ned Mohan, Tore.M.Undeland, William.P.Robbins, Power Electronics converters,Applications and design- Third Edition- John Wiley and Sons-2006
3. M.H. Rashid – Power Electronics circuits, devices and applications- third editionPrentice Hall of India New Delhi, 2007.
4. Erickson, Robert W, "Fundamentals of Power Electronics", Springer, second edition,2010.
5. Simon Ang, Alejandro Oliva, "Power-Switching Converters", Third Edition, CRCPress, 2010.

WEB RESOURCES:

1. https://www.electronicsforu.com/resources/learn-electronics/smps-basics-switched-mode-power-supp ly
2. https://www.tutorialspoint.com/electronic_circuits/electronic_circuits_smps.htm

ONLINE RESOURCES:

1. https://www.classcentral.com/course/powerelectronics-716
2. https://www.classcentral.com/course/swayam-advance-power-electronics-and- control-12956

OUTCOMES:

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

1. Acquire knowledge on dc to dc converters.
2. Acquire knowledge on switched mode power converters.
3. Acquire knowledge on of Resonant Converters.
4. Analyze the PWM techniques for DC-AC converters
5. Acquire knowledge on power conditioners, UPS and Filters.

CO – PO MAPPING:

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

20EEOE905 SDG NO. 4,7	SOLAR ENERGY APPLIANCES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the different types of solar energy
- To know the concepts and process of different types solar energy
- To recognize current and possible future applications of solar energy

UNIT I INTRODUCTION **9**

Basic Heat Transfer Principles- Availability of Solar Energy- Nature of Solar Energy- Solar Energy & Environment- Sun as the source of radiation- Solar radiation- Measurement of solar radiation Irradiance- Solar constant- Insolation- Radiosity- Emissive power- Earth's equator- Meridian Longitude- Sun earth angles- Sunrise, sun set and day length- Solar time- Equation of time Various Methods of using solar energy- Photo thermal, Photovoltaic, Photosynthesis, Present & Future Scope of Solar energy.

UNIT II SOLAR THERMAL ENERGY **9**

Thermal energy storage- Solar cooling- Limitations of solar thermal energy. Solar Radiation, Radiation Measurement, Stationary collectors- FPC- CPC-

ETC- Sun tracking concentrating collectors- PTC- PDR- HFC Fresnel collectors, applications

UNIT III SOLAR PHOTOVOLTAIC CELL **9**

Solar Photovoltaic systems : Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Efficiency and Quality of the Cell, series and parallel connections, maximum power point tracking, Recent developments in PV systems ,applications.

UNIT IV ENERGY STORAGE **9**

Sensible Heat Storage – Liquid media storage – Solid media storage – Latent heat storage - Phase change materials – Thermal-Chemical storage

UNIT V INDUSTRIAL APPLICATIONS OF SOLAR HEAT **9**

Solar Thermal Power Plant, Solar Desalination, Solar Water Heating, Solar Air Heating, Solar Drying, Solar Cooking, Solar Car ,solar ponds, Solar water disinfection(SODIS).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Tiwari G.N, "Solar Energy – Fundamentals Design, Modeling and Applications, Narosa Publishing House, New Delhi, 2002.
2. H.P. Garg and J. Prakash, "Solar Energy- Fundamentals & Applications", Tata McGraw-Hill, 2000

REFERENCES:

1. L D. Partain, L M. Fraas, "Solar Cells and Their Applications", 2nd Edition, John Wiley and Sons, 2010
2. John A. Duffie, William A. Beckman, Solar Energy: Thermal Processes, 4th Edition, John Wiley and Sons, 2013
3. Sukhatme S.P. Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997
4. D.P.Kothari, K.C Singal, Rakesh Ranjan Renewable Energy Sources and Emerging Technologies, PHI Learning Pvt.Ltd, New Delhi, 2013
5. A.K.Mukerjee and Nivedita Thakur, Photovoltaic Systems: Analysis and Design, PHI Learning Private Limited, New Delhi, 2011
6. Chetan Singh Solanki, Solar Photovoltaics : Fundamentals, Technologies and Applications, PHI Learning Private Limited, New Delhi, 2011
7. Soteris A. Kalogirou, "Solar Energy Engineering: Processes and Systems", Academic Press, London, 2009

WEB RESOURCES:

1. https://us.sunpower.com/
2. https://energypedia.info/wiki/Solar_Energy
3. https://photovoltaic-software.com/solar-tools/solar-applications-smartphone

ONLINE RESOURCES:

1. https://swayam.gov.in/nd1_noc19_ph13/preview
2. http://nptel.iisc.ac.in/index.php/2018/05/25/design-of-photovoltaic-systems/
3. https://www.coursera.org/learn/solar-energy-basics
4. https://www.coursera.org/learn/photovoltaic-solar-energy
5. https://www.udemy.com/course/the-full-solar-energy-course-from-zero-to-complete-design/

OUTCOMES:

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

1. Understand the basic concepts of various forms of solar energy
2. Examine various collecting techniques of solar energy and its storage
3. Interpret PV technology principles and conversion of solar energy into Electricity
4. Assess the solar energy potential and its availability
5. Apply the solar energy conversion concept in variety of applications

CO – PO MAPPING:

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

20EEOE906 SDG NO. 4, 7 & 9	INTRODUCTION TO RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To create awareness about renewable Energy Sources and technologies.
- To provide adequate inputs on a variety of issues in harnessing renewable Energy.
- To recognize current and possible future role of renewable energy sources.

UNIT I RENEWABLE ENERGY(RE)SOURCES 9

Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

UNIT II WIND ENERGY 9

Power in the Wind – Types of Wind Power Plants(WPPs)–Components of WPPs-Working of WPPs- Siting of WPPs-Grid integration issues of WPPs.

UNIT III SOLAR PV AND THERMAL SYSTEMS 9

Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds.- Thermal Energy storage system with PCM- Solar Photovoltaic systems : Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.

UNIT IV BIOMASS ENERGY 9

Introduction-Bio mass resources –Energy from Bio mass: conversion processes-Biomass Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.

UNIT V OTHER ENERGY SOURCES 9

Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Fuel cell : Principle of working- various types - construction and applications. Energy Storage System- Hybrid Energy Systems

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Joshua Earnest, Tore Wizeliu, 'Wind Power Plants and Project Development', PHI Learning Pvt.Ltd, New Delhi,2011.
2. D.P.Kothari, K.C Singal, RakeshRanjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi,2013.
3. Scott Grinnell, "Renewable Energy & Sustainable Design", CENGAGE Learning, USA, 2016.

REFERENCES:

1. A.K.Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi,2011.
2. Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited, Delhi, 2015.
3. Chetan Singh Solanki, " SolarPhotovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi,2011.
4. Bradley A. Striebig,AdebayoA.Ogundipe and Maria Papadakis," Engineering Applications in Sustainable Design and Development", Cengage Learning India Private Limited, Delhi, 2016.
5. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University,2004.
6. ShobhNath Singh, 'Non-conventional Energy resources' Pearson Education, 2015.

OUTCOMES:

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

1. To gain knowledge about various renewable Energy Sources and technologies.
2. Analyze and study the operation of various wind energy power plants.
3. Understand the working of various solar collector and the types of solar power plant with MPPT.
4. Understand the basics of biomass, geothermal and hydro power plant with its components.
5. Design the layout, construction and working of the other Renewable energy power plants

CO – PO MAPPING:

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

20EEOE907 SDG NO. 4, 9, 11, 12	FUNDAMENTALS OF POWER ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the operation and characteristics of power semiconductor devices.
- To study the operation of uncontrolled and controlled rectifier and DC to DC converters.
- To understand the operation of DC to AC and AC to AC converters with applications.

UNIT I POWER SWITCHING DEVICES AND CHARACTERISTICS 9

Construction and Characteristics of Rectifier Diodes, Fully Controlled Power Switches like Power BJT, Power MOSFET, IGBT, SCR and GTO, Commutation and Triggering methods.

UNIT II AC-DC CONVERTERS 9

Classification, 1-phase and 3-phase uncontrolled Rectifier, Principle of single phase and three phase controlled rectifier, Applications of rectifier.

UNIT III DC - DC CONVERTERS 9

Classification, principle, output control methods, Types of chopper, Step up, step down, step up-down chopper, Switched mode converters, Applications of chopper.

UNIT IV DC - AC CONVERTERS 9

Inverters, classification, principle, operation of half and full bridge inverters, 3-phase inverters, voltage control methods, Applications of Inverter

UNIT V AC-AC CONVERTERS **9**

AC voltage controllers, integral cycle control, principle of phase controlled converters, 1- phase Cyclo- converters, 3-phase cycloconverters, Applications of AC voltage controller.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. M.H. Rashid,"Power Electronics: Circuits, Devices & Applications", Pearson India, 4th Edition,2014.
2. Ned Mohan, T.M.Undeland and W.P.Robbins, "Power Electronics: Converters, Applications and Design",Wiley India Ltd,2008

REFERENCES:

1. M.S. JamilAsghar, "Power Electronics" Prentice Hall of India Ltd., 2004
2. P.C. Sen, " Power Electronics", McGraw Hill Education (India) Pvt. Ltd.1987.
3. P.S. Bhimbra, " Power Electronics", Khanna Publishers,6th Edition,1990.
4. V.R. Moorthy, "Power Electronics : Devices, Circuits and Industrial Applications" Oxford University Press,2007
5. S.N. Singh, "A Text Book of Power Electronics" DhanpatRai& Sons

WEB RESOURCES:

1. https://books.google.co.in/books/about/Fundamentals_of_Power_Electronics.html?id=On9-rJTR8ygC&redir_esc=y.
2. https://www.powerelectronics.com/learning-resources

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108101126/
2. https://swayam.gov.in/nd1_noc19_ee37/preview
3. https://www.coursera.org/learn/power-electronics

OUTCOMES:

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

1. Gain the knowledge about the operation and characteristics of power semi-conductor devices.
2. Analyze the operation of uncontrolled and controlled single phase and three phase rectifiers.
3. Understand the operation of the different types of DC-DC switching regulators.
4. Understand the operation of single phase and three phase inverter.
5. Understand the operation of AC voltage controller and cycloconverters.

CO – PO MAPPING

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

20EEOE908 SDG NO. 4, 7 & 12	INTRODUCTION TO MICROCONTROLLER	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the basic Architecture and interfacing of 8051 Microcontroller
- To study the basic Architecture and interfacing of PIC microcontroller.
- To study the basics of ARM processor.

UNIT I 8051 MICRO CONTROLLER **9**

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memoryorganization – I/O ports and data transfer concepts– Timing Diagram – Interrupts- Data Transfer, Manipulation, Control Algorithms& I/O instructions, Programming concepts of 8051.

UNIT II MICRO CONTROLLER PROGRAMMING & APPLICATIONS **9**

Simple programming exercises- key board and display interface –Control of servo motor – steppermotor control- Application to automation systems.

UNIT III PIC MICROCONTROLLER **9**

Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture–IC16cxx–PIC micro controller Interrupts- Loop timesubroutine Timers-Timer Programming - Instruction Set -Addressing modes – Simple Operations.

UNIT IV PERIPHERALS AND INTERFACING **9**

I2C Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM—UART-Baud rate selection–Data handling circuit–Initialization –Front panel I/O-Soft Keys– State machines andkey switches– Display of

Constant and Variability strings-LCD and keyboard Interfacing -ADC, DAC and Sensor Interfacing.

UNIT VARM PROCESSOR AND ORGANIZATION **9**

Architecture –ARM programmer's model –ARM Development tools- Memory Hierarchy –ARM Assembly Language Programming–Simple Examples–3-Stage and 5-Stage Pipeline ARM Organization - ARM Implementation–ARM coprocessor interface– Architectural Support forOperating systems and High Level Languages – Embedded ARM Applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture,Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.
2. Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition,2004.

REFERENCES:

1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition,Prentice Hall of India, New Delhi, 2007.
2. Sunil Mathur&Jeebananda Panda, "Microprocessor and Microcontrollers", PHI Learning Pvt. Ltd, 2016.
3. Mazidi, M.A., "PIC Microcontroller" Rollin Mckinlay, Danny causey, Prentice Hall ofIndia, 2007.
4. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade ComputerPublication, 2000.

OUTCOMES:

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

1. Understand the basic concepts of 8051 Microcontroller.
2. Develop skill in simple applications with programming in 8051 Microcontroller.
3. To educate the concepts of architecture, interrupts and timers of PIC microcontroller.
4. Examine the commonly used peripheral / interfacing with PIC microcontroller.
5. Ability to acquire knowledge in architecture of ARM processors. To analyze and apply computing platform and software for engineering problems.

CO-PO MAPPING:

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

20EEOE909 SDG NO. 4, 7	INTRODUCTION TO SMART GRID	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Understand concept of smart grid and its advantages over conventional grid
- To understand smart metering techniques and wide area measurement techniques
- To Understanding the problems associated with integration of distributed generation & its solution through smart grid.

UNIT I INTRODUCTION TO SMART GRID **9**

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, Functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid.

UNIT II SMART GRID TECHNOLOGIES (Transmission) **9**

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control.

UNIT III SMART GRID TECHNOLOGIES (Distribution) **9**

DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High- Efficiency Distribution Transformers, Phase Shifting Transformers, and Plug in Hybrid Electric Vehicles (PHEV).

UNIT IV SMART METERS AND ADVANCED METERING INFRASTRUCTURE **9**

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS **9**

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Computing algorithms for Smart grid, IOT, Cyber Security for Smart Grid.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Stuart Borlase, Smart Grids, Infrastructure, Technology and Solutions, CRC Press, 1e, 2013
2. Gil Masters, Renewable and Efficient Electric Power System, Wiley–IEEE Press, 2e, 2013

REFERENCE BOOKS:

1. A.G. Phadke and J.S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer Edition, 2e, 2017.
2. T. Ackermann, Wind Power in Power Systems, Hoboken, NJ, USA, John Wiley, 2e, 2012

WEB RESOURCES:

1. www.whatissmartgrid.org
2. www.smartgrid.gov

ONLINE RESOURCES:

1. https://swayam.gov.in/nd1_noc19_ee64/preview
2. https://sensus.com/internet-of-things/smart-grid/
3. https://smartgrid.ieee.org/

COURSE OUTCOMES:

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

1. Understand the features of Smart Grid.
2. Assess the role of automation in Transmission and Distribution

3. Apply Evolutionary Algorithms for the Smart Grid and Distribution Generation.
4. Understand operation and importance of PMUs, PDCs, WAMS
5. Understand the control of smart grid

CO- PO MAPPING

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

20EEOE910 SDG NO. 4,3 & 9	BASICS OF PROGRAMMABLE LOGIC CONTROLLERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of PLC Ladder Diagram and its Programming Concepts.
- To learn the Instruction of PLCs and its Applications.
- To understand the concepts of SCADA systems and Process control.

UNIT I INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLER 9

Introduction-Principles of operation, PLC Architecture and Specifications-PLC hardware components -Analog & digital I/O modules, CPU & memory module,-Programming devices .

UNIT II PLC BASICS & LADDER DIAGRAMS 9

PLC ladder diagram- Converting simple relay ladder diagram into PLC Relay ladder diagram-Concept of relays-Relay wiring for logic gates , PLC programming-Simple instructions - Manually operated switches-Mechanically operated switches-Latching relays.

UNIT III PLC COMPONENTS 9

Automations Components Input/Output Devices- Sensors-Optical Sensors-Capacitive Sensors-Inductive Sensor- Ultrasonic Sensors- Angular

displacement (Potentiometers, Encoders,) -Analog Sensors -Current, Voltage Transducers - Temperature Sensors (RTDs,Thermocouples)-Control Actuators-Solenoids- Valves-Hydraulics-Pneumatics

UNIT IV APPLICATIONS OF PLC 9

Timer instructions-On delay, Off delay- Cyclic and Retentive Timers-Up /Down Counters- control instructions- Data manipulating instructions- math instructions; Applications of PLC-Motor start and stop- Simple materials handling applications- Automatic water level controller, Automatic lubrication of supplier Conveyor belt- Automatic car washing machine-Bottle label detection and process control application.

UNIT V SCADA SYSTEM & INDUSTRIAL PROCESS CONTROL 9

Data acquisition systems- Evolution of SCADA- Communication technologies- Monitoring and supervisory Functions- SCADA applications in Utility Automation-Industries - SCADA System Components: Schemes- Remote Terminal Unit (RTU)- Intelligent Electronic Devices (IED)-Communication Network- SCADA Server- SCADA/HMI Systems-Various SCADA architectures-advantages and disadvantages of each system

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Gary Dunning, "Introduction to Programmable Logic Controllers",3rd India edition, Cengage Learning, 2009

2. John Webb, "Programmable Logic Controllers: Principles and Applications",5th edition Prentice Hall of India,2012.

REFERENCES

1. B. G. Liptak "Instrument Engineer's Handbook – Process Software and Digital Network", 3rd edition, CRC Press,2002.
2. Jose A.Romagnoli,AhmetPalazoglu,"Introduction to Process control",CRC TaylorandFrancisgroup, 2005.
3. Richard Cox, "Programmable Controllers", Delmer Thomson learning, 2001.
4. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.
5. William T. Shaw, Cybersecurity for SCADA systems, Penn Well Books, 2006

WEB RESOURCES

1. https://www.sciencedirect.com/topics/computer-science/Programmable-logic-controller
2. https://www.udemy.com/course/intro-to-plcs-programmable-logic-controllers/

ONLINE RESOURCES:

1. https://electrical-engineering-portal.com/resources/plc-programming-Training.

OUTCOMES

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

1. Choose appropriate PLC and explain the architecture.
2. Understand PLC Basic Ladder Diagrams and Programming Logics
3. Gain Complete Knowledge on PLC Components and its Applications
4. Develop PLC programs using various functions of PLCs for a given application.
5. Explain the application development procedures in SCADA and Process controls.

CO- PO MAPPING

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

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SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

Affiliated to Anna University & Approved by AICTE, New Delhi

OPEN ELECTIVES

I - VIII SEMESTER
AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

B.E. DEPARTMENT OF ELECTRONICS & INSTRUMENTATION ENGINEERING

S. NO	COURSE CODE	COURSE TITLE	CONTACT HOURS	WEEK HOURS			CREDITS
				L	T	P	C
1	20EIOE901	Sensor Technologies	3	3	0	0	3
2	20EIOE902	Industrial Measurement and Control	3	3	0	0	3
3	20EIOE903	Biomedical signals and Instrumentation	3	3	0	0	3
4	20EIOE904	Process plant Instrumentation	3	3	0	0	3
5	20EIOE905	Advanced PID control	3	3	0	0	3
6	20EIOE906	Test and Measuring Instruments	3	3	0	0	3
7	20EIOE907	Neural Networks and Fuzzy Logic	3	3	0	0	3
8	20EIOE908	Process Dynamics and Control	3	3	0	0	3
9	20EIOE909	Industrial Automation	3	3	0	0	3
10	20EIOE910	Fault detection and diagnosis	3	3	0	0	3
11	20EIOE911	Cyber physical systems	3	3	0	0	3
12	20EIOE912	Process modeling and simulation	3	3	0	0	3

OPEN ELECTIVES

20EIOE901 SDG NO: 4,9	SENSOR TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Get to know the methods of measurement, classification of transducers and to analyze error.
- To understand the behavior of transducers under static and dynamic conditions and hence to model the transducer.
- Get exposed to different types of resistive transducers and their application areas.
- To acquire knowledge on capacitive and inductive transducers.
- To gain knowledge on variety of transducers and get introduced to MEMS and Smart transducers.

UNIT I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS 9

Units and standards – Static calibration – Classification of errors, Limiting error and probable error – Error analysis – Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers.

UNIT II CHARACTERISTICS OF TRANSDUCERS 9

Static characteristics: - Accuracy, precision, resolution, sensitivity, linearity, span and range. Dynamic characteristics: Mathematical model of transducer, Zero, I and II order transducers, Response to impulse, step, ramp and sinusoidal inputs.

UNIT III VARIABLE RESISTANCE TRANSDUCERS 9

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

UNIT IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS 9

Inductive transducers: – Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers – Synchros – Microsyn – Principle of operation, construction details, characteristics of capacitive transducers – Different

types & Signal Conditioning – Applications:- Capacitor microphone, Capacitive pressure sensor, Proximitysensor.

UNIT V OTHER TRANSDUCERS 9

Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor – Digital transducers – Fiber optic sensors – Thick & Thin Film sensors (Bio sensor & Chemical Sensor) – Environmental Monitoring sensors (Water Quality & Air pollution) – Introduction to MEMS – Introduction to Smart transducers and its interface standard (IEEE 1451).

TOTAL: 45 PERIODS

TEXT BOOKS

1. Doebelin E.O. and Manik D.N., "Measurement Systems", 6th Edition, McGraw-Hill Education Pvt. Ltd., 2011.
2. Sawney A K and PuneetSawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, DhanpatRai & Co, New Delhi, 2013.
3. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge, 2003.

REFERENCES

1. BelaG.Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th Edition, Vol. 1, ISA/CRC Press,2003.
2. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010.E.A.
3. John P. Bentley, Principles of Measurement Systems, III Edition, Pearson Education, 2000.
4. W.Bolton, Engineering Science, Elsevier Newnes, Fifth edition,2006.
5. Murthy, D.V.S., Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi,2010.
6. Ian Sinclair, Sensors and Transducers, 3rd Edition, Elsevier,2012.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_ee41/preview
2. http://www.nptelvideos.in/2012/11/industrial-instrumentation.html
3. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf

ONLINE RESOURCES:

1. https://instrumentationtools.com/tag/sensors-and-transducers-nptel-pdf/
2. https://electronics-tutorials.ws/io/io-

OUTCOMES:

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

1. Apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement and applications.
2. Analyze the static and dynamic characteristics related to sensors & transducers.
3. Design and analyze the working of Resistive Transducers.
4. Design and analyze the various applications of inductive and capacitive transducers in industries.
5. Understand fiber optic sensor, MEMS, Smart transducer and applications.

CO - PO MAPPING

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

20EIOE902 SDG NO: 4,7	INDUSTRIAL MEASUREMENT AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To educate students on different measurement systems.
- To educate students on common types of errors.
- To introduce different types of sensors, transducers, strain gauges, used for measurement.
- To introduce different types of flow meters used for measurement.
- To introduce control equipment's and combined modes of control systems.

UNIT I BASIC MEASUREMENT **9**

Generalised measurement system - Basic standards of measurement - Errors - Classification. Measurements of displacement, force and torque. Dynamometers: Hydraulic, Absorption and Eddy current.

UNIT II STRAIN AND TEMPERATURE MEASUREMENT 9

Measurement of strain - Bonded and unbounded strain gauges. Mechanical - Electrical - Opto mechanical strain gauges. Measurement of temperature - electrical and non-electrical methods - Bimetallic and pressure thermometer, thermocouples - Resistance thermometers - Pyrometry - Calibration methods.

UNIT III PRESSURE AND FLOW MEASUREMENT 9

Measurements of Pressure and flow - Measurements of high pressure and low pressure - Measurements of flow by obstruction meters - Velocity probes - Hot wire anemometer - Calibration of pressure gauges and flow meters.

UNIT IV 9

Automatic control - Open and closed systems, on-off, proportional, and floating modes, reset and rate actions. Basic combined modes for pneumatic, hydraulic and electrical systems.

