BACHELOR OF ENGINEERING

Detailed Syllabus

Programme Code: MECB
Duration: 4Years

EFFECTIVE FROM SESSION: 2021-2022

Faculty of Engineering

CHHATRAPATI SHIVAJI MAHARAJ UNIVERSITY PANVEL, NAVI MUMBAI

(STATE PRIVATE UNIVERSITY ESTABLISHED UNDER ACT XXXII OF GOVT. OF MAHARASHTRA 2018 AND RECOGNIZED BY THE UGC)

About the Programme

The **B. Tech Mechanical Engineering** programme is aimed at imparting knowledge on the fundamental principles of Physics. This programme is beneficial for the students in the area of higher studies, career opportunities in both private and public sectors.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS):

The programme educational objectives of the Mechanical Engineering programme are:

- PEO1 Basic knowledge will apply for identification, formulation, creation, construction, design, development and optimization of various problems related to various fields of Mechanical Engineering.
- PEO2 The skills and knowledge acquired during the course period will apply in the industry.
- PEO3 To be prepared for the successful pursuit of graduate studies and shall have abilities to engage in lifelong learning in various fields.
- PEO4 To demonstrate the ability and measurement of the impact of computing on society, and possess knowledge of ethical, social and professional implications and responsibilities of their work.
- PEO5 The graduates will work and communicate effectively in inter-disciplinary environment, either independently or in a team, and demonstrate leadership qualities.
- PEO6 The graduates will become successful professionals by demonstrating logical and analytical thinking abilities.

PROGRAMME OUTCOMES (PO):

After completion of the **B. Tech Mechanical Engineering** programme, students will be able to:

- PO1 Ability to apply knowledge of mathematics, science and engineering for the solution of mechanical engineering problems.
- PO2 Ability to formulate and analyze complex mechanical engineering problems.
- PO3 Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, and public health.
- PO4 Ability to design and conduct experiments, and to analyze and interpret data.
- PO5 Ability to use the techniques, skills, and modern engineering tools necessary for Mechanical engineering practice
- PO6 Ability to include social, cultural, ethical issues with engineering solutions
- PO7 Ability to consider the impact of engineering solutions on environment and the need for sustainable development
- PO8 Ability to function effectively on multidisciplinary teams.

1 Eligibility:

All such Candidates who have been awarded or are qualified for 10+2 Std. Examination or equivalent certificate with Physics and Mathematics as compulsory subjects along with one of the Chemistry/ Biotechnology/ Biology/Technical Vocational subjects with at least 45% marks in aggregate OR Passed Diploma examination in relevant branch of Engineering with at least 45% marks in aggregate are eligible to apply for admission to the B. Tech. Mechanical Engineering Programme.

2 Duration:
The B. Tech Mechanical Engineering Programme will normally be of four academic years duration spanning over **eight semesters with 172 credits**.

3: Project Evaluation
Evaluation is based on the following:

i) Two progress assessments 30%
ii) Final Project Report 40%
iii) Project presentation and Viva-voce 30%

If the project work is not completed satisfactorily, the student has to work further and again appear for assessment on a specified date, not earlier than two weeks after the first evaluation. The project assessment board shall consist of the following members.
Chairperson: HOD/Dean of Faculty
Members: HOD, if not as chairperson, Project supervisor of the student. The project supervisor may invite an examiner from outside the department or outside the University or from the industry. For the major projects/ dissertation in the Final semester of UG, one of the examiners may be from outside the University or from the industry. The Project Supervisor, through the HOD shall submit a panel of examiners for external examiner to the Controller of Examination.

4: Organization based Projects / Industry Training
Evaluation is based on the following:
i) Two interim progress assessments, approved by Industry supervisor/ Team Leader/HR: 20%
ii) Final Report approved by Industry supervisor/ Team Leader/HR: 50%
iii) Final presentation and Viva-voce 30%
If the Industry Training is not completed satisfactorily, the student has to work further and again appear for assessment on a specified date, not earlier than two weeks after the first evaluation. The assessment board shall consist of the following members.
Chairperson: HOD/Dean of Faculty
Members: HOD, if not as chairperson, External Project supervisor from the concerned industry (optional). The project supervisor may invite an examiner from the concerned industry.

5: Faculty Advisor/ **Counselor/ Mentor**
All students (mentees) will have faculty advisors/ Mentors whose role will be: -
i) To guide and help them on academics.
ii) To monitor their progress in academics and advise them.

6: Semester-wise Teaching and Evaluation scheme.

SEMESTER -I

Course Type	Course Code	Course Name	L	T	P	IA	UE	Total Marks	Credits
BS	MTHG1000	Engineering Mathematics- I	3	1	-	30	70	100	4
BS	PHYG1000	Engineering Physics	3	1	-	30	70	100	4
ES	CSEG1000	Programming for Problem Solving	3	-	-	30	70	100	3
HSM	ENGG1000	Professional English	3	-	-	30	70	50	3
BS	PHYG1001	Engineering Physics Lab	-	-	2	15	35	50	1
ES	CSEG1001	Programming for Problem Solving Lab	-	-	4	15	35	50	2
ES	MECB1000	Engineering Mechanics	3	1	-	30	70	100	4
MC		Induction Program*	3 weeks duration						0
		Total	**15**	**3**	**8**	**180**	**420**	**550**	**21**

Detailed Syllabus

MTHG1000	ENGINEERING MATHEMATICS I	3L:1T:0P	4 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Internal Assessment Test	30 Marks
Tutorial	1 Hr/Week		
Total Credits	4	End-Semester Examination	70 Marks

Course Objectives:

1. To make the students familiarize with concepts and techniques in Calculus, Complex number and Matrices.
2. The aim is to understand advanced level mathematics and its applications.
3. To able to make mathematical models of physical system.

Course Contents

UNIT 1: Matrices: (6 lectures)

Review on matrices: Definition of matrix, types of matrices, Algebra of matrices, Adjoint of matrix, inverse of matrix, Unitary & Orthogonal matrices, Echelon form, Rank of a matrix, Normal form, PAQ normal form. System of homogeneous & non homogeneous equations, Conditions of their consistency & Inconsistency & solutions. Solution of system of linear algebraic equations, by (1) Gauss Elimination Method (2) Gauss Jordan Method (3) Jacobi iteration (4) Gauss Seidel Method

UNIT 2: Complex Numbers: (6 lectures)

Definition of Complex number, Algebra of complex number, Representation of complex number on complex plane, D'Moivre's Theorem. Powers and roots of Exponential & Trigonometric functions. Expansion of $\sin^n\theta, \cos^n\theta$ in terms of sines and cosines of multiples of θ and Expansion of sinnθ, cosnθ in powers of sinθ, cosθ. Circular functions of complex number and Hyperbolic functions. Inverse Circular and Inverse Hyperbolic functions. Logarithmic functions. Separation of real and Imaginary parts of all types of Functions.

UNIT 3: Numerical Integration: (6 lectures)

Numerical integration-Different type of operators such as shift, forward, backward difference and their relation. Interpolation, Newton Interpolation, Integration by (a) Trapezoidal (b) Simpson's 1/3rd (c) Simpson's 3/8th rule.

UNIT 4: Partial Differential Equation: (6 lectures)

Partial derivatives of first and higher order, total differentials, differentiation of composite and implicit functions. Euler's Theorem on Homogeneous functions with two and three independent variables (with proof). Deductions from Euler's Theorem.

UNIT 5: Application of Partial Differentiation, Indeterminate forms and curve fitting: (8 lectures)

Maxima and Minima of a function of two independent variables Indeterminate forms, L-Hospital rule, Fitting of curves by least square method for line, parabola &exponential.

Recommended Text/Reference Books:

1. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. Dr. B.S. Grewal, Higher Engineering Mathematics, 42nd Ed., Khanna Publication
3. Shanti Narayan, A Textbook of Matrices, S. Chand,2010
4. S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall,2012.

Course Outcomes (COs): At the end of the course, the students will be able to

CO1: Apply the concepts of complex numbers to the engineering problems.

CO2: Apply the knowledge of nth order derivatives of standard functions to engineering problems.

CO3: Apply the principles of basic operations of matrices to the engineering problems.

CO4: Apply concepts of partial differentiation (maxima and minima), expansion of functions as an application of successive differentiation.

PHYG1000	ENGINEERING PHYSICS	3L:1T:2P	5 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Internal Assessment Test	45 Marks
Tutorial	1 Hr/Week		
Practical	2 Hrs/Week		
Total Credits	5	End-Semester Examination	105 Marks

Course Objectives:

1. Students will learn basic concepts of Modern Physics and Quantum Mechanics.
2. The aim is to understand working principle of laser and its applications such as welding, cutting and drilling.
3. Students will know about the application of Solid Physics.
4. Student will learn how to synthesize Nanomaterials.
5. Student will be able to enhance technical thinking power in different disciplines.

Course Contents

UNIT 1: Modern Physics and Quantum Mechanics (10 lectures)

Black body radiation spectrum, Assumptions of quantum theory of radiation, Plank's law, Wien's law and Rayleigh Jeans law, for shorter and longer wavelength limits. Wave Particle dualism, DE Broglie hypothesis. Compton Effect. Matter waves and their Characteristic properties, Definition of Phase velocity and group velocity, Relation between phase velocity and group velocity, Relation between group velocity and particle velocity. Heisenberg's uncertainty principle and its application, (Non-existence of electron in the nucleus). Wave function, Properties and physical significance of wave function, Probability density and Normalization of wave function. Setting up of one-dimensional time independent Schrodinger wave equation. Eigen values and Eigen functions. Application of Schrodinger wave equation for a particle in a potential well of infinite depth and for free particle.

UNIT 2: Semiconductor Physics (10 lectures)

Band theory, Direct & indirect band gap semiconductor; Fermi level; Fermi Dirac distribution; Fermi energy level in intrinsic & extrinsic semiconductors; effect of impurity concentration and temperature on fermi level; mobility, current density; Hall Effect; Fermi Level diagram for p-n junction (unbiased, forward bias, reverse bias); Basics of Transistors. Applications of semiconductors: LED, Zener diode, Photovoltaic solar cell.

UNIT 3: Lasers and Optical Fibres (7 lectures)

Einstein's coefficients (expression for energy density). Requisites of a Laser system. Condition for laser action. Principle, Construction and working of CO2 laser and semiconductor Laser. Applications of Laser – Laser welding, cutting and drilling. Measurement of atmospheric pollutants. Holography–Principle of Recording and reconstruction of images. Propagation mechanism in optical fibres. Angle of acceptance. Numerical aperture. Types of optical fibres and modes of propagation. Attenuation, Block diagram discussion of point-to-point communication, applications.

UNIT 4: Solid State Physics (7 lectures)

Space lattice, Bravais lattice–Unit cell, primitive cell. Lattice parameters. Crystal systems. Direction and planes in a crystal. Miller indices. Expression for inter – planar spacing. Co-ordination number. Atomic packing factors (SC, FCC, BCC). Bragg's law, Determination of crystal structure using Bragg's X–ray diffract meter. Polymorphism and Allotropy. Crystal Structure of Diamond, qualitative discussion of Perovskites.

UNIT 5: Nanotechnology (6 lectures)

Introduction to Nano Science, Density of states in 1D, 2D and 3D structures. Nano materials Properties (Optical, electrical, magnetic, structural, mechanical) and applications, Surface to volume ratio; Two main approaches in nanotechnology -Bottom-up technique and Top-down technique; Tools for characterization of Nanoparticles: Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM). Methods to synthesize Nanomaterials: Ball milling, Sputtering, Vapor deposition, Sol-gel method.

Recommended Text/Reference Books:

1. Dr. M.N. Avadhanulu, Engineering Physics, Wiley India Private Ltd., New Delhi. Book series – 2014
2. Dr. P.G. Kshirsagar, Text Book of Engineering Physics, S Chand Publishing, New Delhi – 2012
3. Resnick, Halliday and Walker, Physics, Wiley, 8/e. 2008
4. S.O. Pillai, Solid State Physics, New Age International. Sixth Edition.
5. Chintoo S Kumar, K Takayana and K P J Reddy, Shock waves made simple, Willey India Pvt. Ltd. New Delhi,2014
6. A Marikani, Engineering Physics, PHI Learning Private Limited, Delhi – 2013.

