# INSTITUTE OF ENGINEERING & TECHNOLOGY,

**Lucknow, Uttar Pradesh, India**

*(An Autonomous Constituent Institute of AKTU, Lucknow)*

**EVALUATION SCHEME AND SYLLABI**

***For***

## B. Tech. 2nd Year

## Common Courses to All Branches (Including Elective Courses)

**Effective from the Session: 2023-24**

## Evaluation Scheme for Common Courses

| S. N. | Subject Codes | Subject | Syllabus | Periods | | | Sessional Evaluation Scheme | | | | End Semester Evaluation | | Total | Credit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | CT | TA | Total | PS | TE | PE | | |
| 1 | IAS303/ IAS403 | Maths III | View | 3 | 1 | 0 | 20 | 10 | 30 | | 70 | | 100 | 4 |
| 2 | IAS302/ IAS402 | Maths IV | View | 3 | 1 | 0 | 20 | 10 | 30 | | 70 | | 100 | 4 |
| 3 | IOE03X/ IOE04X | Inter Departmental Elective Courses* | View | 3 | 1 | 0 | 20 | 10 | 30 | | 70 | | 100 | 4 |
| 4 | IAS301/ IAS 401 | Technical Communication | View | 3 | 0 | 0 | 20 | 10 | 30 | | 70 | | 100 | 3 |
| 5 | IVE 301/ IVE 401 | Universal Human values | View | 3 | 0 | 0 | 20 | 10 | 30 | | 70 | | 100 | 3 |
| 6 | INC301/ INC401 | Computer System Security | View | 3 | 0 | 0 | 20 | 10 | 30 | | 70 | | 100 | 0 |
| 7 | INC302/ INC402 | Python Programming | View | 3 | 0 | 0 | 20 | 10 | 30 | | 70 | | 100 | 0 |
| 8 | INC305 | Research Methodology | View | 2 | 0 | 0 | 20 | 10 | 30 | | 70 | | 100 | 0 |
| 9 | INC405 | Practices and Ethical Issues in Research | View | 2 | 0 | 0 | 20 | 10 | 30 | | 70 | | 100 | 0 |

## *List for Common Inter Departmental Elective Courses

| S. N. | Subject Codes | Subject | Branches Not Allowed | Syllabus |
|---|---|---|---|---|
| 1 | IOE030/ IOE040 | Laser System and its Applications | --------- | View |
| 2 | IOE031/ IOE041 | Polymer Science & Technology | CH and allied branches | View |
| 3 | IOE032/ IOE042 | Engineering Mechanics | ME / CE and allied branches | View |
| 4 | IOE033/ IOE043 | Material Science | ME / CE and allied branches | View |
| 5 | IOE034/ IOE044 | Energy Science & Engineering | EE and allied branches | View |
| 6 | IOE035/ IOE045 | Sensor & Instrumentation | EE and allied branches | View |
| 7 | IOE036/ IOE046 | Basics Data Structure &Algorithms | CSE and allied branches | View |
| 8 | IOE037/ IOE047 | Computer Based Numerical Techniques | CSE and allied branches | View |
| 9 | IOE038/ IOE048 | Analog Electronics Circuits | EC and allied branches | View |
| 10 | IOE039/ IOE049 | Communication Engineering | EC and allied branches | View |

# IET

# B. Tech. 2nd Year

## Syllabi for Common Courses (Including Elective Courses)

# IAS303 / IAS403: Mathematics –III (PDE and Numerical Techniques)

**(To be offered to B. Tech. in Civil Engineering)**

**COURSE OUTCOMES**

| | Course Outcome (CO) | Bloom's Level |
|---|---|---|
| | **At the end of this course, the students will be able to:** | |
| CO 1 | Remember the concept of partial differential equation and to solve partial differential equations and analyze the concept of partial differential equations to evaluate the problems concerned with partial differential equations | K1, K3 & K4 |
| CO 2 | Understand the concept of Fourier transforms and apply these to engineering problems | K2 & K4 |
| CO 3 | Understand the concept of statistical techniques, Binomial, Poisson and Normal distributions and apply it to engineering problems, test the hypothesis | K1 & K5 |
| CO 4 | Apply the numerical methods to solve transcendental equations | K3 |
| CO 5 | Apply the numerical methods to solve system of linear equations and differential equations. | K3 & K6 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Module I: Partial Differential Equations (8)**

Origin of Partial Differential Equations, Linear and Non Linear Partial Equations of first order, Lagrange's Equations, Charpit's method, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients.

**Module II: Applications of Partial Differential Equations (8)**

Method of separation of variables, Solution of wave and heat conduction equation up to two dimension, Laplace equation in two dimensions, Fourier integral, Fourier transform, Complex Fourier transform, Inverse transforms, Convolution theorems, Fourier sine and cosine transform, Applications of Fourier transform

**Module III: (8)**

**Statistical Techniques:** Moments, Skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves, Correlation and regression, Binomial, Poisson and Normal distributions, Tests of significations: Sampling theory (small & large), hypothesis, Null hypothesis, Alternative hypothesis, testing of hypothesis: Chi-square test, t-test.

**Module IV: (8)**

**Numerical Techniques–I:** Zeroes of transcendental and polynomial equations using Bisection method, Regula-Falsi method and Newton-Raphson method, Rate of convergence of above methods. Interpolation: Finite differences, Newton's forward and backward interpolation, Lagrange's and Newton's divided difference formula for unequal intervals.

**Module V: (8)**

**Numerical Techniques–II:** Solution of system of linear equations, Matrix Decomposition methods, Jacobi method, Gauss- Seidel method. Numerical differentiation, Numerical integration, Trapezoidal rule, Simpson's one third and three-eight rules, Solution of ordinary differential equations of first order and second order by Picard's and fourth-order Runge-Kutta methods.

**Text Books**


1. Peter V. O'Neil, Advance Engineering Mathematics Thomson (Cengage) Learning, 2007.
2. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
3. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
4. Jain, Iyenger & Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, New Delhi.
5. E. Kreyszig, Advanced Engineering Mathematics; John Wiley & Sons.
6. R.K. Jain & S.R.K. Iyenger, Adnanced Engineering Mathematics, Narosa Publishing House.


**Reference Books**


1. B.S. Grewal, Higher Engineering Mathematics; Khanna Publishers, New Delhi.
2. B.V. Ramana, Higher Engineering Mathematics; Tata McGraw- Hill Publishing Company Limited, New Delhi.
3. J.N. Kapur, Mathematical Statistics, S. Chand & company Ltd.
4. R.K. Jain and S.R.K. Iyenger, Advance Engineering Mathematics; Narosa Publishing House, New Delhi.
5. Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudralaya, 1996.
6. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI Learning Pvt. Limited, New Delhi.
7. E. Balagurusamy, Numerical Methods, Tata McGraw-Hill Publishing Company Limited, New Delhi.


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# IAS 302 / IAS402: Mathematics-IV (PDE, Probability and Statistics)

(To be offered to branches Computer Science & Engineering, Chemical Engineering, Electronics & Communication Engineering, Electrical Engineering, Mechanical Engineering and allied branches)

**Course Objective**

The objective of this course is to familiarize the students with partial differential equation, Fourier transform their application and statistical techniques. It aims to present the students with standard concepts and tools at an intermediate to superior level that will provide them well towards undertaking a variety of problems in the discipline.

