With Effect from the Academic Year 2021 – 2022

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

R20 SCHEME

B.E. (MECHANICAL ENGINEERING)

SEMESTER – III to SEMESTER - IV

With effect from academic year 2021-2022

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Scheme of Instruction as per R20 Curriculum

B.E. (MECHANICAL ENGINEERING)

SEMESTER – III

S. No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration in Hrs	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	20MEC04	Material Science And Metallurgy	3	--	--	3	40	60	3
2	20MEC05	Strength of Materials	3	1	--	3	40	60	4
3	20MEC06	Manufacturing Processes	4	--	--	3	40	60	4
4	20MTC08	Partial Differential Equations And Statistics	3	1	--	3	40	60	4
5	20CSC06	Basics Of Data Structures	2	--	--	3	40	60	2
6	20EGM03	Universal Human Values II- Understanding Harmony	3	--	--	3	40	60	3
7	20CEM01	Environmental Science	2	--	--	2	--	50	*Non Credit
PRACTICALS									
8	20MEC07	Material Science and Metallurgy Lab	--	--	2	3	50	50	1
9	20MEC08	Strength of Materials Lab	--	--	2	3	50	50	1
10	20MEC09	Manufacturing Processes Lab	--	--	2	3	50	50	1
11	20CSC07	Basic data structures Lab	--	--	2	3	50	50	1
MOOCs/Training/Internship			2-3 weeks/90 hours						2
TOTAL			**21**	**02**	**06**	--	**390**	**500**	**24+2**

L: Lecture T: Tutorial D: Drawing P: Practical

CIE - Continuous Internal Evaluation SEE – Semester End Examination

CBIT (A) With Effect from the Academic Year 2021-22

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Scheme of Instruction as per R20 Curriculum

B.E. (MECHANICAL ENGINEERING)

SEMESTER – IV

S. No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	20MEC10	Kinematics of Machines	3	1	--	3	40	60	4
2	20MEC11	Thermodynamics	3	--	--	3	40	60	3
3	20MEC12	Fluid Principles and Hydraulic Machines	3	1	--	3	40	60	4
4	20MEC13	Metal Cutting and Machine Tool Engineering	3	--	--	3	40	60	3
5	20EGM01	Indian Constitution and Fundamental Principles	2	--	--	2	--	50	*Non Credit
6	20EGM02	Indian Traditional Knowledge	2	--	--	2	--	50	*Non Credit
7		Professional Elective - I	3	--	--	3	40	60	3
PRACTICALS									
8	20MEC14	Fluid Principles and Hydraulic Machines Lab	--	--	2	3	50	50	1
9	20MEC15	Metal Cutting and Machine Tool Engineering Lab	--	--	2	3	50	50	1
TOTAL			**19**	**02**	**04**	--	**300**	**500**	**19**

L: Lecture T: Tutorial D: Drawing P: Practical

CIE - Continuous Internal Evaluation SEE – Semester End Examination

Professional Elective – I (3/3)		
SNO	**Subj. Code**	**Name of the Subject**
1	20ME E01	Power Plant Engineering
2	20ME E02	Production and Operations Management
3	20ME E03	Entrepreneurship
4	20ME E04	Mechatronics and Automation

With Effect from the Academic Year 2021 – 2022

20MEC04

MATERIAL SCIENCE AND METALLURGY

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Objectives: Student will understand

1. Structure property relations, analyze the failures of metals and their prevention.
2. Fatigue, creep and diffusion mechanisms.
3. Classification of steels and their application .
4. Working principle of various heat treatment operations
5. Principles of extractive metallurgy.

Outcomes: At the end of the course a student will be able to

1. Understand the crystal structure and various imperfections of crystals.
2. Related material failure by fatigue and creep.
3. Interpret phase diagrams and TTT diagrams.
4. Understand the methods of improvement of mechanical properties by various heat treatment operations.
5. Differentiate the properties and applications of ceramics, polymers and composites.

UNIT - I

Plastic Deformation: Introduction to engineering materials, Imperfections in crystals, Dislocation in crystals, Types of dislocations, Effect of slip and twinning on plastic deformation, Strain hardening, Cold and hot working, Bauschinger effect, Recovery, Recrystallization, Grain growth and its effect on mechanical properties of metals.

Fracture: Types of fracture in metals, Ductile and brittle fracture, Griffith theory of brittle fracture, Crack propagation and ductile to brittle transition temperature.

UNIT - II

Diffusion: Fick's laws of diffusion, Application of diffusion theory in mechanical engineering.

Fatigue: S–N curve, Fatigue crack propagation, Effect of metallurgical variables on fatigue of metal, Low and high cycle fatigue, Experimental determination of fatigue strength (RR–Moore Test).

Creep: Creep strength, Creep curve, Creep deformation mechanisms, Creep test.

UNIT- III

Structure of Alloys: Study of Eutectic, Eutectoid, Peritectic and Peritectoid reactions

Iron–Iron Carbide Equilibrium Diagram: Construction and interpretation, Types of plain carbon steels, Cast irons and their properties and characteristics.

Alloy Steels: Effects of alloying elements like Nickel, Chromium, Manganese, Silicon, Tungsten and Titanium, Types of stainless steel, HSLA, TRIP, HSS, Brass, Bronze, Their

composition and properties.

UNIT - IV

Heat Treatment: Purpose of heat treatment, Annealing, Normalizing, Hardening, Tempering, Construction and interpretation of T–T–T diagram, Austempering and Martempering, Case hardening, Carburizing, Nitriding, Carbo–nitriding, Flame hardening, Induction hardening, Laser and Electron beam hardening.

Introduction to Non-Destructive Testing: Importance of Non-Destructive Testing, Types: Liquid Penetrant Testing, Ultrasonic Testing, Radiography Testing, Applications of Non-Destructive Testing.

UNIT - V

Introduction to Extractive Metallurgy: Method of production of pig iron by blast furnace, Cast iron by cupola furnace and method of production of steel by electric arc process.

Polymers and Ceramics: Polymerization, Thermoplastics and thermosetting plastics, Elastomers, Resins, Types, properties and applications of ceramics

Composites: Concept of composites, Matrix and reinforcement, Classification and Applications of composites.

Text Books:

1. V. Raghavan, Materials Science and Engineering, 4th edition, Prentice Hall of India Ltd., New Delhi, 2005.
2. S.H. Avner, Introduction to Physical Metallurgy, 2nd edition, Tata McGraw Hill Publishers, New Delhi, 2005.

Suggested Reading:

1. S.P. Nayak, Engineering Metallurgy and Material Science, 6th edition, Charotar Publishing House, Gujarat, 2005.
2. G. E. Dieter, Mechanical Metallurgy, 3rd edition, Tata McGraw Hill, New Delhi, 2005.
3. W.D. Callister (Adapted by R. Balasubramaniam), Materials Science and Engineering, 2nd edition, Wiley India, New Delhi, 2014.

CBIT (A) With Effect from the Academic Year 2021-22

20MEC05

STRENGTH OF MATERIALS

Instruction	3 L+1T Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Objectives:

1. Student is exposed to the concept of different types of loads, stresses, strains and analysis of members for axial loads.
2. Student will acquire knowledge in drawing bending and shear force diagrams of beams of various loads and configurations.
3. Student becomes familiar with methods of evaluation of deflection of beams of various configurations and stresses that arise due to simple bending.
4. Student is exposed to the concept of shear stresses in beams, principal stresses, strains and phenomenon of torsion.
5. Student will acquire knowledge in estimating stresses for thin, thick cylindrical shells and buckling of columns.

Outcomes: At the end of the course, a student will be able to

1. Determine stresses and strains in members subjected to axial loads and temperature changes.
2. Draw shear force, bending moment diagrams for different types of beams and calculate stresses and strains due to simple bending.
3. Determine slope and deflection for various configurations of beams using different methods, analyze stress, strain and deflection due to torsion in circular members.
4. Analyze shear stress distribution in different sections of beams and find out principal stresses and strains.
5. Find out stresses and strains in thin, thick cylindrical shells and able to calculate critical buckling loads in columns and struts.

UNIT -I

Stresses and Strains: Definitions, Types of stresses and strains, Elasticity and plasticity, Hooke's law, Stress-strain diagrams for engineering materials, Modulus of elasticity, Poisson's ratio, Relationship between elastic constants, Linear and volumetric strains, Bars of uniform strength, Temperature stresses, Compound bars, Strain energy for axial and torsional loads.

UNIT – II

Beams: Definition of shear force and bending moment, Relation between intensity of loading, Shear force and bending moment, Shear force and bending moment diagrams for cantilever, Simply supported and overhanging beams, Theory of simple bending, Moment of resistance and comparison of various cross-sections.