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

CO1: To impart the ideas of Modern physics and Quantum Mechanics

CO2: To impart the knowledge of Semiconductor Physics and electronic devices

CO3: To make students learn about the mechanism and devices of Lasers and Optical fibers.

CO4: To make students learn the basics of crystal structure and Solid-State Physic

CO5: To impart the knowledge of Nan materials and basics of Nanotechnology.

List of Laboratory Experiments (Any Eight)

1. To determine of wavelength of monochromatic light using Newton's rings.
2. To determine radius of curvature of Plano-convex lens using Newton's rings.
3. To determine position of diffraction minima by studying diffraction at a single slit.
4. To determine unknown wavelength by using plane diffraction grating.
5. To find out resolving power of Diffraction Grating/Telescope.
6. To verify Malus Law.
7. Any experiment based on Double Refraction (Determination of refractive indices, identification of types of crystal).
8. Any Experiment based on Laser (Thickness of wire, determination of number of lines on grating surface).
9. An experiment based on optic fibers.

10. To study IV characteristics of Solar Cell and determine parameters (fill factor and efficiency).
11. To determine band gap of given semiconductor.
12. To determine Hall coefficient and charge carrier density.
13. Temperature dependence characteristics of semiconductor laser.
14. To find out Magnetic susceptibility of given material.
15. Ultrasonic Interferometer: Determination of velocity of ultrasonic waves in given liquid and finds its compressibility.

CSEG1000	PROGRAMMING FOR PROBLEM SOLVING	3L:0T:4P	5 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**45 Marks**
Tutorial	**-**		
Practical	**4 Hrs/Week**		
Total Credits	**5**	**End-Semester Examination**	**105 Marks**

Course Objectives:

1. To learn the fundamentals of computers and understand the various steps in program development.
2. Learn the syntax and semantics of C programming language.
3. To learn the usage of structured programming approach in solving problems.

Course Contents

UNIT 1: Introduction to Programming: (8 lectures)
Introduction to components of a computer system: Memory, processor, I/O Devices, storage, operating system, Concept of assembler, compiler, interpreter, loader and linker. Idea of Algorithm: Representation of Algorithm, Flowchart, Pseudo code with examples, From algorithms to programs, source code. Programming Basics: Structure of C program, writing and executing the first C program, Syntax and logical errors in compilation, object and executable code. Components of C language. Standard I/O in C Fundamental data types, Variables and memory locations, Storage classes.

UNIT 2: Arithmetic expressions & Conditional Branching: (8 lectures)
Arithmetic expressions and precedence: Operators and expression using numeric and relational operators, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and associatively. Conditional Branching: Applying if and switch statements, nesting if and else, use of break and default with switch.

UNIT3: Loops & Functions: (8 lectures)
Iteration and loops: use of while, do while and for loops, multiple loop variables, use of break and continue statements. Functions: Introduction, types of functions, functions with array, passing parameters to functions, call by value, call by reference, recursive functions.

UNIT4: Arrays & Basic Algorithms: (8 lectures)
Arrays: Array notation and representation, manipulating array elements, using multi-dimensional arrays. Character arrays and strings, Structure, union, enumerated data types, Array of structures, Passing arrays to functions. Basic Algorithms: Searching &Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, Notion of order of complexity. Distributed Database: distributed data storage, concurrency control, directory system

UNIT5: Pointer & File Handling: (8 lectures)
Pointers: Introduction, declaration, applications, Introduction to dynamic memory allocation (malloc, calloc, realloc, free), Use of pointers in self-referential structures, notion of linked list (no implementation) File handling: File I/O functions, Standard C preprocessors, defining and calling macros, command-line arguments.

Recommended Text/Reference Books:

1. Schaum's Outline of Programming with C by Byron Gottfried, McGraw-Hill

2. Kernighan Brain W. and Ritchie Dennis M., The C programming by Pearson Education
3. V.Rajaraman, Computer Basics and C Programming by, PHI Learning Pvt. Limited, 2015.
4. E Balaguruswami, Computer Concepts and Programming in C, McGraw Hill
5. BeHrsouz A. Forouzan, Richard F. Gilberg, Thomson, Computer Science- A Structured Programming Approach Using Third Edition, Cengage Learning - 2007.
6. Jeri R. Hanly, Elliot B. Koffman, Problem Solving and Program Design in C, Pearson Addison-Wesley, 2006.
7. Kochan Stephen G., Programming in C, Pearson Education – 2015.
8. D.S. Yadav and Rajeev Khanna, Computer Concepts and Programming in C, New Age International Publication.
9. Anami, Angadi and Manvi, Computer Concepts and Programming, PHI Publication
10. Vikas Gupta, Computer Concepts and Programming in C, Wiley India Publication
11. Reema Thareja, Computer Fundamentals and Programming in C, Oxford Publication

Course Outcomes (COs): At the end of the course, the students will be able to

CO1: To develop simple algorithms for arithmetic and logical problems.
CO2: To translate the algorithms to programs & execution (in C language).
CO3: To implement conditional branching, iteration and recursion.
CO4: To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
CO5: To use arrays, pointers and structures to develop algorithms and programs.

List of Laboratory: Experiments (Any Eight)

1. WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained by the student.
2. WAP that calculates the Simple Interest and Compound Interest. The Principal, Amount, Rate of Interest and Time are entered through the keyboard.
3. WAP to calculate the area and circumference of a circle.
4. WAP that accepts the temperature in Centigrade and converts into Fahrenheit using the formula C/5=(F32)/9.
5. WAP that swaps values of two variables using a third variable.
6. WAP that checks whether the two numbers entered by the user are equal or not.
7. WAP to find the greatest of three numbers.
8. WAP that finds whether a given number is even or odd.
9. WAP that tells whether a given year is a leap year or not.
10. WAP that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.
11. WAP to print the sum of all numbers up to a given number.
12. WAP to find the factorial of a given number.
13. WAP to print sum of even and odd numbers from 1 to N numbers.
14. WAP to print the Fibonacci series.
15. WAP to check whether the entered number is prime or not.

16. WAP to find the sum of digits of the entered number.
17. WAP to find the reverse of a number.
18. WAP to print Armstrong numbers from 1 to 100.
19. WAP to convert binary number into decimal number and vice versa.
20. WAP that simply takes elements of the array from the user and finds the sum of these elements.
21. WAP that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.
22. WAP to find the minimum and maximum element of the array.
23. WAP to search an element in a array using Linear Search.
24. WAP to sort the elements of the array in ascending order using Bubble Sort technique.
25. WAP to add and multiply two matrices of order nxn.
26. WAP that finds the sum of diagonal elements of a mxn matrix.
27. WAP to swap two elements using the concept of pointers.
28. WAP to compare the contents of two files and determine whether they are same or not.
29. WAP to check whether a given word exists in a file or not. If yes then find the number of times it occurs

ENGG1000	PROFESSIONAL ENGLISH	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objectives:

1. To acquaint the students with appropriate language skills with the purpose of improving the existing ones – LSRW.
2. To make the learners understand the importance and effective use of non-verbal communication.
3. To make the learner proficient in public speaking and presentation skills.
4. To guide and teach the students to utilize the principles of professional business and technical writing for effective communication in the global world.
5. To deploy technology to communicate effectively in various situations.

Course Contents

UNIT 1: Communication and Communication Process (6 lectures)
Introduction to Communication, Forms and functions of Communication, Barriers to Communication ((linguistic and semantic, psychological, physical, mechanical, cultural), and overcoming them, Types of communication: verbal and non-verbal communication.
Reading: Introduction to Reading, Barriers to Reading, Types of Reading: Skimming, Scanning, Fast Reading, Strategies for Reading, Comprehension. Listening: Importance of Listening, Types of Listening, and Barriers to Listening.

UNIT2: Writing Skills, Reading Skills & Listening Skills (6 lectures)
Features of Good Language, Technical Style of writing, Writing Emails and it's etiquettes, Technical Reports: Report Writing: Types, Format and Structure of reports.

UNIT3: (7 lectures)
Letter Writing: Types of letters: Job application letter, complaint letter, enquiry letter, reply to enquiry, sales letter. Essential and non-essential parts of letters, formats of letters.

UNIT4: (6 lectures)
Grammar: Types of sentences, Antonyms and Synonyms, Use of Auxiliaries and Modal Auxiliaries, Synonyms and Antonyms, Pairs of confused words, Common Errors in sentences.

UNIT5: (5 lectures)
Soft Skills: Body language, Team work and skills, Decision making ability, Negotiation skills and Interview skills.

UNIT6: (5 lectures)
Dialogues Writing and Speaking: Greeting someone and responding to greet, thanking someone and responding to thanks, making inquiry and responding to enquiry on telephone, making request and responding to request.

List of assignments:

1. Communication and Communication Processes: 02.
2. LSRW- Listening, Speaking, Reading & Writing: 02
3. Letter Writing: 01.
4. Grammar: 01.
5. Soft Skills: 01.
6. Dialogues Writing and Speaking: 01.

Recommended Text/Reference Books:

1. Dalmar Fisher, Jaico, Communication in Organizations, Publishing House
2. Meenakshi Raman & Sangeeta Sharma, Communication Skill, Oxford University Press.
3. R.C. Sharma& Krishna Mohan, Business Correspondence & Report-writing, Tata McGraw-Hill Education.
4. Ashraf Rizvi, Effective Technical Communication, Tata McGraw-Hill.
5. Thomas N. Huckin & Leslie A. Olsen, Technical Writing & Professional Communication for non-native speakers of English, McGraw –Hill.
6. Nicky Stanton, Mastering Communication, Palgrave Master Series
7. www.buisnesscommunicationskills.com
8. www.kcitraing.com
9. www.mindtools.com
10. Journal of Business Communication.

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

CO1: Understand and evaluate information they listen to and express their ideas with greater clarity.

CO2: Speak and respond effectively along the various channels of communication in a business organization.

CO3: Speak convincingly before an audience with the help of an expanded vocabulary and enhanced digital content.

CO4: Communicate through result-oriented writing both within and outside the organization.

CO5: Write a set of effective and easy to understand technical description, instructions.

MECG1000	ENGINEERING MECHANICS	3L:1T:0P	4 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**1 Hr/Week**		
Total Credits	**4**	**End-Semester Examination**	**70 Marks**

Course Objective:

1. To acquaint the concept of equilibrium in two- and three-dimensional system.
2. To study and analyze motion of moving bodies.
3. To lean about the friction and its application
4. To know about Instantaneous center of rotation

Course Contents

UNIT 1: Equilibrium of System of Coplanar Forces (8 lectures)
Condition of equilibrium for concurrent forces, parallel forces and non-concurrent nonparallel general forces and Couples. Types of support: Loads, Beams, Determination of reactions at supports for various types of loads on beams. (Excluding problems on internal hinges) Analysis of plane trusses: By using Method of joints and Method of sections. (Excluding pin jointed frames).

UNIT 2: Forces in space (8 lectures)
Resultant of Non-coplanar Force Systems**:** Resultant of concurrent force system, parallel force system and non-concurrent non-parallel force system. Equilibrium of Non-coplanar Force Systems**:** Equilibrium of Concurrent force system, parallel force system and non-concurrent non-parallel force system.

UNIT 3: Friction (6 lectures)
Introduction to Laws of friction, Cone of friction, Equilibrium of bodies on inclined plane, Application to problems involving wedges, ladders. Principle of virtual work**:** Applications on equilibrium mechanisms, pin jointed frames.

UNIT 4: Kinematics of a Particle (10 lectures)
Rectilinear motion, Velocity & acceleration in terms of rectangular co-ordinate system, Motion along plane curved path, Tangential& Normal component of acceleration, Motion curves (a-t, v-t, s-t curves), Projectile motion. Kinetics of a Particle: Force and Acceleration**: -**Introduction to basic concepts, D'Alemberts Principle, Equations of dynamic equilibrium, Newton's second law of motion. Kinetics of a Particle: Work and Energy**:** Principle of work and energy, Law of conservation of energy. Kinetics of a Particle: Impulse and Momentum**:** Principle of linear impulse and momentum. Law of conservation of momentum. Impact and collision.