**Course Outcomes**

| | Course Outcome (CO) | Bloom's Level (KL) |
|---|---|---|
| At the end of this course, the students will be able to: | | |
| CO 1 | Remember the concept of partial differential equation and to solve partial differential equations | $K_1$& $K_3$ |
| CO 2 | Analyze the concept of partial differential equations to evaluate the problems concerned with partial differential equations | $K_4$ & $K_5$ |
| CO 3 | Understand the concept of correlation, moments, skewness and kurtosis and curve fitting | $K_2$ |
| CO 4 | Remember the concept of probability to evaluate probability distributions | $K_1$ & $K_5$ |
| CO 5 | Apply the concept of hypothesis testing and statistical quality control to create control charts | $K_3$ & $K_6$ |

$K_1$ – Remember, $K_2$ – Understand, $K_3$ – Apply, $K_4$ – Analyze, $K_5$ – Evaluate, $K_6$ – Create

**Module I: Partial Differential Equations**

Origin of Partial Differential Equations, Linear and Non Linear Partial differential Equations of first order, Lagrange's Equations, Charpit's method, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients.

**Module II: Applications of Partial Differential Equations**

Method of separation of variables, Solution of wave and heat conduction equation up to two dimension, Laplace equation in two dimensions, Fourier integral, Fourier transform, Complex Fourier transform, Inverse transforms, Convolution Theorems, Fourier sine and cosine transform, Applications of Fourier transforms.

**Module III: Statistical Techniques I:**

Introduction: Moments, Skewness, Kurtosis, Curve Fitting , Method of least squares, Fitting of straight lines, Fitting of second degree parabola, Exponential curves, Correlation and Rank correlation, Regression Analysis: Regression lines of y on x and x on y, regression coefficients.

**Module IV: Statistical Techniques II:Probability and Distribution:** Introduction to probability, Random variables (Discrete and Continuous Random variable) Probability mass function and Probability density function, Discrete and Continuous Probability distribution: Binomial, Poisson and Normal distributions.

**Module V**: **Statistical Techniques III:Sampling, Testing of Hypothesis and Statistical Quality Control**: Introduction, SamplingTheory (Small and Large), Hypothesis, Null hypothesis, Alternative hypothesis, Testing a Hypothesis, Level of significance, Confidence limits, Test of significance of difference of means, t-test, Z-test and Chi-square test, Statistical Quality Control (SQC), Control Charts , Control Charts for variables ( $\overline{X}$ and R Charts), Control Charts for Variables ( p, np and C charts).

**Text Books**


1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003(Reprint).
3. S. Ross: A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.


**Reference Books**


1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
2. T. Veerarajan : Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi.
3. R.K. Jain and S.R.K. Iyenger: Advance Engineering Mathematics; Narosa Publishing House, New Delhi.
4. J.N. Kapur: Mathematical Statistics; S. Chand & Sons Company Limited, New Delhi.
5. D.N.Elhance, V. Elhance & B.M. Aggarwal: Fundamentals of Statistics; Kitab Mahal Distributers, New Delhi.


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# IAS301 / IAS401: Technical Communication

## Course Objectives:

- Students will be enabled to understand the nature and objective of Technical Communication relevant for the work place as Engineers.
- Students will be able to **develop** a deep understanding of key concepts of writing, designing and speaking.
- Students will **utilize** the technical writing for the purposes of Technical Communication and its exposure in various dimensions.
- Students will be able **build up** interpersonal communication traits that will make the transition from institution to workplace smoother and help them to excel in their jobs.
- Students will be able **use** communication to build their personal brand and **handle** crisis communication

**Unit-1: Fundamentals of Communication and Voice Dynamics:** Role and purpose of communication, Types and flow of Communication, Barriers to effective communication 7 C's of communication, Code and Content; Stimulus & Response, Vowel sounds, Consonant sounds, Tone: Rising and Falling Tone.

**Unit-2: Communication Skills for Career Building:** CV and Résumé Writing, Interview Skills, Group discussion, Effective Profiling, Networking Writing the statement of purpose (SOP), Paper writing and presenting.

**Unit-3**: **Communication Skills for Presentation: Writing, Designing, and Speaking:** Thesis and Project Report writing, Technical Proposal writing, Elements of Speech Delivery: Passion Poise & Illustrations, Conversation Starters, Pitches and Persuasion

**Unit-4: Communication and Leadership Development:** Leadership and Social competence: context, feelings, intentions, behaviors, Difference between Tact and Intelligence, The Art of Storytelling.

**Unit-5: Digital communication and Personality making:** Content creation for Social media: emails, webinars, podcasts, blogs. Communication for Cultural diversity and generation gap in digital environment, Speech and Personality, Personality Analysis: Types of Personality; Concept of Personality: Maslow, Freud, Vivekananda, Jung typology, Personality Assessment.

**Prescribed Books:**

- Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2018, New Delhi
- Personality Development and Soft Skills by Barun K. Mitra, OUP, 2012, New Delhi.
- Technical Communication, by Pfeiffer, 6th edn (Pearson)
- Practical Communication: Process and Practice by L.U.B. Pandey; A.I.T.B.S.Publications India Ltd.; Krishan Nagar, 2014, Delhi.

**Web link/ free resources for reference:**

- https://online.hbs.edu/blog/post/leadership-communication
- https://blog.hubspot.com/marketing/content-creation
- https://vincenttriola.com/blogs/ten-years-of-academic-writing/sigmund-freud-carl-jung-carl-rogers-abraham-maslow
- https://www.verywellmind.com/jungs-theory-of-personality-learning-styles-2795160
- https://www.humanmetrics.com/personality
- https://hbr.org/2022/11/how-great-leaders-communicate.

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# IVE 301 / IVE 401: Universal Human Values and Professional Ethics

**Objectives:**

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content, and process of value education.
2. To help students initiate a process of dialog within themselves to know what they really want to be in their life and profession.
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

**Course Outcome:**

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

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content, and process of value education, explore the meaning of happiness and prosperity, and do a correct appraisal of the current scenario in the society
2. Distinguish between the Self and the Body, and understand the meaning of Harmony in the Self and the Co-existence of Self and Body.
3. Understand the value of harmonious relationships based on trust, respect, and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society
4. Understand the harmony in nature and existence, and workout their mutually fulfilling participation in nature.
5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

**Catalogue Description**

Every human being has two sets of questions to answer for his life: a) what to do? And, b) how to do? The first set pertains to the value domain, and the other to the skill domain. Both are complimentary, but the value domain has a higher priority. Today, education has become more and more skill-biased, and hence, the basic aspiration of a human being, that is to live with happiness and prosperity, gets defeated, in spite of abundant technological progress. This course is aimed at giving inputs that will help to ensure the right understanding and right feelings in the students in their lives and professions, enabling them to lead an ethical life. In this course, the students learn the process of self-exploration, the difference between the Self and the Body, the naturally acceptable feelings in relationships in a family, the comprehensive human goal in society, the mutual fulfillment in nature, and the co-existence in existence. As a natural outcome of such inputs, they are able to evaluate an ethical life and profession ahead.

**UNIT-1 Course Introduction**- Need, Basic Guidelines, Content, and Process for Value Education Understanding the need, basic guidelines, content, and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation –as the mechanism for self-exploration, Continuous Happiness, and Prosperity-A look at basic Human Aspirations, Right understanding, Relationship, and Physical Facilities-the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly – A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

**UNIT-2 Understanding Harmony in the Human Being**-Harmony in Myself, Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer, and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, the meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

**UNIT-3 Understanding Harmony in the Family and Society**- Harmony in Human-Human Relationship Understanding harmony in the Family-the basic unit of human interaction, Understanding values in the human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect(Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in a relationship, Understanding the harmony in the society (society being an extension of the family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society-Undivided
Society (AkhandSamaj), Universal Order (Sarvabhaum Vyawastha) – from family to world family!.

**UNIT-4 Understanding Harmony in Nature and Existence** – Whole existence as Co-existence Understanding the harmony in Nature, Inter connectedness, and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

**UNIT-5 Implications of the above Holistic Understanding of Harmony on Professional Ethics** Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, 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, technologies, and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for the 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.

**Text Books:**

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.