UNIT V 9

Transfer function - Stability - Routh's criterion - Analysis of second order systems - System response to step step, pulse, ramp inputs. Introduction to computerized measurement and control systems (Description only)

TOTAL: 45 PERIODS

TEXT BOOKS:

1) Hollman, J.P., Experimental Methods for Engineers, Tata McGraw Hill.
2) D.S. Kumar, 'Mechanical Measurement & Control', Metropolitan Book Company.

REFERENCE BOOKS:

1) Benjamin Kuo, Automotive Control Engineering, EEE Publications.
2) Beckwith, T.C & Buck, N.L., Mechanical Measurements, Addison Wesley.
3) Nagarth and Gopal, Control Engineering, Wiley Eastern Ltd.
4) Control System by Nagoor Kani, RBA Publications.
5) Erenest O. Doebeling, 'Measurement Systems', McGraw Hill.

WEB REFERENCES:

1) https://www.nptel.ac.in/courses/108105064/
2) http://www.nptelvideos.in/2012/11/industrial-instrumentation.html

3) http://www.nptelvideos.in/2012/11/process-control-and-instrumentation.html

ONLINE RESOURCES:

1) https://www.udemy.com/course/pid-control/
2) https://idc-online.ac.za/industrial-instrumentation-engineering.html

OUTCOMES:

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

1) Work in Quality control and quality assurances divisions in industries
2) Design a sensors and transducers used for stress analysis.
3) Design and maintain measuring equipment's.
4) Understand and design and maintain the measurement of temperature and flow instrument.
5) Understand different modes of operation of controller.

CO- PO MAPPING:

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

20EIOE903 SDG NO. 4, 7	BIOMEDICAL SIGNALS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering.
- To study the communication mechanics in a biomedical signals acquisition and processing.
- To study measurement of certain electrical parameters and medical informatics.
- To understand the basic principles in imaging techniques.
- To have a basic knowledge in life assisting and therapeutic devices.

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II BIOSIGNAL ACQUISITION AND PROCESSING 9

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes. Digital Biomedical Signal Acquisition and Processing - Time–Frequency Signal Representations for Biomedical Signals - Multivariate Spectral Analysis of Electroencephalogram: Power, Coherence, and Second-Order system.

UNIT III ELECTRICAL PARAMETER MEASUREMENT AND MEDICAL INFORMATICS 9

Electro Physiological Measurement - ECG – EEG – EMG - ERG - EOG Lead systems and recording methods – Typical waveforms – Medical Informatics – Introduction, Hospital Information Systems - Electrical safety in medical environment, shock hazards – leakage current - Instruments for checking safety parameters of biomedical equipment.

UNIT IV MEDICAL IMAGING MODALITIES AND ANALYSIS 9

Mammography – Positron-Emission Tomography - Electrical Impedance Tomography - Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems.

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – incubators, drug delivery devices - Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery –Orthopedic prostheses fixation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.
2. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, NewDelhi,2nd edition,2003.
3. Joseph J Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th edition,2012.

REFERENCES:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York,1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition,2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition,2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC,2006.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies,2003.
6. Geddes L. A. and Baker L. E., — Principles of Applied Biomedical Instrumentation||, John Wiley, New York, 1989.
7. Richard Aston, —Principles of Biomedical Instrumentation and Measurement||, Merril Publishing Company, New York, 1990.

WEB REFERENCES:

1. https://www.nhlbi.nih.gov
2. https://psychology.wikia.org/wiki/Medical_therapeutic_devices

ONLINE RESOURCES:

1. https://www.udemy.com/course/biomechanics-cervical-spine-module-1/
2. https://academicearth.org/biomedical-engineering/
3. https://www.edx.org/learn/biomedical-engineering
4. https://www.coursera.org/courses?query=biomedical

5. https://www.distancelearningportal.com/study-options-c/short/269778974/bio-biomedical-engineering-united-states.html
6. https://www.classcentral.com/tag/biomedical-engineering

OUTCOMES:

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

1. To understand the philosophy of the heart, lung, blood circulation and respiration system.
2. To provide latest ideas on biosignal acquisition and processing.
3. To gain knowledge on various sensing and measurement devices of electrical origin and informatics.
4. To bring out the important and modern methods of imaging techniques and their analysis.
5. To explain the medical assistance/techniques, robotic and therapeutic equipment.

CO – PO MAPPING

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

20EIOE904 SDG NO. 4, 9	PROCESS PLANT INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce common unit operations carried out in process industries.
- To prepare them to take up a case study on selected process industries like petrochemical industry.
- To impart knowledge about the different types of Combustion controls
- To understand about the different types of Boiler control and its loops.
- To familiarize the student with the methods of monitoring different parameters like speed, vibration of turbines and their control.

UNIT I COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -I 9

Unit Operation, Measurement and Control - Transport of solid, liquid and gases - Evaporators – Crystallizers-Dryers. Distillation – Refrigeration processes – Chemical reactors.

UNIT II COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -II 9

Unit Operation, Measurement and Control - Process flow diagram of Petro Chemical Industry - Gas oil separation in production platform – wet gas processing – Fractionization Column – Catalytic Cracking unit – Catalytic reforming unit.

UNIT III FURNACE CONTROL 9

Furnace Draught: natural draught, forced draught, induced draught, power requirements for draught systems - Combustion control: Fuel/Air ratio, combustion efficiency, excess air, parallel and cross limited combustion control- soot-blowing operation.

UNIT IV BOILER CONTROL 9

Boiler feed water processing and control - drum level measurement methods - steam temperature control: main steam and reheat steam temperature control, superheater control, deaerator control – distributed control system in power plants – interlocks in boiler operation.

UNIT V TURBINE CONTROL 9

Speed measurement, rotor and casing movement- vibration - shell temperature monitoring and control - steam pressure control - lubricant oil temperature - cooling system.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Sam G. Dukelow, The control of Boilers, instrument Society of America, 1991.
2. Modern Power Station Practice, Vol.6, Instrumentation, Controls and Testing, Pergamon Press, Oxford, 1971.

REFERENCES:

1. Liptak B.G., Instrumentation in Process Industries, Chilton Book Company, 2005
2. Krishnaswamy KM, Bala P, Bala MP, “Power Plant Instrumentation,” Prentice Hall, 2013

3. Tamilmani, Power plant instrumentation, Sams Publishers, 2011.
4. P.K.Nag, Powerplant Engineering, Tata McGraw-Hill Education, 3rd edition, 2007
5. Elonka.S.M.and Kohal A.L., Standard Boiler Operations, McGraw-Hill, New Delhi, 1994.
6. Jain R.K., Mechanical and industrial Measurements, Khanna Publishers, New Delhi, 2008

WEB REFERENCES:

1. https://www.electrical4u.com/thermal-power-generation-plant-or-thermal-power-station/
2. https://www.oreilly.com/library/view/power-plant-instrumentation/9780128009406/
3. https://www.sciencedirect.com/book/9780128009406/power-plant-instrumentation-and-control-handbook
4. https://www.elsevier.com/books/power-plant-instrumentation-and-control-handbook/basu/978-0-08-102804-9

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112107291/
2. https://swayam.gov.in/nd1_noc20_me10/preview

OUTCOMES:

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

1. Understand common unit operations in process industries
2. Understand the dynamics of important unit operations in petro chemical industry
3. Impart knowledge about the different types of controls and control loops
4. Familiarize the student with the methods of monitoring and control different parameters like main steam, reheat steam temperature and steam pressure control
5. Understand about turbine control techniques.

CO – PO MAPPING:

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

20EIOE905 SDG NO. 4, 9	ADVANCED PID CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide an overview of the features associated with Industrial type PID controller.
- To make the students understand the various PID Controller Design methods.
- To provide knowledge about PID stabilization for Linear Time-invariant models.
- To develop the skills needed to design adaptive and non-linear PID control schemes.
- To provide basic knowledge about Fractional-order systems and Fractional-order- controller and to lay the foundation for the systematic approach to Design controller for fractional order systems.

UNIT I INTRODUCTION 9

Evolution of PID controller – PID Controller Structures – PID Implementation Issues – Tuning of PID Controller using Classical Approaches.

UNIT II PID CONTROLLER DESIGN 9

PID Controller Design Techniques : Pole placement, Lamda Tuning, Direct Synthesis, Gain Margin & Phase Margin and Optimization methods - Auto-Tuning.

UNIT III PID STABILIZATION 9

Stabilization of Linear Time-invariant Plants using P/PI/ PID controllers – Optimal Design using PID Controllers – Robust and Non-fragile PID Controller Design.

UNIT IV ADAPTIVE/NON-LINEAR PID CONTROL SCHEMES 9

Gain Scheduled PID Controller - Self-tuning PI/PID Controller – PID Types Fuzzy Logic Controller – Predictive PID Control.

UNIT V INTRODUCTION TO FRACTIONAL ORDER SYSTEM AND FRACTIONAL ORDER PID CONTROLLER 9

Fractional-order Calculus and Its Computations – Frequency and Time Domain Analysis of Fractional-Order Systems - Filter Approximations to Fractional-Order Differentiations –Model reduction Techniques for Fractional Order Systems – Fractional Order PI/PID Controller Design.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Karl J. Astrom and Tore Haggland, “Advanced PID Control”, ISA Publications, 2005
2. Aniruddha Datta, Ming-Tzu Ho, and Shankar P. Bhattacharyya, “Structure and Synthesis of PID Controllers”, Advances in Industrial Control, Springer Verlag London, 2000.

REFERENCES:

1. Antonio Visioli, “Practical PID Control” Springer- Verlag London, 2006.
2. Aidan O' Dwyer, “Handbook of PI and PID Controller Tuning Rules”, Imperial College Press, 2009
3. Xue, D., Chen, Y.Q., and Atherton, D.P., "Linear Feedback Control Analysis and Design with MATLAB, Advances in Design and Control", Society for Industrial and Applied Mathematics, 2008.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108103007/
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/108105088/lec13.pdf
3. https://swayam.gov.in/nd1_noc19_de04/preview

ONLINE RESOURCES:

1. https://www.researchgate.net/publication/327625080_Advanced_Methods_of_PID_Controller_Tuning_for_Specified_Performance
2. http://folk.ntnu.no/skoge/prost/proceedings/acc09/data/papers/1371.pdf

OUTCOMES:

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

- Determine the advanced features supported by the Industrial Type PID Controller.
- Design & implement a P/PI/PID Controllers for a given process and validate through simulations.
- Design and implement optimal/ robust PID controller for a given process and validate through simulations.
- Design and implement adaptive PID controllers and PID types Fuzzy Logic Controller for a given process and validate through simulations.
- Analyze fractional-order systems, fractional-order- controller and design a suitable fractional order P/PI/PID controller for fractional order and Integer order systems.

CO – PO MAPPING:

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

20EIOE906 SDG NO. 4, 9	TEST AND MEASURING INSTRUMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the meters used to measure current and voltage..
- To provide detailed study of power measurement techniques.
- To have adequate knowledge in Resistance, Inductance and Capacitance measuring methods.
- To understand the concept of digital measurement and introduce the meters used for it.
- To introduce different types of waveform generators and analyzers.

UNIT I MEASUREMENT OF VOLTAGE AND CURRENT 9

General features and Classification of electro mechanical instruments. Principles of Moving coil, moving iron instruments. Extension of instrument range: shunt and multipliers, CT and PT.

UNIT II MEASUREMENT OF POWER 9

Electrodynamic wattmeter's, Low Power Factor (LPF) wattmeter, errors, calibration of wattmeter. Single and three phase power measurement, Hall effect wattmeter, thermal type wattmeter.

UNIT III RESISTANCE AND IMPEDENCE MEASUREMENT 9

Different methods of measuring low, medium and high resistances, measurement of inductance & capacitance with the help of AC Bridges, Q Meter.

UNIT IV DIGITAL MEASUREMENT OF ELECTRICAL QUANTITIES 9

Concept of digital measurement, block diagram Study of digital voltmeter, Digital multimeter, Digital LCR meter, Digital wattmeter and energy meters.

UNIT V WAVEFORM GENERATORS AND ANALYZERS 9

DSO, Function generator, Audio frequency signal generation, Waveform analyzers, Spectrum analyzers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Golding, E.W. and Widdis, F.C., Electrical Measurements and Measuring Instruments, A.H.Wheeler and Co, 5th Edition, 2011. .
2. David A. Bell, Electronic Instrumentation and Measurements, Oxford University Press, 3rd Edition, 2013.
3. Shawney A K, A course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Sons. 19th revised edition, 2013.

REFERENCES:

1. Cooper, W.D. and Helfric, A.D., Electronic Instrumentation and Measurement Techniques, Prentice Hall, 1st Edition, 2009
2. Kalsi.H.S, Electronic Instrumentation, Tata Mcgraw Hill Education Private Limited, 3rd Edition, 2012.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/105/108105153/
2. https://swayam.gov.in/nd1_noc19_ee44/

ONLINE RESOURCES:

1. https://circuitglobe.com/ac-bridge.html

OUTCOMES:

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

1. Measure current and voltage.
2. Measure power.
3. Measure resistance, inductance and capacitance.
4. Use digital instruments.
5. Generate and Analyze waveforms.

CO – PO MAPPING:

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

20EIOE907 SDG NO. 4	NEURAL NETWORK AND FUZZY LOGIC	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the concepts of neural networks.
- To provide adequate knowledge about feedback neural networks and control
- To provide adequate knowledge about fuzzy and neuro-fuzzy systems
- To provide comprehensive knowledge of fuzzy logic control to real time systems.
- To provide adequate knowledge of hybrid optimization techniques.

UNIT I 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.

UNIT II NEURAL NETWORKS FOR CONTROL **9**

Feedback networks – Discrete time Hopfield networks – Kohnen's self-organizing maps, Applications of artificial neural network - Process identification – Neuro controller for inverted pendulum. Familiarization with neural network toolbox

UNIT III FUZZY SYSTEMS **9**

Classical sets – Fuzzy sets – Scalar cardinality, fuzzy cardinality, union and intersection– Fuzzification – Defuzzification – Fuzzy rules -Membership function, Familiarization with fuzzy logic toolbox.

UNIT IV FUZZY LOGIC FOR MODELING AND CONTROL 9

Knowledge base – Decision-making logic – Introduction to neuro fuzzy system- Adaptive fuzzy system. Familiarization with ANFIS toolbox

UNIT V HYBRID CONTROL SCHEMES 9

Basic concept of Genetic algorithm and detail algorithmic steps- Solution of typical control problems using genetic algorithm- Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems.

TOTAL:45 PERIODS

TEXT BOOKS:

1. Laurance Fausett, Englewood Cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education, 1992.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 3rd Edition , 2010..
3. S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013.

REFERENCES:

1. Goldberg, "Genetic Algorithm in Search, Optimization and Machine learning", Addison Wesley Publishing Company Inc. 1989 79
2. John Yen & Reza Langari, 'Fuzzy Logic – Intelligence Control & Information', Pearson Education, New Delhi, 2003.
3. M.Gen and R,Cheng, Genetic algorithms and optimization, Wiley Series in Engineering Design and Automation, 2000.
4. Hagan, Demuth, Beale, " Neural Network Design", Cengage Learning, 2012.
5. N.P.Padhy, " Artificial Intelligence and Intelligent Systems", Oxford, 2013.

WEB REFERENCES:

1. https://www.classcentral.com/course/swayam-introduction-to-soft-computing-10053
2. https://swayam.gov.in/nd1_noc20_cs17

ONLINE RESOURCES:

1. https://www.tutorialspoint.com/fuzzy_logic/index.htm
2. https://www.tutorialspoint.com/artificial_neural_network/artificial_neural_network_pdf_version.htm
3. https://www.tutorialspoint.com/genetic_algorithms/index.htm

OUTCOMES:

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

1. Understand the concepts of neural networks.
2. Understand about feedback networks and the applications of neural controller.
3. Understand about fuzzy and neuro-fuzzy systems
4. Understand the concepts of fuzzy logic control to real time systems
5. Understand the concepts of hybrid optimization and its applications.

CO – PO MAPPING

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

20EIOE908 SDG NO. 4, 9	PROCESS DYNAMICS AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts in Process Modelling.
- To impart knowledge on various controller modes.
- To familiarize the characteristics, selection, sizing of control valves.
- To understand the various PID tuning methods.
- To impart knowledge in concepts of advanced process control.

UNIT I PROCESS MODELLING 9

Terms and Objectives- classification of variables – Mathematical Modeling of Processes: Level, Flow, Pressure and Thermal processes – Continuous and batch processes – Self regulation – Servo and regulatory operations – Interacting and Non interacting system.

UNIT II CONTROLLER MODES 9

Basic control action, two position, multi-position, floating control modes.

Continuous controller modes: proportional, integral, derivative. Composite controller modes: P-I, PD, P-I-D, Integral wind-up and prevention. Auto/Manual transfer, Bumpless transfer. Response of controllers for different test inputs. Selection of control modes for processes like level, pressure, temperature and flow.

UNIT III FINAL CONTROL ELEMENT 9

Actuators: Pneumatic and electric actuators – Control Valve Terminology - Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Modeling of a Pneumatically Actuated Control Valve – Control Valve Sizing:– Cavitation and flashing – Control Valve selection.

UNIT IV CONTROLLER TUNING 9

Evaluation criteria - IAE, ISE, ITAE. PID Controller Tuning: Z-N and Cohen-Coon methods, Continuous cycling method and Damped oscillation method, Auto tuning. PID Controller Design Specifications: Criteria based on Time Response.

UNIT V ADVANCED CONTROL SYSTEM 9

Advanced control system: Cascade control, ratio control, feed forward control. Over-ride, split range and selective control. Multivariable process control, interaction of control loops – Three element boiler drum level control- control schemes for distillation column, Heat exchanger, CSTR.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Stephanopoulos, G., "Chemical Process Control – An Introduction to Theory and Practice", Prentice Hall of India, 2005.
2 Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2004.
3. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A.,"Process Dynamics and, Wiley Control" John and Sons, 2nd Edition, 2003

REFERENCES:

1. Coughanowr,D.R.,"Process Systems Analysis and Control",McGrawHill International Edition,2004.
2. Curtis D. Johnson, "Process Control InstrumentationTechnology", 8th Edition,Pearson, 2006.
3. Considine, D.M., Process Instruments and Controls Handbook, Second Edition, McGraw, 1999.
4. Bela.G.Liptak., "Process Control and Optimization"., Instrument

Engineers' Handbook., volume 2, CRC press and ISA,2005.
5. Ramesh C. Panda., T.Thyagarajan., "An Introduction to Process Modelling Identification and Control for Engineers" Narosa Publishing house Pvt. Ltd,2017.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ch11/preview
2. https://nptel.ac.in/courses/103106148/
3. https://nptel.ac.in/courses/103101142/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3126/process-control-and-instrumentation
2. https://freevideolectures.com/course/4304/nptel-chemical-process-control

OUTCOMES:

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

1. Understand technical terms and nomenclature associated with Process control domain and build models using first principles approach.
2. Select the PID controller modes for any process.
3. Select the control valves.
4. Design and implement a PID controller for a given process.
5. Comprehend about the advanced process control strategies.

CO-PO MAPPING:

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

20EIOE909 SDG NO. 4, 9	INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart the knowledge of Industrial Instruments and control strategies.
- To provide fundamental knowledge of PLC and it's programming.
- To impart knowledge on Industrial data communication,SCADA and DCS.
- To impart basic knowledge in factory automation tools.
- To provide fundamental knowledge in building automation tools.

UNIT I INDUSTRIAL INSTRUMENTATION AND CONTROL. 9

Introduction and need for automation-Instrumentation system for measurement of processparameters – overview on flow, level, pressure, temperature, speed, current and voltagemeasurements – proximity and vision based inspection systems – process control systems –continuous and batch process – feedback control system overview

UNIT II PROGRAMMABLE LOGIC CONTROLLER 9

Fundamentals of programmable logic controller - functions of PLCs - features of PLC - selection of PLC - architecture – Basics of PLC programming - logic ladder diagrams – communication in PLCs – Programming Timers and counters – Data Handling - PLC modules - Advanced PLCs.

UNIT III DATA COMMUNICATION AND SUPERVISORY CONTROL SYSTEMS 9

Industrial data communications - fiber optics – Modbus – HART – DeviceNet – Profibus – Fieldbus – Introduction to supervisory control systems – SCADA - Distributed control system (DCS) – Safety systems – man-machine interfaces.

UNIT IV FACTORY AUTOMATION 9

Factory layout - Tools and software based factory modeling - case study on automated manufacturing units, assembly unit, inspection systems and PLC based automated systemsIntroduction to factory automation monitoring software

UNIT V BUILDING AUTOMATION 9

Building layout and its 3D model-Power Distribution System in Buildings-HVAC systems- Systems Design & Operation- PLC in Building Services-Building Automation Systems – control panel- Introduction to building automation software. **TOTAL: 45 PERIODS**

REFERENCE

1. D.Patranabis, "Principles of Industrial Instrumentation", Tata McGraw-Hill Publishing Ltd., New Delhi, 1999.
2. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2004.
3. Frank D. Petro Zella, "Programmable Logic Controller" McGraw – Hill Publications, 1998.
4. Hughes, T., "Programmable Logic Controllers", ISA Press, 2000.
5. Mc-Millan, G.K., "Process/Industrial Instrument and Controls Handbook", McGraw-Hill, NewYork, 1999.
6. Berge, J., "Field Buses for Process Control: Engineering, Operation, and Maintenance", ISA Press, 2004.
7. Mackay, S., Wrijut, E., Reynders, D. and Park, J., "Practical Industrial Data Networks Design, Installation and Troubleshooting", Newnes Publication, Elsevier, 1st Edition, 2004.
8. Lucas, M.P., "Distributed Control System", Van Nastrand Reinhold Company, New York,1986.
9. Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes, 1st Edition, 2004.
10. Shengwei Wang, "Intelligent Buildings and Building Automation", Routledge Publishers, 2009.
11. Frank Lamb, "Hands on Industrial Automation", McGraw-Hill Profession, 2013.

WEB REFERENCES:

1. http://:nfiaautomation.org
2. https://nptel.ac.in/courses/108105063/pdf
3 https://www.academia.edu/15218654/Intelligent_buildings_building_automation

ONLINE REFERENCES:

1. https://www.semanticscholar.org/paper/Fundamentals-of-Industrial-Instrumentation-and-Dunn/615f869778e3ea01eba7e931f508de58b6a8c6f4
2. https://www.academia.edu/40231279/Industrial_Instrumentation_An_Introduction_AN_OVERVIEW_OF_INDUSTRIAL_MEASUREMENT_AND_CONTROL_SYSTEMS_Level_1_Bryon_Lewis

OUTCOMES:

Upon completion not the course the students should be able,

1. To know the functioning of different Industrial Instruments and various control strategies.
2. To understand the fundamentals of PLC and develop programming skills in PLC.
3. To know the different industrial data communication architectures and also about SCADA and DCS.
4. To understand different factory automation tools, systems and monitoring software.
5. To know about the building automation layout, models and monitoring software

CO- PO MAPPING

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

20EIOE910 SDG NO. 4, 9	FAULT DETECTION AND DIAGNOSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an overview of different Fault Detection and Diagnosis methods.
- To present an overview of various types of fault detection schemes using Limit Checking, Parameter estimation methods, Principle Component Analysis.
- To impart knowledge and skills needed to design and detect sensor and actuators faults using structured residual approach as well as directional structured residual approach.
- To impart knowledge and skills needed design and detect faults in sensor and actuators using GLR and MLR based Approaches.
- To impart knowledge and skills needed to detect and quantify and compensate stiction in Control valves.