UNIT 5: Kinematics of a Rigid Body (6 lectures)
Introduction to general plane motion, Instantaneous center of rotation for the velocity, velocity diagrams for bodies in plane motion.

Recommended Text/Reference Books:

1. R. C. Hibbeler.2, Engineering Mechanics, Prentice Hall,2005

2. Beer &Johnston, Engineering Mechanics, Tata McGraw Hill, 10th edition.
3. F. L. Singer, Harper, Engineering Mechanics, Raw Publication
4. Macklin & Nelson, Engineering Mechanics, Tata McGraw Hill

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

CO1: Illustrate the concept of force, moment and apply the same along with the concept of equilibrium in two- and three-dimensional systems with the help of FBD.

CO2: Correlate real-life application to specific type of friction and estimate required force to overcome friction.

CO3: Establish relation between velocity and acceleration of a particle and analyze the motion by plotting the relation

CO4: Illustrate different types of motions and establish Kinematic relations for a rigid body

CO5: Analyze body in motion using force and acceleration, work-energy, impulse-momentum principles.

MC	INDUCTION PROGRAM	3 weeks	0 Credits
Induction program for students to be offered right at the start of the first year	Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations		

SEMESTER II

Course Type	Course Code	Course Name	L	T	P	IA	UE	Total Marks	Credits
BS	MTHG2000	Engineering Mathematics II	3	1	-	30	70	100	4
BS	CHYG2000	Engineering Chemistry	3	1	-	30	70	100	4
ES	MECB2000	Engineering Graphics	3	-	-	30	70	100	3
ES	ELEG2000	Basic Electrical Engineering	3	1	-	30	70	100	4
BS	CHYG2001	Engineering Chemistry Lab	-	-	2	15	35	50	1
ES	MECBG2010	Workshop/Manufacturing Practices	1	-	4	30	70	100	3
ES	ELEG2000	Basic Electrical Engineering Lab	-	-	2	15	35	50	1
MC	EVSG2000	Environmental Sciences	2	1	-	30	70	100	3
		Total	**16**	**4**	**9**	**210**	**490**	**700**	**23**

MECG2000	ENGINEERING MATHEMATICS II	3L:1T:0P	4 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Internal Assessment Test	30 Marks
Tutorial	1 Hrs/Week		
Total Credits	4	End-Semester Examination	70 Marks

Course Objectives:

1. To provide students with sound foundation in applied mathematics to solve real life problems in industry.
2. To understand the concept of differential equation to the engineering problems.
3. To learn vector algebra and vector calculus.

Course Contents

UNIT I: Beta and Gamma functions, and exact differential equation: (4 Lectures)
Beta function and its properties. Gamma functions and its properties. Differential Equation of first order and first degree-Exact differential. Equations. Equations reducible to exact equations by using integrating factors.

UNIT 2: Differential Calculus: (10 Lectures)
Linear differential equations of the type $\frac{dy}{dx} + Py = Q$, equation reducible to linear form, Bernoulli's equation. Higher order Linear Differential Equation with constant coefficient-Complimentary function, particular integrals of differential equation of the type f(D)y = X where ise^{ax} , sin(ax+b), cos(ax+b), xn, e^{ax}V, xV. Successive differentiation: nth derivative of standard functions. Leibnitz's Theorem (without proof) and problems.

UNIT 3: Vector Algebra& Vector Calculus (10 Lectures)
Definition of vector, Dot product, Cross product, Vector triple product, Product of four vectors Scalar point function, Vector point function, Vector differential operator ∇(del). Gradient, Divergence, Curl their properties &related problems. Applications- Normal, Directional derivatives, Solenoidalv & Irrotational fields

UNIT 4: Double Integration: (4 Lectures)
Definition, Evaluation of Double Integrals, change of order of integration, Evaluation of double integrals by changing the order of integration and changing to polar form

UNIT 5: Triple Integration & Application of Double Integration& Triple Integration (10 Lectures)

Definition and evaluation (Cartesian, cylindrical and spherical polar coordinates). Application to double integrals to compute Area, Mass, Volume. Application of triple integral to compute volume.

Recommended Text/Reference Books:

1. P. N. Wartikar and J. N. Wartikar, A text book of Applied Mathematics Vol –I and II Pune Vidyarthi Graha Prakashan
2. Dr.B. S. Grewal, Higher Engineering Mathematics, Khanna Publication
3. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern Limited, 9th Ed.
4. S.S. Sastry, Numerical Analysis, Prentice Hall
5. Sheply Ross, Differential Equations, Wiley India

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

CO1: Apply the knowledge of nth order derivatives of standard functions to engineering problems

CO2: Apply the concepts of First Order and first-degree Differential equation to the engineering problems.

CO3: Apply the concepts of Higher Order Linear Differential equation to the engineering problems.

CO4: Apply concepts of Beta and Gamma function to the engineering Problems.

CO5: Apply concepts of Double integral of different coordinate systems to the engineering problems.

CO6: Apply concepts of triple integral of different coordinate systems to the engineering problems.

CHYG2000	ENGINEERING CHEMISTRY	3L:1T:2P	5 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	3 Hrs/Week	Internal Assessment Test	45 Marks
Tutorial	1 Hr./Week		
Practical	2 Hrs/Week		
Total Credits	5	End-Semester Examination	105 Marks

Course Objectives:

1. To bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfect engineer.
2. To impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based on them.
3. To acquire the knowledge of electrochemistry, corrosion and water treatment which are essential for the Engineers and in industry.
4. To acquire the skills pertaining to spectroscopy and to apply them for medical field.
5. To impart then knowledge of stereochemistry and synthetic aspects useful for understanding reaction pathways.

Course Contents

UNIT 1: Water and its treatment: (10 Lectures)

Introduction – Chemistry of Water Molecule. hardness of water. Types of hardness: temporary and permanent. (Numerical Based on Hardness). units of hardness. Estimation of hardness of water by complex metric method. Methods of softening of water: Lime Soda Process (Numerical), Zeolite Process & ion exchange process (Numerical). Softening of Water Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ionization. Desalination of water – Reverse osmosis. Numerical problems.

UUNIT 2: Energy Sources: (10 Lectures)

Fuels- Definition, classification (solid, liquid & gaseous fuels) - characteristics of a good fuel; Coal - analysis of coal - proximate and ultimate analysis and their significance; Petroleum - refining, knocking - octane and cetane number, cracking - fluid bed catalytic cracking; Natural gas, LPG, CNG - constituents, characteristics and uses. Numerical.

UNIT 3: Molecular structure and Theories of Bonding: (7 Lectures)

Atomic and Molecular orbitals. Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of N2, O2 and F2

molecules. π Molecular orbital of butadiene and benzene. Crystal Field Theory (CFT): Salient Features of CFT – Crystal Field Splitting of transition metal ion d- orbital in Tetrahedral, Octahedral and square planar geometries.

UNIT 4: Corrosion: (7 Lectures)

Corrosion: Causes and effects of corrosion – theories of chemical and electrochemical corrosion – mechanism of electrochemical corrosion. Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion, Corrosion control methods- Cathodic protection – Sacrificial anode and impressed current cathode methods. Surface coatings – metallic coatings – Methods of coating- Hot dipping, cementation – methods of application. Electroless plating and Electroless plating of copper.

UNIT 5: Stereochemistry, Reaction Mechanism and synthesis of drug molecules: (6 Lectures)

Introduction to representation of 3-dimensional structures, Structural and stereoisomers, configurations, symmetry and chirality. Enantiomers, diastereomers, optical activity and Absolute configuration. Conformation alanalysis of n- butane. Substitution reactions: Nucleophilic substitution reactions: Mechanism of SN1, SN2 reactions. Electrophilic and nucleophilic addition reactions: Addition of HBr to propene. Markownikoff and anti Markownikoff additions. Grignard additions on carbonyl compounds. Elimination reactions: Dehydro halogenation of alkylhalides. Saytzeff rule. Oxidation reactions: Oxidation of alcohols using KMnO4. Reduction reactions: reduction of carbonyl compounds using LiAlH4 & NaBH4. Hydroboration of olefins. Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.

Recommended Text/Reference Books:

1. P.W. Atkins, Physical Chemistry, W H Freeman & Co; 7th edition
2. B.L. Tembe, Kamaluddin and M.S. Krishnan, Engineering Chemistry (NPTEL Web-book)
3. B.H. Mahan, University Chemistry, Fourteenth Edition, Pearson
4. C.N. Banwell, Fundamentals of Molecular Spectroscopy, Fourth edition, McGraw Hill Education
5. K.P.C. Volhardt and N.E. Schore, Organic Chemistry: Structure and Function, 5th Edition.

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

CO1: The knowledge of atomic, molecular and electronic changes, band theory related to conductivity.

CO2: The required principles and concepts of electrochemistry, corrosion and in understanding the problem of water and its treatments.

CO3: The required skills to get clear concepts on basic spectroscopy and application to medical field etc.

CO4: The knowledge and configurationally and conformational analysis of molecules and reaction mechanisms.

MTEG2001	ENGINEERING GRAPHICS	3L:0T:4P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hr/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**--**		
Practical	**-**		**-**
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objective:

1. To impart and inculcate proper understanding of the theory of projection.
2. To impart the knowledge of reading a drawing.
3. To improve the visualization skill.
4. To teach basic utility of computer aided drafting (CAD) tool.

Course Contents

UNIT 1: Drafting Technology and Introduction to Any Drafting Software/Package (10 Lectures)

Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice, Dimensioning – linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension. Tolerances – methods of representing tolerances, unilateral and bilateral tolerances, tolerance on linear and angular dimensions, geometrical tolerances. Symbols used on drawing, surface finish symbols, welding symbols. Advantages of using Computer Aided Drafting (CAD) packages, applications of CAD, basic operation of drafting packages, use of various commands for drawing, dimensioning, editing, modifying, saving and printing/plotting the drawings. Introduction to 3D primitives.

UNIT 2: Projection of Points and Lines (10 Lectures)

Lines inclined to both the Reference Planes (Excluding Traces of lines) and simple application based problems on Projection of lines. **Projection of Planes**: - Triangular, Square, Rectangular, Pentagonal, Hexagonal and Circular planes inclined to either HP or VP only. (Exclude composite planes)

UNIT 3: Engineering Curves (6 Lectures)

Ellipse, Parabola, Hyperbola, normal and tangents to these curves, Involute, Cycloid, Epi-cycloid, Hypo-cycloid, Archimedean Spiral, Helix on cone and cylinder

UNIT 4: Orthographic Projections & Isometric Projections (8 Lectures)

Reference planes, types of orthographic projections – First angle projections, third angle projections, methods of obtaining orthographic views by First angle method, Sectional orthographic projections – full section, half section, offset section. Isometric view, Isometric scale to draw Isometric projection, non-Isometric lines, construction of Isometric view from given orthographic views and to construct Isometric view of a Pyramid, Cone, Sphere.

UNIT 5: Auxiliary Projections (6 Lectures)

Auxiliary planes – Auxiliary Vertical Plane (AVP), Auxiliary Inclined Plane (AIP), symmetrical auxiliary view, unilateral auxiliary view, bilateral auxiliary view. Free hand sketching -- FV and TV of standard machine parts – Hexagonal headed nut and bolt, foundation bolts, shafts, keys, couplings, springs, screw thread forms, welded joints, riveted joints.

PART I: Drawing sheet

Five drawing sheets to be prepared on half imperial drawing sheet: (To be completed in 30 Hrs.)

Sheet No.1: Curves (2 problems) & projections of lines (2 problems)
Sheet No. 2: Projections of solids (2 problems) & section of solids (1 problem)
Sheet No.3: Orthographic projections (1 problem) & sect. ortho. Projections (1 problem)
Sheet No.4: Reading of orthographic projections (2 problems)
Sheet No.5: Isometric view (2 problems) & free hand sketches of fasteners.
Home –Work: one sketch book, A-3 consisting of minimum 3 problems from each module. Duly signed sketch book is part of term –work.

PART II: Computer Aided Drawing (Auto –CAD)

Practice on Auto –cad: Theory and practice to be completed during practical sessions.

1 Introduction to Auto –Cad.
2 Fundamental of 2 –D Constructions.
3 Orthographic projections.
4 Sectional orthographic projections.
5 Reading of Orthographic projections.
6 Fundamental of 3 –D drawing Isometric view.