**References:**

1. IvanIllich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people matter ed, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted1986, 1991
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
5. A Nagraj,1998, eevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak. 6. P L Dhar, R R Gaur,1990, Science and Humanism, Common wealth Publishers. 7. A N Tripathy, 2003, Human Values, New Age International Publishers.
8. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
9. E G Seebaue & Robert L.Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
10. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including HumanValues), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

**Mode of Evaluation:**

Assignment / Seminar / Continuous Assessment Test / Semester End Exam **Guidelines and**

**Content for Practice Sessions**

After every two lectures, there will be a one/two-hour practice session. This is meant to provide an opportunity to the students for carrying out self-exploration on the salient propositions made during the lectures. It is to clarify the concepts being introduced and connect them to their everyday life. Further it will also be utilised to make them evaluate their propensities and pre

conditionings vis-à-vis their 'natural acceptance' using examples and issues relevant to them in their day-to-day life situations. Keeping this objective in mind, the following exercises are being proposed for the practice sessions. These are sequentially arranged according to the lecture material. With each of these exercises, the expected outcome is also indicated to facilitate the teacher.

In the text-book, a larger set of practice exercises for self-exploration are given after each chapter, particularly in part 2, of test your understanding. A list of such exercises and the experiences of some of the students and teachers who have done these exercises is also available on the web-site. The teacher may select exercises from this set as well as develop appropriate exercises on their own. Ultimately, it is the teacher who has to use his/ her own creativity to make the best use of these sessions to guide the students towards the expected outcome.

**Practices Session**

**PS 9**

1. What are your personal goals or values that you would like to make effort for? Discuss with your family and find out the goals of other members. Is there a common family goal? What are the goals being pursued by your workplace or educational institution? How much of these

three sets of goals are aligned to each other? What is your role in the fulfilment of these three sets of goals?

2. Assuming that you would like to see your hostel/ educational institution/ workplace/ neighborhood as a model of human society, write down:

a. Its goal(s) – relate it to the four human goals and elaborate on what each goal means. Also develop some key indicators or measures which will show that the goals are realised

b. The system to achieve these goals – Make a comprehensive plan for the fulfilment of each goal. Relate it to the dimensions of human order.

3. Working on the dimension of Education-Sanskar and Sanyam-Health, suggest what programs can be taken up to to ensure right nutrition of the child along with the right sanskar.

**Expected Outcome:** The students are able to see that as a family, a society, the comprehensive human goal is naturally acceptable:

• Right understanding and right feeling in every human being

• Prosperity in every family

• Fearlessness (trust) in society

• Co-existence (mutual fulfilment) in nature/existence

They are able to see that the systems required for their fulfilment include:

Education-Sanskar, Health-Self regulation, Production-Work, Justice-Preservation and Exchange-Storage.

Meaningful participation by every individual, every family, every family cluste, every village, town, city… country and the whole world is required in these systems for the human goals to be fulfilled.

They are also able to see that presently they do not have definite goals and their family goals are unknown or not clearly defined. The goals of their educational institution or workplace are articulated as vision-mission-goals-objectives-values etc. These various goals need to be aligned for them to appreciate, commit and fully participate in their fulfilment. Presently there is neither clarity nor alignment, so there is limited focused effort. They start to refine their goals and think about how to discuss them in their family, in their hostel, institution etc. and make more focused effort.

**Socially Relevant Projects**

*Projects may be chosen to develop all the three aspects, in order of priority:* •

- Right understanding
- Relationship (right feeling and right thought)
- Skills for living in harmony

For illustration, let us take a project of tree plantation. It should help the teacher and students to:

1. Experience and understand mutual fulfillment in nature.

2. Understand human participation in enrichment, protection and right utilization of rest of the nature as well as to get a feel for prosperity within. i.e. get an idea of

a. Right utilization of the products from the tree (like fruit, vegetables, wood etc.)

b. Protection and nurturing of the trees planted; at least to be aware not to damage existing trees while planting the new ones.

3. Planning and Physical plantation of the tree.

The tree plantation project can be helpful in developing the three aspects mentioned. Of course, if they are doing tree plantation primarily as a task to be done or a means to get attention and some press coverage, then the project with the same physical tasks will not be as productive for this course.

Projects should take into consideration local requirements – it should be socially relevant. For instance, a gasifier power generation project in a city can use the waste wood, leaves, cardboard and paper etc. and contribute the clean power in the neighborhood power grid using a net-meter.

***Projects can be of three types:***

1. Study – Observing/Recognizing/Survey/Proposing a solution. e.g. finding out the change in water table in the local area and potential sustainable solutions

2. Modelling / Prototyping – Analysing, doing on a small scale and for a short term. e.g. developing a prototype of a pedal driven generator

3. Implementation – on some scale and for the long term. e.g. establishing an evening school in the local community, solar based lighting and pumping in the village community

***Some topics:***

1. Find out the quantity of food-grain (rice, wheat, corn, jowar etc.) that your family consumes annually. Taking this as the base, find out the total requirement of food-grain for your country. Find out the total production of food-grain in your country. Is the production sufficient? Articulate your conclusions

2. What do we consider important as a family -understanding, relationship and/ or physical facility? Is our time and effort applied for what we consider important? What do we evaluate at the end of every month? Discuss this at home and articulate your conclusions

3. Does my family have sufficient physical facility for my physical needs? Is my family prosperous? What do we need for feeling prosperous? Discuss this at home and articulate your conclusions

4. For the proper development of a child, there is a need to ensure a proper system in the society and make an appraisal of the current state. As a project work, find out the following in the society regarding the nutrition of children:

   a. The demographic divide

   b. Present social determinant of Health

   c. Current child Health Policies

   d. Involvement of Society and steps to be taken in this direction

Suggest policies which would ensure a better state of the society in terms of the above. 5. Find out how much

water is available (rain, rivers, canals), how much water is needed

6. Find out how much water is available annually, and how much is used to generate electricity

7. Find out about power generation from low-head flowing-water, i.e. without making any dams. Can this system be cyclic and mutually-enriching?

8. Find out the change in water table in the local area and suggest possible sustainable solutions

9. List Socially Relevant Work in your state, nearby states, whole country, nearby countries, whole world

10. What is one valuable lesson from your tradition? Study its impact on Trust in your family

11. Document your understanding of the meaning of Health of your Body and the Programme for Health

12. Study the needs of families around your campus that are selling liquor. Suggest ways that they can meet their needs in a mutually fulfilling manner, rather than taking to means that are harmful for the society

13. Study the 'Sulabh-Shauchalaya' organisation and systems. Write a case study report on it with sections on its eco-friendly sustainable technology and human-friendly entrepreneurial system

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# INC 301 / INC 401: Computer System Security

| Course Outcome ( CO) | | Bloom's Knowledge Level (KL) |
|---|---|---|
| At the end of course, the student will be able to | | |
| CO 1 | Remember and understand the basic terminologies and concepts of security threats and cybercrimes. | K1, K2 |
| CO 2 | Remember and understand the approaches used in OS security, concept of buffer overflow and SQL injection attack | K1, K2 |
| CO 3 | Remember and understand the TCP layer security, Firewalls and security models | K1, K2 |
| CO 4 | Remember and understand various cryptographic primitives and their purposes | K1, K2 |
| CO 5 | Understand the various aspects of cyber attacks, cyber security policies and cyber laws | K1, K2 |
| **DETAILED SYLLABUS** | | |