UNIT I INTRODUCTION & ANALYTICAL REDUNDANCY CONCEPTS 9

Introduction – Types of faults and different tasks of Fault Diagnosis and Implementation – Different approaches to FDD: Model free and Model based approaches-Introduction- Mathematical representation of Faults and Disturbances: Additive and Multiplicative types – Design of Residual generator – Residual specification and Implementation.

UNIT II FAULT DETECTION AND DIAGNOSIS USING LIMIT CHECKING AND PROCESS IDENTIFICATION METHODS 9

Limit Checking of absolute values – Trend Checking – Change detection using binary thresholds – adaptive thresholds – Change detection with Fuzzy thresholds – Fault detection using Process Identification methods and Principle Component Analysis.

UNIT III FAULT DETECTION AND DIAGNOSIS USING PARITY EQUATIONS 9

Introduction – Residual structure of single fault Isolation: Structural and Canonical structures- Residual structure of multiple fault Isolation: Diagonal and Full Row canonical concepts – Introduction to parity equation implementation and alternative representation - Directional Specifications: Directional specification with and without disturbances – Parity Equation Implementation.

UNIT IV FAULT DIAGNOSIS USING STATE ESTIMATORS 9

Introduction – Review of State Estimators – Fault Detection and Diagnosis using Generalized Likelihood Ratio Approach and Marginalized Likelihood Ratio Approach

UNIT V CASE STUDIES 9

Fault detection and diagnosis of DC Motor Drives – Fault detection and diagnosis of a Centrifugal pump-pipe system – Fault detection and diagnosis of an automotive suspension and the tire pressures - Automatic detection, quantification and compensation of valve stiction.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Janos J. Gertler, "Fault Detection and Diagnosis in Engineering systems", 2nd Edition, Marcel Dekker, 1998.

2 Rolf Isermann, "Fault-Diagnosis Systems an Introduction from Fault Detection to Fault Tolerance", Springer Verlag, 2006.

REFERENCES:

1 Steven X. Ding, "Model based Fault Diagnosis Techniques: Schemes, Algorithms, and Tools", Springer Publication, 2012.

2 Hassan Noura, Didier Theilliol, Jean-Christophe Ponsart and Abbas Chamseddine, "Fault- Tolerant Control Systems: Design and Practical Applications", Springer Publication, 2009.

3. Blanke, Mogens; Kinnaert, Michel; Lunze, Jan; Staroswiecki, Marcel,"Diagnosis and Fault- Tolerant Control", Springer, 2015.

4. Ali Ahammad Shoukat Choudhury, Sirish L. Shah and Nina F. Thornhill, "Diagnosis of Process Nonlinearities and Valve Stiction: Data Driven Approaches", Springer, 2008.

WEB REFERENCES:

1. https://gregstanleyandassociates.com/whitepapers/FaultDiagnosis/faultdiagnosis.htm

ONLINE RESOURCES:

1. http://www.ece.lsu.edu/mcu/lawss/add_materials/FaultDetectionPart1.pdf

2. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.91.2319&rep=rep1&type=pdf

3. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.94.7491&rep=rep1&type=pdf

OUTCOMES:

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

1. Describe the different approaches to Fault Detection and Diagnosis.
2. Detect faults using Limit Checking, Parameter estimation methods and Principle Component Analysis.
3. Detect sensors and actuators faults using structured residual approach as well as directional structured residual approach.
4. Detect and isolate faults in sensor and actuators using Generalized Likelihood Ratio and Marginalized Likelihood Ratio based Approaches.
5. Detect, quantify and compensate stiction in control valves.

CO- PO MAPPING

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

20EIOE911 SDG NO. 4, 9	CYBER PHYSICAL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the nature of continuous and discrete systems
- To develop synchronous and asynchronous model of processes
- To specify both safety and liveness requirements in temporal logic and to debug the Correctness of the protocol using model checking
- To develop and analyze model of timed and hybrid systems

UNIT I INTRODUCTION 9

Introduction-key features of cyber physical systems- Continuous dynamics: Newtonian mechanics-actor models-properties of systems-feedback control-Discrete dynamics: Discrete systems- Finite state machines

UNIT II SYNCHRONOUS AND ASYNCHRONOUS MODEL 9

Synchronous model: Reactive components-properties of components-composing components-synchronous design, Asynchronous model-asynchronous processes- asynchronous design primitives- coordination protocols.

UNIT III SAFETY AND LIVENESS REQUIREMENT 9

Safety specifications- verifying invariants- Enumerative search- Temporal logic- Model checking-reachability analysis- proving liveness.

UNIT IV TIMED MODEL AND REAL-TIME SCHEDULING 9

Timed processes- Timing based protocols: Timing-Based Distributed Coordination-Audio Control Protocol- Timed automata: Model of Timed Automata-Region Equivalence-Matrix-Based Representation for Symbolic

Analysis, Real-time scheduling

UNIT V HYBRID SYSTEMS **9**

Classes of Hybrid Systems-Hybrid dynamic models: Hybrid Processes-Process Composition-Zeno Behaviors-Stability- designing hybrid systems- linear hybrid automata

TOTAL:45 PERIODS

TEXT BOOKS:

1. Rajeev Alur, Principles of cyber-physical systems, The MIT press, 2015.
2. E. A. Lee and S. A. Seshia, Introduction to Embedded Systems - A Cyber-Physical Systems Approach, Lulu.com, First Edition, Jan 2013.

REFERENCE BOOKS:

1. Sang C.Suh , U.JohnTanik and John N.Carbone , Applied Cyber- Physical systems, Springer,2014

WEB REFERENCES:

1. https://www.digimat.in/nptel/courses/video/106105195/L11.html
2. https://ptolemy.berkeley.edu/projects/cps/

ONLINE RESOURCES:

1. https://www.edx.org/course/cyber-physical-systems
2. https://www.classcentral.com/course/udacity-cyber-physical-systems- design-analysis-10473

OUTCOMES:

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

1. Understand knowledge, opportunities, challenges and Logical Foundations of Cyber Physical Systems.
2. Develop model for synchronous, asynchronous, continuous and discrete systems.
3. Identify safety specifications and critical properties of Cyber Physical Systems.
4. Design and analyze the stability of hybrid systems.
5. Apply automata for timed systems.

CO- PO MAPPING

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

20EIOE912 SDG NO. 4, 9	PROCESS MODELING AND SIMULATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an overview of various methods of process modeling, different computational techniques for simulation.

UNIT I INTRODUCTION **7**

Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.

UNIT II STEADY STATE LUMPED SYSTEMS **9**

Degree of freedom analysis, single and network of process units, systems yielding linear and nonlinear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations.

UNIT III UNSTEADY STATE LUMPED SYSTEMS **9**

Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems.

UNIT IV STEADY STATE DISTRIBUTED SYSTEM **7**

Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.

UNIT V UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELLING APPROACHES 13

Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor. Empirical modeling, parameter estimation, population balance and stochastic modeling

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ramirez, W.; " Computational Methods in Process Simulation ", 2nd Edn., Butterworths Publishers, New York, 2000.
2. Luyben, W.L., " Process Modelling Simulation and Control ",2nd Edn, McGraw-Hill Book Co., 1990

REFERENCES:

1. Felder, R. M. and Rousseau, R. W., " Elementary Principles of Chemical Processes ", John Wiley, 2000.
2. Franks, R. G. E., " Mathematical Modelling in Chemical Engineering ", John Wiley, 1967.
3. Amiya K. Jana,"Process Simulation and Control Using ASPEN", 2nd Edn,PHI Learning Ltd (2012).
4. Amiya K. Jana,"ChemicalProcess Modelling and Computer Simulation" 2nd Edn,PHI Learning Ltd,(2012).

WEB REFERENCES:

1. https://nptel.ac.in/courses/103107096/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3126/process-control-and-instrumentation
2. https://freevideolectures.com/course/5301/dynamics-and-control

OUTCOMES:

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

1. The student should have understood the development of process models based on conservation principles.
2. Analyze and understand steady state lumped systems.
3. Analyze and understand unsteady state lumped systems.
4. Analyze and understand steady state distributed systems.
5. Analyze and understand unsteady state distributed systems and modeling approaches like Emperical modeling, stochastic modeling.

CO – PO MAPPING

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

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SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

Affiliated to Anna University & Approved by AICTE, New Delhi

OPEN ELECTIVES

I - VIII SEMESTER
AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

B.E. DEPARTMENT OF INSTRUMENTATION & CONTROL ENGINEERING

S. NO	COURSE CODE	COURSE TITLE	CONTACT HOURS	WEEK HOURS			CREDITS
				L	T	P	C
1	20ICOE901	Instrumentation and Control	3	3	0	0	3
2	20ICOE902	Modern Electronic Instrumentation	3	3	0	0	3
3	20ICOE903	Medical Instrumentation	3	3	0	0	3
4	20ICOE904	Sensor and Industrial Networks	3	3	0	0	3
5	20ICOE905	Virtual Instrumentation and its Applications	3	3	0	0	3
6	20ICOE906	Control System Design	3	3	0	0	3
7	20ICOE907	Control Valves	3	3	0	0	3
8	20ICOE908	Microprocessors in Automation	3	3	0	0	3
9	20ICOE909	Mechatronic Systems	3	3	0	0	3
10	20ICOE910	Cyber Security for Process Automation	3	3	0	0	3

OPEN ELECTIVES

20ICOE901 SDG NO. 4	INSTRUMENTATION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Understand the concepts of measurement technology.
- To Learn operating principle of Mechanical sensors and transducers used to measure various physical parameters.
- To familiarize with various recording and display devices.
- To understand various systems and derive mathematical model of a system.
- To study time response and frequency response of closed loop control systems.

UNIT I INTRODUCTION 9

Static and dynamic characteristics of measurement systems - standards and calibration - error and uncertainty analysis-statistical analysis of data-and curve fitting

UNIT II MECHANICAL MEASUREMENTS AND INDUSTRIAL INSTRUMENTATION 9

Measurement of displacement, velocity (linear and rotational) acceleration - shock – vibration - force torque power – strain - stress - pressure temperature

UNIT III DATA DISPLAY AND RECORDING DEVICES 9

Data display - CRO – LED - LCD - magnetic tape recorders - x-y recorders - UV recorders - Oscilloscope recorders - digital printers and data loggers.

UNIT IV SYSTEMS AND REPRESENTATION 9

Basic elements in control systems: – Open and closed loop systems – Electrical analogy of mechanical systems – Transfer function – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

UNIT V TIME AND FREQUENCY RESPONSE 9

Time response: – Time domain specifications – Types of test input -I and II order system response – Error coefficients – Generalized error series – Steady state error – Correlation between frequency domain and time domain specifications- Frequency response: – Bode plot – Polar plot – Determination of closed loop response from open loop response.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.
3. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2017.
4. Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014.

REFERENCES:

1. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
3. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.
4. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_ee41/preview
2. http://www.nptelvideos.in/2012/11/industrial-instrumentation.html
3. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf
4. https://nptel.ac.in/courses/107106081

ONLINE RESOURCES:

1. https://instrumentationtools.com/tag/sensors-and-transducers-nptel-pdf/
2. https://electronics-tutorials.ws/io/io-
3. https://freevideolectures.com/course/2337/control-engineering
4. https://instrumentationtools.com/tag/sensors-and-transducers-nptel-pdf/
5. https://electronics-tutorials.ws/io/io-

OUTCOMES:

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

1. Understand various characteristics of measurement system and types of errors in measurement systems.
2. Understand the working principle and applications of various types of mechanical Sensors and Transducers.

3. Understand the working of various display devices and recorders used in Industries and Laboratories.
4. Able to obtain Mathematical model of different types of system by representation and transfer function derivation.
5. Derive and calculate time response and frequency response of closed loop control systems.

CO - PO, PSO MAPPING

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

20ICOE902 SDG NO. 4 & 9	MODERN ELECTRONIC INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce different types of electronic voltmeters and their applications.
- To provide knowledge on various types of cathode ray oscilloscopes, their applications and different types of signal analyzers.
- To introduce different types of waveform generators and analyzers and their applications.
- To educate on virtual instrumentation, its applications, programming and DAQ cards and modules.
- To give exposure to telemetry, modulation techniques and multiplexing.

UNIT I ELECTRONIC INSTRUMENTS 9

Electronic Voltmeter and their advantages – Types, Differential amplifier - source follower - rectifier – True rms reading voltmeter – Electronic multimeter and ohmmeter – Current measurement – Power measurement - Microprocessor based DMM with auto ranging and self diagnostic features.

UNIT II CATHODE RAY OSCILLOSCOPE & SIGNAL ANALYZERS 9

General purpose cathode ray oscilloscope – Dual trace, dual beam and sampling oscilloscopes– Analog and digital storage oscilloscope - frequency selective and heterodyne wave analyzer- Harmonic distortion analyzer – Spectrum analyzer.

UNIT III WAVEFORM GENERATORS 9

Wien's bridge and phase shift oscillators – Hartley and crystal oscillators – Square wave and pulse generators – Triangular wave-shape generator - Signal and function generators – Q meter – Electronic Counters.

UNIT IV VIRTUAL INSTRUMENTATION 9

Virtual instrumentation (VI) – Definition, flexibility – Block diagram and architecture of virtual instruments – Virtual instruments versus traditional instruments – Software in virtual instrumentation - VI programming techniques – DAQ cards for VI applications – DAQ modules with serial communication.

UNIT V TELEMETRY 9

General telemetry system – voltage, current and position telemetry systems – Radio frequency telemetry – Frequency modulation, pulse-amplitude modulation and pulse-code modulation telemetry – Frequency and time multiplexing. **TOTAL: 45 PERIODS**

TEXT BOOKS:

1. A.D. Helfrick and W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall India Private Ltd., New Delhi, 2010.
2. David A Bell, " Electronic Instrumentation and Measurements", Ox for University Press, 2013
3. Jerome J., Virtual Instrumentation using Lab VIEW, Prentice Hall India Private Ltd., New Delhi,2010.

REFERENCES:

1. H.S. Kalsi, Electronic Instrumentation, Tata McGraw-Hill, New Delhi, 2010.
2. J.J. Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education India, New Delhi, 2011.
3. M.M.S. Anand, Electronics Instruments and Instrumentation Technology, Prentice Hall India, New Delhi, 2009
4. Sanjay Gupta, Virtual Instrumentation using Lab view, Tata McGraw-Hill Education, 2010

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_ee44/preview

ONLINE RESOURCES:

1. http://www.ni.com/academic/students/learn/

OUTCOMES:

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

1. Ability to understand and analyze the working of various electronic instruments.
2. Ability to understand and analyze various Cathode ray oscilloscopes and signal analyzers.
3. Ability to understand the concepts of various waveform generators.
4. Ability to understand and analyze Virtual Instruments using software in Virtual Instrumentation and DAQ cards for VI applications.
5. Ability to understand and analyze various telemetry systems.

CO- PO, PSO MAPPING

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

20ICOE903 SDG NO. 4,9	MEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering.
- To study measurement of certain important non-electrical parameters.
- To study measurement of certain important electrical and parameters.
- To understand the basic principles in imaging techniques.
- To have a basic knowledge in life assisting and therapeutic devices.

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system Cardiovascular systems- Respiratory systems -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT 9

Measurement of blood pressure using sphygmomanometer instrument based on Korotkoff sound, indirect measurement of blood pressure, automated indirect measurement, and specific direct measurement techniques.- Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers.

UNIT III BIOELECTRIC POTENTIAL AND MEASUREMENTS 9

Electrode theory, bipolar and uni-polar electrodes, surface electrodes– Electro Physiological Measurement - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms.

UNIT IV MEDICALIMAGING SYSTEM 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems

UNIT V LIFE ASSISTING DEVICES 9

Pacemakers – Defibrillators – Ventilators – incubators, drug delivery devices - Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, NewDelhi, 2007.
2. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, NewDelhi,2nd edition,2003.
3. Joseph J Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th edition,2012.

REFERENCES:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York,1998.

2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition,2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition,2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC,2006.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies,2003.
6. Geddes L. A. and Baker L. E., — Principles of Applied Biomedical Instrumentation||, John Wiley, New York, 1989.
7. Richard Aston, —Principles of Biomedical Instrumentation and Measurement||, Merril Publishing Company, New York, 1990.

WEB REFERENCES:

1. https://www.nhlbi.nih.gov
2. https://psychology.wikia.org/wiki/Medical_therapeutic_devices

ONLINE RESOURCES:

1. https://www.udemy.com/course/biomechanics-cervical-spine-module-1/
2. https://academicearth.org/biomedical-engineering/
3. https://www.edx.org/learn/biomedical-engineering
4. https://www.coursera.org/courses?query=biomedical
5. https://www.distancelearningportal.com/study-options-c/short/269778974/bio-biomedical-engineering-united-states.html
6. https://www.classcentral.com/tag/biomedical-engineering

OUTCOMES:

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

1. To understand the philosophy of the heart, lung, blood circulation and respiration system.
2. To provide latest ideas on devices of non-electrical devices.
3. To gain knowledge on various sensing and measurement devices of electrical origin.
4. To bring out the important and modern methods of imaging techniques.
5. To explain the medical assistance devices

CO – PO, PSO MAPPING

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

20ICOE904 SDG NO. 4 & 9	SENSORS AND INDUSTRIAL NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various techniques and methods of measurement
- To understand the working principle of different types of sensors
- To understand the different applications of sensors and transducers
- To educate on the basic concepts of data networks
- To introduce the basics of internetworking and serial communications

UNIT I INTRODUCTION 9

Basics of Measurements – Classification of errors – Error analysis Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS 9

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn – Accelerometer– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS-APPLICATIONS 9

Strain Gauge, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magnetoresistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.Applications – Automobile – Aerospace - Home appliances – Manufacturing - Environmental monitoring.

UNIT I V DATA NETWORK FUNDAMENTALS 9

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.

UNIT V INTERNET WORKING AND RS 232, Rs485 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 - Devicenet.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.
2. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill,2009.
3. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentationand Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.
4. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial Data Networks Design, Installation and Troubleshooting' Newnes Publication, Elsevier First Edition,2004
5. William Buchanan, Computer Buses, CRC Press, 2000.
6. Behrouz Forouzan, Data Communications & Networking 3rdedition, Tata McGraw hill,2006

REFERENCES:

1. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
2. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.
3. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Prentice Hall of India Pvt. Ltd., 5th Edition.2011.
4. Theodore S Rappaport, Wireless Communication: Principles and Practice, Prentice Hall of India 2nd Edition,2001.
5. William Stallings, Wireless Communication & Networks, Prentice Hall of India,2nd Edition,2005.

WEB REFERENCES:

1. https://epdf.pub/sensors-and-transducerthirdeditiona49c1a3bb3c4a59 35f6b38b05f6b273442633.html
2. https://www.sciencedirect.com/book/9780750658072/practical-industrial-data-networks
3. https://academy.ats-global.com/us/ae/2_communication-and-networks-trainingcourses/C2_industrial-data-networks.html?do=course

ONLINE RESOURCES:

1. https://swayam.gov.in/nd1_noc19_ee41/preview
2. https://www.classcentral.com/course/swayam-sensors-and-actuators-14285
3. https://nptel.ac.in/courses/106105195/

OUTCOMES:

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

1. To expertise in various calibration techniques and signal types for sensors.
2. To study the basic principles of various smart sensors.
3. To apply the various sensors in the Automotive and Mechatronics applications
4. To expose the students to communication systems emerging in the field of instrumentation
5. To understand the basics of inter-networking and serial communications.

CO – PO, PSO MAPPING:

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

20ICOE905 SDG NO. 4&9	VIRTUAL INSTRUMENTATION AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept of virtual instrumentation
- To develop basic VI programs using loops, case structures etc.
- To understand the basics of Data Acquisition.
- To design VI programs for applications in image, signal processing and motion control.
- To analyze the applications of Virtual Instrumentation.

UNIT I INTRODUCTION TO VIRTUAL INSTRUMENTATION 9

Historical perspective - Virtual instrumentation (VI) – Definition, flexibility – Block diagram and Architecture of Virtual Instruments - Virtual instruments versus traditional instruments - System buses - Interface buses: PCMCIA, VXI, SCXI, PXI.

UNIT II DATA-FLOW TECHNIQUES 9

Graphical programming in data flow - Comparison with conventional programming - Software in virtual instrumentation - VI programming techniques – VIS & Sub VIS - loops and charts – arrays – clusters – graphs - case - sequence structures - formula nodes - local and global variable - string and file functions.

UNIT III DATA ACQUISITION BASICS 9

DAQ cards for VI applications – DAQ modules with serial communication. ADC, DAC, DIO, Counters and timers, RS232C/ RS485, GPIB, PC Hardware structure, DMA software and hardware installation.

UNIT IV USE OF ANALYSIS TOOL 9

Advanced analysis tools such as Fourier transforms - Power spectrum - Correlation methods - Windowing and filtering and their applications in signal and image processing - Motion Control.

UNIT V APPLICATIONS OF VIRTUAL INSTRUMENTATION 9

Celsius to Fahrenheit conversion – Oscilloscope - Digital multimeter - Application in Process Control Projects - DC voltage measurement using DAQ - Virtual instrument design for robotics - machine vision - automation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Johnson, G., LabVIEW Graphical Programming, McGraw Hill (2006).
2. Sokoloft, L., Basic Concepts of LabVIEW 4, Prentice Hall Inc. (2004).
3. Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc. (1996).

REFERENCES:

1. Jovitha, Jerome., Virtual Instrumentation using LabVIEW, PHI Learning. 2010.
2. Gupta, S and Gupta, J.P, PC Interfacing for Data Acquisition and Process Control, Instrument Society of America (1988).
3. Lis K Well, Labview for Everyone, Prentice Hall of India.

WEB REFERENCES:

1. https://www.ni.com

OUTCOMES:

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

1. Demonstrate the working of LabVIEW.
2. Explain the various types of structures used in LabVIEW.
3. Analyze and design different type of programs based on data acquisition.
4. Demonstrate the use of LabVIEW for signal processing, image processing etc
5. Design and develop programs for different Applications

CO – PO, PSO MAPPING:

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

20ICOE906 SDG NO. 4 & 9	CONTROL SYSTEMS DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To Design and analyze introduce stability analysis for Electrical, Mechanical systems.
- To Design introduce design of Compensator.

UNIT I SYSTEMS AND REPRESENTATION 9

Basic elements in control systems: – Open and closed loop systems – Electrical analogy of mechanical systems– Transfer function – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs

UNIT II TIME RESPONSE 9

Time response: Time domain specifications–Types of test input–I and II order system response–Error coefficients–Generalized error series–Steady state error-Correlation between frequency domain and time domain specifications.

UNIT III FREQUENCY RESPONSE 9

Frequency response: – Bode plot – Polar plot – Determination of closed loop response from open loop response.

UNIT IV STABILITY 9

Characteristics equation – Root locus construction- Routh Hurwitz criterion – Nyquist stability criterion- Performance criteria.

UNIT V COMPENSATOR DESIGN 9

Design of Lead-Lag controllers using Bode plots. - Design of PI- PD - PID controllers in Frequency domain and Time domain- Effects of P – PI - PID modes of feedback control. **TOTAL: 45 PERIODS**

TEXT BOOKS:

1. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New age International Publishers,2017
2. Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014.