Printout of problems solved in the practical class to be attached in the Term work (on Sr. No. 3 4.,5 & 6)

Practical Examination: Practical examination will be based on Part II of the list T

Recommended Text/Reference Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, SciTech Publishers Corresponding set of) CAD Software Theory and User Manuals

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

CO1: Apply the basic principles of projections in 2D drawings.

CO2: Apply the basic principles of projections in converting 3D view to 2D drawings.
CO3: Read a given drawing.
CO4: Visualize an object from the given two views.
CO5: Use CAD tool to draw different views of an object

ELEG2000	BASIC ELECTRICAL ENGINEERING	3L:1T:2P	5 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**45 Marks**
Tutorial	**1 Hr/Week**		
Practical	**2 Hrs/Week**		
Total Credits	**5**	**End-Semester Examination**	**105 Marks**

Course Objective:

1. To gain proper understanding of the Electric circuit.
2. To impart the knowledge of Electric connections such as delta connection.
3. To understand the basic of transformer.
4. To learn about electric machine.
5. To understand fundamental of boost converters and types of cable

Course Contents

UNIT 1: DC Circuits (8 Lectures)
Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

UNIT 2: AC Circuits (8 Lectures)
Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections

UNIT 3: Transformers (6 Lectures)
Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT 4: Electrical Machines (8 Lectures)
Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-

speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

UNIT 5: Power Converters (6 Lectures)
DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

UNIT 6: Electrical Installations (6 Lectures)
Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Reference Books

1. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, Tata McGraw Hill, 2010.
2. D. C. Kulshrestrha, Basic Electrical Engineering, McGraw Hill, 2009.
3. L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
4. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.
5. V. D. Toro, Electrical Engineering Fundamentals, Prentice Hall India, 1989.

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

CO1: To understand and analyse basic electric and magnetic circuits
CO2: To study the working principles of electrical machines and power converters.
CO3: To introduce the components of low voltage electrical installations

List of experiments/demonstration:

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
3. Transformers: Observation of the no-load current waveform on an oscilloscope (no sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
5. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
6. Torque Speed Characteristic of separately excited dc motor.
7. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super synchronous speed.

8. Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
   9.Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

MTEG2001	WORKSHOP/MANUFACTURING PRACTICES	1L:1T:4P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**1 Hr/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**--**		
Practical	**4 Hrs/Week**		**-**
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objective:

1. To gain proper understanding of the manufacturing methods.
2. To impart the knowledge of additive manufacturing.
3. To understand the basic of fitting operations.
4. To learn about carpentry.
5. To understand fundamental of casting and welding

Course Contents

Detailed contents

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3 lectures)
2. CNC machining, Additive manufacturing (1 lecture)
3. Fitting operations & power tools (1 lecture)
4. Electrical &Electronics (1 lecture)
5. Carpentry (1 lecture)
6. Plastic moulding, glass cutting (1 lecture)
7. Metal casting (1 lecture)
8. Welding (arc welding & gas welding), brazing (1 lecture)

Suggested Text/Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., Elements of Workshop Technology, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.

3. Gowri P. Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
4. Roy A. Lindberg, Processes and Materials of Manufacture, 4th edition, Prentice Hall India, 1998.
5. Rao P.N., Manufacturing Technology, Vol. I and Vol. II, Tata McGraw-Hill House 2017.

(ii) Workshop Practice :(60 Hours) [L: 0; T:0; P: 4 (2 credits)]

1. Machine shop (10 hours)
2. Fitting shop (8 hours)
3. Carpentry (6 hours)
4. Electrical & Electronics (8 hours)
5. Welding shop (8 hours (Arc welding 4 Hrs + gas welding 4 Hrs)
6. Casting (8 hours)
7. Smithy (6 hours)
8. Plastic moulding & Glass Cutting (6 hours)

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

CO1: Students will be able to fabricate components with their own hands.

CO2: Students will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.

CO3: Students will be able to produce small devices.

EVSG2000	ENVIRONMENTAL STUDIES	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**--**		
Practical	**-**		**-**
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objectives:

Through interdisciplinary academic courses, internships, experiential, and co-curricular activities our students become passionate stewards of the environment, scholars in sustainability and environmental management, and experts in environmental studies. With a focus on environmental justice, students develop critical-thinking skills, analyze real-world problems, and understand the power of narrative to create sustainable solutions for local and global communities.

1. To provide students with a broad interdisciplinary liberal arts framework for understanding the relationship between humans and their environment;
2. To provide students with informed perspectives on biological and physical processes relevant to environmental problems, to help students understand responsible environmental policy and practice, and to engage students in ethical reflection regarding environmental problems in local, regional, national, and global communities;
3. To prepare students for careers, citizenship and environmental stewardship through experiential curricular and co-curricular opportunities;

To equip students with the knowledge and skills necessary to pursue professional careers and advanced study related to the multi-faceted nature of environmental studies.

Course Contents

UNIT 1 (8 Lectures)

Multidisciplinary nature of environmental studies: Definition, scope and importance, Need for public awareness, **Natural Resources:** Natural resources and associated problems. a) Forest

resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyles.

UNIT 2 (7 Lectures)

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its conservation- Introduction – Definition: genetic, species and ecosystem diversity. Biogeographically classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic, and option values, Biodiversity at global, National and local levels, India as a mega-diversity nation, Hot-sports of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT 3 (8 Lectures)

Environmental Pollution: Cause, effects and control measures of : a. Air pollution, b. Water pollution, c. Soil pollution, d. Marine pollution, e. Noise pollution, f. Thermal pollution, g. Nuclear hazards, **Solid waste Management** : Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. **Disaster management**: floods, earthquake, cyclone and landslides.

UNIT4 (7 Lectures)

Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Case Studies, Environmental ethics: Issues and possible solutions., Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act Wildlife Protection Act Forest Conservation Act Issues involved in enforcement of environmental legislation. Public awareness.

UNIT 5 (6 Lectures)

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Programme. Environment and human health. Human

Rights. Value Education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

UNIT 6 (4 Lectures)

Visit to a local area to document environmental assets: river/ forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common plants, insects, birds.
- Study of simple ecosystems-pond, river, hill slopes, etc.

Suggested Text/Reference Books:

1. Dr Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, Orient Black Swan; Pune,
2. E-copy: https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf
3. Dr. Sushmitha Baskar, Environmental Studies for Undergraduate Courses, Unicorn Books
4. Asthana D.K., Asthana Meera, A Textbook of Environmental Studies, S Chand & Company

Course Outcomes (COs): At the end of the course, the students will be able to

CO1: Articulate the interconnected and interdisciplinary nature of environmental studies

CO2: Demonstrate an integrative approach to environmental issues with a focus on sustainability

CO3: Use critical thinking, problem-solving, and the methodological approaches of the social sciences, natural sciences, and humanities in environmental problem solving

CO4: Communicate complex environmental information to both technical and non-technical audiences

CO5: Understand and evaluate the global scale of environmental problems; and

Reflect critically on their roles, responsibilities, and identities as citizens, consumers and environmental actors in a complex, interconnected world.

SEMESTER III

Course Type	Course Code	Course Title	Hours/ Week			Theory Marks		Practical Marks		Total Marks	Credits
			L	T	P	IA	ESE	IA	ESE		
BS	MTHG3000	Engineering Mathematics III	3	1	-	30	70	-	-	100	4
DC	MECB3000	Thermodynamics	3	1	-	30	70	-	-	100	4
DC	MECB3010	Production Process I	3	-	-	30	70	-	-	100	3
ES	EETB3000	Basic Electronics	3	1	-	30	70	-	-	100	4
BS	ZBCB3000	Biology for Engineers	3	-	-	30	70	-	-	100	3
Dc	MECB3011	Production Process Lab	-	-	2	-	-	15	35	50	1
ES	EETB3000	Basic Electronics Lab	-	-	2	-	-	15	35	50	1
DC	MECB3001	Thermal Engineering –I Lab	-	-	2	-	-	15	35	50	1
MC	LLLB3000	Constitution of India	3	-	-	30	70	-	-	100	0
	TOTAL		**15**	**3**	**6**	**180**	**720**	**45**	**105**	**750**	**21**

MTHG3000	ENGINEERING MATHEMATICS III	3L:1T:0P	4 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**1 Hr/Week**		
Practical	**-**		**-**
Total Credits	**4**	**End-Semester Examination**	**70 Marks**

Course Objectives:

1. To provide sound foundation in the mathematical fundamentals necessary to formulate, solve and analyze engineering problems.
2. To understand the concept of Fourier Series, its complex form and enhance the problem-solving skill.
3. To learn the Laplace Transform, Inverse Laplace Transform of various functions, its application
4. To understand the concept of Correlation and Regression to the engineering problems
5. To understand the concept of Z - transformation.

Course Contents

UNIT I: Laplace Transform (10 Lectures)

Introduction, Definition of Laplace transform, Laplace transform of constant, trigonometrically, exponential functions Important properties of Laplace transform: Change of scale property, First shifting theorem, Laplace transform of L{t^n f(t)}, L{ f(t)/t}, Laplace transform of integral $\int_0^t f(u)du$ *or* $\int_0^t f(t)dt$, Laplace transform of derivatives. Periodic function and their Laplace transform Inverse Laplace transform of standard functions, related problems, Inverse Laplace transform with Partial fraction and Convolution theorem. Application to solve initial and boundary value problem involving ordinary differential equations with one dependent variable and constant coefficients.

UNIT 2: **Fourier series (10 Lectures)**

Dirichlet's conditions, Fourier series of periodic functions with period 2π and 2L. Fourier series for even and odd functions. Half range sine and cosine Fourier series, Parseval's identities. Orthogonal and Ortho-normal functions, Complex form of Fourier series. Fourier Integral Representation

UNIT 3: Matrices (5 Lectures)

Eigen values and Eigen vectors. Cayley-Hamilton theorem (without proof). Similar matrices, Diagonalizable of matrix. Derogatory and non-derogatory matrices, functions of square matrix.

UNIT 4: Correlation &Regression (5 Lectures)

Karl Pearson's coefficient of correlation, covariance, Spearman's Rank correlation. Lines of Regression.

UNIT 5: Partial Differential Equations (10 Lectures)

Classification of partial differential equations of second order, Heat equation, Wave Equation Solution of one-dimensional heat conduction equation, steady state configuration for heat flow, solution of one-dimensional wave equation, transverse vibrations of an elastic string, Numerical Solution of Partial differential equations using Bender-Schmidt Explicit Method and simplified Crank- Nicolson implicit method.

Suggested Text/Reference Books:

1. A text book of Applied Mathematics, P.N. Wartikar and J.N. Wartikar, Vol – I and –II by Pune Vidyarthi Graha.
2. Higher Engineering Mathematics, Dr. B.S. Grewal, Khanna Publication
3. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited,9thEd.
4. Matrices by Shanti Narayan.
5. Numerical Method by S.S. Sastry, Prentice Hall
6. Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd.
7. Numerical Methods, Kandasamy, S. Chand & CO.

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

CO1: Demonstrate the ability of using Laplace Transform and Fourier Series in solving the Ordinary Differential Equations and Partial Differential Equations.

CO2: Use matrix algebra with its specific rules to solve the system of linear equations.

CO3: Apply the concept of Correlation and Regression to the engineering problems.

CO4: Apply the concept of Z- transformation and its inverse of the given sequence

CO5: Expand the periodic function by using Fourier series and complex form of Fourier series

MECB3000	THERMODYNAMICS	3L:1T:2P	5 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**45 Marks**
Tutorial	**1 Hr/Week**		
Practical	**2 Hrs/Week**		
Total Credits	**4**	**End-Semester Examination**	**105 Marks**

Course Objective:

1. To learn about work and heat interactions, and balance of energy between system and its surroundings
2. To learn about application of I law to various energy conversion devices
3. To evaluate the changes in properties of substances in various processes
4. To understand the difference between high grade and low-grade energies and II law, limitations on energy conversion

Course Contents

UNIT 1: (10 Lectures)

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.

UNIT2: (7 Lectures)

Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.

UNIT 3: (6 Lectures)

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two-phase systems - Const. temperature and Const. pressure
heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollie's chart.