| Unit | Topic | Lecture |
|---|---|---|
| **I** | Overview of Computer Security Concepts : Threats, Active and passive Attack, User Identification and Authentication, Message Integrity, Non-repudiation, Availability, Access Control, Database and Cloud Security, Malicious Software, Proxy Servers and Anonymizers, Phishing, Identity Theft, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan-horses and Backdoors, DoS and DDoS Attacks | **06** |
| **II** | Overview of Linux/Unix Security and Database Security**:** Unix/Linux Security Architecture, User Account, Superuser, Group, Login/password, Shadow Password File, The Inode, Permissions for Directories, Acess Control: Set UserID and Set GroupID, Changing Permissions, Changing the Root of the Filesystem, Environment Variables, Audit Logs and Intrusion Detection, Buffer Overflow, Scripting , SQL Injection Attacks | **06** |
| **III** | TCP Session Hijacking, TCP SYN Flooding Attacks, Domain Name System, Cache Poisoning Attack, DNS Rebinding Attack, SSL Connection<br>Intrusion Detection, Firewalls and Intrusion Prevention Systems<br>Bell–LaPadula Model and Biba Model of security<br>Management Issues: Security Management and Risk Assessment, Human Resources Security, Legal and Ethical Aspects | **06** |
| **IV** | Overview of Cryptographic Techniques: Symmetric Encryption, Decryption, Public Key Cipher, Authentication, Message Authentication Codes, Key Exchanges, Steganography, Digital signatures, Public Key Infrastructure, Electronic Payments Systems | **06** |
| **V** | Cybercrimes, Cyber stalking, Botnets. Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Privacy Threats, Challenges in Computer Forensics.<br>Introduction to security policies and cyber laws: Need for An Information Security Policy, Introduction to Indian Cyber Law, Objective and Scope of the Digital Personal Data Protection Act 2023, Intellectual Property Issues, Overview of Intellectual Property Related Legislation in India, Patent, Copyright, Trademarks. | **06** |

**Text books:**

1. Dieter Gollman, “Computer Security”, 3rd edition, Wiley.
2. William Stallings, Lawrie Brown, "Computer Security: Principles and Practice", 3rd edition, Prentice Hall.
3. Sunit Belapure and Nina Godbole, “Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives”, Wiley India.

**Reference books:**

1. T. J. Mowbray, “Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions”, John Wiley & Sons.
2. J. Graham, R. Olson and R. Howard, “Cyber Security Essentials”, CRC Press.
3. Anti Hacker Tool Kit (Indian Edition) by Mike Shema, McGraw-Hill.

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# INC 302 / INC 402: Python Programming

| Course Outcome ( CO) | | Bloom's Knowledge Level (KL) |
|---|---|---|
| **At the end of course, the student will be able to understand** | | |
| CO 1 | Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements. | K1, K2 |
| CO 2 | Demonstrate proficiency in the handling of strings and functions | K1, K2 |
| CO 3 | Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets. | $K_3$ |
| CO 4 | Identify the commonly used operations involving file systems and regular expressions. | K1, K2 |
| CO 5 | Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python | K2, K3 |

**DETAILED SYLLABUS**

| Unit | Topic | Lecture |
|---|---|---|
| **I** | **Introduction to Python:** Python variables, Python basic Operators, Understanding python blocks. Python Data Types, Declaring and using Numeric data types: int, float etc. | **06** |
| **II** | **Python Program Flow Control Conditional blocks:** if, else and else if, Simple for loops in python, For loop using ranges, string, list and dictionaries. Use of while loops in python, Loop manipulation using pass, continue, break and else. Programming using Python conditional and loop blocks. | **06** |
| **III** | **Python Complex data types:** Using string data type and string operations, Defining list and list slicing, Use of Tuple data type. String, List and Dictionary, Manipulations Building blocks of python programs, string manipulation methods, List manipulation. Dictionary manipulation, Programming using string, list and dictionary in-built functions. Python Functions, Organizing python codes using functions. | **06** |
| **IV** | **Python File Operations**: Reading files, Writing files in python, Understanding read functions, read(), readline(), readlines(). Understanding write functions, write() and writelines() Manipulating file pointer using seek Programming, using file operations. | **06** |
| **V** | **Python packages:** Simple programs using the built-in functions of packages matplotlib, numpy, pandas etc. GUI Programming: Tkinter introduction, Tkinter and PythonProgramming, Tk Widgets, Tkinter examples. Python programming with IDE. | **06** |

**Books:**


1. Wesley J. Chun, "Core Python Applications Programming", 3rd Edition , Pearson Education, 2016
2. Lambert, Fundamentals of Python: First Programs with MindTap, 2nd 1st edition , Cengage Learning publication
3. Charles Dierbach, "Introduction to Computer Science using Python", Wiley, 2015
4. Jeeva Jose & P.SojanLal, "Introduction to Computing and Problem Solving with PYTHON", Khanna Publishers, New Delhi, 2016
5. Downey, A. et al., "How to think like a Computer Scientist: Learning with Python", John Wiley, 2015
6. Mark Lutz, "Learning Python", 5th edition, Orelly Publication, 2013, ISBN 978- 1449355739
7. John Zelle, "Python Programming: An Introduction to Computer Science", Second edition, Course Technology Cengage Learning Publications, 2013, ISBN 978- 1590282410
8. Michel Dawson, "Python Programming for Absolute Beginers" , Third Edition, Course Technology Cengage Learning Publications, 2013, ISBN 978-1435455009
9. David Beazley, Brian Jones., "Python Cookbook", Third Edition, O'relly Publication, 2013.


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# INC-305 Research Methodology

| CO | Statement | Knowledge Level, |
|---|---|---|
| Upon the completion of the course, the student will be able to: | | |
| **CO1** | Learn about the basics of research, need of research, methods and problems in research, presentation of research. | K1 |
| **CO2** | Understand the types of data and collection of data along with the selection of appropriate method of data collection. | K2 |
| **CO3** | Analyze and evaluate the data using different descriptivemeasures and present them graphically. And, also the data estimation and fit the regression models along with measurement of different components of the time-series | K3 |
| **CO4** | Evaluate the sampling of data and create detailed report along with knowledge of plagiarism. | K4, K6 |

*K1 – Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate K6 – Create*

**UNIT I**

**Introduction:** Nature and objectives of research, Study and formulation of researchproblem, Scope and formulation of hypothesis, Research Methods versus Methodology.

**Defining the Research Problem:** What is a Research Problem? Selecting the Problem, Necessity of Defining the Problem.

**UNIT II**

**Methods of Data Collection:** Collection of primary data, Observation method, Interview method, Collection of data through questionnaires, Collection of data through schedules, Difference between questionnaires and Schedules, Collection of secondary data, Selectionof appropriate method for data collection, Case study method

**UNIT III**

**Processing and Analysis of Data:** Measures of central tendency and dispersion, Linear regression, Least square principle and fitted models, Karl Pearson's correlation coefficient,Rank correlation, Lines of regression, estimation of data.

**UNIT IV**

**Sampling Fundamentals:** Need for sampling, some fundamental definitions, Important sampling distributions, Central limit theorem, Sampling theory, Sandler's *A*-test, Concept of standard error, Estimating the population,

**Technical Writing and reporting of research:** Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing, Research Journals, Intellectual property, Plagiarism.

**Text Book/Reference Books**


1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques, NewAge International publishers, Third Edition.
2. Dowdy, S., Wearden, S. and Chilko, D., Statistics for Research, Wiley series(2004). 2nd ed.
3. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K., Probability and Statistics forEngineers and Scientists, Dorling Kindersley (2007). 7th ed.
4. Jhonson, R.A, Gupta C. B., Miller and Freund's Probability and Statistics forEngineers, Dorling Kindersley (2007). 7th ed.
5. Meyer, P.L. Introductory Probability and Statistical Applications, Addison Wesley(1970).
6. Medhi, J., Stochastic Processes, New Age International, 2005.
7. Goon, Gupta, Das, Gupta, Fundamental of Statistics, Vol II, Wold Press, 1999


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# INC-405 Practices and Ethical Issues In Research

**L T P: 2 0 0**

| Course Outcome | Statement | Knowledge Level, *KL* |
|---|---|---|
| | Upon the completion of the course, the student will be able to: | |
| **CO1** | Learn about the overview of theories, basics of research, Ethics with respect to science and research, Nature of moral judgements and reactions | K1 |
| **CO2** | Understand the academic integrity and academic research along with the research misconduct, falsification, manipulation of data, and publication ethics | K2 |
| **CO3** | Analyze the criteria and principles for good research practice. Meaning of scientific misconduct and fraud. Cases and procedures for establishing misconduct, preventions and sanctions. | K3 |
| **CO4** | Apply acquire skills of presenting arguments and create results of ethical inquiries along with the fundamentals of computer role in research | K6 |

*K1 – Remember K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate K6 – Create*

**UNIT-I**

**Introduction to ethics and research ethics:** Overview of theories and methods in ethics and research ethics, Nature and objectives of research, Ethics with respect to science and research, Nature of moral judgements and reactions.