REFERENCES:

1. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.
2. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Pearson Education, 2009.
3. John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor & Francis Reprint 2009.
4. RamesC.Panda and T. Thyagarajan, "An Introduction to Process Modelling Identification and Control of Engineers", Narosa Publishing House, 2017.
5. M.Gopal, "Control System: Principle and design", McGraw Hill Education, 2012.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ee13/preview
2. https://nptel.ac.in/courses/107106081/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/5301/dynamics-and-control
2. https://freevideolectures.com/course/2337/control-engineering

OUTCOMES:

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

1. To analyze and develop various representations of system.
2. Design time domain and frequency domain analysis of various models of linear system
3. To analyze characteristics of the system and design mathematical model
4. Design and analyze the stability of the system.
5. Design appropriate compensator for the given specifications.

CO – PO, PSO MAPPING:

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

20ICOE907 SDG NO. 4 & 9	CONTROL VALVES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic terminologies and types of control valves and actuators
- To understand the characteristics of control valves
- To select control valves and actuators based on the requirement
- To analyze various control valve problems and to test the quality of valves

UNIT I INTRODUCTION TO CONTROL VALVES 9

Basics of Control Valves - Importance of Control Valve In Process Industry - Basic Terminologies - Sliding Stem Control Valve - Rotatory Stem Control Valve Terminologies - Types Of Control Valves Globe Valve - Sanitary Valves - Rotary Valves- Valve Trim Types.

UNIT II ACTUATORS AND CONTROL VALVE ACCESSORIES 9

Actuators – Schematics - Working of Actuator - Types of Actuators- Hydraulic, Pneumatic - Electrical Actuators. Pneumatic Actuator: Linear- Spring &Diaphragm- Piston Type- Rotary: Scotch Yoke - Rack and Pinion. Valve Body Bonnets - Control Valve Packing - Control Valve Accessories-Positioner And It Types, I/P Coil - Volume Boosters - Position Transmitters - Limit Switches - Solenoid Valves - Special Control Valves.

UNIT III VALVE CHARACTERISTICS, SIZING AND SELECTION 9

Valve Performance and Characteristics For Different Types Of Valves - Dead Band – Causes – Effects - Performance Test - Valve Response Time- Importance Of Supply Pressure - Dead Time And Solutions To Minimize Dead Time - Valve Sizing-Actuator Sizing - Valve Selection - Actuator Selection.

UNIT IV COMMON CONTROL VALVE PROBLEMS 9

Cavitations and Flashing - Control Valve Noise- Noise Prediction and Reduction Techniques - General Valve Problems Valve Passing - Valve Stuck Up - Calibration Issues - Packing Leak -Insufficient Flow - Control Valve Installation and Commissioning Guidelines - Environmental and Application Consideration for valve selection.

UNIT V QUALITY TESTS AND STANDARDS 9

Quality Check of Control Valves - Non-Destructive Testing: Radiography Test - Ultrasonic Test - Leak And Liquid Penetrating Test - Magnetic Particle Testing -

Factory Acceptance Test - Control Valve And Actuator Maintenance - Control Valve Diagnostics - ISA 75.25.01: 2000: Test Procedure For Control Valves Response Measurement From Step Inputs - IEC60534-4 : 2006: Industrial Process Control Valves - Inspection &Routine Testing.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Control system components, M.D.Desai, PHI Learning.
2. ISA Handbook for control valves, James W Hutchison ,ISA

REFERENCES:

1. Instrumentation Engineer's Handbook, B.G.Liptak, Chilton Book co.,Philadelphia.
2. Valve selection Handbook- R.W.Zappe Gulf Publishing Co.,Huston.

WEB REFERENCES:

1. https://www.emerson.com/documents/automation/control-valve-handbook-en-3661206.pdf
2. https://youtu.be/XAItnsUcES0
3. https://nptel.ac.in/content/storage2/courses/108105063/pdf/L-25(SS)(IAC)%20((EE)NPTEL).pdf

ONLINE RESOURCES:

1. https://www.valin.com/resources/articles/why-equal-percentage-valves-act-linear
2. https://www.valin.com/resources/articles/predicting-cavitation-damage-in-control-valves
3. https://www.valin.com/resources/articles/modern-tools-for-sizing-control-valves-and-actuators
4. https://www.instrumentationtoolbox.com/2014/03/basics-of-control-valve-positioners.html

OUTCOMES:

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

1. Ability to understand terminologies associated with control valves.
2. Ability to determine the characteristic features of different types of control valves.
3. Ability to compare the merits and limitations of different types of actuators.

4. Ability to analyse and recommend appropriate control valves characteristics for a given application and to carry out design calculations
5. Ability to understand the common problems associated with control valves and industry popular standard and the different quality testing methods and procedures for control valves.

CO – PO, PSO MAPPING

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

20ICOE908 SDG NO. 4&9	MICROPROCESSORS IN AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the basic of digital logic circuits.
- To impart knowledge on 8085 architecture.
- To learn the basic programming using 8085 processor.
- To interface various IC's with 8085 processor.
- To learn the basics of digital control system.

UNIT I BASICS OF DIGITAL CIRCUITS 9

Number Systems, codes, digital electronics: Logic Gates, combinational circuits design - Flip-flops - sequential logic circuits design: Counters - Shift registers.

UNIT II 8085 MICROPROCESSOR 9

Introduction to 8085 Functional Block Diagram- Registers, ALU, Bus systems - Timing and control signals -Machine cycles instruction cycle and timing states - instruction timing diagrams - Memory interfacing.

UNIT III PROGRAMMING 8085 MICROPROCESSOR 9

Assembly Language Programming: Addressing modes - Instruction set - simple programs in8085: Concept of Interrupt - Need for Interrupts- Interrupt structure - Multiple Interrupt requests and their handling - Programmable interrupt controller.

UNIT IV INTERFACING 8085 WITH PERIPHERALS 9

Interfacing peripherals: Programmable peripheral interface (8255) - Interfacing Analog to Digital Converter - Digital to Analog converter - Multiplexed seven segments LED display systems - Stepper Motor Control - Data Communication: Serial Data communication (8251) - Programmable Timers (8253).

UNIT V OVERVIEW OF DIGITAL CONTROL SYSTEM 9

Introduction to Digital Control: Sampling theorem - Signal conversion and Processing - Z-Transform - Digital Filters -Implementation of Digital Algorithm.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited
2. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar, PENRAM International Publishers.
3. Digital Control Systems, Benjamin C. Kuo, Oxford University Press (2/e, Indian Edition,2007)

REFERENCES:

1. Digital Computer Electronics: An Introduction to Microcomputers, Albert Paul Malvino,Tata McGraw-Hill Publishing Company Ltd.
2. Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, Prentice Hall.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108107029/

OUTCOMES:

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

1. Construct various logic circuits using both combinational and sequential circuits.
2. Explain the architecture of 8085 microprocessor.

3. Understand and write the assembly language programming in Microprocessor
4. Understand the importance of Interfacing.
5. Explain the implementation of digital algorithms.

CO-PO, PSO MAPPING:

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

20ICOE909 SDG NO. 4,9	MECHATRONIC SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide a basic background to mechatronics and link to more specialized skills
- To develop the mix of skills in mechanical engineering, electronics and computing
- To familiarize about sensors and control system used in mechatronics
- To develop confidence and competence in designing mechatronics systems.

UNIT I MECHATRONICS 9

Introduction to Mechatronics Systems - Measurement Monitoring Systems Automation - Control Systems -Microprocessor based Controllers. Sensors and Transducers - Performance Terminology - Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors - Selection of Sensors

UNIT II ACTUATION SYSTEMS 9

Pneumatic and Hydraulic Systems - Directional Control Valves - Rotary Actuators. Mechanical Actuation Systems - Cams - Gear Trains - Ratchet and

pawl - Belt and Chain Drives - Bearings. Electrical Actuation Systems - Mechanical Switches - Solid State Switches - Solenoids - D.C Motors - A.C Motors - Stepper Motors -Servomotors.

UNIT III SYSTEM MODELS AND CONTROLLERS 9

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational - Translational Systems, Electromechanical Systems - Hydraulic - Mechanical Systems. Continuous and discrete process Controllers - Control Mode - Two - Step mode - Proportional Mode - Derivative Mode - Integral Mode - PID Controllers - Digital Controllers - Velocity Control - Adaptive Control - Digital Logic Control - Micro Processors Control

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 9

Programmable Logic Controllers - Basic Structure - Input / Output Processing -Programming - Mnemonics - Timers, Internal relays and counters - Shift Registers - Master and Jump Controls - Data Handling - Analogue Input / Output - Selection of PLC

UNIT V DESIGN OF MECHATRONICS SYSTEM 9

Stages in designing Mechatronics Systems - Traditional and Mechatronic Design - Possible Design Solutions Case Studies of Mechatronics Systems, Automatic washing Machine - Automatic Camera - Pick and place robot - Automatic Car Park Systems - Engine Management SystemsRoad vehicles and Medical Technology.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. M. D. Singh, and J. G. Joshi, Mechatronics, Prentice Hall of India, New Delhi,2009
2. David G. Alciature and Michael B. Histand, Introduction to Mechatronics and Measurement Systems, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,2007
3. W. Bolton, Mechatronics: Electronic control systems in Mechanical and Electrical Engineering, Pearson Education, New Delhi,2013
4. NitaigourPremchandMahalik, Mechatronics : Principles, Concepts and Applications, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,2008
5. K. P. Ramachandran, G. K. Vijayaraghavan, and M. S. Bala-Sundram, Mechatronics : Integrated Mechanical Electronic Systems, Wiley India Pvt. Ltd.,New Delhi 2008
6. Newton C. Braga, Mechatronic Source Book, Delmar Cengage Learning, 2009

REFERENCES:

1. Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education
2. A Textbook of Mechatronics,R.K.Rajput, S. Chand & Company Private Limited .
3. Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS PublishingCompany (Thomson Learning Inc.)

WEB REFERENCES:

1. https://iitk.ac.in/robotics/
2. https://nptel.ac.in/courses/112103174/

ONLINE RESOURCES:

1. https://ocw.mit.edu/courses/mechanical-engineering/2-737-mechatronics-fall-2014/
2. https://www.mechatronic.co.uk/case-studies/videos/

OUTCOMES:

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

1. Identify the Mechatronics system based on sensor and transducer; analyze the sensors for Particular applications.
2. Characterize the components and design the Hydraulic and Pneumatic circuit for Industrial applications
3. Analyze the characteristics of actuators and select the suitable actuator for applications
4. Develop the simple programmable logic controller and differentiate relay logic with ladder logic
5. Develop the mechatronics system design and implement the Process parameters for given application

CO- PO, PSO MAPPING

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

20ICOE910 SDG NO. 4&9	CYBER SECURITY FOR PROCESS AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the Industrial security environment and cyberattacks
- To analyze and assess risks in the industrial environment
- To access- design and implement cybersecurity
- To test and troubleshoot the industrial network security system

UNIT I INTRODUCTION 9

Industrial security environment-Industrial automation and control system (IACS) culture Vs ITParadigms-Cyberattacks: Threat sources and steps to successful cyberattacks.

UNIT II RISK ANALYSIS 9

Risk identification- classification and assessment- Addressing risk: Cyber Security Management System (CSMS) - organizational security - physical and environmental security - network segmentation - access control - risk management and implementation.

UNIT III ACCESSING THE CYBERSECURITY OF IACS 9

Identifying the scope of the IACS- generation of cybersecurity information- identification of vulnerabilities- risk assessment-evaluation of realistic threat scenarios- Gap assessment-capturing Ethernet traffic- documentation of assessment results.

UNIT IV CYBERSECURITY DESIGN AND IMPLEMENTATION 9

Cybersecurity lifecycle- conceptual design process- detailed design process- firewall design remote access design- intrusion detection design.

UNIT V TESTING AND MAINTENANCE IN PROCESS PLANTS 9

Developing test plans- cybersecurity factory acceptance testing- site acceptance testing- network and application diagnostics and troubleshooting- cybersecurity audit procedure- IACS incident response.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ronald L and Krutz, Industrial Automation and Control System Security Principles,ISA,2013.
2. David J.Teumim, Network Security, Second edition,ISA,2010

REFERENCES:

1. Edward J.M. Colbert and Alexander Kott, Cyber,security of SCADA and other industrialcontrol systems, Springer, 2016.
2. Perry S. Marshalland John S. Rinaldi, Industrial Ethernet, Second edition, ISA, 2004

WEB REFERENCES:

1. http://www.nptelvideos.in/2012/11/cryptography,and,network, security.html
2. https://swayam.gov.in/nd1_noc20_cs33/preview

ONLINE RESOURCES:

1. https://www.ul.com/offerings/industrial,automation,and,control, system,cybersecurity
2. https://www.isa.org/training,certifications/isa,training/ instructor,led/course,descriptions/ic32e/

OUTCOMES:

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

1. Ability to apply basis of science and engineering to understand Industrial securityenvironment and cyber-attacks.
2. Ability to analyze and assess risks in the industrial environment
3. Ability to access the cybersecurity of IACS.
4. Ability to design and implement cyber security
5. Ability to test and troubleshoot investigate and explore feasible solution for a moderate industrial problem

CO- PO, PSO MAPPING

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

Sri SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

Affiliated to Anna University & Approved by AICTE, New Delhi

OPEN ELECTIVES

I - VIII SEMESTER
AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

B.TECH. DEPARTMENT OF INFORMATION TECHNOLOGY

S. NO	COURSE CODE	COURSE TITLE	CONTACT HOURS	WEEK HOURS			CREDITS
				L	T	P	C
1	20ITOE901	Distributed Computing Systems	3	3	0	0	3
2	20ITOE902	Computer System Architecture	3	3	0	0	3
3	20ITOE903	Web Design	3	3	0	0	3
4	20ITOE904	Data Warehousing and Data Mining Concepts	3	3	0	0	3
5	20ITOE905	Data Science for Engineers	3	3	0	0	3
6	20ITOE906	Software Quality Assurance	3	3	0	0	3
7	20ITOE907	C# and .Net Programming	3	3	0	0	3
8	20ITOE908	Mobile Application Development	3	3	0	0	3
9	20ITOE909	Software Project Management Systems	3	3	0	0	3
10	20ITOE910	Computer Graphics & Multimedia Systems Design	3	3	0	0	3

OPEN ELECTIVES

20ITOE901 SDG NO. 4	DISTRIBUTED COMPUTING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the basics of communications in distributed systems
- To learn the naming methodologies and clock synchronization
- To learn about the consistency and replication protocols
- To understand the fault tolerance and failure detection models and security issues in distributed systems

UNIT I INTRODUCTION **9**

Definition-Goals-Types-Architecture-Processes-Examples of Distributed Systems–Trends in Distributed Systems –Challenges - Case study: World Wide Web.

UNIT II COMMUNICATION IN DISTRIBUTED SYSTEM **9**

Foundations - Layered Protocols - Types of Communication - Remote Procedure Call - Basic RPC Operation - Parameter Passing - RPC - Based Application Support- Variations on RPC - Example - DCE RPC - Message - Oriented Communication - Simple Transient Messaging with Sockets - Advanced Transient Messaging - Message - Oriented Persistent Communication - Example: IBM's Websphere Message-Queuing System - Example - Advanced Message Queuing Protocol (AMQP) - DS 3.02 Multicast Communication - Application - Level Tree - Based Multicasting - Flooding - Based Multicasting - Gossip - Based Data Dissemination.

UNIT III SYNCHRONIZATION IN DISTRIBUTED SYSTEM **9**

Naming: Names - Identifiers - and Addresses - Flat Naming - Structured Naming - Attribute - Based Naming - Coordination - Physical Clocks - Clock Synchronization Algorithms - Logical Clocks - Lamport's Logical Clocks - Vector Clocks - Mutual Exclusion Algorithms - Election Algorithms - Location Systems- Distributed Event Matching Gossip - Based Coordination.

UNIT IV DATA CENTRE **9**

Introduction - Data - Centric Consistency Models - Client - Centric Consistency Models - Replica Management - Consistency Protocols - Case Study - Caching and Replication in the Web.

UNIT V SECURITY IN DISTRIBUTED SYSTEM 9

Fault Tolerance: Introduction to Fault Tolerance - Process Resilience - Reliable Client - Server Communication - Reliable Group Communication - Distributed Commit – Recovery - Security - Introduction to Security - Secure Channels - Secure Channels - Secure Naming - Security Management.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Maarten Van Steen Andrew S. Tanenbaum, "Distributed Systems", Published by Maarten Van Steen This book was previously published by: Pearson Education, Inc. Edition: 3. Version: 02 (December 2018).

REFERENCES:

1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.
2. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
3. Liu M.L., "Distributed Computing, Principles and Applications", Pearson Education, 2004.
4. Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, USA, 2003.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/106/106106168/
2. https://www.udemy.com/course/data-science-real-world-business/

ONLINE RESOURCES:

1. file:///E:/syllabus/Autonomous%20-%20syllabus/DS-OE/ebook-distributed-systems-2nd-edition.pdf
2. file:///E:/syllabus/Autonomous%20-%20syllabus/DS-OE/text-tanenbaum.pdf

OUTCOMES:

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

1. Elucidate the Basics and Trends in Distributed Systems.
2. Visualize the Network and remote method invocation of Distributed Systems.
3. Understand the Naming conventions and clock coordination.
4. Understand Location Based Systems, Consistency models and Replica Management.

5. Learn about the Fault Tolerance models and security issues in distributed system.

CO - PO, PSO MAPPING :

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

20ITOE902 SDG NO. 4	COMPUTER SYSTEM ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit
- To learn the basics of pipelined execution
- To understand the memory hierarchies, cache memories and virtual memories
- To learn memory concepts and Input ,output data transfer with in a digital computer

UNIT I INTRODUCTION 9

Computing and Computers - Evolution of Computers - System Design- Register Level - Processor - Level - CPU Organization - Data Representation - Fixed – Point Numbers - Floating Point Numbers - Instruction Formats - Instruction Types - Addressing Modes.

UNIT II ARITHMETIC UNIT 9

Fixed Point Arithmetic - Addition - Subtraction - Multiplication and Division - Combinational and Sequential ALUs - Carry Look Ahead Adder - Booth's Algorithm - Non-Restoring Division Algorithm - Floating Point Arithmetic - Modified Booth's Algorithm.

UNIT III PIPELINING 9

Basic Concepts – Data Hazards – Instruction Hazards – Influence on Instruction Sets – Data Path and Control Considerations – Performance Considerations – Exception Handling.

UNIT IV MEMORY ORAGNIZATION 9

Random Access Memories - Serial - Access Memories - RAM Interfaces - Magnetic Surface Recording - Optical Memories - Multilevel Memories - Cache & Virtual Memory - Memory Allocation - Associative Memory.

UNIT V SYSTEM ORGANIZATION 9

Communication Methods - Buses - Bus Control - Bus Interfacing - Bus Arbitration - I/O and System Control - Interface Circuits - Handshaking - Interrupts - DMA - Multiprocessors - Fault Tolerance - RISC and CISC Processors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. John P. Hayes, "Computer Architecture and Organization", Third Edition, Tata McGraw Hill, 2012.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, "Computer Organization and Embedded Systems", Sixth Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. William Stallings, "Computer Organization and Architecture – Designing for Performance", Eighth Edition, Pearson Education, 2010.
2. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Fifth Edition, Morgan Kaufmann / Elsevier, 2014..
3. V. P. Heuring, H.F. Jordan, "Computer Systems Design and Architecture", Second Edition, Pearson Education, 2004.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_cs25/preview
2. https://nptel.ac.in/courses/106/105/106105163
3. http://www.cse.iitd.ac.in/~srsarangi/archbooksoft.html

ONLINE RESOURCES:

1. https://freevideolectures.com/course/4633/nptel-computer-architecture-organization/8

2. http://www.ics.p.lodz.pl/~dpuchala/CompArch/Lecture_6.pdf
3. https://www.edx.org/learn/computer-architecture

OUTCOMES:

1. Describe the organization and working principle of computer hardware components.
2. Outline the operation of arithmetic unit
3. Gain Knowledge of designing and the execution sequence of the processor
4. Understand hierarchical memory system and its types
5. Learn about the Input ,output data transfer with in a digital computer.

CO- PO, PSO MAPPING

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

20ITOE903 SDG NO. 4,8 & 9	WEB DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Understand the concepts of HTML controls and CSS
- To provide exposure in client and server side programming
- To build applications using XML and DHTML
- To create simple web pages using webserver technologies

UNIT I INTRODUCTION TO WEB DESIGNING 9

Introduction - The Internet in Industry and Research - HTML5 - CSS3 - JavaScript - Canvas - JQuery - Evolution of the Internet and World Wide Web - Web Basics - Multitier Application Architecture - Client-Side Scripting versus Server - Side Scripting - World Wide Web Consortium (W3C) - Creating Structured Documents - Introducing XHTML - Core Elements and Attributes -

Attribute Groups - Basic Text Formatting - Presentational Element - Phrase Elements - Lists - Editing Text - Comments – Font - Links and Navigation - Basic Links - Creating Links with the Element - Images and Objects.

UNIT II HTML TABLES, FORMS, FRAMES & CSS 9

Tables - Elements and Attributes - Forms - Elements and Form Controls - Creating Labels for Controls and the Element - Frames - Elements - Creating Links Between Frames - Nested framesets - Cascading Style Sheets - Rules - Properties - Controlling Fonts - Text Formatting - Text Pseudo - Classes - Selectors - Lengths - Introducing the Box Model.

UNIT III CLIENT SIDE AND SERVER SIDE PROGRAMMING 9

Client-Side Programming: JavaScript-Introduction to Scripting-Control Structures-Functions-Arrays Objects: Math, String, Date, Boolean & Number.

Server Side Programming: Servlets- Overview and Architecture - Handling HTTP Get Requests-Handling HTTP Post Requests - Redirecting Requests to Other Resources - Session Tracking.

UNIT IV DHTML & XML 9

DHTML : Combining HTML - CSS and Javascript - Events and Buttons - Controlling Your Browser - XML - Introduction to XML - Uses of XML - Simple XML - XML Key Components - DTD and Schemas - Well Formed using XML with Application - XML - XSL and XSLT - Introduction to XSL - XML Transformed Simple Example - XSL Elements - Transforming with XSLT.

UNIT V WEB SERVERS (IIS, PWS AND APACHE) 9

Introduction-HTTP Request Types- System Architecture - Client-Side Scripting Versus Server-Side Scripting -Accessing Web Servers-Microsoft Internet Information Services (IIS) - Microsoft Personal Web Server (PWS) - Apache Web Server - Requesting Documents: XHTML, ASP, Perl , Python, PHP

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Deitel, Deitel and Nieto, "Internet and World Wide Web – How to program", Pearson Education Publishers, 2000.
2. Jon Duckett ,"Beginning Web Programming with HTML, XHTML, and CSS Wiley, Second Edition, 2004.

REFERENCES:

1. Thomno A. Powell, "The Complete Reference HTML and XHTML", Fourth Edition, Tata McGraw Hill, 2003.
2. Steven Holzner," HTML Black Book", Dremtech press.

3. Web Technologies, Black Book, Dreamtech Press
4. Web Applications : Concepts and Real World Design, Knuckles, Wiley-India

WEB REFERENCES:

1. https://www.computer-pdf.com/web-programming/
2. https://www.cs.uct.ac.za/mit_notes/web_programming.html
3. https://www.w3schools.com/html/default.asp

ONLINE RESOURCES:

1. https://www.udemy.com/course/web-design-for-beginners-real-world-coding-in-html-css/
2. https://www.coursera.org/specializations/web-design

OUTCOMES:

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

1. Acquire basic knowledge to design website.
2. Construct a basic website using HTML and Cascading Style Sheets.
3. Learn to apply the techniques of client and server side scripting.
4. Build dynamic web page with DHTML and XML concepts.
5. Able to create websites using various webserver technologies.