UNIT – III

Slopes and Deflections: Slope and deflection calculations of cantilever, Simply supported

beams subjected to point loads and uniformly distributed loads with Macaulay's and double integration methods.

Torsion of Circular Cross-sections: Theory of pure torsion, Power transmission in solid and hollow circular shafts, Combined bending and torsion.

UNIT – IV

Shear Stresses in Beams: Distribution of shear stresses in rectangular, I-section, T-section, Solid and hollow circular sections.

Principal Stresses and Strains: Analysis of biaxial state of stress with and without shear, Mohr's Circle.

UNIT – V

Cylinders: Stresses in thin and thick cylinders with internal and external pressures.

Columns and Struts: Euler's and Rankine's formulae for axial load applications. Secant and Perry formulae for eccentrically loaded columns.

Textbooks:

1. S.S. Rattan., Strength of Materials, 3rd edition, Tata Mc-Graw Hill, 2017.
2. Ferdinand P. Beer, E. Russell Johnston, John T. Dewolf and David F. Mazurek., Mechanics of Materials, 8th edition, McGraw-Hill, New York, 2020.

Suggested Reading:

3. James M Gere, Mechanics of materials, 8th edition, Cengage Learning, 2013.
4. R.C. Hibbeler, Mechanics of Materials, 9th edition, Pearson, 2018.
5. S. Ramamrutham., Strength of Materials, 16th edition, Dhanpatrai and Sons, 2011.

20MEC06

MANUFACTURING PROCESSES

Instruction	4 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Objectives: To enable the students to

1. Understand various terms related to manufacturing processes
2. Understand various manufacturing processes
3. Provide the ability to solve simple problems such as riser design and sheet metal calculations
4. Compare various Manufacturing processes
5. Select suitable manufacturing process for a given component

Outcomes: At the end of the course, a student will be able to

1. Define various terms related to manufacturing processes
2. Demonstrate the understanding of various manufacturing processes
3. Solve simple problems such as riser design and sheet metal calculations
4. Compare various manufacturing processes
5. Choose suitable manufacturing process for a given component

UNIT – I

Manufacturing Processes: Classification and importance.

Casting: Introduction, Classification of casting processes, Types of patterns, Pattern materials, Pattern allowances, Elements of gating system, Types of gates, Purpose and requirements of riser, Chvorinov's rule, Optimum shape and dimensions of riser, Riser design by Caine's method and Modulus method.

UNIT - II

Moulding and Melting: Moulding sand and its ingredients, Required properties of moulding sand, Core and core prints, Melting by Cupola furnace, Induction and arc furnace, Casting defects and remedies

Special Casting Processes: Pressure die casting, Centrifugal casting, shell moulding, Investment casting and CO_2 moulding.

UNIT- III

Arc Welding: Introduction to welding, Classification of welding processes, DCSP, DCRP, AC, shielded metal arc welding, Submerged arc welding, Gas Tungsten arc welding and gas metal arc welding,

Resistance Welding: Principle, Spot, Projection, Seam, Butt and percussion welding processes.

Solid State Welding: Friction welding, Ultrasonic welding and explosive welding

Other Welding Processes: Oxy-Acetylene welding, Laser beam welding, Electron beam welding, Soldering and brazing.

UNIT – IV

Bulk Deformation Processes: Open die, Closed die and isothermal forging processes, Rolling

process, Nomenclature of rolling , Geometric relationships in rolling, Direct, indirect, hydrostatic and impact extrusion processes , Wire drawing process

Sheet Metal Operations: Shearing process, Shearing load, Energy required, Types of shearing processes, Cup drawing process, Calculation of blank diameter for a given cup, Drawing load, Sheet bending process and bend allowance.

High Energy Rate Forming Processes: Explosive forming, Electro-hydraulic forming and electromagnetic forming.

UNIT – V

Additive Manufacturing: Introduction, Stereolithography, Fused deposition modeling, Selective laser sintering and applications of additive manufacturing

Powder Processing: Introduction, Production of powders, Mixing, Blending, Compacting and Sintering, Merits, Demerits and application of powder metallurgy products.

Processing of Plastics, Ceramics and Composites: Injection moulding, Blow moulding and thermoforming of plastics, Injection moulding and slip casting of ceramics, Roll bending and filament winding of composites.

Text Books:

1. G.K. Lal and S.K. Choudhury., Fundamentals of Manufacturing Processes, Alpha science International Ltd., 2005.
2. Mikell P.Grover., Principle of Modern Manufacturing, 5th edition, Wiley , 2014,

Suggested Reading:

3. P.N. Rao., Manufacturing Technology, Vol.1, 3rd edition, Tata McGraw Hill Publ., 2011.
4. John Schey., Introduction to Manufacturing Processes, 2nd edition, McGraw Hill Education, 1999
5. Amitabh Ghosh and Mallick., Manufacturing Science, 4th edition, Assoc. East West Press Pvt. Ltd., 2011.

20MTC08

PARTIAL DIFFERENTIAL EQUATIONS AND STATISTICS

Instruction	3 L + 1THours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Objectives:

1. To learn Numerical solution of ODE and Engineering problems.
2. To form PDE and to find its solution.
3. To know the model of wave and heat equations.
4. Able to fit the hypothetical data using probability distribution.
5. To learn fitting of distribution and predicting the future values.

Outcomes: On successful completion of this course the students shall be able to

1. Find solution of initial value problems of ODE by numerical method.
2. Solve Linear and non-linear PDE's.
3. Solve one-dimension wave and heat equations and two dimension Laplace equation.
4. Use the basic probability for fitting the Random phenomenon.
5. Analyze the random fluctuations of probability distribution and principles of least square approximations for the given data.

UNIT-I:

Numerical Methods: Solution of algebraic and transcendental equations by bisection method, Regula-Falsi method, Newton-Raphson method, Numerical solutions of first order ordinary differential equations by Taylor's series method, Euler's method, Modified Euler's method and Runge-Kutta method of fourth order.

UNIT-II:

Partial Differential Equations: Formation of partial differential equations, Linear equations of first order (Lagrange's linear equations), Solution of first order non-linear partial differential equation (standard forms) and Charpits method.

UNIT-III:

Applications of Partial Differential Equations: Solution by method of separation of variables, Solution of one dimensional wave equation, Solution of one dimensional heat equation, Solution of two dimensional Laplace equation and its related problems.

UNIT-IV:

Basic Probability: Basic probability, Conditional probability, Baye's theorem, Random variable, Discrete probability distribution and continuous probability distribution, Expectation, Addition and multiplication theorem of expectation, Properties of variance, Moments (moments about the mean and moments about a point)

UNIT-V:

Probability Distributions and Curve Fitting: Poisson distribution, MGF and cumulants of the Poisson distribution, Normal distribution, Characteristics of normal distribution MGF and CGF of normal distribution, Areas under normal curve, Correlation, Coefficient of correlation and lines of regression, Curve fitting by the method of least squares, Fitting of straight lines, Second degree parabola, Exponential and growth curves.

Textbooks:

1. B.S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers, 2017.
2. S.C.Gupta and V.K. Kappoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, 2014.

Suggested Reading:

1. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993.
3. Sheldon Ross, A First Course in Probability, 9th Edition, Pearson publications, 2014.

With Effect from the Academic Year 2021-22

20CSC06

BASICS OF DATA STRUCTURES

(Common for all Programmes except CSE & IT)

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Prerequisites:
Basic knowledge of programming language such as C or C++ is preferred (but not mandatory) and some mathematical maturity also will be expected.

Objectives: To introduce
1. Basic linear and non-linear data structures.
2. Analyzing the performance of operations on data structures.
3. Different sorting and searching techniques and their complexities.

Outcomes: The students will be able to
1. Identify various data structures, searching & sorting techniques and their applications.
2. Describe the linear and non-linear data structures, searching and sorting techniques.
3. Apply suitable data structures to solve problems.
4. Analyze various searching and sorting techniques.
5. Evaluate the linear and non-linear data structures.

UNIT – 1
Introduction: Data types, Data structures, Types of data structures, Operations, ADTs, Algorithms, Comparison of algorithms, Complexity, Time and space tradeoff.
Recursion: Introduction, Format of recursive functions, Recursion vs Iteration, Examples.

UNIT – 2
Linked Lists: Introduction, Linked lists and types, Representation of linked list, Operations on linked list, Comparison of linked lists with arrays and dynamic arrays.

UNIT – 3
Stacks and Queues: Introduction to stacks, Applications of stacks, Implementation and comparison of stack implementations, Introduction to queues, Applications of queues and implementations, Priority queues and applications
Searching and Sorting: Linear searching, Binary Searching, Sorting algorithms, Bubble sort, Selection sort, Quick sort, Heap sort

UNIT – 4
Trees: Definitions and concepts, Operations on binary trees, Representation of binary tree, Conversion of general trees to binary trees, Representations of trees, Tree traversals and Binary search tree.