**Academic Integrity:** Research Misconduct/Fabrication/Unethical Practices

**UNIT-II**

**Academic/Research:** Falsification, Manipulation or Tempering of Data, Literature Review and Proper Use of E-Resources, Using Design thinking Methods to Avoid Plagiarism, Writing Quality.

**Academic Publications:** Challenges to avoid plagiarism Scientific Reading, Cite and Write Report writing using popular word processing packages such as MS word, Open Office etc., Style Manuals and Bibliographies. Ex. APA, MLA, Chicago, IEEE

**UNIT-III**

**Good research practice, research integrity and scientific misconduct:** Criteria and principles for good research practice. Meaning of scientific misconduct and fraud. Cases and procedures for establishing misconduct, preventions and sanctions.

**How to handle data:** The meaning of secrecy and confidentiality, Features and Functionalities of Anti-Plagiarism Software, Organization dealing with plagiarism issues (eg. Retract/Deluze)

**UNIT-IV**

**Responsibility for the results of research:** Responsibility for research and the results and consequences of research. The limits of responsibility. Risks and the precautionary principle. Study and formulation of research problem, Scope and formulation of hypothesis, Preparation and presentation of research results and in project proposals.

**Text Book/Reference Books**


8. Collste, G, Introduction to Ethics.
9. De Peol & Royakkers 2011, Ethics, Technology and Engineering, 8.3 The Engineers Responsibility for Safety (pp 223-238)
10. Loue, S., Textbook of Research Ethics: Theory and Practice, Springer (2002). 1st ed.
11. Dowdy, S., Wearden, S. and Chilko, D., Statistics for Research, Wiley series (2004). 2nd ed


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# IOE 030 / IOE 040: Laser Systems and its Applications

**Course Outcomes:**

| On completion of course the students are able : | | |
|---|---|---|
| **CO No.** | **CO Statement** | **BTL** |
| **CO1** | To understand the basic concept of coherence , absorption and emission process of radiation. | Understanding |
| **CO2** | To understand the concept of population inversion necessary for laser action and laser gain and optical cavities. | Understanding, Analyze |
| **CO3** | To understand the laser action in various energy levels. | Understanding, Apply |
| **CO4** | To study different types of lasers such as gas laser liquid laser solid laser, semiconductor laser with examples. | Understanding, Apply |
| **CO5** | To know the application of laser in different fields such as medical, industrial, communication etc. applications along with safety consideration. | Apply |

**Unit I: Laser Introduction, Energy Levels and Transition: [8]**

Introduction, Definition, Properties of laser beams, Concept of coherence, Temporal coherence, Spatial coherence, Longitudinal Coherence length, Transverse Coherence length, Absorption, Spontaneous Emission and Stimulated emission processes with its characteristics, Einstein's A and B coefficients and Relation between these coefficient.

**Unit II: Laser Amplifiers and Oscillations [9]**

Population inversion, Meta stable state, Pumping- types, Optical pumping methods, Two, three and four level pumping schemes, Gain in lasers, Gain factor, Optical Cavities/Resonators, Fabry-Perot optical resonator, Loop gain, Gain at threshold, Stability, Stability diagram.

**Unit III: Laser component, Principle and Types. [6]**

Main components of Laser, Principle of Laser action, Introduction to general lasers and their types. Two, Three & Four level Lasers, CW Lasers, Pulsed Lasers, Method of Short pulse generation and its Measurement. **Unit IV: Specific Laser Systems: [9]**

Atomic gas Lasers – He-Ne laser, Argon Ion Laser; Molecular Gas Lasers- Carbon dioxide laser, excimer laser; Liquid Lasers- Organic dye lasers, Solid Sate Lasers- Ruby lasers, Nd-YAG Laser, Semiconductor diode laser.

**UNIT V: Applications and Hazards and Safety Consideration : [10]**

Laser applications in medicine and surgery- effect of laser on biological tissues, diagnostic of disease, ophthalmology, general surgery, dermatology, dentistry, advantages and disadvantages; Laser applications in materials processing – hole drilling, cutting, laser hardening, advantage and disadvantage of laser in material processing; Laser applications in optical communication; Laser applications in metrology; Laser applications in LIDAR; Laser applications in holography; Laser hazards and safety consideration.

## Reference Books:

1. K.R. Nambiar, "Laser Principles, Types and Application" New Age International.
2. S. A. Ahmad, "Laser concepts and Applications" New Age International.
3. A. K. Katiyar, C. K. Pandey and Manisha Bajpai, Fundamentals of Laser Systems and Applications.

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# IOE 031 / IOE 041: Polymer Science & Technology

**(For Students other than Chemical Engineering and allied branches)**

**Course Aim** The aim of this course is to provide students with a comprehensive view of polymer science and technology, including the chemical structure of various polymers, methods of measuring the molecular weight, polymerization kinetics, and polymer processing technologies. The focus is mainly on processing of polymers as well as on the behavior and technical applications of different polymeric materials.

**Course Objectives:** To provide fundamental and applied knowledge of polymers and their synthesis, manufacturing, processing, characterization and applications of polymers in space, oceans, electronics, agriculture, automobile, sports and building constructions.

| Unit | Topics | Lectures Hours |
|---|---|---|
| 1 | Introduction, Chemistry of Polymer Synthesis, Classification, Functionality, Tacticity, Crystallinity in Polymers and its Effect on Properties of Polymers, Concepts of Average Molecular Weight in Polymers, Polymer Reaction Kinetics, Physical Properties, Factors Affecting Strength. | 8 |
| 2 | Effect of Structure on Properties of Polymers, Organic Polymers, Step Growth and Chain Growth Polymerization and its Mechanism, Coordination Polymerization, Copolymerization. | 8 |
| 3 | Polymer Processing, Injection, Moulding, Blow Moulding, Compression Moulding, Introduction to High Performance Polymers and Polymer Composites. | 8 |
| 4 | Preparation, Properties and Technical Applications of Thermoplastic (PVC, PVA, PTEE), Thermostats (PF, UF, MF) and Elastomers (SBR, Nitril Rubber, Butyl Rubber, Polychloroprene), Vulcanization of Rubber and its advantages, Biopolymers and Degradation of Polymers. | 8 |
| 5 | Epoxy Resins, Silicones, Application of Polymer in Space, Ocean, Electronics, Medical, Agriculture, Automobile, Sports and Building Construction. | 8 |

**Course Outcomes:** Upon completion of this course, the students will be able to:

| Units | Course Outcomes | Bloom's Levels |
|---|---|---|
| U-1 | Understand the concept of polymer synthesis, Functionality, Crystallinity, Calculation of average molecular weight, reaction kinetics, physical properties and factors affecting the strength of polymers. | K4 |
| U-2 | Understand the properties of polymers, types and mechanism of polymerization. | K3 |
| U-3 | Understand and apply the various processing and manufacturing techniques, high performance polymer and polymer composites. | K3 |
| U-4 | Understand the preparation, properties and technical applications of polymers. | K3 |
| U-5 | Understand the applications of different polymeric materials in current scenario of development. | K3 |

**Text Books:**


1. Polymer Science, Wiley & Sons, 3rd Edition, By Billmeyer, F.W. Jr. ISBN: 978-8126511105 (2007).
2. Fundamentals of Polymers, McGraw Hill By Kumar, A., Gupta, R. K. ISBN: 0-8247-0867-9 (2003).
3. Polymer Science and Technology, 3rd Edition, Prentice Hall By Joel R Fried, ISBN: 978-0- 13-703955-5, (2014).
4. Polymer Science and Technology, 1st Edition, CRC Press Inc By Robert O Ebewele, ISBN: 978-0849389399 (2000).
5. Polymer Science and Technology, 3rd Edition, McGraw Hill Education (India) Private Limited, By Ghosh Premamoy, ISBN: 978-0070707047 (2011).