CO – PO, PSO MAPPING :

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

20ITOE904 SDG NO. 4	DATA WAREHOUSING AND DATA MINING CONCEPTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the principles of Data warehousing and Data Mining
- To be familiar with the Data warehouse architecture and its Implementation
- To understand the various Data preprocessing Methods
- To perform classification and clustering of data

UNIT I DATA WAREHOUSING **9**

Data warehousing Components –Building a Data warehouse –- Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata.

UNIT II ANALYTICAL PROCESSING **9**

Online Analytical Processing (OLAP) – Need – Multidimensional Data Model – OLAP Guidelines – Multidimensional Versus Multi-relational OLAP – Categories of Tools – OLAP Tools and the Internet.

UNIT III DATA MINING **9**

Introduction – Data – Types of Data – Data Mining Functionalities – Interestingness of Patterns – Classification of Data Mining Systems – Data Mining Task Primitives – Integration of a Data Mining System with a Data Warehouse – Issues –Data Preprocessing.

UNIT IV CLASSIFICATION IN DATA MINING **9**

Classification and Prediction – Basic Concepts – Decision Tree Induction – Bayesian Classification – Rule Based Classification – Classification by Back Propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods Prediction.

UNIT V CLUSTERING IN DATA MINING **9**

Cluster Analysis – Types of Data – Categorization of Major Clustering Methods – K-means– Partitioning Methods – Model-Based Clustering Methods –Based Cluster Analysis – Outlier Analysis – Data Mining Applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. AlexBerson and Stephen J.Smith, "Data Warehousing, Data Mining and OLAP", Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
2. Jiawei Han and MichelineKamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2012.

REFERENCES:

1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Person Education, 2007.
2. K.P. Soman, ShyamDiwakar and V. Aja, "Insight into Data Mining Theory and Practice", Eastern Economy Edition, Prentice Hall of India, 2006.
3. G. K. Gupta, "Introduction to Data Mining with Case Studies", Eastern Economy Edition, Prentice Hall of India 2006.
4. DanielT.Larose, "Data Mining Methods and Models", Wiley-Interscience, 2006.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/105/106105174/
2. https://swayam.gov.in/nd1_noc20_cs12/preview
3. https://www.nitt.edu/home/academics/departments/cse/programmes/mtech/curriculum/semester_2/electi ves/data_warehousing_and_data_mining/

ONLINE RESOURCES:

1. https://www.hinduwebsite.com/webresources/data_warehousing.asp
2. https://www.docsity.com/en/study-notes-for-data-mining-and-data-warehouse/4594644/

OUTCOMES:

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

1. Understand the concepts of data warehousing architecture and components.
2. Apply the data mining techniques and methods to large data sets using processing tools.
3. Design and analyse the data and data mining functionalities.
4. Understand the various classification algorithms and compare the various classifying algorithms.
5. Apply various clustering techniques and the trends in data mining.

CO – PO, PSO MAPPING:

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

20ITOE905 SDG NO. 4	DATA SCIENCE FOR ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn fundamentals of Python language used in Data Science
- To learn fundamental concepts of statistical concepts used in Data Science
- To Learn Modeling in Data Science
- To gain practical knowledge through case studies

UNIT I INTRODUCTION 9

Data Science - Introduction - Python - Virtual Environments - Whitespace Formatting - Functions - Strings - Exceptions - List - Strings - Tuples - Dictionaries -Counters - Sets - ControlFlow - Truthiness - Sorting - List Comprehensions - Automated Test and Assert-OOP - Iterables and Generators - Randomness - Regular Expressions - Functional Programming - Zip and Argument Unpacking - Args and Kwargs – Type Annotations - Visualizing Data.

UNIT II MATHEMATICAL FOUNDATIONS IN DATA SCIENCE 9

Linear Algebra - Statistics - Probability-Hypothesis and Inference - Gradient Descent - Getting Data - Working with data.

UNIT III PREDICTIVE AND REGRESSION MODELS 9

Modelling - Machine Learning-Overfitting and Underfitting - Correctness - The Bias variance Trade off – Feature Extraction and collection- K-Nearest Neighbors-Naïve Bayes. Regression- Linear, Multiple, Logistic.

UNIT IV DATA SCIENCE METHODOLOGIES **9**

Decision Tree - Entropy - Entropy of a Partition - Creation of a Decision Tree - Random Forest - Neural Networks - Perceptron - Feed Forward Neural Networks - Back Propagation - Example - Deep Learning.

UNIT V CLUSTERING AND NLP **9**

Clustering - Idea - Model - Example - Choosing K - Example - Bottom-up Hierarchical Clustering - NLP - Word Clouds - Ngram Language Models - Gibbs Sampling - Topic Modeling - Word Vectors - Recurrent Neural Networks - Example - Network Analysis - Case Studies - Walmart Sales Forecasting Data Set - Text Mining Data Set.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Joel Grus, "Data Science from Scratch", O'Reilly Media, Inc., Second Edition, May, 2019.

REFERENCES:

1. Peter Bruce and Andrew Bruce "Practical Statistics for Data Scientist", O'Reilly Media,Inc.,First Edition, May, 2017.
2. Michael Freeman, "Programming Skills For Data Science" Pearson India 2020 Edition.
3. Allen. B. Downey, "Think Stats", O'Reilly Media, Inc., Fourth Edition, May, 2012.

WEB REFERENCES:

1. 1.https://nptel.ac.in/courses/106/107/106107220/
2. 2.https://www.amazon.com/Data-Science-Scratch-Principles-Python-ebook/dp/B07QPC8RZX/ref=sr_1_fkmr2_1?
3. dchild=1&keywords=Programming+Skills+For+Data+Science+2020+Edition+by+Michael+Freeman%2C+PEARSON +INDIA&qid=1586631850&s=books&sr=1-1-fkmr2

ONLINE RESOURCES:

1. https://www.amazon.com/Practical-Statistics-Data-Scientists-Essential/dp/1491952962/ref=sr_1_1?keywords=Practical+Statistics+for+Data+Scientists&qid=1575012408&sr=8-1
2. https://www.amazon.com/Programming-Skills-Data-Science-Addison-Wesleyebook/dp/B07KMDCHT2/ref=sr_1_fkmr0_1?dchild=1&keywords= Programming+Skills+For+Data+Science+2020+Edition+by+Michael +Freeman%2C+PEARSON+INDIA&qid=1586631850&s=books&sr=1-1-fkmr0

OUTCOMES:

Upon completion of the course the student will be able to

1. Understand fundamentals of Python language used in Data Science.
2. Learn fundamental concepts of statistical concepts used in Data Science.
3. Exploring methods to work with Data.
4. Elucidate Modeling in Data Science.
5. To gain practical knowledge through case studies.

CO – PO, PSO MAPPING:

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

20ITOE906 SDG NO. 4 & 9	SOFTWARE QUALITY ASSURANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the basics of software quality
- Learn about the Software Quality Assurance (SQA) architecture
- Learn about the management components of software quality
- Understand the integration of the SQA components into the project lifecycle

UNIT I INTRODUCTION TO SOFTWARE QUALITY AND ARCHITECTURE 9

Need for Software Quality – Quality Challenges – Software Quality Assurance (SQA) – Definition and Objectives – Software Quality Factors - McCall Squality Model – SQA System and Architecture – Software Project Life Cycle Components – Pre Project Quality Components – Development and Quality Plans.

UNIT II SQA COMPONENTS AND PROJECT LIFE CYCLE 9

Software Development Methodologies – Quality Assurance Activities in the

Development Process - Verification & Validation – Reviews – Software Testing – Software Testing Implementations – Quality of Software Maintenance – Pre-Maintenance of Software Quality Components – Quality Assurance Tools – Case Tools for Software Quality – Software Maintenance Quality – Project Management.

UNIT III SOFTWARE QUALITY INFRASTRUCTURE 9

Procedures and Work Instructions - Templates - Checklists – 3S Developing - Staff Training and Certification Corrective and Preventive Actions – Configuration Management – Software Change Control – Configuration Management Audit - Documentation Control – Storage and Retrieval.

UNIT IV SOFTWARE QUALITY MANAGEMENT AND METRICS 9

Project Process Control – Computerized Tools - Software Quality Metrics – Objectives of Quality Measurement – Process Metrics – Product Metrics – Implementation – Limitations of Software Metrics– Cost of Software Quality – Classical Quality Cost Model – Extended Model – Application of Cost Model.

UNIT V STANDARDS, CERTIFICATIONS AND ASSESSMENTS 9

Quality Management Standards – ISO 9001 and ISO 9000-3 – Capability Maturity Models – CMM and CMMI Assessment Methodologies - Bootstrap Methodology – SPICE Project – SQA Project Process Standards – IEEE 1012 & 1028 – Organization of Quality Assurance – Department Management Responsibilities – Project Management Responsibilities – SQA Units and Other Actors in SQA Systems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Daniel Galin, "Software Quality Assurance", Pearson Publication, 2009.

REFERENCES:

1. Alan C. Gillies, "Software Quality: Theory and Management", International Thomson Computer Press,1997.
2. Mordechai Ben-Menachem, "Software Quality: Producing Practical Consistent Software", International Thompson Computer Press, 1997.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/105/106105150/

ONLINE RESOURCES:

1. https://lecturenotes.in/m/47339-note-of-software-testing-and-quality-assurance-by-chhaya-khattri

OUTCOMES:

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

1. Understand the basics of software quality.
2. Learn about the Software Quality Assurance (SQA) architecture.
3. Learn about the management components of SQA.
4. Integrate the SQA components into the project lifecycle.
5. Analyze the role of SQA in project development.

CO – PO, PSO MAPPING:

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

20ITOE907 SDG NO. 4	C# AND .NET PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn basic programming in C# and the object oriented programming concepts
- To update and enhance skills in writing Windows applications, ADO.NET and ASP.NET
- To study the advanced concepts in data connectivity, WPF, WCF and WWF with C# and .NET 4.5
- To implement mobile applications using .Net compact framework

UNIT I C# LANGUAGE BASICS 9

.Net Architecture - Core C# - Variables - Data Types - Flow control - Objects and Types-Classes and Structures - Inheritance- Generics – Arrays and Tuples - Operators and Casts – Indexers.

UNIT II C# ADVANCED FEATURES 9

Delegates - Lambdas - Lambda Expressions - Events - Event Publisher - Event Listener - Strings and Regular Expressions - Generics - Collections - Memory Management and Pointers - Errors and Exceptions - Reflection.

UNIT III BASE CLASS LIBRARIES AND DATA MANIPULATION 9

Diagnostics -Tasks - Threads and Synchronization - .Net Security - Localization - Manipulating XML - SAX and DOM - Manipulating Files and the Registry - Transactions - ADO.NET- Peer-to-Peer Networking - PNRP - Building P2P Applications - Windows Presentation Foundation (WPF).

UNIT IV WINDOW BASED APPLICATIONS 9

Window Based Applications - Core ASP.NET- ASP.NET Web Forms - Windows Communication Foundation (WCF)- Introduction to Web Services - .Net Remoting - Windows Service - Windows Workflow Foundation (WWF) - Activities – Workflows.

UNIT V .NET FRAMEWORK AND COMPACT FRAMEWORK 9

Assemblies - Shared Assemblies - Custom Hosting with CLR Objects - Appdomains - Core XAML - Bubbling and Tunneling Events- Reading and Writing XAML - .Net Compact Framework - Compact Edition Data Stores – Errors - Testing and Debugging – Optimizing Performance – Packaging and Deployment – Networking and Mobile Devices.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner, "Professional C# 2012 and .NET 4.5", Wiley, 2012.
2. Harsh Bhasin, "Programming in C#", Oxford University Press, 2014.

REFERENCES:

1. Ian Gariffiths, Mathew Adams, Jesse Liberty, "Programming C# 4.0", OReilly, Fourth Edition, 2010.
2. Andrew Troelsen, "Pro C# 5.0 and the .NET 4.5 Framework", Apress publication, 2012.
3. Andy Wigley, Daniel Moth, Peter Foot, "Mobile Development Handbook", Microsoft Press, 2011.
4. Ian Gariffiths, Mathew Adams, Jesse Liberty, "Programming C# 4.0", OReilly, Fourth Edition, 2010.

WEB REFERENCES:

1. http://archive.oreilly.com/oreillyschool/courses/csharp2/C.NET%202%20C%20Programming%20in%20the%20.NET%20Framework%20v1.pdf
2. http://mocom.xmu.edu.cn/home/project/soft/CSharp/Professional%20Csharp%207%20and%20.NET%20Core%202.0.pdf

OUTCOMES

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

1. Understand the basic concept of .NET framework and C# Language.
2. Write various applications using C# Language in the .NET Framework.
3. Develop distributed applications using .NET Framework.
4. Create mobile applications using .NET compact Framework.
5. Understand the basic concept of .NET framework and C# Language.

CO – PO, PSO MAPPING

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

20ITOE908 SDG NO. 4&9	MOBILE APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To describe those aspects of mobile programming that make it unique from programming for other platforms
- To utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces
- To program mobile applications for the Android operating system that use basic and advanced phone features
- To deploy applications to the Android marketplace for distribution.

UNIT I INTRODUCTION TO ANDROID 9

Android OS Design and Features – Android Development Framework - SDK Features- Installing and Running Applications on Eclipse Platform - Creating AVDs - Types of Android Applications - Best Practices in Android Programming - Android Tools - Android Application Lifecycle – Activities - Activity Lifecycle - Activity States - Monitoring State Changes.

UNIT II ANDROID UI ARCHITECTURE & UI WIDGETS 9

Saving Data - Interacting with Other Apps - Working with System Permissions - Apps with Content Sharing - Shared Preferences - Preferences Activity - Files Access - SQLite Database - Threads - Overview of Services in Android - Implementing a Service - Service Lifecycle - Inter Process Communication.

UNIT III DATA STORAGE, SERVICES & CONTENT PROVIDERS 9

Saving Data - Interacting with Other Apps - Working with System Permissions - Apps with Content Sharing - Shared Preferences - Preferences Activity - Files Access - SQLite Database - Threads - Overview of Services in Android - Implementing a Service - Service Life Cycle - Inter Process Communication.

UNIT IV INTENTS AND BROADCASTS 9

Using Intents to Launch Activities - Explicitly Starting New Activity - Implicit Intents - Passing Data to Intents - Getting Results from Activities - Native Actions - Using Intent to Dial a Number or to Send SMS - Broadcast Receivers – Using Intent Filters to Service Implicit Intents - Resolving Intent Filters - Finding and Using Intents Received within an Activity - Notifications – Creating and Displaying Notifications - Displaying Toasts.

UNIT V ADVANCED APPLICATIONS 9

Building Apps with Multimedia - Building Apps with Graphics & Animations - Building Apps with Location Based Services and Googlemaps - Building Apps with Connectivity & Cloud - Sensors - Bluetooth - Camera - Telephony Services.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. RetoMeier, "Professional Android 2 Application Development", Wiley India Pvt. Ltd, First Edition, 2012.
2. Phillips, Stewart, Hardy and Marsicano, "Android Programming", Second Edition , Big Nerd Ranch Guide, 2015.
3. James C Sheusi, "Android Application Development for Java Programmers", Cengage Learning, 2013.

REFERENCES:

1. MarkMurphy, "Beginning Android 3", A Press Springer India Pvt. Ltd., First Edition, 2011.
2. EricHellman, "Android Programming", Pushing the limits by Hellman, Wiley, 2013.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/106/106106147/
2. https://developer.android.com/training/basics

ONLINE RESOURCES:

1. http://web.stanford.edu/class/cs193a/videos.shtml?ref=hackr.io

OUTCOMES:

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

1. Understand the basics of Android devices and Platform.
2. Describe the architecture and advanced features of android technology.
3. Interpret and use the data storage, file sharing and IPC in android platform.
4. Build mobile applications using multimedia graphics and animations.
5. Publish Android applications in to Android Market.

CO-PO, PSO MAPPING:

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

20ITOE909 SDG NO. 4 & 9	SOFTWARE PROJECT MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the software project planning and evaluation techniques
- To plan and manage projects at each stage of the software development life cycle
- To learn about the activity planning and risk management principles
- To deliver successful software projects that support organization's strategic goals

UNIT I PROJECT EVALUATION AND PROJECT PLANNING 9

Importance of Software Project Management – Activities Methodologies – Categorization of Software Projects – Setting Objectives – Management Principles – Management Control – Project Portfolio Management – Cost-Benefit Evaluation Technology – Risk Evaluation – Strategic Program Management – Stepwise Project Planning.

UNIT II PROJECT LIFE CYCLE AND EFFORT ESTIMATION 9

Software Process and Process Models – Choice of Process Models - Rapid Application Development – Agile Methods – Dynamic System Development Method – Extreme Programming– Managing Interactive Processes – Basics of Software Estimation – Effort and Cost Estimation Techniques – COSMIC Full Function Points - COCOMO II - A Parametric Productivity Model.

UNIT III ACTIVITY PLANNING AND RISK MANAGEMENT 9

Objectives of Activity planning – Project Schedules – Activities – Sequencing and Scheduling – Network Planning Models – Formulating Network Model – Forward Pass & Backward Pass Techniques – Critical Path (CRM) Method – Risk Identification – Assessment – Risk Planning – Risk Management – PERT Technique – Monte Carlo Simulation – Resource Allocation – Creation of Critical Paths – Cost Schedules.

UNIT IV PROJECT MANAGEMENT AND CONTROL 9

Framework for Management and Control – Collection of Data – Visualizing Progress – Cost Monitoring – Earned Value Analysis – Prioritizing Monitoring – Project Tracking – Change Control – Software Configuration Management – Managing Contracts – Contract Management.

UNIT V STAFFING IN SOFTWARE PROJECTS 9

Managing People – Organizational Behavior – Best Methods of Staff Selection –

Motivation – The Oldham – Hackman Job Characteristic Model – Stress – Health and Safety – Ethical and Professional Concerns – Working in Teams – Decision Making – Organizational Structures – Dispersed and Virtual Teams – Communications Genres – Communication Plans – Leadership.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Bob Hughes, Mike Cotterel and Rajib Mall, "Software Project Management" Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

REFERENCES:

1. Robert K. Wysocki, "Effective Software Project Management", Wiley Publication, 2011.
2. Walker Royce, "Software Project Management", Addison-Wesley, 1998.
3. Gopalaswamy Ramesh, "Managing Global Software Projects ", McGraw Hill Education (India), Fourteenth Reprint 2013.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_cs70/preview
2. https://nptel.ac.in/courses/106/105/106105218/
3. https://freevideolectures.com/course/4071/nptel-software-project-management

ONLINE RESOURCES:

1. http://ebooks.lpude.in/management/mba/term_4/DCAP304_DCAP515_SOFTWARE_PROJECT_MANAGEMENT.pdf
2. https://www.simplilearn.com/project-estimation-techniques-article
3. https://mymanagementguide.com/project-evaluation-planning-the-general-guidelines/
4. https://mymanagementguide.com/project-evaluation-planning-the-general-guidelines/
5. https://epdf.pub/effective-software-project-management3153.html
6. https://www.slideshare.net/sheetal_singh/software-project-management-by-walker-royce

OUTCOMES:

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

1. Understand Project Management Principles while developing software and gain intensive knowledge about the basic project management concepts.
2. Obtain adequate knowledge about software process models and software effort estimation techniques.
3. Estimate the risks involved in various project activities.
4. Define the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles.
5. Learn staff selection process and the issues related to people management.

CO- PO, PSO MAPPING

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

20ITOE910 SDG NO. 4&9	COMPUTER GRAPHICS AND MULTIMEDIA SYSTEMS DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To become familiar with various software programs used in the creation and Implementation of multi-media
- To understand the Two-dimensional & Three-Dimensional Graphics and their transformations
- To appreciate illumination and color models
- To become familiar with clipping techniques& Blender Graphics

UNIT I OUTPUT PRIMITIVES & TWO-DIMENSIONAL GRAPHICS 9

Basic – Line – Curve and Ellipse Drawing Algorithms – Examples – Applications - Attributes – Input techniques – Two Dimensional Geometric Transformations – Two Dimensional Clipping and Viewing.

UNIT II THREE-DIMENSIONAL GRAPHICS 9

Three Dimensional Geometric and Modeling Transformations – Translation - Rotation - Scaling - Composite Transformations - Three Dimensional Viewing – Viewing Pipeline - Viewing Coordinates - Projections - Clipping.

UNIT III ILLUMINATION, COLOR MODELS & ANIMATION 9

Light Sources - Basic Illumination Models – Halftone Patterns and Dithering Techniques - Properties of Light - Standard Primaries and Chromaticity Diagram - Intuitive Colour Concepts - RGB Colour Model - YIQ Colour Model - CMY Colour Model - HSV Colour Model - HLS Colour Model - Colour Selection - Virtual Reality - Animation.

UNIT IV MULTIMEDIA SYSTEMS DESIGN &FILE HANDLING 9

Multimedia Basics – Multimedia Applications – Multimedia System Architecture - Defining Objects for Multimedia Systems – Multimedia Data Interface Standards – Multimedia Databases - Compression and Decompression – Data and File Format Standards – Digital Voice and Audio – Full Motion Video – Storage and Retrieval Technologies.

UNIT V HYPERMEDIA 9

Multimedia Authorizing and User Interface - Hypermedia Messaging - Mobile Messaging - Hypermedia Message Component -Creating Hypermedia Message - Integrated Multimedia Message Standards - Integrated Document Management - Distributed Multimedia System.

CASE STUDY: BLENDER GRAPHICS

Blender Fundamentals–Drawing Basic Shapes–Modelling–Shading & Textures.

TOTAL :45 PERIODS

TEXT BOOKS:

1. Donald Hearn and Pauline Baker M, “Computer Graphics", Prentice Hall, New Delhi.
2. Andleigh, P. K and Kiran Thakrar, “Multimedia Systems and Design”, PHI, 2003.

REFERENCES:

1. Judith Jeffcoate, “Multimedia in practice: Technology and Applications”, PHI, 1998.
2. Foley, Vandam, Feiner and Hughes, “Computer Graphics: Principles and Practice”, Second Edition, Pearson Education, 2003.

3. Jeffrey McConnell, “Computer Graphics: Theory into Practice”, Jones and Bartlett Publishers, 2006.
4. Hill F S Jr., "Computer Graphics", Maxwell Macmillan , 1990.
5. Peter Shirley, Michael Ashikhmin, Michael Gleicher, Stephen R Marschner, Erik Reinhard, KelvinSung, and AK Peters, “Fundamentals of Computer Graphics”, CRC Press, 2010.
6. William M. Newman and Robert F.Sproull, “Principles of Interactive Computer Graphics”, McGraw Hill, 1978.

WEB REFERENCES:

1.. https://www.blender.org/support/tutorials
2. http://www.doc.ic.ac.uk/~dfg/graphics/graphics.html
3. http://www.nptelvideos.in/2012/11/computer-graphics.html
4. http://cs.wellesley.edu/~cs110/lectures/M01-color/graphics.pdf

ONLINE RESOURCES:

1. www.scratchapixel.com
2. http://dl.finebook.ir/book/9e/11032.pdf
3. https://www.blender.org/support/tutorials/
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-837-computer-graphics-fall-2012/download-course-materials/

COURSE OUTCOMES:

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

1. Understand the basics of computer graphics and discuss various algorithms for scan conversion.
2. Implement geometric transformations, viewing and clipping techniques
3. Render projected objects to naturalize the scene in 2D view and use of illumination, Color models & animation for this.
4. Understand the concepts of Multimedia, Multimedia system architecture and Multimedia databases; Select and use appropriate image compression & decompression techniques necessary for practice.
5. Understand different types of Multimedia Authoring tools &Hypermedia; Design basic 3D scenes using Blender Graphics.