UNIT –5
Graphs: Introduction, Applications of graphs, Graph representations, graph traversals, Minimal Spanning Trees

Text Books:

1. Narasimha Karumanchi, Data Structures and Algorithms Made Easy, CareerMonk Publications, 2017
2. E.Horowitz ,S. Sahni and Susan Anderson-Freed, Fundamentals of Data structures in C, 2nd Edition, Silicon Press, 2007)
3. ReemaThareja, Data Structures using C, Oxford, 2014

Suggested Reading:

1. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
2. https://www.edx.org/course/foundations-of-data-structures
3. https://sites.google.com/site/merasemester/data-structures/data-structures-1#DS
4. https://www.cs.usfca.edu/~galles/visualization/Algorithms
5. https://www.coursera.org/specializations/data-structures-algorithms

20EGM03

UNIVERSAL HUMAN VALUES II: UNDERSTANDING HARMONY

(Common for all Programs)

Instruction	2 L+1T Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	3

Course Objectives:

This course aims to:

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

Course Outcomes:

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

1. Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. They would have better critical ability.
4. They would also become sensitive to their commitment towards what they have understood (human values, human relationship, and human society).
5. 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.

The course has 28 lectures and 14 practice sessions:

UNIT-I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation-as the process for self-exploration.
- Continuous Happiness and Prosperity- A look at basic Human Aspirations.
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current Scenario.
- 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

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.
- 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 Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
- Programs to ensure Sanyam 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

- 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.
- Understanding the meaning of Trust; Difference between intention and competence.
- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.
- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co -existence as comprehensive Human Goals.
- 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

- Understanding the harmony in the Nature.
- Interconnectedness and mutual fulfilment among the four orders of nature - recyclability and self-regulation in nature.
- Understanding Existence as Co-existence of mutually interacting units in all - pervasive space.
- 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

- 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, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems.
- 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.

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.

Mode of Conduct (L-T-P-C 2-1-0-3)

- Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.
- While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.
- In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self- exploration.
- Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.
- Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practicals are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignments and/or activities are included.
- The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

Assessment:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-

assessment, peer assessment etc. will be used in evaluation.
Example:
Assessment by faculty mentor: 10 marks
Self-assessment/Assessment by peers: 10 M
Socially relevant project/Group Activities/Assignments: 20 marks
Semester End Examination: 60 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

Text Books:

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1 The teacher's manual
2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

1. A Nagaraj Jeevan Vidya: Ek Parichaya, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. Cecile Andrews, Slow is Beautiful
4. Gandhi - Romain Rolland (English)
5. Dharampal, "Rediscovering India"
6. E. FSchumacher. "Small is Beautiful."
7. J. C. Kumarappa "Economy of Permanence"
8. Pandit Sunderlal "Bharat Mein Angreji Raj"
9. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth"
10. 10.Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule"
11. Maulana Abdul Kalam Azad, India Wins Freedom -
12. Vivekananda - Romain Rolland (English)
13. The Story of Stuff (Book).

CBIT (A) With Effect from the Academic Year 2021-22

20CEM01

ENVIRONMENTAL SCIENCE

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	0

Objectives: To enable the student

1. Identify environmental problems arising due to over utilization of natural resources and understand the importance of use of renewable energy sources
2. Become aware about the importance of eco system and interlinking of food chain.
3. Identify the importance of biodiversity in maintaining ecological balance.
4. Learn about various attributes of pollution management and waste management practices.
5. Contribute for capacity building of nation for arresting and/or managing environmental disasters.

Outcomes: At the end of the course, student is able to

1. Identify the natural resources and realize the importance of water, food, forest, mineral, energy, land resources and affects of over utilization.
2. Understand the concept of ecosystems and realize the importance of interlinking of food chains.
3. Contribute for the conservation of bio-diversity.
4. Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
5. Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.

UNIT- I:

Environmental Studies: Definition, Scope and importance, Need for public awareness.

Natural resources: Use and over utilization of natural resources, Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT – II:

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Role of producers, Consumers and decomposers, Energy flow in an ecosystem, Food chains, Food webs, Ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and aquatic ecosystems.

UNIT – III:

Biodiversity: Genetic, Species and ecosystem biodiversity, Bio-geographical classification of India, India as a mega diversity nation, Values of biodiversity, Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Methods of conservation of biodiversity.

UNIT – IV:

Environmental Pollution: Cause, Effects and control measures of air pollution, Water pollution, Marine pollution, Soil pollution, Noise pollution, Solid waste management, Nuclear hazards.

Environmental Legislations: Environment protection Act, Air, Water, Forest & Wild life Acts, Issues involved in enforcement of environmental legislation, Responsibilities of state and central pollution control boards

UNIT – V:

Social Issues and the Environment: Water conservation methods, Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change, Global warming, Ozone layer depletion, Forest fires and Contemporary issues.

Text Books:

1. Y. Anjaneyulu, Introduction to Environmental Science, B S Publications, 2004.
2. Suresh K. Dhameja, Environmental Studies, S. K. Kataria & Sons, 2009.

Suggested Reading:

1. C. S. Rao, Environmental Pollution Control Engineering, Wiley, 1991.
2. S. S. Dara, A Text Book of Environmental Chemistry &Pollution Control, S. Chand Limited, 2006

CBIT (A) With Effect from the Academic Year 2021-22

20MEC07

MATERIAL SCIENCE AND METALLURGY LAB

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Objectives: Students will

1. Acquire basic knowledge by understanding iron-carbide diagram and its application in engineering.
2. Expose to Metallographic study and analysis of various metals.
3. Acquire knowledge in determining the hardness of metals before and after various Heat treatment operations.
4. Understand differences between different heat treatment methods.
5. Understand the relation between micro structure and properties.

Outcomes: At the end of the course, a student will be able to

1. Identify crystal structure of various metals.
2. Measure hardness and can correlate with microstructure.
3. Perform a suitable heat treatment operation based on desired properties.
4. Underlines the importance of grain size in evaluating the desired mechanical properties.
5. Correlate the heat treatment methods and the mechanical properties obtained

List of the experiments

1. Study of metallurgical microscope.
2. Observing the microstructure of low carbon steel, medium carbon steel and high carbon steel specimens.
3. Observing the microstructure of austenitic stainless steel, high speed steel and case carburized steel specimens.
4. Observing the microstructure of grey cast iron, white cast iron and spheroidal cast iron specimens.
5. Observing the microstructure of Al-Si alloy, and malleable cast iron specimens.
6. Preparation of α-β brass and normalized steel specimens for micro structural observation.
7. Preparation of medium carbon steel and mild steel specimens for micro structural observation.
8. Preparation of nodular cast iron and grey cast iron specimens for micro structural observation.
9. Determination of grain size using image analyzer.
10. Annealing and preparation of the given Steel specimen for microstructural observation.
11. Normalizing and preparation of the given Steel specimen for microstructural observation.
12. Hardening and preparation of the given Steel specimen for microstructural observation.
13. Comparative study on the influence of heat treatments (annealing, normalizing and hardening) on the microstructure and hardness of the given Steel specimen.

Note: A minimum of 12 experiments need to be conducted.

Suggested Reading:

1. V. Raghavan, Materials Science and Engineering, 4th edition, Prentice Hall of India Ltd., New Delhi, 2005.
2. S. H. Avner, Introduction to Physical Metallurgy, 2nd edition, Tata McGraw Hill Publishers, New Delhi, 2005.
3. Virtual labs – Physical Metallurgy Lab, NITK SURATHKAL.

CBIT (A) With Effect from the Academic Year 2021-22

20MEC08

STRENGTH OF MATERIALS LAB

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Objectives: Students will

1. Demonstrate an understanding of tension, and the relationship between stress, strain and application of Hooke's law.
2. Demonstrate an understanding of types of beams, deflections and measurement of material property through deflections.
3. Demonstrate an understanding of torsion and deformations resulting from torsion.
4. Demonstrate the understanding of hardness and its measurement using different scales like Brinnel and Rockwell.
4. Demonstrate an understanding of measurement of shear modulus and young's modulus for machine members like helical and leaf springs through loading respectively.

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

1. Draw stress-strain curve for an isotropic material and understand the salient features of it.
2. Determine the Young's modulus of various beam materials and leaf spring by conducting load-deflection test.
3. Rigidity modulus of a given shaft specimen by torsion test and shear modulus of closely coiled helical spring.
4. Evaluate hardness of different materials using different scales
5. Find the compressive and crushing strengths of concrete cubes and bricks.