UNIT4: (8 Lectures)

First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale

UNIT 5:(9 Lectures)

Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Energy balance equation and Energy analysis.

Suggested Text/Reference Books:

1. PK Nag, Basic and Applied Thermodynamics, MCGRAW HILL INDIA
2. Kroos & Potter, Thermodynamics for Engineers, Cengage Learning
3. Shavit and Gutfinger, Thermodynamics, CRC Press.
4. Cengel, Thermodynamics- Engineering Approach, MCGRAW HILL INDIA.
5. Joel, Basic Engineering Thermodynamics, Pearson.
6. Radhakrishnan Fundamentals of Engineering Thermodynamics, PHI.
7. Dhar, Engineering Thermodynamics, Elsevier.

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

CO1: After completing this course, the students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions

CO2: Students can evaluate changes in thermodynamic properties of substances

CO3: The students will be able to evaluate the performance of energy conversion devices

CO4: The students will be able to differentiate between high grade and low-grade energies

List of Experiments: (Any six are to be performed)

1. Layout of Thermodynamics laboratory
2. Calibration of Bourden Tube Pressure Gauge.
3. To investigate the first law and Second law of thermodynamic using heat Engine
4. To investigate the relation between pressure and temperature of Saturated Steam using Marcet Boiler.
5. Study of Steam Bench
6. Determination of Dryness Fraction of Steam using Steam Bench.
7. Study of the processes of Heat Engine
8. Study of the Steam Engine.
9. Study of the 2 Stroke Petrol Engine.
10. Study of the 4 Stroke Petrol Engine.
11. Study of the 4 Stroke Diesel Engines.
12. Study of the Wankel Engines

MECB3010	PRODUCTION PROCESS I	3L:0T:2P	4 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**2 Hrs/Week**		**-**
Total Credits	**4**	**End-Semester Examination**	**70 Marks**

Course Objective:

1. To study basic production processes.
2. To study how to select appropriate production processes for a specific application.
3. To study machine tools

Course Contents

UNIT 1: Introduction (10 Lectures)

Definition, need and classification of manufacturing process based on chip-less and chip-removal processes. Various generating & forming processes. Classification of machine tools based on form of the work piece and on field of application. Classification of Production Processes: Examples and field of applications Pattern materials and allowances, Types of patterns, Sand properties, Sand moulding, Machine molding

UNIT 2: Casting (6 Lectures)

Gating system: Types of risers, types of gates, solidification Melting- cupola& induction furnaces. Special casting processes: CO2 and shell moulding, Investment casting, die casting, Vacuum casting, Foundry: molding and core sands and their properties molding machines, centrifugal casting, die casting shell molding; Lost wax molding; continuous casting. Inspection & casting defects and remedies.

UNIT 3: Metal Shaping and Forming (10 Lectures)

Metal working, Elastic and plastic deformation, Concept of strain hardening, Hot and cold working, Rolling, Principle and operations, roll pass sequence, Forging, Forging operations, extrusion, Wire and tube drawing processes. Forging: Method of forging, forging hammers and presses, Principle of forging tool design, Cold working processes: Shearing, Drawing Squeezing, Blanking, Piercing, deep drawing, Coining and embossing, Metal working defects, cold heading, Riveting, Thread rolling bending and forming operation. Numerical Calculation of Different process parameters of metal shaping and forming.

UNIT 4: Metal Joining Processes (7 Lectures)

Welding: Classification of welding, Oxy-acetylene welding, types of flames, equipment used, welding methods & applications, Arc welding principle and working of metal arc welding, TIG & MIG welding, submerged arc welding, electro-slag welding & stud welding PAM welding. Applications merits & demerits of above welding processes, fluxes used, Thermit welding,

Resistance welding, Friction welding, ultrasonic, explosive, LASER, electron beam welding, Welding defects and remedies Soldering and brazing techniques & applications Fastening processes.

UNIT 5: Molding with polymers and Ceramics (7 Lectures)

Moulding with polymers: Moulding with polymers: Basic concepts related to Injection Moulding, Compression moulding, Transfer moulding, Blow Moulding, Rotational Moulding, Thermoforming and Extrusion. Applications of plastics in Engineering field 4.2 Moulding with ceramics: Blow moulding and extrusion of glass.

Suggested Text/Reference Books:

1. S. Kalpakjian, Manufacturing Engineering and Technology, Pearson.
2. Kalpakjian, Manufacturing Processes, Pearson
3. DeGarmo's Materials and Processes in Manufacturing, 11th Ed. Black, Ronald A Kosher, Wiley India
4. O. P. Khanna, Welding Technology, Dhanpat Rai publishers
5. R.K. Jai, Production technology, Khanna publishers.
6. P.C. Sharma, Production Technology, S Chand & Co Ltd.
7. P.N. Rao, Manufacturing Technology Vol. II, Tata McGraw Hill.

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

CO1: Demonstrate understanding of casting process
CO2: Illustrate principles of forming processes
CO3: Demonstrate applications of various types of welding processes.
CO4: Differentiate chip forming processes such as turning, milling, drilling, etc.
CO5: Illustrate the concept of producing polymer components and ceramic components.
CO5: Distinguish between the conventional and modern machine tools.

List of Experiments:

1. Students have to make jobs in following shops of Workshop
2. To make different joints by arc welding
3. To make joints of Mild steel plates in Fitting shop
4. Different type of turning on Lathe Machine
5. Study of measuring instruments
6. Study of Different Workshop tools

EETB3000	BASIC ELECTRONICS	3L:1T:2P	4 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**45 Marks**
Tutorial	**1 Hr/Week**		
Practical	**2 Hrs/Week**		
Total Credits	**4**	**End-Semester Examination**	**105 Marks**

Course Objective:

1. Student will learn the fundamental skills of semiconductor and components like diode, transistor, FET, MOSFET and operational amplifier.
2. Student will know the design of electronics circuit & component value.
3. Students will gain the knowledge in the different area of electronics system.

Course Contents

UNIT 1: PN junction diode (10 Lectures)

Depletion layer, barrier potential, forward and reverse bias, break down voltage, PIV characteristics of PN junction diode, knee voltage, ideal PN junction diode, junction capacitance, break down diode (Zener diode). Photo diode and light emitting diode

UNIT 2: Rectifiers and filters (10 Lectures)

Half wave and full wave rectifiers (center tape and bridge), regulation ripple factor, R-C, L-C and Pi filters. Clipping and clamping circuit, voltage multiplier

UNIT 3: BJT (10 Lectures)

Basic theory and operation of PNP and NPN transistors, characteristics of C-B, C-E, C-C configuration. Biasing: Base bias, emitter feedback bias, voltage divider bias, load line, operating point. Incremental analysis using h model.

UNIT-4: FET and Feedback amplifiers (4 Lectures)

FET: introduction, operation, JFET parameters, JFET characteristics, JFET amplifiers. MOSFET: Introduction, operation, MOSFET parameters. Feedback amplifiers

UNIT-5: Integrated circuit (6 Lectures)

Characteristics of ideal, operational amplifiers. Application as inverting, non-Inverting amplifiers. Summer, difference, differentiator, integrator.

Suggested Text/Reference Books:

1. Boylestad and Nashelsky, Electronic devices and circuit theory, Pearson.
2. Albert Malvino & Davis J Bates, Electronic principle, TMH.
3. V K Mehta and Rohit Mehta, Principles of electronics, S. Chand.
4. Salivahanan, Electronics devices & Circuit TMH

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

CO1: To study basics of semiconductor & devices and their applications in different areas.

CO2: To study different biasing techniques to operate transistor, FET, MOSFET and operational amplifier in different modes.

CO3: Analyze output in different operating modes of different semiconductor devices. Compare design issues, advantages, disadvantages and limitations of basic electronics.

List of Experiments:

1. Familiarization with Laboratory Instruments (Oscilloscope, Function Generator, Digital Millimeter, DC Power Supply)
2. Characterization of Passive Circuit Elements (R, L, C).
3. Time Response of RC and RL Circuits.
4. Frequency Response of RC and RLC Circuits.
5. Equivalent Circuits and Circuit Identification.
6. Bipolar Junction Transistor (BJT) Circuits (Inverter, Common Emitter Amplifier).
7. Operation Amplifiers.
8. Basic Combinational Circuits.
9. Synchronous and Ripple Counters.

ZBCB30000	BIOLOGY FOR ENGINEERS	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**--**		**-**
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objective:
To introduce students to modem biology with an emphasis on evolution of biology as a multi-disciplinary field, to make them aware of application of engineering principles in biology, and engineering robust solutions inspired by biological examples.

Course Contents

UNIT 1: Biomolecules (10 Lectures)
To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA.Two carbon units and lipids.

UNIT 2: Enzymes (10 Lectures)
To convey that without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyze reactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

UNIT 3. Information Transfer (10 Lectures)
The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

UNIT 4: Macromolecular analysis (4 Lectures)
How to analyses biological processes at the reductionist level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

UNIT 5: Metabolism (6 Lectures)
The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2

+ H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

Suggested Text/Reference Books:

1. Tmh, Biology for Engineers McGraw-Hill Education India Pvt. Ltd, New Delhi Edition-1st Edition
2. Dr Tanu Allen Dr Sohini Singh, Biology for Engineers, Vayu education of India
3. Nicholas Britton, Springer London Ltd, Essential Mathematical Biology (Springer Undergraduate Mathematics Series)
4. Arthur T Johnson, Biology for Engineers, CRC Press; 1st edition

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

CO1: Design, perform experiments, analyze and interpret data for investigating complex problems in biotechnology Engineering and related fields.

CO2: Gain the knowledge of Biology, Science and Engineering concepts to solve problems related to field of Biology

CO3: Identify, analyze and understand problems related to biology Engineering and finding valid conclusions with basic knowledge in biological Engineering.

LLLB3000	CONSTITUTION OF INDIA	2L:0T:2P	0 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**2 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**2 Hrs/Week**		**-**
Total Credits	**0**	**End-Semester Examination**	**70 Marks**

Course Objectives:

The objective of the course is how to deal and adjust in the society under government regulations. Constitution is the highest law of the land and every department owes its origin to its laws. To make governance better an engineer must conduce to E-governance through computers and knowledge of cyber laws. An engineer must know the limits of state action and regulations by acquainting himself with the laws that applied by the bureaucrats. Since an engineer works at different places and sights, he must have the basic knowledge of center – state relations with reference to policy of financing the key projects. The knowledge of Constitution is necessary for him in order to ensure that the rules and regulations under which public and private sector works, do not violate the provisions of the Constitution. Knowledge of corporate culture is necessary for him. He must understand the compulsions of the public private partnership and philosophy of state ownership of key industries.

Course Contents

UNIT 1:

Introduction to Constitution of India, Role of Public Sector Undertakings in economic development, public policy making in India and influence of new globalized world order

UNIT 2:

I.T. Law in India - Section 4-10 of I.T Act: Cyber laws in India - Section 43-47 of I.T Act- Section 65-78 of I.T Act, E-Governance and role of engineers in E-Governance.

UNIT 3:

Socialist policy of India and its relevance, Role of Planning Commission in economic development, Finance Commission and center-State relations

UNIT 4:

Fundamental Rights and Fundamental Duties, Directive Principles of State Policy, Politics of Industrialization in India and the policy of Liberalization Privatization and Globalization (LPG)

UNIT 5:

Need for reformed engineering serving at the Union and State level, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development

Suggested Text/Reference Books:

1. Brij Kishore Sharma, An Introduction to the Constitution of India
2. Relevant document related Government of India Policy.
3. Cyber Law by Dr. Gupta and Agarwal.
4. www.indiancourts.nic.in
5. Awasthi and Maheshwari, Public Administration

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

CO1: Understand the basics of Constitution of India.

CO2: Understand the role of Public Sector Undertakings in economic development

CO3: Understand the Public policy making in India and influence of new globalized world

CO4: Understand E-Governance and role of engineers in E-Governance.