CO- PO, PSO MAPPING

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

Sri SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

Affiliated to Anna University & Approved by AICTE, New Delhi

OPEN ELECTIVES

I - VIII SEMESTER
AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

B.E. DEPARTMENT OF MECHANICAL ENGINEERING

S. NO	COURSE CODE	COURSE TITLE	CONTACT HOURS	WEEK HOURS			CREDITS
				L	T	P	C
1	20MEOE901	Production of Automotive Components	3	3	0	0	3
2	20MEOE902	Farm Tractors	3	3	0	0	3
3	20MEOE903	Selection of Materials	3	3	0	0	3
4	20MEOE904	Welding Process and Technology	3	3	0	0	3
5	20MEOE905	Productivity and Reengineering	3	3	0	0	3
6	20MEOE906	Work System and Facilities Design	3	3	0	0	3
7	20MEOE907	Special Purpose Vehicles	3	3	0	0	3
8	20MEOE908	Testing of Materials	3	3	0	0	3
9	20MEOE909	Solar Energy Utilization	3	3	0	0	3
10	20MEOE910	Advanced Casting and Forming Processes	3	3	0	0	3

OPEN ELECTIVES

20MEOE901 SDG NO. 3,4,7, 8,9, 11,12,13,15	PRODUCTION OF AUTOMOTIVE COMPONENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the functional requirement of automotive component for the required manufacturing process.
- To have in-depth knowledge of various engineering materials used in automobile engineering
- To select the materials for the Automotive components based on its functionality
- To select suitable manufacturing processes for the Automotive components economically.

UNIT I ENGINE COMPONENTS 9

Overview -Material selection and Manufacturing methods for the Engine Components. Engine block- Casting- Conventional and expendable pattern. Cylinder head- Casting, machining. Crank shaft, connecting rod, camshaft- Forging, machining. Piston Gravity, squeeze, die casting, machining and finishing. Valve forging, friction welding, machining, Piston and Piston ring manufacturing -Centrifugal, HPDC, LPDC, machining and finishing. Castings Processes for Oil pan and Carburettors. Push Rods, Rocker Arm , Tappets, Spark Plug- Forging, Machining, Finishing and Heat treatment.

UNIT II TRANSMISSION COMPONENTS 9

Overview - Material selection and Manufacturing methods for transmission system. Flywheel - Casting and Machining. Clutch - Friction plate, clutch housing, pressure plate conventional and fine blanking, composite friction lining. Methods of Gear manufacture – Gear hobbing and gear Shaping machines - gear generation - gear finishing and shaving – Grinding and lapping of hobs and shaping cutters –gear honing –gear broaching. Gearbox -Casting, precision forging, powder metallurgy, heat treatment and finishing. Propeller shaft -Continuous casting, extrusion.

UNIT III BODY COMPONENTS 9

Surface treatment –Plastics – Plastics in Automobile vehicles –Processing of plastics - Body Panel -Thermoforming and hydro forming, press forming, stretch forming. Emission control system –catalytic converter –Hydro forming of exhaust manifold and lamp housing. Welding – Resistance welding and

other welding processes with the use of Robots in Body weldment. Instrument Panel -Principle of injection molding, injection molding of instrument panel. Bumpers - Molding of bumpers, reinforced reaction injection molding, Manufacture of polymer panels.

UNIT IV CHASSIS COMPONENTS 9

Material selection and manufacturing methods for Vehicle Frame Manufacturing, Wheel drum, Brake drum, Brake shoes, wheel rim and wheel housing manufacturing. Steering systems, shock absorbers, dead axle – casting, forging, machining and finishing operation- Heat treatment procedures for chassis components. Axle-Differential –Axle Shaft –Bearing –fasteners-Forging, casting and machining. Leaf and coil spring -Forging and machining, composite leaf spring and wrap forming of coil spring. Thermal barrier coating fir valves, surface coatings for cylinder liners, piston rings and pistons.

UNIT V TYRES AND ADVANCED MATERIALS MANUFACTURING 9

Tire and tube manufacturing, spray painting, powder coating, Prototype Manufacturing -RPT,3-D Printing, chemical vapour deposition, physical vapour deposition, cryogenic grinding of powders, sealants, sound proof materials, structural adhesives, MMC liners – Selection of materials for Auto components. Gear box components, connecting rods, crankshaft, cam shaft heat treatment surface hardening and finishing operations.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Heldt P M, High Speed Combustion Engines, Oxford IBH publishing Co., Calcutta, 1996.
2. Kalpakjian, Manufacturing Engineering and Technology, Pearson Education, 2005.

REFERENCES

1. B.P. Bhardwaj, The Complete Book on Production of Automobile Components and Allied Products, NIIR Project Consultancy Services, 2014.
2. Degarmo E P, Materials and process in Manufacturing, Macmillan Publishing Co, 1997.
3. John A S, Introduction to Manufacturing Processes, Tata McGraw -Hill, 2012.
4. Kalpakjian, Manufacturing Processes For Engineering Materials, Pearson Education, 2009.

5. Philip F O and JairoMunuz, Manufacturing Processes and Systems, John Wiley and Sons, New York, 1998.

WEB RESOURCES:

1. http://ceb.ac.in/knowledge-center/E-BOOKS/The%20Automotive%20Development%20Process%20-%20Daniel%20Sorensen.pdf
2. https://www.niir.org/books/book_pdf/101230/niir-complete-book-on-production-automobile-components-allied-products.pdf
3. https://www.sciencedirect.com/book/9781845694630/materials-design-and-manufacturing-for-lightweight-vehicles
4. https://www.sciencedirect.com/book/9780081021774/green-composites-for-automotive-applications
5. https://www.sciencedirect.com/book/9781845695613/advanced-materials-in-automotive-engineering

ONLINE RESOURCES:

1. https://www.youtube.com/

OUTCOMES:

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

1. Acquire knowledge on various materials and their manufacturing techniques for Automotive Engine Components
2. Explain about various materials and their manufacturing techniques for Automotive Transmission Components
3. Describe about various materials and their manufacturing techniques for Automotive Body Components
4. Elucidate various materials and their manufacturing techniques for Automotive Chassis Components
5. Acquire knowledge on Tyre manufacturing and other advanced Manufacturing techniques of Automotive Components.

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	1	1	-	1	-	-	-	2	2
CO2	3	3	2	-	-	1	1	-	1	-	-	-	2	2
CO3	3	2	2	-	-	1	1	-	1	-	-	-	2	2
CO4	3	2	2	-	-	1	1	-	1	-	-	-	2	2
CO5	3	2	2	-	-	1	1	-	1	-	-	-	2	2

20MEOE902 SDG NO. 2,4,8,9,12,13,15	FARM TRACTORS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the students to the different systems and working principles of tractor, power tiller, makes of tractors and power tillers.
- To Reduce labour and loss of crops and food products
- To improve the productivity of Food Crops.
- To increase economic return to farmers.

UNIT I TRACTORS **9**

Classification of tractors - Tractor engines – construction of engine blocks, cylinder head and crankcase - features of cylinder, piston, connecting rod and crankshaft – firing order combustion chambers.

UNIT II ENGINE SYSTEMS **9**

Valves-inlet and outlet valves – valve timing diagram. Air cleaner- exhaust – silencer. Cooling systems - lubricating systems - fuel system – governor-electrical system.

UNIT III TRANSMISSION SYSTEMS **9**

Transmission - clutch - gear box - sliding mesh - constant mesh - synchro mesh. Differential, final drive and wheels. Steering geometry - steering systems - front axle and wheel alignment. Brake - types - system.

UNIT IV HYDRAULIC SYSTEMS **9**

Hydraulic system - working principles, three point linkage - draft control - weight transfer, theory of traction - tractive efficiency – tractor chassis mechanics - stability - longitudinal and lateral. Controls - visibility - operators seat.

UNIT V POWER TILLER, BULLDOZER AND TRACTOR TESTING **9**

Power tiller - special features - clutch - gear box - steering and brake. Makes of tractors, power tillers and bulldozers. Bulldozer- salient features – turning mechanism, track mechanism, components – operations performed by bulldozers. Types of tests- test procedure - need for testing & evaluation of farm tractor - Test code for performance testing of tractors and power tillers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jain, S.C. and C.R. Rai. Farm tractor maintenance and repair, Standard publishers and distributors, New Delhi, 1999.

REFERENCES

1. Barger, E.L., J.B. Liljedahl and E.C. McKibben, Tractors and their Power Units. Wiley Eastern Pvt. Ltd., New Delhi, 1997.
2. Domkundwar A.V. A course in internal combustion engines. Dhanpat Rai& Co. (P) Ltd., Educational and Technical Publishers, Delhi,1999.
3. Black, P.O. Diesel engine manual. Taraporevala Sons& Co., Mumbai, 1996.
4. Grouse, W.H. and Anglin, D.L. Automotive mechanics. Macmillan McGraw-Hill, Singapore, Indian Standard Codes for Agricultural Implements Published by ISI, New Delhi, 1993.
5. Jagadeeshwar Sahay, Elements of Agricultural Engineering, Standard Publishers Co., New Delhi, 2010

WEB RESOURCES:

1. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=498
2. http://www.hillagric.ac.in/edu/coa/agengg/lecture/243/agriengg-243.htm
3. https://www.agrimoon.com/farm-power-and-machinery-icar-ecourse-pdf-book/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/126105009/

OUTCOMES:

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

1. Explain the working principle and various components of tractor engines
2. Interpret the tractor engine fuel lubricant, coolant and electrical systems
3. Explain the power transmission system
4. Explain principle of hydraulic system and traction control
5. Explain transmission system, farming mechanisms and track mechanism for power filter and bulldozer

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	1	-	-	-	-	1	2	3	3	2
CO2	3	2	2	1	2	-	-	-	-	1	2	3	2	3
CO3	3	2	2	1	2	-	-	-	-	1	2	3	3	3
CO4	3	1	2	1	2	-	-	-	-	1	2	3	3	2
CO5	3	1	1	1	1	-	-	-	-	1	2	3	2	2

20MEOE903 SDG NO. 4, 9, 12	**SELECTION OF MATERIALS** (Use of Ashby Charts are permitted)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand different types of availability materials
- To use easy and effective way for selecting required materials
- To understand the various manufacturing processes and their properties.
- To examine the materials and their desired properties by applying various testing methods.
- To identify the material properties.

UNIT I ENGINEERING MATERIALS 9

Introduction – classification of engineering materials – selection of materials for engineering purposes –selection of materials and shape –classification metal and alloys, polymers, ceramics and glasses, composites, natural materials,-non metallic materials- smart materials - physical, metrical properties of metals

UNIT II MATERIAL PROPERTIES 9

Mechanical properties – fatigue strength – fracture Toughness - Thermal Properties - Magnetic Properties - Fabrication Properties –electrical , optical properties - Environmental Properties , Corrosion properties –shape and size - Material Cost and Availability– failure analysis

UNIT III MANUFACTURING PROCESSING AND ECONOMIC ANALYSIS 9

Interaction of Materials Selection, Design, and Manufacturing Processes - Production Processes and Equipment for Metals - Metal Forming, Shaping, and Casting - Plastic Parts Processing - Composites Fabrication Processes -

Advanced Ceramics Processing – surface treatment - Resource -The Price and Availability of Materials

UNIT IV MATERIALS SELECTION CHARTS AND TESTING 9

Ashby material selection charts-Testing of Metallic Materials - Plastics Testing - Characterization and Identification of Plastics - Professional and Testing Organizations - Ceramics Testing - Nondestructive Inspection.

UNIT V APPLICATIONS AND USES 9

Selection of Materials for Biomedical Applications - Medical Products - Materials in Electronic Packaging - Advanced Materials in Sports Equipment - Materials Selection for Wear Resistance - Advanced Materials in Telecommunications - Using Composites - Manufacture and Assembly with Plastics, fiber and Diamond Films.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ashby, M. F. Materials selection in mechanical design, 3rd edition. Elsevier, 2005.
2. Ashby, M. F. and Johnson, K. Materials and design – the art and science of material selection in product design. Elsevier, 2002

REFERENCES

1. Charles, J. A., Crane, F. A. A. and Furness, J. A. G. Selection and use of engineering materials, 3rd edition. Butterworth-Heinemann, 1997
2. Handbook of Materials Selection. Edited by Myer Kutz2002 John Wiley & Sons, Inc., NewYork.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/104/112104122/
2. https://www.sciencedirect.com/topics/materials-science/material-selection-chart

ONLINE RESOURCES:

1. https://www.coursera.org/learn/materials-science
2. https://www.udemy.com/course/basics-of-material-selection-in-mechanical-design/
3. https://www.edx.org/course/structural-materials-selection-and-economics

OUTCOMES:

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

1. Explain about selection of metals, alloys, composites, non metallic materials.
2. Explain about properties of mechanical, fabrication and environmental of materials.
3. Describe material selection, design and manufacturing processes.
4. Explain material selection chart and testing.
5. Summarize the application of materials in medical, packaging and sports equipments.

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	1	1	-	-	-	-	2	3	3
CO2	3	2	2	1	1	2	2	-	-	-	-	2	3	3
CO3	3	2	2	1	1	2	2	-	-	-	-	3	3	3
CO4	3	2	2	1	1	2	2	-	-	-	-	3	3	3
CO5	3	2	2	1	1	2	2	-	-	-	-	2	3	3

20MEOE904 SDG NO. 4,9,12	WELDING PROCESS AND TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Welding processes and its Equipment development
- To recognize the type of metal, electrode, and tools that are used in arc welding.
- To know safety measure when use the welding machine along the welding process
- To control and automate Arc welding processes.

UNIT I WELDING TECHNIQUES 9

Oxy-Acetylene Welding, Arc Welding Techniques- Manual Metal Arc Welding (MMAW), Shielded Metal Arc Welding (SMAW), Submerged Arc Welding (SAW), Tungsten Inert Gas Welding (TIG), Metal Inert Gas Welding (MIG), Plasma Arc Welding (PAW), Electron Beam Welding (EBW), Thermit Welding, LASER Welding

UNIT II ELECTRICAL AND THERMAL CHARACTERISTICS 9

Welding Power Sources: Characteristics, Selection Criteria, Welding Energy Input and Energy Sources, Conventional power source designs, Electronic power regulation systems, Output level, sequence and function control, Practical implications of electronic power regulation and control

Arc Physics and Thermal Characteristics: Arc Characteristics, Various modes of Metal Transfer, Heat Input Rate, Heat Flow Equations, Width of Heat Affected Zone (HAZ),Cooling Rates.

UNIT III WELDING PROCESS CONTROL, MONITORING AND AUTOMATION 9

Control and Monitoring: Manual control techniques, automated control techniques, Monitoring techniques

Welding Automation: Automation options, Simple mechanization, Dedicated and special-purpose automation, Robotic welding, Modular automation, Programmable control, Remote-control slave and automated systems, Advances in welding automation, Evaluation of and justification for automated welding

UNIT IV WELD DEFECTS, DESTRUCTIVE AND NON DESTRUCTIVE TESTING OF WELDMENTS 9

Weld Defects: Various Welding Defects and Remedial measures

Destructive Testing of Weldments: Tensile Test, Bend Test, Hardness Test, Toughness Test, Fatigue Test

Non Destructive Testing of Weldments: Visual Testing, Liquid Penetration Testing, Magnetic Particle Inspection, Eddy Current Testing, Ultrasonic Testing, Thermal Imaging, Acoustic Emission Testing, Radiography Testing, Leak Proof Testing.

UNIT V WELDING ECONOMICS, SAFETY AND SUSTAINABILITY 9

Need for time standards, definition of standard time, various methods of computing standard time, analytical calculation, computerization of time standards Definition of terms, composition of welding costs, cost of consumables, labour cost, cost overheads, formulae for total cost.

Safety and environmental factor, Skill and training requirements, Areas for development, Process application trends, Sustainability in Welding, Welding for Industry 4.0

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Parmer R.S., "Welding Engineering and Technology", 1st Edition, Khanna Publishers, New Delhi, 2008

2. Parmer R.S., "Welding Processes and Technology", Khanna Publishers, New Delhi, 1992.

REFERENCES

1. Nadkarni S.V. "Modern Arc Welding Technology", Oxford IBH Publishers, 1st Edition, 2005.
2. Schwartz M.M. "Metals Joining Manual". McGraw Hill Books, 1979.
3. Tylecote R.F. "The Solid Phase Welding of Metals". Edward Arnold Publishers Ltd. London.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/107/112107090/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/103/112103263/
2. https://nptel.ac.in/courses/112/103/112103244/
3. https://nptel.ac.in/courses/112/107/112107089/
4. https://nptel.ac.in/courses/113/106/113106087/

OUTCOMES:

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

1. Gather knowledge on various welding techniques
2. Understand basic electrical and thermal characteristics for welding process
3. Get awareness on welding automation, monitoring and process control of welding process
4. Estimate on various welding defects and testing methods for the quality of welded plates
5. Generate and imply the welding safety and its economics in the welding operations to get sustainability

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	-	-	-	-	-	2	2	2
CO2	3	3	2	2	2	2	-	-	-	-	-	2	2	2
CO3	3	3	2	2	2	2	-	-	-	-	-	2	2	2
CO4	3	3	2	2	2	2	-	-	-	-	-	2	2	2
CO5	3	3	2	2	2	2	-	-	-	-	-	2	2	2

20MEOE905 SDG NO. 4,8,9,12	PRODUCTIVITY AND RE-ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To apprise the students on productivity improvement techniques for an organization
- To create a system that response with flexibility of the changes through business process reengineering.
- To restructure the organizations by focusing on the ground-up design of their business processes
- To help organizations fundamentally rethink how they do their work in order to improve customer service, cut operational costs, and become world-class competitors

UNIT I PRODUCTIVITY-INTRODUCTION, MEASUREMENT AND EVALUATION 9

Basic concept and meaning of Productivity – Significance of Productivity – Factors affecting Productivity – Productivity cycle, Scope of Productivity Engineering and Management, Productivity measurement in International, National and Industrial level – Total Productivity Model – Productivity measurement in Manufacturing and Service sectors- Performance Objective Productivity (PO) model – Need for Productivity Evaluation- Evaluation Methodology.

UNIT II PRODUCTIVITY-PLANNING AND IMPLEMENTATION 9

Need for Productivity Planning – Short term and long term productivity planning – Productivity improvement approaches, Principles - Productivity Improvement techniques – Technology based, Material based, Employee based, Product based techniques – Managerial aspects of Productivity Implementation schedule, Productivity audit and control.

UNIT III INTRODUCTION TO RE-ENGINEERING 9

Business Process Re-engineering: Introduction - historical outlook – working definition of BPR Analytical and Process Tools and Techniques - Role of Information and Communication Technology in BPR – Requirements and steps in BPR Implementation – Case studies. Overview on four phases of Re-engineering process-Setting the Foundation for Re-engineering: Fallacy of programme change – elements of effective change –Importance of planning for Reengineering - limitations – key points on planning for Re-engineering

UNIT IV RE-ENGINEERING – APPROACH AND STEPS 9

Creating vision, missing and guiding principles – developing three to five-year strategic plan – scenario approach – critical issues approach-goal approach-developing yearly operational or breakthrough plans. Identification of current business processes – establishing the scope of the process – mapping project – mapping and analyzing the process. Process Creation: Creating the ideal process – testing the new process – implementing the new process.

Evaluation: Evaluating the improvement (criteria) of measurements hurdles foreseen in designing and implementing meaningful measures.

UNIT V ORGANIZATION IN RE-ENGINEERING 9

Exploration by the top management for Re-engineering – work force preparation for involvement and change planning for the future-Responsibilities and roles of leader, process owner, Reengineering team steering committee and Re-engineering Czar –DSMCQ and PMP organization Transformation models – Process Improvement Models like PMI, Edosomwan, LMICIP and NPRDC Models. Key points for succeeding at Reengineering – case studies.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jeffrey N.Lowenthal, Re-engineering the organization– A step-by-step Approach to Corporate Revitalization, Tata McGraw Hill Publishing Co. Ltd., New Delhi, India, 1994.
2. Sumanth, D.J: Productivity Engineering and Management, TMH, New Delhi, 1990.

REFERENCES

1. Edosomwan, J.A. Organizational Transformation and Process re-Engineering, British Cataloging in publications, 1996.
2. Premvrat, Sardana, G.D. and Sahay, B.S. Productivity Management - A systems approach, Narosa Publications, New Delhi, 1998.
3. Michael Hammer and James Champy, Re-engineering the corporation – A Manifesto for Business Revolution, NicholarBarkey Publishing, London, UK,Revised Edition 2006
4. Michael Hammer, The Re-engineering Revolution Handbook, Herper – Collins Publishers, London, UK, 2000.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112107292
2. https://nptel.ac.in/courses/112107142

ONLINE RESOURCES:

1. https://www.youtube.com
2. https://nptel.ac.in

OUTCOMES:

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

1. Measure and Evaluate Productivity of an Organization
2. Implement various Productivity Control techniques in an Organization
3. Explain the Business Process Reengineering and its usage.
4. Discuss steps to create vision, mission and guiding principles and applying the three to five years strategic plans by using various reengineering approaches
5. Analyze role of workforce preparation, roles of leaders, process owners, reengineering team.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	-	3	3	3	3	3	1	3
CO2	-	-	-	-	-	3	-	3	3	3	3	3	1	3
CO3	-	-	-	-	-	3	-	3	3	3	3	3	1	3
CO4	-	-	-	-	-	3	-	3	3	3	3	3	1	3
CO5	-	-	-	-	-	3	-	3	3	3	3	3	1	3

20MEOE906 SDG NO. 4,9 &12	WORK SYSTEM AND FACILITIES DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the basic principles in Work place design, Facilities Planning, Location and Layout designs
- To ensure a smooth flow of Men and Materials.
- To avoid unnecessary delay due to Transportation and Motions
- To reduce the Manufacturing Lead time.

UNIT I WORK SYSTEM DESIGN **9**

Work Study: Basic Concept, Steps Involved in Work Study, Concept of Work

Content, Techniques of Work Study, Human Aspects of Work Study.

Method Study: Basic Concept, Steps Involved in Method Study, Recording Techniques, Operation Process Charts-Examples.

Flow Process Charts: Examples, Two-Handed-Process Charts, Multiple Activity Charts, Flow Diagrams. String Diagrams: Principles of Motion Economy, Micro-Motion Study, Therbligs, SIMO Charts.

Memo-Motion Study, Cycle graph and Chrono-Cycle Graph, Critical Examination Techniques, Development and Selection of New Method, Installation and Maintenance of Improved Methods.

UNIT II WORK MEASUREMENT 9

Work Measurement: Basic Concept, Techniques of Work Measurement, Steps Involved in Time Study, Time Study Equipment, Performance Rating. Performance Rating: Examples, Allowances, Computation of Standard Time, Numerical on Computation of Standard Time, Case Study

Work Sampling: Basics, Procedure of Work Sampling Study, Numerical Problems on work sampling, Introduction to Synthetic Data and PMTS, Introduction to MTM and MOST

Ergonomics: Basic Concept, Industrial Ergonomics, Anthropometry, Man-Machine System-1, Man-Machine System-2 Case Studies of: Office Chair, Tower Crane Cabin, Car Seat, Computer System, Assembly Line Worker.