List of the experiments:

1. Tension test on mild steel.
2. Compression test on mild steel.
3. Tension test on cast iron.
4. Compression test on cast iron.
5. Brinell's and Rockwell's hardness tests.
6. Izod Impact test.
7. Load-deflection test on a leaf spring to find out the Young's modulus of leaf material.
8. Deflection test on a helical spring to determine the rigidity modulus.
9. Torsion of shaft to determine the rigidity modulus of shaft material.
10. Defection test on a cantilever beam to determine the Young's modulus.
11. Deflection test on a simply supported beam to determine the Young's modulus.
12. Deflection test on propped cantilever to determine the Young's modulus.

13. Deflection test on continuous beam to determine the Young's modulus.
14. Crushing and compression test on bricks and concrete cubes.

15. Look at each component (arm, leg, seat, back, etc.) of a chair in a classroom and decide what type of familiar structure it is and what type of loads act on it during normal use. List each component, state where and how the load acts and select the theory which you would have to consider when analyzing the stresses in the chair.

Note: A minimum of 12 experiments need to be conducted.

Suggested Reading:

1. S.S. Rattan., Strength of Materials, 3rd edition, Tata Mc-Graw Hill, 2017.
2. R. C. Hibbler, Mechanics of Mechanics of Materials, 9th Pearson, 2018.
3. Virtual labs – Strength of Materials Lab, NITK Surathkal.

CBIT (A) With Effect from the Academic Year 2021-22

20MEC09

MANUFACTURING PROCESSES LAB

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Objectives: To enable the students to

1. Test the moulding sand and analyze the same.
2. Test the bead geometry and correlate the results to the input parameters.
3. Use TIG, MIG and Spot welding machines and experiment with them.
4. Test the formability characteristics of a given sheet metal and study different types of dies.
5. Understand the various type of sheet metal forming dies

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

1. Test the moulding sand and analyze the same.
2. Test the bead geometry and correlate the results to the input parameters.
3. Use TIG, MIG and spot welding machines and experiment with them.
4. Test the formability characteristics of a given sheet metal.
5. Demonstrate the understanding of various types of dies

List of the Experiments:

Casting:

1. Design of a simple pattern with various allowances.
2. Moulding sand testing: GCS, GSS, DCS and DSS
3. Moulding sand testing: Permeability and shatter index.
4. Finding out the GFN and Moisture content for a given sand sample.
5. Melting and Pouring of Aluminum.

Welding:

1. Study of Arc welding process, comparison of the bead geometry with DCSP, DCRP and A.C.
2. Study of resistance welding process and spot welding of MS Sheets.
3. Study of TIG welding process and plotting cooling curve in TIG welding process
4. Study of SAW Welding process and finding out deposition efficiency of the process.
5. Study of MIG welding process and testing of weld bead formed by MIG welding.

Metal Forming:

1. Evaluation of Formability of a given sheet material using Erichsen cupping test.
2. Study of Progressive die design and manufacturing of washer components using the same on a fly press (capacity 6 Tons) and estimation of forces.
3. Study of Compound die design and manufacturing of washer components using the same on double body fly press (capacity 8 Tons) and estimation of forces.
4. Study of Combination die design and manufacturing of cylindrical cups using the same on a hydraulic power press (capacity 50 Tons) and estimation of drawing force.
5. Study of extrusion dies and demonstration of extruding lead material
6. 3 D Printing of a simple component.

Note: A minimum of 12 experiments need to be conducted.

Suggested Reading:

1. P.N. Rao., Manufacturing Technology, Vol.1, 3rd edition, Tata McGraw Hill Publ., 2011.
2. Amitabh Ghosh and Mallick., Manufacturing Science, 4th edition, Assoc. East West Press Pvt. Ltd., 2011.
3. Metal Forming Virtual Simulation Lab, Dayalbagh Educational Institute, Agra

20CSC07

Basics of Data Structures Lab
(Common for all Programmes except CSE & IT)

Instruction	2 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	50 Marks
Credits	1

Pre-requisites: Any Programming Language

Course Objectives:

1. Design and construct simple programs by using the concepts of Data structures as abstract data type.
2. To have a broad idea about how efficiently pointers can be used in the implement of data structures.
3. To enhance programming skills while improving their practical knowledge in data structures.
4. To strengthen the practical ability to apply suitable data structure for real time applications.

Course Outcomes: The students will be able to

1. Implement the abstract data type.
2. Demonstrate the operations on stacks, queues using arrays and linked lists
3. Apply the suitable data structures including stacks, queues to solve problems
4. Analyze various searching and sortingtechniques.
5. Choose proper data structures, sorting and searching techniques to solve real world problems

List of Experiments

1. Implementation of operations on arrays
2. Implementation of Stack.
3. Implementation of Queue.
4. Implementation of basic operations on Single Linked List.
5. Implementation of Searching techniques.
6. Implementation of Sorting Techniques
7. Case study like Banking System, Students Marks Management, Canteen Management, Library Management etc
8. Open Ended questions

Text Books

1. Brian W Kernighan, Dennis Ritchie, C Programming Language, PH PTR, 2nd Edition.
2. Richard M Reese, Understanding and Using C Pointers, O`Reily , 2013.

WebLinks

https://nptel.ac.in/courses/106102064/
https://www.udemy.com/algorithms-and-data-structures-in-python/

With effect from academic year 2021-22

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

R20 SCHEME

B.E. (MECHANICAL ENGINEERING)

SEMESTER – IV

S. No.	Course Code	Title of the Course	Scheme of instruction			Scheme of examination			Credits
			Hours per week			Duration in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	20MEC10	Kinematics of Machines	3	1	--	3	40	60	4
2	20MEC11	Thermodynamics	3	--	--	3	40	60	3
3	20MEC12	Fluid Principles and Hydraulic Machines	3	1	--	3	40	60	4
4	20MEC13	Metal Cutting and Machine Tool Engineering	3	--	--	3	40	60	3
5	20EGM01	Indian Constitution and Fundamental Principles	2	--	--	2	--	50	*Non Credit
6	20EEM01	Indian Traditional Knowledge	2	--	--	2	--	50	*Non Credit
7		Professional Elective - I	3	--	--	3	40	60	3
PRACTICALS									
8	20MEC14	Fluid Principles and Hydraulic Machines Lab	--	--	2	3	50	50	1
9	20MEC15	Metal Cutting and Machine Tool Engineering Lab	--	--	2	3	50	50	1
TOTAL			**19**	**02**	**04**	--	**300**	**500**	**19**

L: Lecture T: Tutorial D: Drawing P: Practical

CIE - Continuous Internal Evaluation SEE – Semester End Examination

Professional Elective – I (3/3)		
SNO	**Subj. Code**	**Name of the Subject**
1	20MEE01	Power Plant Engineering
2	20MEE02	Production and Operations Management
3	20MEE03	Entrepreneurship
4	20MEE04	Mechatronics and Automation

CBIT (A) With Effect from the Academic Year 2021-22

20MEC10

KINEMATICS OF MACHINES

Instruction	3 L+1T Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Objectives: At the end of the course, student will be able to understand

1. Basic elements of mechanisms and their motion characteristics, DOF
2. Velocity and Acceleration analysis of various mechanisms.
3. Principles involved in functioning of pivots, collars, clutches, belts, brakes and dynamometers
4. Drawing displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers.
5. Selecting gear and gear train depending on application.

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

1. Understand basic elements of mechanisms and their motion characteristics, DOF.
2. Analyze Velocity and Acceleration of various mechanisms.
3. Understand and Evaluate Principles involved in functioning of pivots, collars, clutches, belts, brakes and dynamometers.
4. Design displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers.
5. Select gear and gear train depending on application

UNIT - I

Basics of Mechanisms: Definition of kinematic link, Pair, Kinematic chain, Mechanism and machine, Degrees of freedom, Grubler's criterion, Inversions of four bar mechanism, Inversions of single and double slider crank chains.

Mechanism with Lower Pairs and Straight Line Motion Mechanism: Pantograph and Geneva mechanisms. Ackerman and Davis steering gear mechanisms and Hooke's Joint. Peaucellier, Hart, Scott-Russel, Watt and Tchebicheff mechanisms.

UNIT - II

Velocity and Acceleration of Mechanisms: Velocities of mechanisms by instantaneous centre, Body centrode, Space centrode, Kennedy's theorem, Determination of velocity and acceleration of different mechanisms by relative velocity method including Coriolis component of acceleration, Freudenstein's method for synthesis of four bar linkage.

UNIT- III

Friction: Friction in pivots, Collars. Clutches - Single and Multi plate, Cone and centrifugal clutches.

Brakes and Dynamometers: Block or shoe, Band and block, Internal expanding shoe brake, Prony brake, Rope brake, Belt transmission torsion dynamometers.