**Reference Books:**


1. Principles of Polymer Processing, 2nd Edition, Wiley Interscience, Tadmo, Z; Gogos, C.G., ISBN: 0-471-38770-3 (2006).
2. Polymer Science and Engineering, Prentice Hall of India, Williams, D. J., ISBN: 978-0136856368 (1971).
3. Handbook of Polymer Science and Technology, 1st Volume, 1st Edition, CBS Publication By Ferry MH, ISBN: 978-8123911328 (2012).


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# IOE 032/ IOE042 Engineering Mechanics

| Unit | Topics | Contact Hours |
|---|---|---|
| I | Two-dimensional force systems: Basic concepts, Laws of motion, Principle of transmissibility of forces, transfer of a force to parallel position, resultant of a force system, simplest resultant of two dimensional concurrent and non-concurrent force systems, distribution of force systems, free body diagrams, equilibrium and equations of equilibrium.<br>Friction: Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction. | 8 |
| II | Beam: Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams.<br>Trusses: Introduction, simple truss and solution of simple truss, methods of F-joint and methods of sections. | 10 |
| III | Centroid and moment of inertia: Centroid of plane, curve, area, volume and composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principle moment of inertia, mass moment of inertia of circular ring, disc, cylinder, sphere, and cone about their axis of symmetry. | 7 |
| IV | Kinematics of rigid body: Introduction, plane motion of rigid body, velocity and acceleration under translational and rotational motion, relative velocity.<br>Kinetics of rigid body: Introduction, force, mass and acceleration, work and energy, impulse and momentum, D'Alembert's principle and dynamic equilibrium. | 8 |
| V | Simple stress and strain: Introduction, normal and shear stresses, stress-strain diagrams for ductile and brittle material, elastic constants, one-dimensional loading of members of varying cross sections, strain energy.<br>Pure bending of beams: Introduction, simple bending theory, stress in beams of different cross sections.<br>Torsion: Introduction, torsion of shafts of circular cross sections, torque and twist, shear stress due to torque. | 10 |

**Course Outcomes:** At the end of this course, the students will be able to:

| COs | Statements |
|---|---|
| CO1 | To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering. |
| CO2 | Analysis of forces on beams and trusses. |
| CO3 | To evaluate centroid for different geometries. |
| CO4 | To implement the concept of Kinematics and Kinetics of rigid body. |
| CO5 | To understand about stress and strain. |

## Reference Books:


1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010).
3. A Textbook of Engineering Mechanics, R.K. Bansal, Laxmi Publications.
4. Engineering Mechanics, R.S. Khurmi, S.Chand Publishing.
5. Meriam J.L. and Kraige L.G., "Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons (1993).
6. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3 rd Edition,Vikas Publishing House Pvt. Ltd., (2005).
7. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, (1998).
8. Engineering mechanics by Irving H. Shames, Prentice-Hall.


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# IOE 033/ IOE043 Materials Science

| Unit | Topics | Hours |
|---|---|---|
| I | Phase Diagrams:<br>Solid solutions – Hume Rothery's rules – the phase rule – single component system – one-component system of iron – binary phase diagrams – isomorphous systems – the tie-line rule – the lever rule – application to isomorphous system – eutectic phase diagram – peritectic phase diagram – other invariant reactions – free energy composition curves for binary systems – microstructural change during cooling. | 8 |
| II | Ferrous Alloys:<br>The iron-carbon equilibrium diagram – phases, invariant reactions – microstructure of slowly cooled steels – eutectoid steel, hypo and hypereutectoid steels – effect of alloying elements on the Fe-C system – diffusion in solids – Fick's laws – phase transformations – T-T-T-diagram for eutectoid steel – pearlitic, baintic and martensitic transformations – tempering of martensite – steels – stainless steels – cast irons. | 10 |
| III | Mechanical Properties:<br>Tensile test – plastic deformation mechanisms – slip and twinning – role of dislocations in slip – strengthening methods – strain hardening – refinement of the grain size – solid solution strengthening – precipitation hardening – creep resistance – creep curves – mechanisms of creep – creep-resistant materials –fracture – the Griffith criterion – critical stress intensity factor and its determination – fatigue failure – fatigue tests – methods of increasing fatigue life – hardness – Rockwell and Brinell hardness – Knoop and Vickers microhardness. | 7 |
| IV | Magnetic, Dielectric & Superconducting Materials:<br>Ferromagnetism – domain theory – types of energy – hysteresis – hard and soft magnetic materials – ferrites – dielectric materials – types of polarization – Langevin-Debye equation – frequency effects on polarization – dielectric breakdown – insulating materials – Ferroelectric materials – superconducting materials and their properties. | 8 |
| V | New Materials:<br>Ceramics – types and applications – composites: classification, role of matrix and reinforcement, processing of fiber reinforced plastics – metallic glasses: types, glass forming ability of alloys, melt spinning process, applications – shape memory alloys: phases, shape memory effect, pseudoelastic effect, NiTi alloy, applications – nanomaterials: preparation (bottom up and top-down approaches), properties and applications – carbon nanotubes: types. | 10 |

**Course Outcomes:** At the end of this course, the students will be able to:

| COs | Statements |
|---|---|
| CO1 | To understand phase diagrams and explain the phenomenon of microstructure development. |
| CO2 | To understand different ferrous alloy and its microstructure. |
| CO3 | To understand in detail about various mechanical properties. |
| CO4 | To study about different Magnetic, Dielectric & Superconducting Materials. |
| CO5 | Study about composites and its different types. |

**Reference Books:**


1. Balasubramanian, R. ―Callister's Materials Science and Engineering‖. Wiley India Pvt. Ltd., 2014.
2. Raghavan, V. ―Physical Metallurgy: Principles and Practice‖. PHI Learning, 2015.
3. Raghavan, V. ―Materials Science and Engineering: A First course‖. PHI Learning, 2015.
4. Askeland, D. ―Materials Science and Engineering‖. Brooks/Cole, 2010.
5.Smith, W.F., Hashemi, J. & Prakash, R. Materials Science and Engineering‖. Tata McGraw Hill Education Pvt. Ltd., 2014.
6. Wahab, M.A. ―Solid State Physics: Structure and Properties of Materials‖. Narosa Publishing House, 2009


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# IOE034 / IOE044: Energy Science & Engineering

| | Course Outcomes | Cognitive Level |
|---|---|---|
| | **After completing the course the students will be able to:** | |
| **CO1** | Understand the energy concepts, conversion processes, and their environmental consequences. | Understand |
| **CO2** | Understand the diverse non-conventional energy sources, including wind, geothermal, ocean thermal, and hydropower, enabling them to analyze, design, and contribute to sustainable energy solutions and advancements in renewable energy technologies. | Understand |
| **CO3** | Analyse and contribute to advancements in nuclear science, technology, and safety protocols. | Analyse |
| **CO4** | Understand solar energy principles, semiconductor physics, photovoltaic device operation, and various generations of solar cells, enabling them to design, analyse, and contribute to the development and application of solar energy technologies. | Understand |
| **CO5** | Understand the fuel cycles, environmental impact, energy storage, conservation strategies, and green engineering principles. | Understand |

**Unit-1: Energy and its Usage:** Classification of energy sources, Common forms of energy, Units and scales of energy use, Mechanical energy and transport, Heat energy: Conversion between heat and mechanical energy, Electromagnetic energy: Storage, conversion, transmission and radiation, Energy in chemical systems and processes, flow of CO2, Entropy and temperature, carnot and Stirling heat engines, Phase change energy conversion, refrigeration and heat pumps, World energy status, Energy scenario in India, Environmental aspects of energy.