UNIT III FACILITY LOCATION ANALYSIS 9

Introduction, Factors affecting location decisions , Location theory , Qualitative models , Semi-Quantitative models -Composite measure , Brown & Gibbs model , Break-Even analysis model, Factor rating method, Load distance method, Center of gravity method- Single facility location problems – Median model, Gravity location model, Mini-Max model, Multi-facility location problems, Transportation method.

UNIT IV LAYOUTS- CLASSIFICATION AND PLANNING PROCEDURE 9

Facilities Requirement-Location and layout-Need for a layout study - Objectives and Features of a good Layout-Factors influencing layout - Classification- product, process, cellular and fixed position layouts - Layouts for service businesses and warehouses - Product design Cycle Systematic

Layout Planning procedure: Information gathering, flow analysis and activity analysis, relationship diagram, space requirements and availability. Nadler's ideal system approach, Immer's basic steps, Apple's layout procedure, Reed's layout procedure

UNIT V COMPUTERIZED LAYOUT PLANNING 9

Concepts and Designing for Process layout: CRAFT, ALDEP, CORELAP – Trends

in computerized layout, Algorithms and models for Group Technology - ROC and Bond Energy Algorithms.

Line balancing for Product Layout - Objectives, Line balancing techniques – Largest Candidate rule- Kilbridge and Wester method- RPW method- COMSOAL.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Richard Francis. L. and John A.White, Facilities Layout and location -An analytical approach, Prentice Hall Inc., 2002.

REFERENCES

1. Tompkins, White et al., Facilities planning, John Wiley & Sons, inc. 2003.
2. Krajewski, J. and Ritzman, Operations Management – Strategy and Analysis, Addison – Wesley publishing company inc. 5th Edition, 1999.
3. James Apple, M, Plant layout and Material Handling, John Wiley,3rd Edition, 1977.
4. Sundaresh.S.Heragu, Facilities Design, 4th edition,CRC press,2016.
5. Edward Frazelle, World-Class Warehousing and Material Handling, McGraw Hill Publishers,2016.

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc19_me50/preview
2. https://www.inc.com/encyclopedia/facility-layout-and-design.html
3. https://www.slideshare.net/Kitlaserna/design-of-work-systems

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=pwUFis8Y6j4

OUTCOMES:

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

1. Examine the methods of doing work with an aim of finding the means of effective and efficient use of resources.
2. Set up of standards of performance for the work being carried out.
3. Identify factors in facility location decisions
4. Identify suitable procedure for Layout Planning
5. Classify types of layout planning algorithms.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	-	3	3	3	3	3	1	3
CO2	-	-	-	-	-	3	-	3	3	3	3	3	1	3
CO3	-	-	-	-	-	3	-	3	3	3	3	3	1	3
CO4	-	-	-	-	-	3	-	3	3	3	3	3	1	3
CO5	-	-	-	-	-	3	-	3	3	3	3	3	1	3

20MEOE907 SDG NO. 4, 9, 11, 12	SPECIAL PURPOSE VEHICLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enhance the knowledge of the students about the various equipment's used in earth moving, applications.
- To understand the construction and working of the vehicle for constructional application.
- To describe the working nature of farm equipment's based on their application.
- To discriminate the various industrial and other vehicles based on the purpose.
- To acquire the knowledge on the functioning of military vehicle and commercial vehicles

UNIT I EARTH MOVERS **9**

Bull dozers and Dumpers: Construction layout ,Articulated haulers, front-end loaders, backhoe loaders, Bull dozers- Tilt dozers and Angle dozers, front end loaders, scrappers, Selection criteria of prime mover for dumpers, capacity and applications of Dumpers

Graders: Description, specification of tractor towed graders and motor graders, classification and functions of graders, functional details of spreading, mixing, ditching, bank sloping, snow removal, stripping, scarifying, and finishing, elementary details of transmission system, running gear and operating equipment air braking system; hydraulic system and its components, steering system of lights, medium and heavy graders, merits and limitations of graders.

Mining Equipments: Excavators classification based on attachments, face shovel, drag shovel, hoe, drag-line and grab or clam shell, advantages and

limitations, Hydraulic shovels, bucket conveyors , surface miners – High wall Miners.

UNIT II CONSTRUCTION VEHICLES 9

Construction Vehicles: Capacity and applications of cranes- General description, specifications and functions, excavator mounted cranes, mobile cranes with strut and cantilever type jibs, tractor towed and tractor mounted cranes, Articulated Trucks, Concrete ready mixer, Trenchers, Asphalt Pavers, Road Reclaimers.

Compaction Vehicles: General description, specification and functions, smooth wheeled rollers, pneumatic tired rollers, agricultural Rollers, sheep's foot rollers, vibrating compactors.

Other Construction Vehicles: Draglines, Drillers, Borewell machine.

UNIT III FARM VEHICLES 9

Tractors: General description, specification and functions, light, medium and heavy wheeled tractors, crawler tracks mounted / wheeled - factors affecting efficiency of output of tractors, simple problems, merits and demerits.

Harvester: Top lifting harvesters-General description, working, specification and functions paddy harvesting machines, Sugarcane harvesting, feller bunchers, forest machines.

UNIT IV INDUSTRIAL AND OTHER VEHICLES 9

Industrial Vehicles: Self-propelled and tractor towed haulage vehicles and pneumatic – tires, dumpers – front tipping; trucks – rear tipping, tractor towed semi-trailers and trailers (rear and side tipping, bottom dumping). General description, specification and functions, fork lift trucks, alternative front-end equipment (attachments) – Jib arm, shovel bucket, squeeze clamp, boom, fork extensions, barrel forks. Scissors lift trucks, Utility vehicles, towing vehicles, man-lift chassis, material handlers, reclaimers,

Other Vehicles: General description, specification and functions- Ambulance, Oil tankers, Double decker bus, Vestibule bus, Fire Fighting vehicles.

UNIT V COMBATING AND MILITARY VEHICLES 9

Combat Vehicles: Special features and constructional details of Main Battle tank, gun carriers, transport vehicles, Armoured vehicle-launched bridge, amphibious bridging vehicle, surveillance vehicle, communication vehicles.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Abrosimov. K. Bran berg.A. andKatayer.K., " Road making Machinery ", MIR Publishers, Moscow,1971.

2. Rodichev and G.Rodicheva, Tractor and Automobiles, MIR Publishers,1987.
3. Wong.J.T., " Theory of Ground vehicles ", John Wiley & Sons, New York,1987.

REFERENCES

1. B. Geleman and M. Moskovin, Farm tractors, MIR publishers, Moscow.
2. Bart H Vanderveen, Tanks and Transport vehicles, Frederic Warne and Co ltd.,London.
3. Kolchin,A and V.Demidov, Design of Automotive Engines for Tractor,MIRPublishers,1972.
4. Peurifoy R.L "Construction Planning, Equipment and Methods", Tata McGraw-Hill, New Delhi,2002.
5. Wong J " Terramechanics and Off-Road Vehicle Engineering", Butterworth-Heinemann, 2009

WEB RESOURCES:

1. https://bookz.sarkariresultnotes.com/Tanks_And_Combat_Vehicles_Of_The_Warsaw_EBOOK.pdf
2. www.shortcoursesportal.com
3. https://www.agrimoon.com
4. https://www.eit.global/courses/mvt-intro-course

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/126/105/126105009/
2. https://nptel.ac.in/courses/114/105/114105030/

OUTCOMES:

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

1. Understand the construction layout of earth moving equipment's.
2. Apply the knowledge to design a new concept for construction application.
3. Demonstrate their skill in developing modern techniques for future farming vehicles
4. Understand the working of Industrial vehicles and other vehicles.
5. Distinguish the various military vehicles and infer their particular technology.

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	1	1	-	-	-	1	1	3	2
CO2	3	3	3	2	2	1	1	-	1	-	2	1	3	3
CO3	3	2	1	-	-	2	3	2	1	2	1	1	2	3
CO4	3	1	1	-	-	2	2	1	-	-	2	2	2	3
CO5	3	2	2	-	-	-	2	-	-	-	2	1	2	2

20MEOE908 SDG NO. 4, 9, 12	TESTING OF MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the need, classification, principles of various testing processes and their methods.
- To identify a suitable testing technique to inspect industrial component.
- To acquire the knowledge on the applications various testing methods
- To enumerate the merits and demerits of the various testing processes.

UNIT I INTRODUCTION TO MATERIAL TESTING 9

Overview of materials- classification of material testing and purpose of testing-Development of testing, testing organizations and its committee-Testing standards-Result analysis of various testing and advantages.

UNIT II MECHANICAL TESTING 9

Introduction to Mechanical tests- Hardness tests (Rockwell, Brinell and Vickers hardness tests)–Tensile test, Impact tests (Charpy and Izod) Principles, Techniques, Methods ,Advantages, Limitations and applications.

Bend test, Shear test, Creep and Fatigues test-Principles, Techniques, Methods, Advantages, Limitations and applications.

UNIT III NON-DESTRUCTIVE TESTING 9

Visual inspection test, liquid penetration test and magnetic particle test. Thermography test - Principles, techniques, advantages, limitations and applications. Radiography test and Eddy current test, Ultrasonic test, Acoustic emission - Principles, techniques, advantages, limitations and applications..

UNIT IV MATERIAL CHARACTERIZATION TESTING 9

Macroscopic and microscopic observation, optical and electron microscopy (SEM and TEM) -Principles, Types, Advantages, Limitations and Applications.

Diffraction techniques, spectroscopic techniques, electrical and magnetic techniques-principles,Types, Advantages, Limitations and Applications.

UNIT V OTHER TESTING 9

Thermal testing: Differential scanning calorimetry, Differential thermal analysis, techniques- Thermo mechanical and dynamic mechanical analysis-techniques-Principles, Advantages, Applications.

Chemical testing: X-ray fluorescence, elemental analysis by inductively coupled plasma-Optical emission spectroscopy, Plasma-mass spectrometry.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. BaldevRaj ,T.Jayakumar, M.Thavsimuthu-"Practical Non-Destructive Testing", Narosa Publishing House.
2. Field Foster- "The Mechanical Testing of Materials and Alloys", 7th Edition, Cousens Press, 2007.

REFERENCES

1. Cullity.B.D-"Elements of X-ray diffraction", 3rd Edition, Addition-Wesley Company, Inc., Newyork 2000.
2. Metals Handbook: Mechanical testing,(Volume 8) ASM Handbook committee, 9th Edition, American Society of Metals,1978.
3. ASM Metals Handbook, Non Destructive Evaluation and Quality Control", American Society of Metals,Metals Park, Ohio, USA.
4. Brandon D.G-"Modern Testing in Metallography", Van Nostrand Inc., NJ, USA,1986.

WEB RESOURCES:

1. http://www.matweb.com/reference/link.aspx
2. http://www.materials.unsw.edu.au/tutorials/online-tutorials/materials-testing

ONLINE RESOURCES:

1. https://www.classcentral.com/course/swayam-theory-and-practice-of-non-destructive-testing-9872
2. https://www.ndtclassroom.com/
3. https://www.youtube.com/channel/UCbuRPq0WYr1iAAZsvmSq1qw

OUTCOMES:

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

1. Acquire knowledge on various materials, their classification and suitability for a process; understand the development, need and advantages of testing, organization of testing methods and standardization.
2. Explain about various mechanical testing principles, techniques, their merits and demerits and applications.
3. Enumerate various non-destructive testing methods, principles, their applications in various engineering fields. and their advantages and limitations.
4. Describe about the various material characterization testing, principles, their advantages and disadvantages and their applications.
5. Elucidate the other miscellaneous testing methods like thermal testing, thermo mechanical testing, chemical testing their principles, techniques used, their applications and their merits and demerits.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	0	0	1	1	0	0	0	0	3	3	3
CO2	3	2	1	0	0	1	1	0	0	0	0	3	3	3
CO3	3	2	1	0	0	1	1	0	0	0	0	3	3	3
CO4	3	2	1	0	0	1	1	0	0	0	0	3	3	3
CO5	3	2	1	0	0	1	1	0	0	0	0	3	3	3

20MEOE909 SDG NO. 4,7,8,9,11, 12,13,14,15	SOLAR ENERGY UTILIZATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge and accomplish a decent employment in solar energy sector and advance quickly to significant positions of leadership in their Profession.
- To moving towards advanced research for mitigating the shortcomings in solar energy systems.
- To become a successful entrepreneur and be a part of a supply chain or manufacture or market solar energy products for sustainable development.
- To lead an ethical life by engaging in lifelong learning experiences for developing environmentally sustainable and economically affordable solar energy products for societal upliftment.

UNIT I SOLAR RADIATION AND COLLECTORS 9

Source of radiation - Solar -constant - Extra terrestrial radiation. Sun earth relationship - atmospheric attenuation - terrestrial radiation : diffuse radiation at the ground - average daily, hourly global and diffuse radiation - influence of inclined planes - solar charts - measurement of diffuse, global and direct solar radiation : pyroheliometer, pyranometer, pyregeometer, net pyradiometer - sunshine recorder - an overview of solar radiation data in India.

Flat plate collector, Evacuated tubular collectors, Concentrator collectors – classification - design and performance parameters - tracking systems - compound parabolic concentrators - parabolic trough concentrators - concentrators with point focus - Heliostats – performance of the collectors.

UNIT II SOLAR THERMAL TECHNOLOGIES 9

Principle of working, types, design and operation of - Solar heating and cooling systems - Thermal Energy storage systems – Solar Desalination – Solar cooker: domestic, community – Solar pond – Solar drying. Solar green house: classification : winter / summer/ ,free standing, pit type - thermal modelling of a green house

Solar powered absorption a/c system (ammonia/water) solar pump, solar chimney, solar drier, solar dehumidifier, solar still. Advanced concepts of collection in space.

Energy storage: sensible, latent heat and thermo –chemical storage –pebble bed phase change materials - Glauber's salt -organic compounds.

UNIT III SOLAR PV FUNDAMENTALS 9

Semiconductor – properties - energy levels - basic equations of semiconductor devices physics. Solar cells - p-n junction: homo and hetro junctions - metal-semiconductor interface - dark and illumination characteristics - figure of merits of solar cell - efficiency limits - variation of efficiency with band-gap and temperature - efficiency measurements - high efficiency cells – Solar thermo-photovoltaics.

UNIT IV SPV SYSTEM DESIGN AND APPLICATIONS 9

Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPV systems - stand alone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems.

UNIT V SOLAR PASSIVE ARCHITECTURE 9

Thermal comfort - bioclimatic classification – passive heating concepts: direct heat gain - indirect heat gain - isolated gain and sunspaces - passive cooling concepts: evaporative cooling - Radiative cooling - application of wind, water and earth for cooling; shading - paints and cavity walls for cooling - roof radiation traps - earth air-tunnel. – energy efficient landscape design - thermal comfort.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Sukhatme S.P.,. Nayak.J.P, 'Solar Energy – Principle of Thermal Storage and collection", Tata McGraw Hill, 2008.
2. Rai.G.D., Solar Energy, S.Chand Publications, New Delhi, 2000

REFERENCES

1. Goswami D.Y., Kreider, J. F. and Francis., "Principles of Solar Engineering', Taylor and Francis, 2000.
2. Chetan Singh Solanki, "Solar Photovoltatics – Fundamentals, Technologies and Applications", PHI Learning Private limited, 2011.
3. Solar Energy International, "Photovoltaic – Design and Installation Manual" – New Society Publishers, 2006.
4. Roger Messenger and Jerry Vnetre, "Photovoltaic Systems Engineering", CRC Press, 2010.

5. Edward E. Anderson, "Fundamentals for solar energy conversion"-Addison Wesley pub., 1983.
6. Duffie, j.A. and Beckman, W.A., "Solar Engineering of Thermal Process", John Wiley, 1991.
7. N.D. Koushika "Solar Energy Principles And Applications", -IBT publications and distributors, New Delhi,1988.
8. M.H.rasheed " power electronic circuits, devices and applications"-prentice hall international, New Jerset-1988.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/105/112105050/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/115/103/115103123/
2. https://nptel.ac.in/courses/115/107/115107116/
3. https://nptel.ac.in/courses/113/104/113104084/
4. https://nptel.ac.in/courses/112/105/112105051/
5. https://www.coursera.org/specializations/solar-energy
6. https://www.coursera.org/learn/solar-energy-basics
7. https://www.coursera.org/learn/solar-energy-system-design
8. https://www.coursera.org/learn/solar-cells
9. https://www.coursera.org/learn/photovoltaic-solar-energy
10. https://www.coursera.org/learn/solar-energy-and-electrical-system-design

OUTCOMES:

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

1. Explain Solar Radiation Spectrum and types of Collectors
2. Apply the various Solar Thermal Energy Storage Systems and its applications
3. Identify various Materials used in Solar PV Cell
4. Design Simple Solar Photovoltaic System
5. Explain Passive Heating and Cooling technology using Solar Power

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	1	1	2	-	-	-	2	2	3	2
CO2	3	3	3	3	1	1	2	-	-	-	2	2	3	2
CO3	3	3	3	3	1	1	2	-	-	-	2	2	3	2
CO4	3	3	3	3	1	1	2	-	-	-	2	2	3	2
CO5	3	3	3	3	1	1	2	-	-	-	2	2	3	2

20MEOE910 SDG NO. 4,8,9,12	ADVANCED CASTING AND FORMING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know about the casting principles.
- To learn about the special casting processes
- Understanding the behaviour of engineering material under various processing conditions
- To study various Unconventional Forming techniques
- To equip with the recent trends in Foundry and Forming units.

UNIT I PRINCIPLES OF CASTING 10

Solidification of pure metals and alloys - Fluidity- Shrinkage in cast metals - Absorption of gases - Degassing methods - Progressive solidification - Directional solidification of single crystal and columnar-grained castings and its application to aerospace castings. Hot spot & Junction - Design for moulding-Design for core support. Principle of gating and riser - Improvement of yield efficiency - Simple problems in gating and risening for steels and cast irons. Principles and applications of melting processes, Induction, Vacuum Arc, Skull, Plasma Arc and Electron Beam Melting. Melting of Nickel, Titanium, Iron and Cobalt based alloys. Melt processing: Principles of grain refining and modification.

UNIT II ADVANCED CASTING PROCESSES 10

Special casting processes - Shell moulding, investment casting, Carbon - Dioxide moulding, Centrifugal casting, Die casting, Continuous casting, Squeeze casting, Full mould processes, Semi-Solid metal casting,Thixocasting and Rheocasting process, Compo casting, Hybrid Evaporative Pattern Casting Process, Counter Gravity Sand Casting, Slush Casting, Slip Casting, Gel Casting, Metal infiltration technology and Casting of Metal Matrix Composites, Micro-

casting, Inert Environment/ Vacuum Casting and Solidification, Compocasting, Metallic Foam production, Roll Casting, Casting of Intermetallics, and rapid sand casting.

UNIT III CONVENTIONAL FORMING TECHNIQUES 9

Classification of forming process- Mechanics of metal working

Forging-Hot, Cold and Warm Forging – types of presses and hammers. Classification, Open die forging and Closed die forging, calculation of forging loads, - forging defects – causes and remedies, residual stresses in forging. Rolling: Classification of rolling processes, types of rolling mills, hot and cold rolling.

Direct and indirect extrusion, variables affecting extrusion, deformation pattern, equipments, port– hole extrusion die, hydrostatic extrusion, defects and remedies-Tube extrusion and production of seamless pipe and tube. Drawing of rods, wires and tubes. Sheet Metal Forming techniques.

UNIT IV UNCONVENTIONAL FORMING TECHNIQUES 9

Unconventional forming: High energy rate forming - Explosive forming - Magnetic Pulse forming - Electro hydraulic forming, Electro Magnetic forming, Hydro forming – Severe Plastic Deformation, Equal Channel Angular Pressing (ECAP), Equal Channel Angular Rolling (ECAR), High-pressure torsion (HPT), Powder forming techniques, Rubber Pad forming, Metal Spinning, Rubber Pad Forming, Dynapark , Petroforge forming, Micro- Incremental Forming

UNIT V AUTOMATION, QUALITY CONTROL AND USE OF COMPUTER AIDED ANALYSIS IN FOUNDRY & FORMING UNITS 7

Introduction to Automation. Mechanization of foundry and forging units. Pollution control in foundry. Casting defects and forming defects – Identification, Analysis and Remedies, Quality Control Tools and Techniques, Computer Aided Analysis for Casting and Forming Process. Role of Industry 4.0 and Internet of Things in Casting and forming process.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Heine R W., Loper, C.R.Rosenthal, P.C.,"Principles of Metal Casting",Tata-McGraw Hill Publishing Co Ltd, New Delhi, 1995.
2. Dieter, "Mechanical Metallurgy ", Tata McGraw - Hill, 2005.

REFERENCES

1. Peter Beelay “Foundry Technology” Butterworth, Second edition, 2001.
2. Ravi.B “Metal Casting Computer aided Design and Analysis” Prentice Hall,

2005.
3. Srinivasan.N.K “Foundry Engineering” Khanna Tech pub co, New Delhi, 2000.
4. Avitzur , "Metal Forming Processes and Analysis ", Tata McGraw - Hill ,2005.
5. Harris, J.N., "Mechanical working of Metals - Theory and Practice”, Pergamon Press ,1995
6. Taylour Altan , Soo-IK-Oh and Harold L.Gegel ,"American Society for Metals " , 1983.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/107/112107084/
2. https://nptel.ac.in/courses/112/106/112106153/
3. https://nptel.ac.in/courses/112/107/112107078/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/107/112107083/
2. https://nptel.ac.in/courses/112/107/112107215/
3. https://nptel.ac.in/courses/112/107/112107250/
4. https://nptel.ac.in/courses/112/103/112103279/

OUTCOMES:

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

1. Understand the principles of Metal Casting
2. Choose a special Casting process for a particular application
3. Gain knowledge about Conventional Forming techniques
4. Get Insight about various Unconventional Forming techniques.
5. Acquire knowledge in Automation of Foundry and Forming unit.

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	1	1	-	-	-	1	2	2	2
CO2	3	2	2	2	1	1	1	-	-	-	1	2	2	2
CO3	3	2	2	2	1	1	1	-	-	-	1	2	2	2
CO4	3	2	2	2	1	1	1	-	-	-	1	2	2	2
CO5	3	2	3	3	2	2	2	1	-	2	2	2	2	2

Sri SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

Affiliated to Anna University & Approved by AICTE, New Delhi

OPEN ELECTIVES

I - VIII SEMESTER
AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2020

B.E. PRODUCTION ENGINEERING

S. NO	COURSE CODE	COURSE TITLE	CONTACT HOURS	WEEK HOURS			CREDITS
				L	T	P	C
1	20PROE901	Fibre Reinforced Plastics	3	3	0	0	3
2	20PROE902	Product Design and Development	3	3	0	0	3
3	20PROE903	Production Technology of Agricultural machinery	3	3	0	0	3
4	20PROE904	World Class Manufacturing	3	3	0	0	3
5	20PROE905	Internal Combustion Engines	3	3	0	0	3
6	20PROE906	New Product Development	3	3	0	0	3
7	20PROE907	Testing of Materials	3	3	0	0	3
8	20PROE908	Maintenance Engineering	3	3	0	0	3
9	20PROE909	Selection of Materials	3	3	0	0	3

OPEN ELECTIVES

20PROE901 SDG NO. 4,9	FIBRE REINFORCED PLASTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the various materials for composite structure.
- To equip with the knowledge of sandwich structure technology.
- To provide knowledge in fracture mechanics of composites.
- To impart knowledge in fatigue and damping capacity of composite materials.
- To provide understanding of various manufacturing/fabricating techniques for composite structures.