UNIT - IV

Cams: Types of cams and followers, Displacement diagrams for followers, Uniform motion, Parabolic motion, Simple harmonic motion, Cycloidal motion, Drawing cam profile with knife edge follower, Translating roller follower and translating flat follower, Cams of specified contours, Tangent cam with roller follower, Circular arc (convex) cam with roller follower.

UNIT - V

Gears: Classification of gears, Spur gears, Nomenclature, Law of gear tooth action, Involute as gear tooth profile, Interference of involute gears, Minimum number of teeth to avoid interference, Contact ratio, Cycloidal tooth profile, Comparison of involute and cycloidal tooth profile.

Gear Trains: Gear trains, Simple, Compound, Reverted and epicyclic gear trains, Differential of an automobile.

Text Books:

1. Thomas Bevan., Theory of Machines, CBS Publishers, 2009.
2. S.S. Rattan., Theory of Machines, 4th edition, Tata McGraw Hill Publishers, 2017.

Suggested Reading:

1. C.S. Sharma and Kamlesh Purohit., Theory of Mechanisms and Machines, PHI Learning Pvt. Limited, 2006.
2. Amitabh Ghosh and A.K.Mallik., Theory of Machines, 3rd edition, East West Publications, 2009.
3. J.E. Shigley, Theory of Machines, 3rd edition, Tata Mc.Graw Hill Publishers, New Delhi, 2014.

CBIT (A) With Effect from the Academic Year 2021-22

20MEC11

THERMODYNAMICS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Objectives: Students will understand

1. Basic definitions of thermodynamics and significance of Zeroth law of thermodynamics.
2. The importance and application of first law of thermodynamics.
3. The principles associated with second law of thermodynamics.
4. Properties of pure substances and use of Mollier diagram.
5. Various air standard cycles, vapour power cycles and their importance.

Outcomes: At the end of the course a student will be able to

1. Understand the concepts of system, thermodynamic properties, thermodynamic equilibrium and various methods of pressure and temperature measurements.
2. Apply the first law of thermodynamics to various thermodynamic processes along with the applications of steady flow energy equation.
3. Apply the Second law of thermodynamics to analyze heat pumps, refrigerators, heat engines and to evaluate entropy changes.
4. Evaluate the properties of pure substances and analyze the performance of steam power cycles.
5. Evaluate performance of air standard cycles and analyze the properties of gas mixtures.

UNIT - I

Introduction: Thermodynamics, Macroscopic and Microscopic approaches, Thermodynamic systems, Properties, Processes and cycles, Thermodynamic equilibrium, Quasi – static process, Measurement of pressure, Zeroth law of thermodynamics and its significance, Measurement of temperature, Reference points, Ideal gas equation.

UNIT - II

Energy Interactions and First Law of Thermodynamics: Concept of heat and work, First law of thermodynamics for closed system, Energy a property of the system, Application of first law to various thermodynamic processes like isobaric, Isochoric, Isothermal, Adiabatic and polytropic, Definition of enthalpy, PMM1, First law applied to flow processes, Application of SFEE to Nozzle, Diffuser, Throttling device, Turbine, Compressor and heat exchanger.

UNIT- III

Second Law of Thermodynamics: Limitations of first law of thermodynamics, Kelvin–Planck and Clausius statements of second law of thermodynamics, PMM2, Equivalence of Kelvin-Planck and Clausius statement, Reversible and irreversible processes, Carnot

theorem, Clausius inequality, Calculation of entropy change during various thermodynamic processes, Principle of entropy increase, T–s diagrams, Application of entropy principle for mixing of two fluids, Introduction to available and unavailable energy, Third law of thermodynamics, Helmholtz and Gibb's functions.

UNIT - IV

Pure Substances: Properties of pure substances, P–V diagram, P–T diagram, P-V-T surface, T–s diagram, h–s diagram, Dryness fraction, Use of steam tables, Maxwell relations, Clapeyron equation.

Vapour Power Cycles: Vapour power cycles - Carnot cycle, Simple Rankine cycle, Representation on p-v, T-s and h-s diagrams, Evaluation of performance parameters, Efficiency, Work ratio, Specific steam consumption and heat rate.

UNIT - V

Air Standard Cycles: Air standard cycles, Otto, Diesel, Dual combustion cycles, Working principle, Derivation of expression for air standard efficiency, Comparison of Otto, Diesel and dual cycles for the same compression ratio, For the same maximum pressure and temperature.

Non-reactive Ideal Gas Mixtures: Mole fraction, Mass fraction, Partial pressure, Dalton's law of partial pressures, Amagat-Leduc law of partial volumes, Relation between partial pressures, Mole fraction and volume fraction, Gas constant, Molecular mass, Specific heats of gas mixtures, Relation between volumetric and gravimetric analysis, Determination of theoretical air fuel ratio and equivalence ratio for various fuels,

Text Books:

1. P.K. Nag., Engineering Thermodynamics, 6th edition, Tata McGraw Hill Publishing, 2017
2. Yunus Cengel and Michael Boles., Thermodynamics: An Engineering Approach, 8th edition, McGraw Hill Education, 2017.

Suggested Reading:

1. R.K. Rajput., Engineering Thermodynamics, 4th Edition, Laxmi Publications, 2016.
2. Mahesh M Rathore., Thermal Engineering, Tata McGraw Hill Publishers, 2013.
3. D.S. Kumar., Engineering Thermodynamics, S.K. Kataria and Sons, 2014.

CBIT (A) With Effect from the Academic Year 2021-22

20MEC12

FLUID PRINCIPLES AND HYDRAULIC MACHINES

Instruction	3 L + 1T Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Objectives: Students will

1. Learn properties of fluids, laws related to fluid flow and their applications.
2. Understand the principles and problems associated with impact force of jet on the vanes
3. Understand various principles and performance characteristics related to Reciprocating pumps.
4. Come to know the working principles and performance characteristics of Centrifugal pumps.
5. Learn the working principle and efficiencies of hydraulic turbines.

Outcomes: At the end of the course, a student will be able to

1. Determine the various properties of fluid and their applications
2. Understand the methodology in calculation of impact force exerted by the jet on the vanes
3. Acquire the knowledge of the functionality and performance of reciprocating pumps.
4. Estimate the performance and testing of centrifugal pumps.
5. Acquire knowledge in the functionality, performance and testing of hydraulic turbines.

UNIT - I

Properties and Laws of Fluid Flow: Fluids, Properties, Density, Specific weight, Specific gravity, Viscosity, Newton's law of viscosity, Pressure, Laws of fluid flow, Continuity theorem, Bernoulli's theorem, Pitot tube, Venturimeter, Notches, Darcy Weisbach equation, Hydraulic machines, Impulse-momentum equation and applications.

UNIT - II

Impact of Jet on Vanes: Layout of hydraulic power plant, Working principle, Velocity triangles, Impact force exerted, Power developed and efficiency of jet impinging on a fixed flat vertical vane, A single and series of flat moving vertical vanes, At the center and at one end of a fixed symmetrical and unsymmetrical curved vane, At the center and at one end of a single and series of symmetrical and unsymmetrical moving curved vanes.

UNIT- III

Reciprocating Pumps: Classification and working principle, Discharge, Slip, Coefficient of discharge, Power required to drive the pump and efficiency, Variation of pressure head due to acceleration of piston and pipe friction, Ideal and actual indicator diagrams, Separation, Safe speed to avoid separation, Air vessels, Work saved, Quantity of water entering into or coming out of air vessels and performance characteristic curves.

UNIT - IV

Centrifugal Pumps: Classification and working principle, Comparison over reciprocating pumps, Velocity triangles, Head equivalent of workdone, Efficiencies, Pressure rise, Minimum starting speed, Specific speed, Physical significance, Model testing, Conditions of similarity, Priming, Performance characteristic curves, Common operational problems (troubles), reasons and remedies.

UNIT - V

Hydraulic Turbines: Classification and working, Velocity triangles, Power developed and efficiencies of Pelton wheel, Francis turbine and Kaplan turbines, Design of hydraulic turbines, Specific speed, Physical significance, Unit testing, Unit quantities, Model testing, Conditions for similarity and performance characteristic curves.

Text Books:

1. P.N. Modi and S.M. Seth., Hydraulics and Fluid Mechanics Including Hydraulic Machines, 22nd edition, Standard Book House, New Delhi, 2019.
2. R.K. Bansal., A Text Book of Fluid Mechanics and Hydraulic Machines, 9th edition, Laxmi Publications (P) Ltd., New Delhi, 2015.