CO5: Understand the Socialist policy of India

CO6: Understand the role of Planning Commission in economic development

CO7: Understand the Finance Commission and center-State relations

CO8: Understand the Fundamental Rights and Fundamental Duties

SEMESTER IV

Course Type	Course Code	Course Title	Hours/ Week			Theory Marks		Practical Marks		Total Marks	Credits
			L	T	P	IA	ESE	IA	ESE		
DC	MECB4000	Thermal Engineering	3	1	-	30	70	-	-	100	4
DC	MECB4010	Strength of Material	3	1	-	30	70	-	-	100	4
DC	MECB4020	Computer Aided Machine Drawing	1	-	2	-	-	-	50	50	2
DC	MECB4030	Introduction to Fluid Mechanics	3	-	-	30	70	-	-	100	3
DC	MECB4040	Material Science	3	-	-	30	70	-	-	100	3
DC	MECB4050	Metrology and Quality Control	3	1	-	30	70	-	-	100	4
DC	MECB4011	Strength of Material Lab	-	-	2	-	-	15	35	50	1
DC	MECB4031	Introduction to Fluid Mechanics Lab	-	-	2	-	-	15	35	50	1
	TOTAL		**16**	**3**	**6**	**150**	**350**	**30**	**120**	**650**	**22**

MECB4000	Thermal Engineering	3L:1T:2P	5 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**45 Marks**
Tutorial	**1 Hr/Week**		
Practical	**2 Hrs/Week**		**-**
Total Credits	**5**	**End-Semester Examination**	**105 Marks**

Course Objective:

1. To learn about of I law for reacting systems and heating value of fuels
2. To learn about gas and vapor cycles and their first law and second law efficiencies
3. To understand about the properties of dry and wet air and the principles of psychrometry
4. To learn about gas dynamics of air flow and steam through nozzles
5. To learn the about reciprocating compressors with and without intercooling
6. To analyze the performance of steam turbines

Course Contents

UNIT 1(10 Lectures)

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations use free energy.

UNIT 2 (10 Lectures)

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, energy analysis. Super-critical and ultra-super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual Cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties.

UNIT 3 (4 Lectures)

Properties of dry and wet air, use of psychrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.

UNIT 4(6 Lectures)

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for

isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, supersaturation- compressible flow in diffusers, efficiency of nozzle and diffuser

UNIT 5(10 Lectures)

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. Analysis of steam turbines, velocity and pressure compounding of steam turbines

Suggested Text/Reference Books:

1. Sonntag, R. E, Borgnakke, C. and Van Waylen, Fundamentals of Thermodynamics, John Wiley and Sons, 2003, 6th Edition
2. Jones, J. B. and Duggan, R. E., Engineering Thermodynamics, Prentice-Hall of India,1996
3. Moran, M. J. and Shapiro, H. N., Fundamentals of Engineering Thermodynamics, John Wiley and Sons,1999
4. Nag, P.K, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd,1995

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

CO1: After completing this course, the students will get a good understanding of various power cycles and heat pump cycles.

CO2: They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors

CO3: They will be able to understand phenomena occurring in high-speed compressible flows.

MECB4010	STRENGTH OF MATERIAL	3L:0T:2P	5 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**45 Marks**
Tutorial	**1 Hr/Week**		
Practical	**2 Hrs/Week**		**-**
Total Credits	**5**	**End-Semester Examination**	**105 Marks**

Course Objective:

1. To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads
2. To calculate the elastic deformation occurring in various simple geometries for different types of loading

Course Contents

UNIT-1: Stress, Strain and Deformation of Solids (10 Lectures)

Simple Stresses and strains – Elastic constants – Relationship between elastic constants – Stress Strain Diagram – Ultimate Stress – Yield Stress – Deformation of axially loaded member – Composite Bars – Thermal Stresses – Compound stress, State of Stress in two dimensions – Stresses on inclined planes – Principal Stresses and Principal Planes – Maximum shear stress – Mohr's circle method.

UNIT-2: Transfer of Loads and Stresses in Beams (10 Lectures)

Types of loads, supports, beams – concept of shearing force and bending moment – Relationship between intensity of load, Shear Force and Bending moment – Shear Force and Bending Moment Diagrams for Cantilever, simply supported and overhanging beams with concentrated load, uniformly distributed load, uniformly varying load and concentrated moment.

UNIT-3: Deflection of Beams (6 Lectures)

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams – Conjugate beam and strain energy – Castiglianos theorem, Maxwell's reciprocal theorems.

UNIT-4: Torsion & Simple Bending (6 Lectures)

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical

springs, carriage springs. Theory of Simple Bending – Stress Distribution due to bending moment and shearing force – Flitched Beams Leaf Springs.

UNIT-5: Columns and Struts (8 Lectures)

Buckling load, Types of end conditions for column, Euler's column theory and its limitations, Ranking and Johnson formula. Concept of Thin and Thick cylinder (Lama's Theorem).

Suggested Text/Reference Books:

1. Rajput. Strength of Materials, S. Chand and Co, New Delhi, 2015.
2. Punmia.B.C., Ashok Kumar Jain and Arun Kumar Jain, SMTS –I Strength of materials, Laxmi publications. New Delhi, 2015
3. Rattan. S. S, Strength of Materials, Tata McGraw Hill Education Private Limited, New Delhi, 2012
4. Bansal. R.K. Strength of Materials, Laxmi Publications Pvt. Ltd., New Delhi, 2010
5. Junnarkar.S.B. and Shah.H.J. J, Mechanics of Structures, Vol I, Charotar Publishing House, New Delhi 2016.

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

CO1: Demonstrate fundamental knowledge about various types of loading and stresses induced.
CO2: Draw the SFD and BMD for different types of loads and support conditions.
CO3: Analyze the stresses induced in basic mechanical components.
CO4: Estimate the strain energy in mechanical elements.
CO5: Analyze the deflection in beams.
CO6: Analyze buckling and bending phenomenon in columns, struts and beams

List of Experiments: (Any six experiments are to be performed)

1. Rockwell hardness test.
2. Izod Impact test of metallic materials.
3. Ultimate tensile test of metallic materials.
4. Deflection test of beams
5. Torsion test of metallic materials.
6. Fatigue test of metallic materials.
7. Charpy Impact test.

MECB4020	INTRODUCTION TO FLUID MECHANICS	3L:0T:2P	4 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**45 Marks**
Tutorial	**-**		
Practical	**2 Hrs/Week**		**-**
Total Credits	**4**	**End-Semester Examination**	**105 Marks**

Course Objective:

1. To learn about the application of mass and momentum conservation laws for fluid flows
2. To understand the importance of dimensional analysis
3. To obtain the velocity and pressure variations in various types of simple flows
4. To analyze the flow in water pumps and turbines.

Course Contents

UNIT 1(10 Lectures)

Definition of fluid, Properties of fluids, mass density, specific volume, specific gravity, viscosity, Newton's law of viscosity, Units and dimensions-, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow.

UNIT 2(10 Lectures)

Fluid Kinematics: Eulerian and Lagrangian approach to solutions; Continuity equation in partial derivative form in one, two and three dimensions. Velocity and acceleration in an Eulerian flow field; Definition of streamlines, path lines and streak lines; Definition of steady/unsteady, uniform/non-uniform, one-two and three dimensional flows; Definition of control volume and control surface, Understanding of differential and integral methods of analysis. Definition and equations for stream function, velocity potential function, rotational and irrotational vortex flows;

UNIT 3(6 Lectures)

Fluid Dynamics: Integral equations for the control volume: Reynold's Transport theorem, equations for conservation of mass, energy and momentum, Bernoulli's equation and its application in flow measurement, pitot tube, venturi meter, orifice and nozzle meters. Differential equations for the control volume: Mass conservation in 2 and 3 dimensions in rectangular, Euler's equations in 2,3 dimensions and subsequent derivation of Bernoulli's equation; Navier-Stokes equations (without proof) in rectangular Cartesian co-ordinates; Exact

solutions of Navier-Stokes Equations to viscous laminar flow between two parallel planes (Couette flow and plane Poiseuille flow)

UNIT 4 (6 Lectures)

Real fluid flows: Definition of Reynold's number, Laminar flow through a pipe (Hagen-Poiseuille flow), velocity profile and head loss; Turbulent flows and theories of turbulence-Statistical theory, Eddy viscosity theory and Prandtl mixing length theory; velocity profiles for turbulent flows- universal velocity profile, 1/7th power law; Velocity profiles for smooth and rough pipes. Darcy's equation for head loss in pipe (no derivation), Moody's diagram, pipes in series and parallel, major and minor losses in pipes

UNIT 5 (8 Lectures)

Boundary Layer Flows: Concept of boundary layer and definition of boundary layer thickness, displacement, momentum and energy thickness; Growth of boundary layer, laminar and turbulent boundary layers, laminar sub-layer; Von Karman Momentum Integral equation for boundary layers (without proof), analysis of laminar and turbulent boundary layers, drag, boundary layer separation and methods to control it, streamlined and bluff bodies

Aerofoil theory: Definition of aerofoil, lift and drag, stalling of aerofoil, induced drag

Suggested Text/Reference Books:

1. Yunus A Cengel and John M Cimbala, Fluid Mechanics, McGraw Hill Education, 3rd Edition
2. C S P Ojha, Fluid Mechanics and Machinery, Chandramouli and R Berndtsson, Oxford University Press
3. Victor Streeter, Benjamin Wylie and K W Bedford, Fluid Mechanics, McGraw Hill Education, 9th Edition
4. K. L. Kumar, Fluid Mechanics, S Chand; Reprint Edition 2006
5. James A. Fay, Introduction to Fluid Mechanics, Prentice Hall India Learning Private Limited
6. S. K. Ukarande, Fluid Mechanics and Hydraulics, Anne Books Pvt. Ltd

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

CO1: Upon completion of this course, students will be able to mathematically analyze simple flow situations

CO2: Students will be able to understand the turbulence

CO3: They will be able to evaluate the performance of pumps and turbines.

List of Experiments: (Any six experiments are to be performed)

1. To determine the co-efficient of drag by stroke's law for spherical bodies
2. To determine the critical Reynold's number for flow through commercial pipes.
3. To determine the coefficient of discharge for flow over a broad crested weir
4. To study the characteristics of hydraulic jump on a horizontal floor and sloping glacis including friction blocks.
5. To study the scouring phenomenon around a bridge pier model.
6. To study the scouring phenomenon for flow past a spur.
7. To study the scouring phenomenon for flow past a spur.
8. To study the momentum characteristic of a given jet

9. To determine head loss due to various pipe fittings.
10. To study the phenomenon of cavitation in pipe flow.

MECB4040	MATERIAL SCIENCE	3L:0T:2P	4 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**45 Marks**
Tutorial	**-**		
Practical	**2 Hrs/Week**		**-**
Total Credits	**4**	**End-Semester Examination**	**105 Marks**

Course Objective:

1. To study basic engineering materials, their structure-property-performance
2. To study strengthening processes including heat treatment processes in order to enhance properties.
3. To study new materials and their applications

Course Contents

UNIT 1: Introduction (10 Lectures)

Introduction: Historical Perspective of Materials, Classification of Materials, Engineering Materials, Advanced Materials and Future Materials like ceramics, polymers, composites etc. Atomic Structure, Bonding and Crystal Structure of Solids: Atomic Structure, Atomic Bonding in Solids, Bravais Lattices, Crystal Structures, Crystalline, Quasi Crystalline and Non-Crystalline Materials, Miller Indices, Miller-Bravais Indices for Planes and Directions of Cubic and Non-Cubic Structures, structure of ceramics, polymers, and composites materials

UNIT 2: Mechanical Properties of Metals (10 Lectures)

Mechanical Behavior of Metals and Alloys: Types of Loading, Stress-Strain Curves for Brittle and Ductile Materials, Theoretical and Observed Shear Stress, Critical Resolved Shear Stress, Deformation – Elastic, Anelastic, Plastic and Super Plastic, Yield Criteria, Macroscopic Aspects of Plastic Deformation, Toughness Measurements by – S-S Curve, Impact Testing and Fracture Toughness Testing, material behavior in micro-nano regime.