UNIT I INTRODUCTION **9**

Definition, Reason for composites, Classifications of composites, Thermosets - Epoxy; Unsaturated polyester resin; vinyl ester,polyimides etc.,- preparation, properties, and uses.

UNIT II REINFORCEMENTS **9**

Types, Properties, chemistry and applications of fillers such as silica, titanium oxide, talc, mica etc., Manufacturing process, Properties, structure and uses of Glass fiber- Carbon, Aramid, Boron, jute, sisal, cotton.

UNIT III FABRICATIONS OF THERMOSET COMPOSITES **9**

Hand lay up method, compression and transfer moulding, pressure and vacuum bag process, filament winding, protrusion, reinforced RIM, RRIM, Injection moulding, of thermosets, SMC and DMC, Advantages and disadvantages of each method.

UNIT IV TESTING OF COMPOSITES **9**

Destructive and non-destructive tests; Destructive- tensile, compression, flexural, impact strength, Hardness – Fatigue- toughness HDT ,basic concepts of fracture mechanisms

UNIT V APPLICATIONS OF COMPOSITES **9**

Aerospace, land transport, marine, structural, chemical plants and corrosion

resistant products, mechanical engineering and energy applications sports, electrical, electronic and communication applications, biomedical applications, repairs and maintenance etc.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Hand book of composite by G. Lubin, Van Nostrand Co., New York 1969.
2. Polymers and Polymer Composites in Construction by L.C. Holleway, 1990

REFERENCES:

1. Engineering Plastics and Composites by John C. Bittence, 1990
2. Handbook of Plastics, Elastomers and Composites by Chrles A Harper, 1975
3. Designing with Reinforced composites- Technology-Performance, Economics-Rosato, 2st Ed. 1997.
4. Delwane Composite design Encyclopedia – (Vol 3 Processing and Fabrication / Technology _ Ed. Leif Carlssen. And Joahn W. Hillispie, Technomic Publishing Ah. Lancaster U.S.A.
5. Fiber glass Reinforce Plastics – Nicholas P. Cheremisinoff and Composites Paul N. Cheremmisinoff.,
6. Noyes Publications, N.J. U.S.A. 1995.
7. Composite applications – the future is now, Thomas J. Drozdr, (Eds), Published by Society of Manufacturing Engineers, Michigan, 1989.
8. Polymer layered silicate and silica nano composites, Y.C. Ke, P. Stroeve and F.S. Wang, Elsevier, 2005

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_me29/preview
2. https://swayam.gov.in/nd1_noc19_me67/preview

ONLINE RESOURCES:

1. https://online-learning.tudelft.nl/courses/frp-composites-in-structural-engineering/

OUTCOMES:

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

1. Select various materials for designing composite structures.
2. Apply knowledge of fracture mechanics of composites during designing of composite structures.
3. Analyse critically the damping capacity of composite materials.

4. Correlate various manufacturing/fabricating techniques for composite structures based on design
5. Understand the various fields of applications of composites.

CO - PO, PSO MAPPING

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

20PROE902 SDG NO. 4,9,11,12	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The course aims at providing the basic concepts of product design, product features and its architecture.
- The student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

UNIT I INTRODUCTION **9**

Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.

UNIT II CONCEPT GENERATION AND SELECTION **9**

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT III PRODUCT ARCHITECTURE **9**

Implications – Product change – variety – component standardization –

product performance – manufacturability – product development management – establishing the architecture – creation –clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications

UNIT IV INDUSTRIAL DESIGN **9**

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process– investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT **9**

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs– Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Kari T.Ulrich and Steven D.Eppinger, "Product Design and Development", McGraw-Hill International Edns. 1999.

REFERENCES:

1. Kemnneth Crow, "Concurrent Engg./Integrated Product Development", DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh, "Tool Design –Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/107/112107217/
2. https://swayam.gov.in/nd1_noc20_me12/preview
3. https://ocw.mit.edu/courses/sloan-school-of-management/15-783j-product-design-and-development-spring-2006/lecture-notes/

ONLINE RESOURCES:

1. https://snscourseware.org/snscenew/notes.php?cw=CW_5d2536555ae15
2. https://www.linkedin.com/learning/rapid-prototyping-for-product-design?trk=learning-topics_learning_search-card&upsellOrderOrigin=default_guest_learning.

OUTCOMES:

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

1. To provide the basic concepts of product design, product features and its architecture.
2. Knowledge gained through prototyping technology will help the student to make a prototype of a problem
3. To achieve the desired product design and development
4. To find out proper methods of incorporating the design into the product.
5. To design some products for the given set of applications.

CO – PO, PSO MAPPING

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

20PROE903 SDG NO. 2,4,8,9,12	PRODUCTION TECHNOLOGY OF AGRICULTURAL MACHINERY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept and basic mechanics of metal cutting, working of standard machine tools, such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching.
- To understand the basic concepts of Computer Numerical Control (CNC) machine tool and CNC programming.

UNIT I ENGINEERING MATERIALS **9**

Engineering materials - their classification - Mechanical properties of materials, strength, elasticity, plasticity, stiffness, malleability, ductility, brittleness, toughness, hardness, resilience, machinability, formability, weldability. Steels and cast irons: Carbon steels, their classification based on percentage of carbon as low, mild, medium & high carbon steel, their properties & applications. Wrought iron, cast iron. Alloy steels: Stainless steel, tool steel.

UNIT II MACHINING **9**

Basic principles of lathe - machine and operations performed on it. Basic description of machines and operations of Shaper-Planner, Drilling, Milling & Grinding.

UNIT III WELDING **9**

Introduction, classification of welding processes. Gas welding, types of flames and their applications. Electric Arc welding. Resistance welding, Soldering & Brazing processes and their uses.

UNIT IV ADVANCED MANUFACTURING PROCESS **9**

Abrasive flow machining - abrasive jet machining - water jet machining - Electro Discharge Machining (EDM) - Wire cut EDM - Electro Chemical Machining (ECM) - Ultrasonic Machining / Drilling (USM / USD) - Electron Beam Machining (EBM) - Laser Beam Machining (LBM).

UNIT V CNC MACHINE **9**

Numerical control (NC) machine tools - CNC: types, constitutional details, special features - design considerations of CNC machines for improving machining accuracy - structural members - slide ways - linear bearings - ball screws - spindle drives and feed drives. Part programming fundamentals - manual programming.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. "Manufacturing Engineering and Technology", Kalpakjian and Schmid, Pearson, 2010.
2. Hajra Choudry, "Elements of workshop technology - Vol II", Media promoters, 2002.

REFERENCES:

1. Gupta. K.N., and Kaushik, J.P., 1998, Workshop Technology Vol I and II, New Heights, Daryaganj, New Delhi.
2. Arthur. D., et. al. 1998, General Engineering Workshop Practice, Asia Publishing House, Bombay.
3. Chapman W.A.J., Workshop Technology, 1992, Part I, II, III, E.L.B.S. and Edward Amold Publishers Ltd, London.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_me14/preview
2. https://nptel.ac.in/courses/112104195/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3193/advanced-manufacturing processes
2. http://ecoursesonline.iasri.res.in/course/view.php?id=70

OUTCOMES:

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

1. To understand about concept and basic mechanics of engineering materials.
2. To understand about working of standard machine tools.
3. To understand about the various welding process and equipments used.
4. To understand about the various advanced manufacturing process .
5. To understand about basic concepts of Computer Numerical Control (CNC) machine tool and CNC programming.

CO – PO, PSO MAPPING

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

20PROE904 SDG NO. 4,9,12	WORLD CLASS MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understanding of the concept and importance of strategy planning for manufacturing industries
- To apply principles and techniques in the identifiable formulation and implementation of manufacturing strategy for competitive in global context.

UNIT I INDUSTRIAL DECLINE AND ASCENDANCY 9

Manufacturing excellence - US Manufacturers - French Manufacturers - Japan decade – American decade - Global decade

UNIT II BUILDING STRENGTH THROUGH CUSTOMER – FOCUSED PRINCIPLES 9

Customer - Focused principles - General principles - Design - Operations - Human resources - Quality and Process improvement - Promotion and Marketing.

UNIT III VALUE AND VALUATION 9

Product Costing - Motivation to improve - Value of the enterprises QUALITY - The Organization : Bulwark of stability and effectiveness - Employee stability – Quality Individuals Vs. Teams - Team stability and cohesiveness - Project cohesiveness and stability.

UNIT IV STRATEGIC LINKAGES 9

Product decisions and customer service - Multi-company planning - Internal manufacturing planning - Soothing the demand turbulence.

UNIT V IMPEDIMENTS 9

Bad plant design - Mismanagement of capacity - Production Lines - Assembly Lines – Whole Plant Associates - Facilitators - Teamsmanship - Motivation and reward in the age of continuous Improvement.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. By Richard B. Chase, Nicholas J. Aquilano, F. Robert Jacobs – "Operations Management for Competitive Advantage", McGraw-Hill Irwin, ISBN 0072323159
2. Moore Ran, "Making Common Sense Common Practice: Models for Manufacturing Excellence", Elsevior Multiworth

REFERENCES:

1. Narayanan V. K., "Managing Technology & Innovation for Competitive Advantage", Pearson Education Inc.
2. Korgaonkar M. G., "Just In Time Manufacturing", MacMillan Publishers India Ltd.,
3. Sahay B. S., Saxena K. B. C., Ashish Kumar, "World Class Manufacturing", MacMillan Publishers

WEB REFERENCES

1. https://www.trainingregistry.com/courses/manufacturing/lean-world-class-manufacturing
2. https://www.eu-japan.eu/news/world-class-manufacturing-training-programme-session-i

ONLINE RESOURCES

1. http://manufacturingskillsinstitute.org/training-programs/world-class-manufacturing/
2. https://www.monsterindia.com/courses-certifications/quality-management/certified-world-class-manufacturing-wcm-practices-manager-vs-1107/1502

OUTCOMES:

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

1. Able to understand the concept and the importance of manufacturing strategy for industrial enterprise competitiveness.
2. Able to understand the focused principles on customer relationship.
3. Apply appropriate techniques in the analysis an devaluation of company's opportunities for enhancing competitiveness in the local regional and global context.
4. Apply various strategic linkages for planning in the industries.
5. Identify formulation and implement strategies for manufacturing and therefore enterprise competitiveness.

CO – PO, PSO MAPPING

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

20PROE905 SDG NO. 4,9,12	INTERNAL COMBUSTION ENGINES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart the basic fundamental knowledge on IC engines and its working.
- To study about some of the recent trends in IC engines

UNIT I INTRODUCTION IC ENGINE 9

Introduction, Types of IC engines, Constructional details IC engine, working, principles – 2 & 4 stroke engines, Cycles – Air standard cycles, Fuel air cycles and actual cycles, Actual Indicator diagram for four stroke and two stroke engines, General fuel properties, ignition properties – octane and cetane rating, Materials for engine components.

UNIT II PETROL ENGINES 9

Working and constructional details of petrol engines, Carburetor – constructional and working, types of carburetors, additional features in modern carburetor, A/F ratio calculation, Petrol Injection - introduction, Ignition – introduction and requirements, Battery and magneto coil ignition system, Electronic ignition system, Stages of combustion in petrol engines, Combustion chambers for petrol engine, formation of knock in petrol engine.

UNIT III DIESEL ENGINES 9

Working and constructional details of diesel engines, fuel injection – requirements, types of injection systems – inline, distributor pumps, unit injector, Mechanical and pneumatic governors. Fuel injector, Types of injection nozzles, Spray characteristics. Injection timing, Split and multiple injection,

Stages of combustion in Diesel engines, direct and indirect combustion chambers for diesel engine, knocking in diesel engine, Introduction on supercharging and turbocharging.

UNIT IV COOLING AND LUBRICATION **9**

Requirements, Types- Air cooling and liquid cooling systems, forced circulation cooling system, pressure and Evaporative cooling systems, properties of coolants for IC engine. Need of lubrication, Lubricants for IC engines - Properties of lubricants, Types of lubrication – Mist, Wet and dry sump lubrication systems.

UNIT V MODERN TECHNOLOGIES IN IC ENGINES **9**

HCCI Engines – construction and working, CRDi injection system, GDI Technology, E - Turbocharger, Variable compression ratio engines, variable valve timing technology, Fuel cell, Hybrid Electric Technology.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ganesan.V., Internal Combustion Engines, Tata McGraw Hill Publishing Co., New York,1994.
2. Ramalingam. K. K., Internal Combustion Engines, Scitech publications, Chennai, 2003.

REFERENCES:

1. Ellinger, H.E., Automotive Engines, Prentice Hall Publishers, 1992.
2. Heldt.P.M. High Speed Combustion Engines, Oxford IBH Publishing Co., Calcutta,1975.
3. Obert E.F., Internal Combustion Engines Analysis and Practice, International Text Books:Co., Scranton, Pennsylvania, 1988.
4. William. H. Crouse, Automotive Engines, McGraw Hill Publishers, 1985.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_me42/preview
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://nptel.ac.in/courses/112104033/

ONLINE RESOURCES:

1. https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2017/

2. https://alison.com/course/mechanical-engineering-internal-combustion-engine-basics

OUTCOMES:

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

1. Able to understand the basics of internal combustion engines.
2. Able to understand the basic components and working of petrol engines.
3. Able to understand the basic components and working of diesel engines.
4. To understand about various cooling and lubrication used in IC engines.

To understand about various modern technologies in IC engines

CO – PO, PSO MAPPING

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

20PROE906 SDG NO. 4,8,9,11	NEW PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- This course aims at introducing the students to the basic concepts of engineering design and product development with focus on the front end processes.
- At the end of this course the student is expected to demonstrate an understanding of the overview of all the product development processes and knowledge of concept generation and selection tools.

UNIT I INTRODUCTION **9**

Need for developing products – the importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product

development-planning for products –establishing markets- market segments-relevance of market research.

UNIT II CUSTOMER NEEDS **9**

Identifying customer needs –voice of customer –customer populations-hierarchy of human needs- need gathering methods – affinity diagrams – needs importance- establishing engineering characteristics-competitive benchmarking- quality function deployment- house of quality- product design specification-case studies.

UNIT III CREATIVE THINKING **9**

Creative thinking –creativity and problem solving- creative thinking methods-generating design concepts-systematic methods for designing –functional decomposition – physical decomposition – functional representation –morphological methods-TRIZ- axiomatic design.

UNIT IV DECISION MAKING AND PRODUCT ARCHITECTURE **9**

Decision making –decision theory –utility theory –decision trees –concept evaluation methods –Pugh concept selection method- weighted decision matrix –analytic hierarchy process – introduction to embodiment design –product architecture – types of modular architecture –steps in developing product architecture.

UNIT V DESIGN AND COST ANALYSIS **9**

Industrial design – human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost – overhead costs – activity based costing –methods of developing cost estimates – manufacturing cost –value analysis in costing.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development ", 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9
2. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2015, Pearson Education,ISBN 9788177588217

REFERENCES:

1. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7.

2. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition, 4th Edition, 2009, ISBN 978-007-127189-9.
3. Yousef Haik, T. M. M. Shahin, "Engineering Design Process", 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141.
4. Staurt Pugh, "Tool Design –Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_mg03/preview
2. https://swayam.gov.in/nd2_imb19_mg01/preview
3. https://nptel.ac.in/courses/110104084/

ONLINE RESOURCES:

1. http://www.yourarticlelibrary.com/products/product-development-notes-on-new-product-development-process/13582
2. https://www.enotesmba.com/2013/05/marketing-notes-product-development-process.html
3. http://www.udel.edu/alex/chapt11.html

OUTCOMES:

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

1. To develop familiarity with models of innovation and the marketing and technology interface
2. To learn how to integrate the customer and end-consumer into this process.
3. To learn methods of generating, evaluating and testing product ideas
4. To identify relevant components and plan a product launch
5. Study various manufacturing cost components and learn cost analysis of product design

CO – PO, PSO MAPPING

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

20PROE907 SDG NO. 4,9,11	TESTING OF MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the various destructive and non destructive testing methods of materials and its industrial applications.
- To study about material characterization testing and its applications.

UNIT I INTRODUCTION TO MATERIALS TESTING 9

Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

UNIT II MECHANICAL TESTING 9

Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT III NON DESTRUCTIVE TESTING 9

Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission-Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT IV MATERIAL CHARACTERIZATION TESTING 9

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT V OTHER TESTING 9

Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo- mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Cullity, B. D., "Elements of X-ray diffraction", 3rd Edition, Addison-Wesley Company Inc., New York, 2000.
3. P.Field Foster, "The Mechanical Testing of Metals and Alloys" 7th Edition, Cousens Press, 2007.

REFERENCES:

1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
2. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA.
3. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.

WEB REFERENCES:

1. https://nptel.ac.in/courses/113106032/#
2. https://nptel.ac.in/courses/113102080/#
3. https://nptel.ac.in/courses/112108150/
4. https://nptel.ac.in/courses/113107078/
5. https://nptel.ac.in/courses/113102080/#
6. https://nptel.ac.in/courses/112108150/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/113106034/
2. http://www.materials.unsw.edu.au/tutorials/online-tutorials/materials-testing

OUTCOMES:

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

1. Identify suitable testing technique to inspect industrial component.
2. Ability to use the different technique and know its applications and limitations.
3. To know the differences between destructive and non destructive testing.
4. To analyse about various material characterization techniques and its limitations.
5. To identify various advanced testing methods with its advantages and limitations.

CO – PO, PSO MAPPING

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

20PROE908 SDG NO. 4,9&12	MAINTENANCE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities
- To explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements
- To illustrate some of the simple instruments used for condition monitoring in industry.

UNIT I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 10

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.

UNIT II MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE 9

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM.

UNIT III CONDITION MONITORING 9

Condition Monitoring – Cost comparison with and without CM – On-load testing and offload testing – Methods and instruments for CM – Temperature

sensitive tapes – Pistol thermometers – wear-debris analysis.

UNIT IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS 10

Repair methods for beds, slideways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

UNIT V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 7

Repair methods for Material handling equipment - Equipment records –Job order systems -Use of computers in maintenance.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Srivastava S.K., "Industrial Maintenance Management", - S. Chand and Co., 1981
2. Venkataraman .K "Maintancence Engineering and Management", PHI Learning, Pvt. Ltd., 2007

REFERENCES:

1. Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 1995
2. White E.N., "Maintenance Planning", I Documentation, Gower Press, 1979.
3. Garg M.R., "Industrial Maintenance", S. Chand & Co., 1986.
4. Higgins L.R., "Maintenance Engineering Hand book", McGraw Hill, 5th Edition, 1988.
5. Armstrong, "Condition Monitoring", BSIRSA, 1988.
6. "Advances in Plant Engineering and Management", Seminar Proceedings - IIPE, 1996.
7. Davies, "Handbook of Condition Monitoring", Chapman &Hall, 1996.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105048/
2. https://swayam.gov.in/nd1_noc20_ae03/preview

ONLINE RESOURCES:

1. http://omnexacademy.com/certified-maintenance-engineer.html
2. https://www.iti.com/maintenance
3. https://www.pertecnica.in/industrial-mechanical-maintenance-course/
4. https://www.udemy.com/course/engineering-and-maintenance-management-in-a-lean-environment/

OUTCOMES:

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

1. To understand about the basic principles and practices of maintenance planning.
2. To understand about the maintenance policies and methods of preventive maintenance.
3. To monitor the various machineries in industries for effective maintenance.
4. To understand the various repair methods for basic machine elements.
5. To understand about the various repair methods for material handling equipments.

CO – PO, PSO MAPPING

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

20PROE909 SDG NO. 4,9 & 11	SELECTION OF MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The subject exposes students to the basics parameter for selection of same and different classes of materials.
- The subject also exposes students about various manufacturing processes, their properties, and applications.

UNIT I ENGINEERING MATERIALS **9**

Introduction – classification of engineering materials – selection of materials for engineering purposes –selection of materials and shape –classification metal and alloys, polymers, ceramics and glasses, composites, natural materials,-non metallic materials- smart materials - physical, metrical properties of metals.

UNIT II MATERIAL PROPERTIES **9**

Mechanical properties – fatigue strength – fracture Toughness - Thermal Properties - Magnetic Properties - Fabrication Properties –electrical , optical properties - Environmental Properties , Corrosion properties –shape and size - Material Cost and Availability– failure analysis.

UNIT III MANUFACTURING PROCESSING AND ECONOMIC ANALYSIS 9

Interaction of Materials Selection, Design, and Manufacturing Processes - Production Processes and Equipment for Metals - Metal Forming, Shaping, and Casting - Plastic Parts Processing - Composites Fabrication Processes - Advanced Ceramics Processing – surface treatment - Resource -The Price and Availability of Materials.

UNIT IV MATERIALS SELECTION CHARTS AND TESTING **9**

Ashby material selection charts-Testing of Metallic Materials - Plastics Testing - Characterization and Identification of Plastics - Professional and Testing Organizations - Ceramics Testing - Non destructive Inspection.

UNIT V APPLICATIONS AND USES **9**

Selection of Materials for Biomedical Applications - Medical Products - Materials in Electronic Packaging - Advanced Materials in Sports Equipment - Materials Selection for Wear Resistance - Advanced Materials in Telecommunications - Using Composites - Manufacture and Assembly with Plastics, fiber and Diamond Films.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ashby, M. F. Materials selection in mechanical design, 3rd edition. Elsevier, 2005.
2. Ashby, M. F. and Johnson, K. Materials and design – the art and science of material selection in product design. Elsevier, 2002.

REFERENCES:

1. Charles, J. A., Crane, F. A. A. and Furness, J. A. G. Selection and use of engineering materials, 3rd edition. Butterworth-Heinemann, 1997
2. Handbook of Materials Selection. Edited by Myer Kutz2002 John Wiley & Sons, Inc., NewYork.

WEB REFERENCES:

1. https://nptel.ac.in/content/storage2/courses/112101005/downloads/Module_2_Lecture_1_final.pdf

2. https://nptel.ac.in/content/storage2/courses/112101005/downloads/Module_2_Lecture_2_final.pdf
3. https://nptel.ac.in/courses/112108150/

ONLINE RESOURCES:

1. https://nptel.ac.in/content/storage2/courses/downloads_new/112104203/Assignment-8_noc18_mm10_97.pdf
2. http://www.materials.unsw.edu.au/tutorials/online-tutorials/materials-testing

OUTCOMES:

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

1. To understand about the different types of available materials.
2. Ability to identify the material properties.
3. Easy and effective way to select required materials.
4. To analyse the materials using various material testing charts and testing methods.
5. To select suitable materials for machineries in various industrial applications.

CO – PO, PSO MAPPING

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

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which will help to create DECENT WORK AND ECONOMIC GROWTH. Our prosperity shall be fuelled

by investments in INDUSTRY, INNOVATION AND INFRASTRUCTURE that will help us to

REDUCE INEQUALITIES by all means. We will live in SUSTAINABLE CITIES AND COMMUNITIES.

RESPONSIBLE CONSUMPTION AND PRODUCTION will help in healing our planet.

CLIMATE ACTION will reduce global warming and we will have abundant,

flourishing LIFE BELOW WATER, rich and diverse LIFE ON LAND.

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and will build long term PARTNERSHIPS FOR THE GOALS.

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