Suggested Reading:

1. R.S. Khurmi and N. Khurmi., Hydraulics, Fluid Mechanics and Hydraulic Machines, 20th edition, S.Chand publishing, 2014
2. S. Ramamrutham., Hydraulics, Fluid Mechanics and Fluid Machines, Dhanpat Rai and Sons, New Delhi, 2004.
3. Madan Mohan Das., Fluid Mechanics and Turbomachines, PHI Learning Private Limited, New Delhi, 2009.

CBIT (A) With Effect from the Academic Year 2021-22

20MEC13

METAL CUTTING AND MACHINE TOOL ENGINEERING

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Objectives:

1. Various cutting tool materials and tool geometry.
2. Factors effecting tool life and thermal aspects of metal cutting.
3. The working principles of various of types of lathes, drilling machine and milling machines ,
4. The working principles of boring machines, grinding machines and thread production
5. Working principles of non-conventional machines and jigs and fixtures

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

1. Describe tool geometry, select tool material for machining of various material and identify the types of chips.
2. Calculate cutting forces, MRR, power consumption under different cutting conditions.
3. Classify the mechanisms of tool wear, estimate tool life using Taylor's equation under various cutting conditions
4. Identify the basic parts, specifications, operations of various machine tools and understand jigs & fixtures
5. Classify methods of unconventional machining and identify suitable method for a given component.

Unit-I

Cutting Tool Materials: High carbon steel, HSS, Stellite, Carbides, Coated carbides and diamond.

Tool Geometry: Nomenclature of single point cutting tool by ASA and ORS, Geometry of drills, Milling cutters and broaches, Recommended Tool angles.

Chip Formation: Basic chip formation process, Types of chips, BUE, Chip breakers.

Machining: Orthogonal and oblique cutting, Mechanics of metal cutting, Merchant's analysis, Shear angle solutions of Merchant and Lee & Shafer.

Unit-II

Thermal Aspects of Metal Cutting: Sources of heat and heat distribution, Various methods of measurement of temperature, Cutting fluids and applications.

Tool Wear, Tool Life & Machinability: Types of wear, Mechanism of tool wear, Tool life & machinability, Effects of process parameters on tool life, Taylor's tool life equation.

Economics of machining: Tool life for maximum production and minimum cost.

Unit-III

Constructional Features and Specifications of Machine Tools: Various operations on lathe, Types of lathes and special attachments on a centre lathe, Drilling, Milling operations, Indexing methods, Shaper, Planer, Slotter and their differences, Quick return mechanisms,

Automatic feed devices. Jig boring machines, Differences between horizontal and vertical jig boring machines

Unit- IV

Grinding Machines: Types of grinding, Abrasives and bonds used for grinding wheels. Specification and selection of wheels. Principles of broaching, Lapping, Honing, Polishing, Buffing, Super finishing and burnishing.

Screws and Gear Manufacturing: Screw making by tapping, Chasers, Thread rolling, Thread milling, Thread grinding. Gear shaping, Gear hobbing, Gear shaving and grinding.

Unit-V

Jigs and Fixtures: Design principles for location and clamping. Tool holding and work holding devices, Quick clamping devices, Types of Jigs and fixtures.

Unconventional Machining: Principles of working and applications of USM, AJM, WJM, EDM, ECM, LBM and EBM.

Text Books:

1. B.L. Juneja, G.S. Shekhon and Seth Nitin., Fundamentals of metal cutting & Machine tools, New Age Publishers, 2003.
2. P.N. Rao., Manufacturing Technology – Metal Cutting & Machine Tools, Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.

Suggested Reading:

1. David A. Stephenson and John S. Agapiou., Metal Cutting Theory and Practice, 3rd edition, CRC Press, March 2016
2. Amitabha Ghosh and Ashok Kumar Mallik., Manufacturing Science, 2nd Edition, Affiliated East-West Press Pvt. Ltd, 2010.
3. M.C. Shaw., “Metal Cutting Principles”, Clarendon Press, Oxford 1984.

CBIT (A) With Effect from the Academic Year 2021-22

20EGM01

INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	0 Non Credit Course

Objectives: The course will introduce the students to:

1. History of Indian Constitution and how it reflects the social, political and economic perspectives of the Indian society.
2. Growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Various Organs of Governance and Local Administration.

Outcomes: After successful completion of the course the students will be able to:

1. Understand the making of the Indian Constitution and its features.
2. Identify the difference among Right To equality, Right To freedom and Right to Liberty.
3. Analyze the structuring of the Indian Union and differentiate the powers between Union and States.
4. Distinguish between the functioning of Lok Sabha and Rajya Sabha while appreciating the importance of Judiciary.
5. Differentiate between the functions underlying Municipalities, Panchayats and Co-operative Societies.

UNIT - I

Constitution of India: Constitutional history, Govt of India Act 1909, 1919 and 1935, Constitution making and salient features. Directive principles of state policy, Its importance and implementation.

UNIT - II

Scheme of the Fundamental Rights & Duties: The Fundamental Rights, Equality, Certain freedom under Article 19, Life and personal liberty under Article 21, Fundamental Duties and the legal status.

UNIT - III

Union Government and its Administration - Structure of the Indian union, Federalism, Distribution of legislative and financial powers between the union and the states, Parliamentary form of government in India, Executive, President's role, Power and position.

UNIT - IV

Legislature and Judiciary: Central Legislature, Powers and functions of Lok Sabha and Rajya Sabha.

Judiciary: Supreme court, Functions, Judicial review and judicial activism

UNIT - V

Local Self Government - District's administration head (Collector), Role and importance.
Municipalities: Introduction, Mayor and role of elected representative, CEO of municipal corporation.
Panchayati Raj: Introduction, Zilla panchayat, Elected officials and their roles, CEO zilla **Panchayat:** Position and role, Block level, Organizational hierarchy (different departments).
Village level: Role of elected and officials.

Text Books:

1. Ed Prof V Ravindra Sastry, Indian Government & Politics, 2nd edition, Telugu Akademy, 2018.
2. Indian Constitution at Work**,** NCERT, First edition 2006, Reprinted- January 2020.

Suggested Reading:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, Framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edition, Lexis Nexis, 2014.
4. D.D. Basu**,** Introduction to the Constitution of India, Lexis Nexis, 2015.

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

CBIT (A) With Effect from the Academic Year 2021-22

20EGM02 INDIAN TRADITIONAL KNOWELDGE

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	2 MID Sem assignments (Optional)
Credits	0 Non Credit Course

Objectives:

1. To get a knowledge in Indian Culture
2. To Know Indian Languages and Literature and the fine arts in India
3. To explore the Science and Scientists of Medieval and Modern India

Outcomes: After completion of this course, students will be able to:

1. Understand philosophy of Indian culture
2. Distinguish the Indian languages and literature
3. Learn the philosophy of ancient, medieval and modern India
4. Acquire the information about the fine arts in India
5. Know the contribution of scientists of different eras.

UNIT-I

Culture and Civilization: Culture, Civilization and heritage, General characteristics of culture, Importance of culture in human literature, Cultural diversity, Aesthetics, Women seers, Indus culture, Indian cuisine, Martial arts

UNIT-II

Education System: Education in ancient, Medieval and modern India, Aims of education, Subjects, Languages, Science and scientists of ancient India, Science and scientists of medieval India, Scientists of modern India

UNIT-III

Linguistic Wealth: Indian Languages and Literature, The role of Sanskrit, Paleography, Significance of scriptures to current society, Indian semantics and lexicography, Bhakti literature, Darsanas

UNIT-IV

Art, Technology & Engineering: Sculpture, Painting and handicrafts, Indian music, Dance drama and theatre, Introduction to mayamatam, Iron and steel technology, Use of metals in medicinal preparations

UNIT-V

Science and Logic: Helio-centic system, Sulbasutras, Katapayadi, Hindu calendar, 6 pramanas in Indian logic, Scientific method applied to therapeutics, Fallacies, Tarka – Induction & Deduction, Ayurvedic biology, Definition of health

Essential Readings:

1. Kapil Kapoor, Text and Interpretation: The Indian Tradition**,** ISBN: 81246033375, 2005
2. Samskrita Bharati, Science in Samskrit, ISBN-13: 978-8187276333, 2007
4. Satya Prakash, Founders of sciences in Ancient India, Govindram Hasanand, ISBN-10: 8170770009, 1989
5. Brajendranath Seal, The Positive Sciences of the Ancient Hindus, Motilal Banarasidass, ISBN-10: 8120809254, 1915

Suggested Readings:

1. Swami Vivekananda, *Caste, Culture and Socialism*, Advaita Ashrama, Kolkata ISBN-9788175050280
2. Swami Lokeswarananda, *Religion and Culture*, Advaita Ashrama, Kolkata ISBN-9788185843384
3. Kapil Kapoor, *Language, Linguistics and Literature: The Indian Perspective*, ISBN-10: 8171880649, 1994.
4. Karan Singh, *A Treasury of Indian Wisdom: An Anthology of Spiritual Learn*,ISBN: 978-0143426158, 2016
5. Swami Vivekananda, *The East and the West*, Advaita Ashrama, Kolkata 9788185301860
6. Srivastava R.N., *Studies in Languages and Linguistics*, Kalinga Publications ISBN-13: 978-8185163475
7. Subhash Kak and T.R.N. Rao, Computation in Ancient India, Mount Meru Publishing ISBN-1988207126
8. R.N Misra, *Outlines of Indian Arts Architecture, Painting, Sculpture, Dance and Drama*, IIAS, Shimla & Aryan Books International, ISBN 8173055149
9. S. Narain, *Examinations in ancient India*, Arya Book Depot, 1993
10. M. Hiriyanna, Essentials of Indian Philosophy, Motilal Banarsidass Publishers, ISBN-13: 978-8120810990, 2014
11. Ravi Prakash Arya, Engineering and Technology in Ancient India, Indian Foundation for Vedic Science, ISBN-10: 1947593072020

SWAYAM/Nptel:

1. History of Indian Science and Technology - https://onlinecourses.swayam2.ac.in/arp20_ap35/preview
2. Introduction to Ancient Indian Technology – https://onlinecourses.nptel.ac.in/noc19_ae07/preview
3. Indian Culture & Heritage - https://onlinecourses.swayam2.ac.in/nos21_sc11/preview
4. Language and Society - https://nptel.ac.in/courses/109/106/109106091/
5. Science, Technology & Society - https://nptel.ac.in/courses/109/103/109103024/
6. Introduction to Indian Philosophy - https://nptel.ac.in/courses/109/106/109106059/
7. Introduction to Indian Art - An appreciation - https://onlinecourses.nptel.ac.in/noc20_hs09/preview

CBIT (A) With Effect from the Academic Year 2021-22

20MEE01

POWER PLANT ENGINEERING

(Professional Elective - I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Objectives:

1. Different types of power plants and their site selection criteria
2. Operation of thermal power plant
3. About hydraulic power plants, dams and spillways
4. Different types of nuclear power plants including Pressurized water reactor, Boiling water reactor, Liquid metal fast breeder reactor and Gas cooled reactor
5. The power plant economics, environmental and safety aspects of power plant operation.

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

1. Identify different handling equipment used in steam plant.
2. Understand various coal combustion methods.
3. Recognize different types of dams, spill ways and hydro electric power plants.
4. Classify nuclear power plants based on moderator and coolant.
5. Analyze economics related to power plants and effect of pollutants.

UNIT - I

Introduction: Energy and power, Sources of energy, Classification of power plants, Power development in India.

Steam power plant: Plant Layout, Site selection factors, Types of coal, Requirements of good coal handling plant, Coal and ash handling systems, Removal of dust and dust collectors.

UNIT II

Coal Combustion and Firing Methods: Overfeed stoker, Chain grate and spreader stokers, Underfeed stoker, Multi-retort stoker, Unit system, Central bin system, Pulverized fuel burners, Cyclone burner, Fluidized bed combustion.

UNIT III

Hydro Electric Power Plant: Hydrological cycle, Recording and non recording rain gauges, Run-off flow measurement, Flow and mass duration curves, Site selection, Components and layout of hydro power plant, Types of dams and spillways, Classification of hydro electric plants.

UNIT - IV

Nuclear Power Plant: Breeding and fertile materials, Comparison of fission and fusion

processes, Essential components of a nuclear reactor, Pressurized water reactor, Boiling water reactor, Gas cooled reactor, Liquid metal cooled reactors, Breeder reactor, Radioactive waste disposal.

UNIT - V

Power Plant Economics: Terms and definitions, Types of loads, Load curve, Load duration curve, Fixed and operating costs, methods to find depreciation cost, Various types of tariffs.
Environmental considerations: Effluents from power plants and impact on environment.

Text Books:

1. R.K. Rajput, A Text Book of Power Plant Engineering, 5th edition, Laxmi Publications (P) Ltd, New Delhi, 2016.
2. P.K. Nag, Power Plant Engineering, 4th edition, McGra Hill Education (India) Private Limited, New Delhi, 2014.

Suggested Reading:

1. R. Yadav, Fundamentals of Power Plant Engineering, Central Publishing House, Allahabad, 2012.
2. R.K. Hegde, Power Plant Engineering, Pearson Education India, 2015.
3. P.C. Sharma, A Text Book of Power Plant Engineering, S.K. Kataria & sons, New Delhi, 2016.

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20MEE02

PRODUCTION AND OPERATIONS MANAGEMENT

(Professional Elective-I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Objectives:

1. Understand plant layout design to facilitate material flow and processing of a product in the most efficient manner
2. 2. Gain some ability to recognize situations in a production system environment that suggests the use of certain quantitative methods to assist in decision making on operations management and strategy.
3. Understand how Materials Requirement Planning and MRPII systems are used in managing operations
4. Recognize the importance of Inventory control to ensure their availability with minimum capital lock up.
5. Evaluate the quality processes in manufacturing and service sector to improve the operational performance

Outcomes: At the end of the course, the students are able to

1. Understand the role of production system and its design in production and operations management.
2. Apply forecasting techniques for predicting demand
3. Use aggregate planning, master scheduling and materials requirement planning in a production system
4. Compare various inventory control techniques used in production system.
5. Apply the quality control tools to improve performance of production system.

UNIT-I

Introduction: Production systems, Classification and characterisation

Plant Location and Layout: Factors affecting plant location, Objectives of plant layout, Types of layouts, Merits and demerits.

Work Study: Productivity, Introduction to method study and work measurement, Standard time calculations, Work sampling.

UNIT-II

Forecasting: Introduction, Forecasting objectives and uses, Demand patterns, Qualitative models, Market survey, Delphi method, Quantitative models, Moving average, Weighted

moving average, Simple exponential smoothing, Trend adjusted exponential smoothing, Simple regression.

Forecast Errors: Mean absolute deviation, Mean square error, Mean forecast error, Mean absolute percentage error

UNIT-III

Aggregate Planning and Master Scheduling: Introduction, Objectives of aggregate planning, Cost in aggregate planning, Strategies in aggregate planning, Master production scheduling.

Materials Requirement Planning: Importance, MRP system, Inputs and outputs, Bill of materials.

UNIT-IV

Inventory Control: Importance, Inventory control systems, Types of Inventories, Inventory costs, Deterministic Inventory models, Basic purchase model, Purchase model with instantaneous replenishment and with shortages, Basic production model, Production model with shortages, Inventory model with price breaks, Just-in-time system eévolution and its characteristics.

UNIT-V

Quality Control: Introduction, Quality gurus and their contributions, Quality tools, Process capability, Quality control by control charts, Sampling plans, Operating characteristic curve, Introduction to total quality management and six-sigma.

Text Books:

1. Joseph G. Monks., Operations Management: Theory and Problems, 3rd edition, McGraw Hill International Edition, 1987.
2. William J. Stevenson., Operations Management, 8th edition, Tata McGraw Hill Edition, 2005.

Suggested Reading:

1. Everrete E. Adam and Ronald J. Ebert., Production & Operations Management, 5th edition, Prentice Hall of India, 2005.
2. R. Panneerselvam., Production and Operations Management, 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2006.
3. Elwood S. Buffa., Modern Production/Operations Management, 5th edition, John Wiley Publishers, Singapore, 2002

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20MEE03

ENTREPRENEURSHIP

(Professional Elective - I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Objectives:

1. Concept and procedure of idea generation.
2. The nature of industry and related opportunities and challenges.
3. Elements of business plan and it s procedure.
4. Project management and its techniques.
5. Behavioural issues and Time management.

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

1. Understand the concept and essence of entrepreneurship.
2. Identify business opportunities and nature of enterprise.
3. Analyze the feasibility of new business plan.
4. Apply project management techniques like PERT and CPM for effective planning and execution of projects.
5. Use behavioral, leadership and time management aspects in entrepreneurial journey.

UNIT-I

Entrepreneurship: Definition, Functions of entrepreneurs, Qualities of entrepreneurs, Entrepreneur vs intrapreneur, First generation entrepreneurs, Women entrepreneurs, Innovation, Creativity, Intellectual property in entrepreneurial journey, Conception and evaluation of ideas and their sources, Need and importance of startups and incubation centers.

UNIT-II

Indian Industrial Environment: Competence, Opportunities and challenges, Entrepreneurship and economic growth, Small scale industry in India, Objectives, Linkage among small, medium and large scale industries, Types of enterprises, Corporate social responsibility.