UNIT 3: Failure Mechanisms (10 Lectures)

Fracture: Definition and types of factures, Brittle fracture: Griffith's theory of fracture, Orowan's modification, Dislocation theory of fracture, Critical stress and crack propagation velocity for brittle fracture, Ductile fracture: Notch effect on fracture, Fracture toughness, Ductility transition, Definition and significance

Definition of fatigue and significance of cyclic stress, Mechanism of fatigue and theories of fatigue failure, Fatigue testing, Test data presentation and statistical evolution, S-N Curve and its

interpretation, Influence of important factors on fatigue, Notch effect, surface effect, Effect of pre-stressing, corrosion fatigue, Thermal fatigue. Definition and significance of creep, Effect of temperature and creep on mechanical behaviors of materials, Creep testing and data presentation and analysis, Mechanism and types of creep, Analysis of classical creep curve and use of creep rate in designing of products for load bearing applications, Creep Resistant material

UNIT 4: Thermal and Magnetic Properties of Materials (5 Lectures)

Heat capacity. Thermal expansion. Thermal conductivity. Thermal stresses. Diamagnetism and paramagnetic. Ferromagnetism. Antiferromagnetism and ferrimagnetism. Influence of temperature on magnetic behavior. Domains and Hysteresis, Superconducting materials. Types of polymers, Plastics, Special purpose plastics. Particle reinforced composites. Fiber reinforced composites. Structural composites

UNIT 5: New Materials (5 Lectures)

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, pseudo elastic effect, NiTi alloy, applications – nanomaterials: preparation (bottom up and top-down approaches), properties and applications – carbon nanotubes: types.

Suggested Text/Reference Books:

1. William D. Callister, Jr. – Adapted by R. Balasubramaniam, Materials Science and Engineering, Wiley India (P) Ltd
2. V.D. Kodgire, Material Science and Metallurgy, Everest Publishing House
3. Courtney, Mechanical Behavior of Materials, McGraw Hill International New Delhi
4. B.K. Agrawal, Introduction of Engineering Materials, McGraw Hill Pub. Co. ltd
5. G.E. Dieter, Mechanical Metallurgy, McGraw Hill International New Delhi
6. A.R. Bailey, A text book of Metallurgy, Macmillan & Co. Ltd., London
7. W.F. Smith, The Structure and Properties of Engineering Alloys, McGraw hill Int.
8. Y. Lakhtin, Engineering Physical Metallurgy, Mir Publishers, Moscow
9. Sydney Avner, Introduction to Physical Metallurgy, McGraw Hill
10. E.C. Rollason - ELBS SOC, Metallurgy for Engineers Edward Arnold, London

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

CO1: Identify various crystal imperfections, deformation mechanisms, and strengthening mechanisms

CO2: Demonstrate understanding of various failure mechanisms of materials.

CO3: Interpret Iron-Iron carbide phase diagram, and different phases in microstructures of materials at different conditions.

CO4: Select appropriate heat treatment process for specific applications.

CO5: Identify effect of alloying elements on properties of steels

CO6: Illustrate basics of composite materials, Nano- materials and smart materials.

MECB4050	METROLOGY AND QUALITY CONTROL		3L:1T:2P	5 Credits
Teaching Scheme		**Evaluation Scheme**		
Lectures	**3 Hrs/Week**	**Internal Assessment Test**		**45 Marks**
Tutorial	**1 Hrs/Week**			
Practical	**2 Hrs/Week**			**-**
Total Credits	**5**	**End-Semester Examination**		**105 Marks**

Course Objectives:

CO1: To acquaint with measuring equipment used for linear and angular measurements.

CO2: To familiarize with different classes of measuring instruments and scope of measurement in industry and research

CO3: To acquaint with operations of precision measurement, instrument/equipment for measurement

CO4: To inculcate the fundamentals of quality concepts and statistics in metrology

Course Contents

UNIT 1 Introduction (10 Lectures)

Meaning of metrology, precision, accuracy, errors in measurement, calibration. Linear Measurement: Standards- line standard, end standard, wave length standard, classification of standards, precision and non-precision measuring instrument, slip gauges. Angular Measurement: Sine bar, Sine center, Uses of sin bar, angle gauges, Auto Collimator & Angle Dekker, Constant Deviation Prism Interferometry: Introduction, flatness testing by interferometry, NPL flatness interferometer. Laser interferometry.

UNIT 2: Limits, Fits and Tolerances and Gauge design (10 Lectures)

Meaning of limit, Fits and Tolerance, Cost-Tolerance relationship, concept of Interchangeability, Indian Standard System (ISS). Design of limits gauges: Types, Uses, Taylor's principle, Design of limit gauges.

Inspection of geometric parameters: Flatness, Straightness, Parallelism, Concentricity, Squareness, circularity and Cylindricity. Comparators: Uses, types, advantages and disadvantages of various types of comparators.

Recent trends in Metrology: Introduction to CMM, Measuring geometrical parameters with CMM. techniques for automated inspection – contact and non-contact inspection methods – in processes automated measuring methods machine vision, optical inspection methods

UNIT3: Surface finish measurement (9 Lectures)

Surface texture, Meaning of RMS and CLA values, Tomlinson's Surface meter, Taylor- Hobson surface meter, grades of roughness, specifications. External screw threads terminologies, floating carriage instruments, pitch and flank measurement of external screw thread, application of Tool Makers Microscope, use of profile projector. Spur gear parameters, gear tooth thickness measurement, gear tooth vernier caliper, constant chord method, span micrometer, base tangent comparator, lead and profile measurement

UNIT4: Introduction to Quality and Quality Control (6 Lectures)

Meaning of quality, Approaches-Deming's Approach, Juran's Approach, cost of quality, value of quality, quality control, quality circle, quality policy. 100% inspection and Sampling inspection, Statistics in selective inspection Introduction to statistical quality control: Control chart: - Attribute (P, np, C, U) and variable (X & R chart), sampling inspection, Operating Characteristic curves and sampling plans, 7 tools of problem solving, Quality Function Deployment (Q.F.D), Kaizen, Introduction to Six sigma, process capability index (Cp, Cpk) concept, methods of determining Cp and Cpk .

UNIT5: Quality Management Systems (5 Lectures)

History and evaluation of ISO9000 series, importance and over view of ISO9000-1998 series standards, structure of ISO9000-2000 series standards, clauses of ISO9000 series standards and their interpretation and implementation, quality system documentation, BIS standards, ISO/TS 16949 and audit ISO14000: Environmental management concept, and requirement of ISO14001, benefits of environmental management systems. OH, and AS standards.

Reliability, availability and maintainability; Distribution of failure and repair times; determination of MTBF and MTTR, reliability models; determination of system reliability; preventive maintenance and replacement. Design of Experiments.

Suggested Text/Reference Books:

1. R. K. Jain, Engineering Metrology, Khanna Publication.
2. I.C. Gupta, A Text book of Engineering Metrology, Dhanpat Rai and Sons.
3. K. J. Hume, Engineering Metrology, TBS The Book Service Ltd; 3rd edition
4. K. W. B. Sharp, Practical Engineering Metrology, Pitman Publication.
5. Grant, Statistical Quality Control, McGraw Hill.
6. A.S.T.M.E, Hand Book of Industrial Metrology, Prentice Hall.
7. J. M. Joran, Hand Book of Quality Control, McGraw Hill Publication.

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

CO1: Demonstrate inspection methods and different gauges

CO2: Illustrate working principle of measuring instruments and calibration methodology

CO3: Illustrate basic concepts and statistical methods in quality control

CO4: Demonstrate characteristics of screw threads, gear profile, and tool profile

CO5: Illustrate the different sampling techniques in quality control

CO6: Illustrate different nondestructive techniques used for quality evaluation

SEMESTER V

Course Type	Course Code	Course Title	Hours/ Week			Theory Marks		Practical Marks		Total Marks	Credits
			L	T	P	IA	ESE	IA	ESE		
DC	MECB5000	Heat Transfer	3	1	-	30	70	-	-	100	4
DC	MECB5010	Automation in Manufacturing	3	-	-	30	70	-	-	100	3
DC	MECB5020	Theory of Machine	3	-	-	30	70	-	-	100	3
DC	MECB5030	Production Process II	3	-	-	30	70	-	-	100	3
DC	MECB5040	Entrepreneurship Management	3	-	-	30	70	-	-	100	3
DC	MECB5001	Heat Transfer Lab	-	-	2	-	-	15	35	50	1
DC	MECB5021	Theory of Machine Lab	-	-	2	-	-	15	35	50	1
DC	MECB5031	Professional Communication & Ethics*	2	--	2	--	--	15	35	50	2
	TOTAL		**17**	**1**	**6**	**150**	**350**	**45**	**105**	**650**	**20**

* Theory for entire class to be conducted

MECB5000	HEAT TRANSFER	3L:1T:2P	5 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**45 Marks**
Tutorial	**1 Hrs/Week**		
Practical	**2 Hrs/Week**		**-**
Total Credits	**5**	**End-Semester Examination**	**105 Marks**

Course Objectives:

1. To Study basic heat transfer concepts applicable for steady state and transient conditions
2. To Study mathematical modelling and designing concepts of heat exchangers

Course Contents

UNIT1: Conduction (10 Lectures)

Basic concepts - Mechanism of heat transfer - Conduction, convection and radiation - General differential equation of heat conduction - Fourier law of conduction - Cartesian coordinate - One dimensional steady state heat conduction - Conduction through plane wall, cylinders and spherical systems - Composite systems - Critical thickness of insulation - Conduction with internal heat generation - Extended surfaces - Unsteady heat conduction - Lumped analysis - Infinite and semi-infinite solids.

UNIT2: Convection (10 Lectures)

Hydrodynamic and thermal boundary layer: Principles and governing equations - Dimensional analysis of free and forced convection heat transfer. Forced convection - External flow - Flow over plates, cylinders and spheres and bank of tubes - Internal flow - Free convection - Flow over vertical plate, horizontal plate, inclined plate, cylinders and spheres.

UNIT3: Radiation (8 Lectures)

Basic concepts, laws of radiation - Wien's displacement law - Stefan Boltzmann law, Kirchhoff law - Black body radiation - grey body radiation - Shape factor algebra - Electrical analogy - Radiation shields - Solar radiation - Introduction to gas radiation.

UNIT4: Phase Change Heat Transfer and Heat Exchangers (6 Lectures)

Nusselt's theory of condensation - Regimes of pool boiling and flow boiling, correlations in boiling and condensation. Heat exchangers: Types - Overall heat transfer coefficient - Fouling factors - analysis - LMTD, ε - NTU methods - Introduction to compact heat exchanger.

UNIT5: - Mass Transfer (6 Lectures)

Basic concepts - Diffusion mass transfer - Fick's law of diffusion - Equimolar counter diffusion - Stefan's law, evaporation in atmosphere, convective mass transfer - Momentum, heat and mass transfer analogy - Convective mass transfer correlations

Suggested Text/Reference Books:

1. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age International, 2009.
2. Kothandaraman.C. P, Fundamentals of Heat and Mass Transfer, New Age International, New Delhi, 2006.
3. Holman.J.P. P, Heat and Mass Transfer, Tata McGraw-Hill, 2008.
4. Ozisik.M.N. N, Heat Transfer, McGraw-Hill Book Co., 2003.
5. Nag.P.K. K, Heat Transfer, Tata McGraw-Hill, New Delhi, 2006.
6. Frank.P, Incropera and D.P, DeWitt, Fundamentals of Heat and Mass Transfer, John Wiley and Sons, 2001.
7. Yunus.A, Cengel, Heat and Mass transfer, Tata- McGraw Hill Education, 2007.

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

CO1: Identify the three modes of heat transfer (conduction, convection and radiation).

CO2: Illustrate basic modes of heat transfer

CO3: Develop mathematical model for each mode of heat transfer

CO4: Develop mathematical model for transient heat transfer

CO5: Demonstrate and explain mechanism of boiling and condensation

CO6: Analyze different heat exchangers and quantify their performance

List of Experiments:

1. Determination of Thermal Conductivity of Metal Rod.
2. Determination of Thermal Conductivity of Insulating Powder.
3. Measurement of Emissivity
4. Determination of Stefan-Boltzmann constant
5. Determination of Heat Transfer coefficient by Pin-Fin Apparatus.
6. Determination of Effectiveness of Shell and Tube heat exchanger.
7. Determination of effectiveness of Parallel and Counter Flow Heat Exchanger.
8. Determination of heat transfer coefficient by Forced Convection.
9. Determination of Heat Transfer coefficient by drop and film wise condensation method.