**Unit-2: Conventional & Non-Conventional Energy sources:** Biological energy sources and fossil fuels, Fluid dynamics and power in the wind, available resources, fluids, viscosity, types of fluid flow, lift, Wind turbine dynamics and design, wind farms, Geothermal power and ocean thermal energy conversion, Tidal-wave/ hydropower, Miscellaneous Non-conventional energy technologies.

**Unit-3: Nuclear Energy:** Fundamental forces in the universe, Quantum mechanics relevant for nuclear physics, Nuclear forces, energy scales and structure, Nuclear binding energy systematics, reactions and decays, Nuclear fusion, Nuclear fission and fission reactor physics, Nuclear fission reactor design, safety, operation and fuel cycles, Biological effects of radiation, calculation of radiation effects, computation of exposure and dose, philosophy of reactor safety & containment.

**Unit-4: Solar Energy:** Introduction to solar energy, fundamentals of solar radiation and its measurement aspects, Basic physics of semiconductors, Carrier transport, generation and recombination in semiconductors, Semiconductor junctions: metal-semiconductor junction & p-n junction, Essential characteristics of solar photovoltaic devices, First Generation Solar Cells, Second Generation Solar Cells, Third Generation Solar Cells, Applications of solar energy.

**Unit-5: Systems and Synthesis:** Fuel cycles, waste and proliferation, Climate change, Energy storage, Energy conservation. Engineering for Energy conservation: Concept of Green Building and Green Architecture; Green building concepts, LEED ratings; Identification of energy-related enterprises that represent the breadth of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption.

**Reference/Text Books**


1. Non-Conventional Energy Resources, B. H. Khan, Mc Graw Hill Education.
2. Energy and the Challenge of Sustainability, World Energy Assessment, UNDP, New York.
3. Introductory Nuclear Physics, R. K. Puri and V.K. Babbar, Narosa Publishing House.
4. Physics of Solar Cells: From Basic Principles to Advanced Concepts by Peter Wurfel, John Wiley & Sons.
5. Principles of Solar Engineering, D.Y. Goswami, F. Kreith and J.F. Kreider, Taylor and Francis, Philadelphia.


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# IOE035 / IOE045: Sensor & Instrumentation

| | Course Outcomes | Cognitive Level |
|---|---|---|
| | **After completing the course the students will be able to:** | |
| **CO1** | Understand the energy concepts, conversion processes, and their environmental consequences. | Understand |
| **CO2** | Understand the diverse non-conventional energy sources including wind, geothermal, ocean thermal, and hydro power, enabling them to analyze, design, and contribute to sustainable energy solutions and advancements in renewable energy technologies. | Understand |
| **CO3** | Understand and contribute to advancements in nuclear science, technology, and safety protocols. | Understand |
| **CO4** | Understand solar energy principles, semiconductor physics, photovoltaic device operation, and various generations of solar cells, enabling them to design, analyse, and contribute to the development and application of solar energy technologies. | Understand |
| **CO5** | Understand the fuel cycles, environmental impact, energy storage, conservation strategies, and green engineering principles. | Understand |

**Unit-1:** Definition, Classification & selection of sensors, Measurement of displacement using Potentiometer, LVDT & Optical Encoder, Measurement of force using strain gauge, Measurement of pressure using LVDT based diaphragm & piezoelectric sensor.

**Unit-2:** Measurement of temperature using Thermistor, Thermocouple & RTD, Concept of thermal imaging, Measurement of position using Hall effect sensors, Proximity sensors: Inductive & Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive.

**Unit-3:** Graphical programming techniques, Data types, Advantage of Virtual Instrumentation techniques, Concept of WHILE & FOR loops, Arrays, Clusters & graphs, Structures: Case, Sequence & Formula nodes, Need of software based instruments for industrial automation.

**Unit-4:** Basic block diagram, Analog and Digital IO, Counters, Timers, Types of ADC: successive approximation and sigma-delta, Types of DAC: Weighted Resistor and R-2R Ladder type, Use of Data Sockets for Networked Communication.

**Unit-5:** General Structure of smart sensors & its components, Characteristics of smart sensors: Self-calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.

**Text/ Reference Books:**


1. DVS Murthy, Transducers and Instrumentation, PHI.
2. D Patranabis, Sensors and Transducers, PHI.
3. S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & Process Control, 2nd ED, Instrument Society of America, 1994.
4. Gary Johnson / Lab VIEW Graphical Programing, McGraw Hill.
5. Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI.
6. A.D. Helfrick and W.D. Cooper, Modern Electronic Instrumentation & Measurement Techniques, PHI.
7. Hermann K.P. Neubert, “Instrument Transducers”, Oxford University Press.


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# IOE 036 / IOE 046: Basics of Data Structures and Algorithms

| Course Outcome ( CO) | | Bloom's Level |
|---|---|---|
| **At the end of course, the student will be able to understand** | | |
| **CO 1** | Understand linear data structures, their implementation and application | **K3, K4** |
| **CO 2** | Understand stack and queue and demonstrate the knowledge in the application to the problems involving recursion | **K3, K4** |
| **CO 3** | Implementation of binary tree, tree operations including traversal. | **K2, K3** |
| **CO 4** | Understanding Graph, graph operations, implementation and applications. | **K2, K3** |
| **CO 5** | Understand and analyze the complexity of various sorting algorithms | **K3, K4** |

**DETAILED SYLLABUS**

| Unit | Topic | Lecture |
|---|---|---|
| **I** | **Introduction:** Basic Terminology, Elementary Data Organization, Built in Data Types in C, Efficiency of an Algorithm, Asymptotic notations, Abstract Data Types (ADT)<br>**Arrays**: Definition, Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order.<br>**Linked lists:** Array Implementation and Pointer Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition Subtraction & Multiplications of Single variable & Two variables Polynomial. | 08 |
| **II** | **Stacks:** Abstract Data Type, Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Iteration and Recursion- Principles of recursion, Fibonacci numbers, and Hanoi towers, Tradeoffs between iteration and recursion.<br>**Queues:** Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues in C, Dequeue and Priority Queue. | 08 |
| **III** | **Trees:** Basic terminology used with Tree, Binary Trees, Binary Tree Representation: Binary Search Tree, Strictly Binary Tree, Complete Binary Tree, Extended Binary Trees, Tree Traversal algorithms: Inorder, Preorder and Postorder, Constructing Binary Tree from given Tree Traversal, Insertion , Deletion, Searching & Modification of data in Binary Search tree. | 08 |
| **IV** | **Graphs:** Terminology used with Graph, Data Structure for Graph Representations: Adjacency Matrices, Adjacency List, Graph Traversal: Depth First Search and Breadth First Search, Minimum Spanning Trees, Prim's and Kruskal's algorithm. Shortest Path algorithms. | 08 |
| **V** | **Searching:** Concept of Searching, Sequential search, Index Sequential Search, Binary Search. Concept of Hashing & Collision resolution Techniques used in Hashing.<br>**Sorting:** Insertion Sort, Selection, Bubble Sort, Quick Sort, Merge Sort, Heap Sort and Radix Sort. | 08 |

**Text books:**


1. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein, "Data Structures Using C and C++", PHI Learning Private Limited, Delhi India
2. Lipschutz, "Data Structures" Schaum's Outline Series, Tata McGraw-hill Education (India) Pvt. Ltd.


**Reference books:**


1. Horowitz and Sahani, "Fundamentals of Data Structures", Galgotia Publications Pvt Ltd Delhi India.
2. Gilberg, Forouzan, Data Structures: A Pseudocode Approach with C 3rd edition , Cengage Learning publication
3. R. Kruse etal, "Data Structures and Program Design in C", Pearson Education.
4. Berztiss, AT: Data structures, Theory and Practice, Academic Press.
5. Jean Paul Trembley and Paul G. Sorenson, "An Introduction to Data Structures with applications", McGraw Hill.