UNIT-III

Formulation of Business Plan: Introduction, Business model canvas, Elements of business plan and its salient features, Technical analysis, Profitability and financial analysis, Marketing analysis, Executive summary. Choice of technology and collaborative interactions, Sources of finance and Incentives for entrepreneurs. Busines firm registration procedures.

UNIT-IV

Project Management: Meaning and definition of project, Project organization, Project planning, Execution and control using CPM and PERT techniques, Human aspects of project management, Assessment of tax burden, Environmental issues.

UNIT-V

Behavioral Aspects of Entrepreneurs: Personality determinants, Maslow's hierarchy of needs, Leadership concepts and models, Values and attitudes, Motivation aspects, Change behavior.

Time Management: Approaches of time management, Strengths and weaknesses, Time management matrix and the urgency addiction

Text Books:

1. Vasant Desai., Dynamics of Entrepreneurial Development and Management, 6th edition, Himalaya Publishing House, Mumbai, 1997.
2. Prasanna Chandra., Projects: Planning, Analysis, Selection, Implementation and Review, 8th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1995.

Suggested Reading:

1. Robert D. Hisrich and Michael P. Peters., Entrepreneurship, 5th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi,2005.
2. Stephen R. Covey., First Things First, 1st edition, Free press, New York, 2003.
3. S.S. Khanka., Entrepreneurial Development, 4th edition, S. Chand & Co. Pvt. Ltd., New Delhi, 2012.

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20MEE04

MECHATRONICS AND AUTOMATION

(Professional Elective–I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Objectives:

1. To understand the electrical and mechanical systems and their interconnection to perform a task.
2. Apply mechanical, electronics, control, and computer engineering in the design of mechatronics systems to specific applications.
3. Design of mechatronics systems to specific applications.
4. Interfacing and actuation of a microprocessor and compare the performance of various controllers
5. Design, development, and working of various automated systems.
6. Automation principles for various industrial applications

Outcomes: At the end of the course, the students are able to

1. Apply the concept of mechatronics and analyze electrical and mechanical systems and their interconnection for a given application.
2. Apply mechanical, electronics, control, and computer engineering in the design of mechatronics systems to specific applications.
3. Analyze the design, interfacing, and actuation of a microprocessor and Compare the performance of various controllers (P, PD, PI and PID)
4. To design, develop automated systems for various applications.
5. To design and develop automated and autonomous robotic systems using AI and IOT for various industrial applications.

UNIT - I

Introduction to Mechatronics Systems: Need of interface of electrical & electronic devices with mechanical elements, Concept of mechatronics, Flow chart of mechatronics system, Elements of mechatronics system, Drive mechanisms, Actuators, Feedback devices and control system application in industries and systems development.

Sensors and Transducers: Sensors for displacement, Position and proximity, Velocity, Motion, Force, Fluid pressure, Liquid flow, Liquid level, Temperature, (thermistor, thermocouple), Light sensors and selection of sensors.

UNIT – II

Pneumatic and Hydraulic Actuation Systems: Valves, Pumps and accessories, Hydraulic circuits, Mechanical servo control circuits, Electro-hydraulic servo control and hydro pneumatic circuits with examples.

Mechanical Actuation Systems: Cams, Gear trains, Ratchet and pawl.

Electrical Actuation Systems: Mechanical switches, Solenoids, DC motors, AC motors, Stepper motors and servo motors.

UNIT - III

Microprocessor Technology: Introduction, Architecture, Configuration, Programming and using of 8051 controller with 'C' language, Interfacing input and output devices for various applications.

Process Controllers: Controllers, Uses of controllers, Open loop and closed loop control, Proportional, PD, PI, PID controllers, Analog and digital methods of control.

UNIT - IV

Introduction to Automation: Importance of automation, Use of mechatronics, Systems required, Purpose of automatic control, Implementation of industrial control system, Introduction to automatic control theory

Design of an Automated System: Building blocks of an automated system, Working principle, Selection of various components of an automated system, Specifications of various elements, Use of design data books and catalogues.

UNIT - V

Case Studies of Mechatronics Systems; Pick and place robot, Automatic car park systems, Automatic washing machine and engine management systems.

Introduction to robotic automation: Artificial Intelligence (AI) based systems, IOT in manufacturing industries.

Text Books:

1. William Bolton., Mechatronics: Electronic control systems in mechanical and electrical engineering, 6th edition, Pearson Education, 2015
2. Ronald P. Hunter., Automated process control systems – concepts and Hardware, 2nd edition, PHI, 1987.

Suggested Reading:

1. Devdas Shetty and Richard A. Kolk., Mechatronics System Design, Cengage Learning, 2010.
2. HMT Ltd., Mechatronics, Tata McGraw Hill Publishing Company Limited, New Delhi, 1998.
3. A.K Sawhney., A course on Electrical and Electronic Measurements and Instrumentation, Dhanapatirai& co, 2015

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20MEC14

FLUID PRINCIPLES AND HYDRAULIC MACHINES LAB

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Objectives: Students will

1. Determine discharge of fluid flow.
2. Verify fluid laws like Bernoulli's equation and determine losses through pipes.
3. Determine impact force of jet on the vanes
4. Demonstrate knowledge in evaluating performance characteristics of pumps.
5. Evaluate the performance characteristics of turbines

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

1. Carry out discharge measurements
2. Determine the energy loss in conduits.
3. Calculate forces and work done by a jet on fixed or moving, flat and curved blades.
4. Evaluate the performance characteristics of pumps.
5. Demonstrate the characteristics curves of turbines.

List of the Experiments:

1. Verification of Bernoulli's equation.
2. Determination of Darcy's friction factor and nature of water flow through pipes
3. Determination of coefficient of discharge for venturimeter
4. Determination of coefficient of discharge for rectangular notch
5. Determination of coefficient of discharge for V- notch
6. Determination of impact force of jet on fixed flat and fixed curved vanes
7. Performance and characteristic curves of reciprocating pump
8. Performance and characteristic curves of centrifugal pump
9. Performance and characteristic curves of self priming pump.
10. Performance and characteristic curves of gear pump.
11. Performance and characteristic curves of Pelton wheel
12. Performance and characteristic curves of Francis Turbine under constant speed and variable speed conditions
13. Performance and characteristic curves of Kaplan turbine under constant speed and variable speed conditions

Note: A minimum of 12 experiments need to be conducted.

Suggested Reading:

1. P.N. Modi and S.M. Seth., Hydraulics and Fluid Mechanics Including Hydraulic Machines, 22nd edition, Standard Book House, New Delhi, 2019.
2. R.K. Bansal., A Text Book of Fluid Mechanics and Hydraulic Machines, 9th edition, Laxmi Publications (P) Ltd., New Delhi, 2015.
3. Virtual labs – Fluid Machinery Lab, NITK SURATHKAL

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20MEC15

METAL CUTTING AND MACHINE TOOL ENGINEERING LAB

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Objectives: Students will learn

1. To grind single point cutting tool using HSS as cutting tool
2. To do various operations like plain turning, step turning, knurling
3. Work shop practice on lathe drilling and milling machines
4. Measure cutting forces during machining on Lathe machine, milling
5. Unconventional machining operations like EDM & ECM

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

1. Identify tool geometry and grind to a given tool signature
2. Perform various machining operations to produce components of different shapes and also using jigs &fixtures.
3. Determine the shear angle at various cutting conditions.
4. Evaluate cutting forces using dynamometer, estimate MRR & power consumption under different cutting conditions
5. Plan and create components of utility using various manufacturing facilities in the laboratory.

List of the experiments:

1. Facing and plain turning operations on lathe.
2. Step turning and knurling on lathe machine.
3. Taper turning on lathe.
4. Drilling and boring on lathe.
5. Thread cutting on lathe.
6. Influence of process parameters on MRR in turning operation.
7. Grinding of single point cutting tool.
8. Gear cutting using (a) Plain Indexing. (b) Compound indexing using universal dividing head.
9. Measurement of cutting forces during machining on lathe machine and milling machine.
10. Finding shear angle experimentally in turning operation.
11. Grinding flat surfaces using surface grinding machine and measurement of surface finish.
12. Process parameters of electro discharge machining (EDM).
13. Design utility component, pre/pare process sheet for the manufacturing of the same and produce the component in the lab.

Note: A minimum of 12 experiments need to be conducted.

Suggested Reading:

1. B.L. Juneja., G.S. Shekhon and Seth Nitin, Fundamentals of Metal Cutting & Machine tools, New Age Publishers, 2003.
2. P.N. Rao, Manufacturing Technology – Metal Cutting & Machine Tools, Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.
3. Virtual labs – Machine Tools Lab, IITB MUMBAI