# IOE 037 / IOE 047: Computer Based Numerical Techniques

| Course Outcome ( CO) | | Bloom's Level |
|---|---|---|
| **At the end of course , the student will be able to:** | | |
| CO 1 | Understand the concept of errors in numerical computation and able to apply methods to find roots of equations | $K_3$, $K_4$ |
| CO 2 | Apply the methods and write computer algorithms to find interpolating polynomials for the given data | $K_3$, $K_4$ |
| CO 3 | Analyse and apply the methods to find the best fit polynomial and non polynomial curves for the given data | $K_3$, $K_4$ |
| CO 4 | Apply the methods, analyze the convergence and write algorithms to solve given system of equations | $K_3$, $K_4$ |
| CO 5 | Remember the concept of formula based the solution of differentiation, integration methods and ordinary differential equations and write computer algorithms | $K_3$ |

**DETAILED SYLLABUS**

| Unit | Topic | Lecture |
|---|---|---|
| **I** | **Introduction to Computer Arithmetic and Errors:** Floating Point Arithmetic, Machine epsilon, Round off Error, Chopping Error, Truncation Error, Associative and Distributive Law in Floating Point arithmetic, Inherent Error, Error propagation, Numerical Instability<br>**Roots of Equation:** Iterative Methods: Bisection method, Regula-Falsi method, Newton-Raphson method rate of convergence, Aitken Acceleration of Convergence, Modified Newton Raphson Method for Multiple roots, Sturm theorem, Birge-Vieta Method for Polynomials, Computer Algorithms of these methods | **08** |
| **II** | **Interpolation:** Newton's forward difference and backward difference Interpolation, formula. Interpolation with unequal intervals: Langrange's Interpolation, Newton Divided difference formula, Algorithms and Error Analysis of Lagrange and Newton divided difference interpolations, Relationship in various difference operators, Piecewise Linear Interpolation, Cubic Spline Interpolation, Natural Spline | **08** |
| **III** | **Curve fitting:** Least Squares Approximation, Linear and Non linear Regression, Multiple regression, ill Conditioning in Least Squares Methods, Gram-Schmidt Process of Orthogonalization. Computer Algorithms of Least Square Curve Fitting, Chebshev Polynomial Approximations, Lanczos Economization of Power Series | **08** |
| **IV** | **Solution of Simultaneous Linear Algebraic Equations:** Direct methods: Gauss Elimination Method, ill Conditioned Systems, Condition Number, Iteration Methods: Jacobi Method, Gauss-Siedal method, Successive Over Relaxation Method, Rate of Convergence | **08** |
| **V** | **Numerical Differentiation:** Introduction, Numerical differentiation based on interpolation and finite differences<br>**Numerical Integration:** Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Newton cotes Integration, Gaussian Integration: Gauss Legendre and Lobatto Methods, Error analysis of Integration Methods, Computer Algorithms<br>**Solution of differential Equations**: Picard's Method, Euler's Method, Taylor's Method, Runge - Kutta Methods, Predictor Corrector Methods, Stability of solution | **08** |

**Text books:**

1. Jain, Iyengar and Jain, "Numerical Methods for Scientific and Engineering Computations", New Age International.

**Reference Books**

1. Gerald and Wheatley, "Applied Numerical Analyses", Pearson Education.
2. Rajaraman V, "Computer Oriented Numerical Methods", Pearson Education.

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# IOE038 / IOE048: Analog Electronics Circuits

**Prerequisites:- Basic idea of Fundamental of Electronics Engineering**

**Course Objectives:-**

1. Define various BJT amplifier models systems.
2. Understand High frequency transistor models, frequency response systems.
3. Interpret various feedback topologies and Oscillators circuit Review
4. Analyze various parameters Current mirror: Basic topology and its variants.
5. Op-Amp applications: Review of topologies

| Unit | | Chapter/ reference | Lectures |
|---|---|---|---|
| **I** | BJT amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., | | 8 |
| **II** | High frequency transistor models, design procedure for particular specifications, low frequency analysis of multistage amplifiers<br>Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin. | | 8 |
| **III** | Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues<br>Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt,<br>Clapp etc.), non-sinusoidal oscillators. | | 8 |
| **IV** | Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load, differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR, | | 8 |
| **V** | Op-Amp design: Design of differential amplifier for a given specification, design of gain stages and output stages, compensation. Op-Amp applications: precision rectifier, Schmitt trigger and its applications, active filters: Low pass, high pass, band pass and band stop, design guidelines. | | 8 |

**Text Books** :-

1. A.S. Sedra and K.C. Smith, “Microelectronic Circuits,” Saunder's College11 Publishing,6th edition.

**Course Outcomes**: At the end of this course students will demonstrate the ability to:

1. Understand the characteristics transistors and FET as amplifers
2. Design and analyze Feedback design amplifiers
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits Design

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# IOE039 / IOE049: Communication Engineering

**Prerequisites:- Basic idea of signals, Engineering mathematics**

**Course Objectives:-**

1. Define various fundamental aspects of the communication systems.
2. Understand various modulation & demodulation techniques used in communication systems.
3. Interpret various radio transmitter & receiver circuits and different types of noise in communication systems.
4. Analyze various parameters such as modulation index, channel capacity, transmission efficiency, S/N ratio etc. used in communication systems.

| Unit | | Chapter/ reference | Lectures |
|---|---|---|---|
| **1.** | **Introduction**<br>Overview of communication system, communication channel, Need for modulation, Review of signals and system, frequency domain representation of signals, principles of amplitude modulation systems- DSB, SSB and VSB modulations. | 1,2,3,4[1] | 8 |
| **2.** | **Continuous wave Modulation**<br>Angle modulation representation of FM and PM signals, spectral characteristics of angle modulated signals. FM Modulators and Demodulators, FM Broadcasting | 2 [2]<br>5 [1] | 8 |
| **3.** | **Random Processes and Noise**<br>Review of probability and random process, Gaussian and white noise characteristics, noise in amplitude modulation systems, noise in frequency modulation systems, pre-emphasis and de-emphasis, threshold effect in angle modulation. | 6 [1]<br>7 [1] | 8 |
| **4.** | **Pulse Modulation**<br>Pulse modulation, sampling process, pulse amplitude and pulse codemodulation (PCM), differential pulse code modulation. Delta modulation, noise considerations in PCM, time division multiplexing, digital multiplexers. | 3[2] | 8 |
| **5.** | Digital modulation schemes- phase shift keying, frequency shift keying,quadrature amplitude modulation, continuous phase modulation and minimum shift keying. | 6 [2]<br>10 [2] | 8 |

**Text Books :-**


1. P Ramakrishna Rao., “Communication Systems”, Mc Graw Hill Education
2. Haykin S., "Communications Systems," John Wiley and Sons, 2001.
3. Proakis J. G. and Salehi M., "Communication Systems Engineering," Pearson Education,2002.


**Reference books :-**


4. Taub H. and Schilling D.L., "Principles of Communication Systems,” Tata McGraw Hill,2001.
5. Wozencraft J. M. and Jacobs I. M., “Principles of Communication Engineering,” JohnWiley, 1965.
6. B.P. Lathi.,”Modern Digital and Analog Communication Systems” fourth edition.
7. Barry J. R., Lee E. A. and Messerschmitt D. G., “Digital Communication,” KluwerAcademic Publishers, 2004.


**Course Outcomes**: At the end of this course students will demonstrate the ability to:

CO1: Compare different analog modulation schemes for their efficiency andbandwidth.
CO2: Analyze the behavior of a communication system in presence of noise.
CO3: Investigate pulsed modulation system and analyze their system performance.
CO4: Investigate various multiplexing techniques.
CO5: Analyze different digital modulation schemes and compute the bit error performance.

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