MECB5010	AUTOMATION IN MANUFACTURING	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**-**		**-**
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objectives

1. To understand the importance of automation in the of field machine tool based manufacturing
2. To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC
3. To understand the basics of product design and the role of manufacturing automation

Course Contents

UNIT1: Computer Graphics and Techniques for Geometric Modeling (8 Lectures)

Computer Graphics: Two dimensional computer graphics, vector generation, the windowing transformation, Three dimensional Computer graphics, viewing transformation, Homogeneous coordinates, Perspective projection, Hidden line removal & hidden surface removal algorithm, light & shade ray tracing. The parametric representation of geometry, Bezier curves, Cubic Spline curve, B-Spline curve, parametric representation of line, circle, ellipse & parabola. Constructive solid geometry (CSG), Boundary Representation (B-Rep), Wire Frame Modeling, Solid Modeling, Surface Modeling, Parametric Modeling, feature based modeling, Feature recognition, Design by feature.

UNIT2: Transformation, Manipulation & Data Storage (8 Lectures)

2D & 3D Transformations (Translation, Rotation, & Scaling & Magnification), Concatenations, Matrix representation, Problems & object oriented programming on Transformations. Object transformation, mirror transformation, Artificial Intelligence in Design & Manufacturing, Representation of Knowledge, and Knowledge base Engineering.

UNIT3: NC & CNC Technology (8 Lectures)

Tape coding & format, Manual Part Programming, Computer Aided Part Programming, CNC functions & advantages, DNC, adaptive Control, CNC programming concepts, Trends & new developments in NC, Part programmers job, functions of a post processor, NC part programming languages, Elements of a APT language, The Macro Statement in APT, NC programming with

interactive graphics. Constructional details of CNC machines, Feedback devices- Velocity & displacement, Machining Centers and its types, Automated Material Handling & storage Systems like Robots, AGVs and AS/RS etc.

UNIT4: Computer Integrated Manufacturing & Technology Driven Practices (8 Lectures)
Introduction, Evolution, Objectives, CIM Hardware and Software, CIM Benefits, Nature and role of the elements of CIM, Identifying CIM needs, Data base requirements of CIM, Role of CAD/CAM in CIM, Obstacles to Computer Integrated Manufacturing, Concept of the future CIM systems, Socio -techno- economic aspects of CIM.

UNIT5: Rapid Prototyping and Tooling (8 Lectures)
Introduction to RP, Technology Description, Overview of RP, Benefits and Application. RP Processes: Process overviews, STL file Generation, Classes of RP systems: Stereo-lithography Approach (SLA), SLA with photo-polymerization (mathematical modelling of the process), SLA with liquid thermal polymerization, Selective Laser Sintering (SLS), Fused deposition modelling, Laminated object manufacturing, Laser powder forming. Prototype properties: Material properties, colour, dimensional accuracy, stability, surface finish, machinability, environmental resistance, operational properties. RP Applications: Design, Concept Models, Form & fit checking, Functional testing, CAD data verification, Rapid Tooling, Rapid manufacturing, Science & Medicine, RP processes for MEMS, Photolithography, Direct Laser Writer, Bulk Lithography for 3D micro fabrication.

Suggested Text/Reference Books:

1. "CAD/CAM Computer Aided and Manufacturing" by Mikell P. Groover and Emory W. Zimmers, Jr., Eastern Economy EditionGroover and Zimmers, CAD/CAM, Prentice Hall India Ltd.
2. "CAD/ CAM , Theory & Practice" by Ibrahim Zeid, R. Sivasubramanian, Tata McGraw Hill Publications
3. "CAD/CAM Principles and Applications" by P.N. Rao, Tata McGraw Hill Publications
4. "CAD/CAM/CIM" by P. Radhakrishan, S. Subramanyan, V. Raju, New Age International Publishers
5. "CNC Machines" by B.S. Pabla and M. Adithan, New Age International Publishers.
6. "Rapid Prototyping:Principles and Applications" RafiqNoorani, Wiley

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

CO1: SW to construct a specific solid part.

CO2: Upon completion of this course, the students will get a comprehensive picture of computer based automation of manufacturing operations

CO3: The specific solid part will be output to a 3-D printer (in the OEDK). The students will complete tutorials on FEA stress analysis, thermal analysis and vibration analysis

MECB5020	THEORY OF MACHINE	3L:0T:2P	4 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**45 Marks**
Tutorial	**-**		
Practical	**2 Hrs/Week**		**-**
Total Credits	**3**	**End-Semester Examination**	**105 Marks**

Course Objectives:

1. To acquaint with working principles and applications of Governors / Gyroscope
2. To study static and dynamic force analysis in the mechanisms
3. To familiarize with basics of mechanical vibrations
4. To study the balancing of mechanical systems

Course Contents

UNIT1: Fundamentals of Kinematics and Mechanisms (10 Lectures)

Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom (Mobility), Kutzbach criterion, Grubler's criterion. Four bar chain and its inversions, Grashoff's law, Slider crank chain and its inversions, Double slider crank chain and its inversions. Straight line mechanisms such as: Peaucellier Mechanism, Scott Russell Mechanism, Grasshopper Mechanism, watt mechanism. Equivalent linkage of mechanisms., Steering gear mechanisms: Condition for correct steering, Davis steering gear mechanism, Ackermann steering gear mechanism.

UNIT2: Clutches (8 Lectures)

Requirements of Clutches, Types of Clutches and Clutch materials, Positive clutches, friction clutches, Friction Clutches - Analysis of frictional torque, power transmission .Power loss in Friction in single plate, multiple plate clutch, and cone clutch, Centrifugal Clutches - construction, working

UNIT-3: Governors (10 Lectures)

Comparison between governors and flywheel, Types - centrifugal governors, inertia governors, Watt, Porter, Proell, Force analysis of spring loaded governors - Hartnell, hartung, Wilson Hartnell, Force analysis of spring and gravity loaded governor, Performance characteristics of governors- stability, sensibility, isochronisms, Hunting, governor effort and governor power, coefficient of insensitiveness.

UNIT4: Belts, Chains and Brakes: (8 Lectures)

Belts: Introduction, Types and all other fundamentals of belting, Dynamic analysis –belt tensions, condition of maximum power transmission

Chains (No problems): types of chains, chordal action, variation in velocity ratio, length of chain (No problems)

Brakes (No problems): Introduction, types and working principles, Introduction to braking of vehicles

UNIT5: Gears (6 Lectures)

Classification of gears, Gear Terminology. Law of Gearing, Path of contacts, Arc of contacts, Contact ratio, Velocity ratio, Gear trains (Simple, Compound, Epicyclic gear trains), Numerical Transmission**,** Necessity of gear box, Sliding mesh, constant mesh, Law of gearing

Suggested Text/Reference Books:

1. F.B. Sayyad, Kinematics of Machinery, MacMillan Publishers Pvt Ltd., Tech-max educational resources, 2011.
2. Rattan, S.S, Theory of Machines, 4th Edition, Tata McGraw-Hill, 2014.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., Theory of Machines and Mechanisms, 4th Edition, Oxford University Press, 2014.
4. Allen S. Hall Jr., Kinematics and Linkage Design, Prentice Hall, 1961
5. Cleghorn. W. L, Mechanisms of Machines, Oxford University Press, 2014

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

CO1: Demonstrate working Principles of different types of linkage of the mechanical systems

CO2: Demonstrate working principles of different types of joints of the mechanical systems

CO3: Demonstrate working principles of different types of governors and gyroscopic effects on the mechanical systems

CO4: Illustrate basic of static and dynamic forces

CO5: Demonstrate basic concepts of balancing of forces and couples

List of Experiments: (Any six are to be performed)

1. Draw solution of eight problems on balancing of masses (Minimum four half imperial size drawing sheets)
2. Experimental investigation on performance of balancing of masses
3. Verification of Gyroscopic principle and determination of gyroscopic couple
4. To study the Performance of Governor
5. To study principles of at least one dynamometer
6. To study the different types of brakes using models
7. To determine moment of inertia of a disc by using Single rotor system and Trifiller suspension
8. To determine moment of inertia of a uniform rod by using a) Bifiller suspension b) Compound pendulum
9. To determine equivalent mass of spring for a spring mass system
10. To determine the damping coefficient for a spring mass dash pot system to obtain experimentally frequency response curves

MECB5030	PRODUCTION PROCESS II	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**-**		**-**
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objective:

1. To study basic metal cutting processes.
2. To understand various machines operations.
3. To study machine tools

Contents

UNIT 1: Theory of Metal Cutting (7 Lectures)

Single point cutting tool nomenclature, geometry. Mechanics of Chip Formation, Types of Chips. Merchants circle diagram and analysis, Ernst Merchant's solution, shear angle relationship, problems of Merchant's analysis. Tool Wear and Tool failure, tool life. Effects of cutting parameters on tool life. Tool Failure Criteria, Taylor's Tool Life equation. Problems on tool life evaluation.

UNIT 2: Lathe, Shaping and Planning Machines (8 Lectures)

Classification, constructional features of Turret and Capstan Lathe. Tool Layout, shaping Machine, Planning Machine, driving mechanisms of lathe, shaping and planing machines, Different operations on lathe, shaping machine and planing machine. Simple problems on machining time calculations.

UNIT 3: Drilling and Milling machines (8 Lectures)

Classification, constructional features, drilling & related operations. Types of drill & drill bit nomenclature, drill materials.

Milling machines: Classification, constructional features, milling cutters nomenclature, up milling and down milling concepts. Various milling operations.

UNIT 4: Grinding machines and Indexing (9 Lectures)

Types of abrasives, Grain size, bonding process, grade and structure of grinding wheels, grinding wheel types. Classification, constructional features of grinding machines (Centerless, cylindrical and surface grinding). Selection of grinding wheel. Grinding process parameters. Dressing and truing of grinding wheels.

Indexing: Simple, compound, differential and angular indexing.

UNIT 5: Broaching process, Finishing and other Processes (8 Lectures)

Broaching process: Principle of broaching. details of a broach. Types of broaching machines: constructional details. Applications, advantages and limitations.

Finishing and other Processes: Lapping and Honing operations- principles, arrangement of set up and application. Super finishing process polishing, buffing operation and application.

Suggested Text/Reference Books:

1. S. Kalpakjian, Manufacturing Engineering and Technology, Pearson.
2. Kalpakjian, Manufacturing Processes, Pearson
3. Degarmon's Materials and Processes in Manufacturing, 11th Ed. Black, Ronald A Kohser, Wiley India
4. O. P. Khanna, Welding Technology, Dhanpat Rai publishers
5. R.K. Jain, Production technology, Khanna publishers.
6. P.C. Sharma, Production Technology, S Chand & Co Ltd.
7. P.N. Rao, Manufacturing Technology Vol. II, Tata McGraw Hill.

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

CO1: Demonstrate understanding of cutting process

CO2: Illustrate principles of lathe processes

CO3: Demonstrate applications of various types of grinding processes.

CO4: Differentiate chip forming processes such as turning, milling, drilling, etc.

CO5: Understand the broaching processes.

HUMG5000	ENTREPRENEURSHIP MANAGEMENT	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**-**		
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objectives

The purpose of the paper is to orient the learner toward entrepreneurship as a career option and creative thinking and behavior.

Course Contents

UNIT 1 Introduction (8 Lectures)

Meaning, elements, determinants and importance of entrepreneurship and creative behavior; Entrepreneurship and creative response to the society' problems and at work; Dimensions of Entrepreneurship: intrapreneurship, technopreneurship, cultural entrepreneurship, international entrepreneurship, netpreneurship, ecopreneurship, and social entrepreneurship

UNIT 2 Entrepreneurship and Micro, Small and Medium Enterprises (8 Lectures)

Concept of business groups and role of business houses and family business in India; The contemporary role models in Indian business: their values, business philosophy and behavioral orientations; Conflict in family business and its resolution

UNIT 3 (8 Lectures)

Public and private system of stimulation, support and sustainability of entrepreneurship. Requirement, availability and access to finance, marketing assistance, technology, and industrial accommodation, Role of industries/entrepreneur's associations and self-help groups, The concept, role and functions of business incubators, angel investors, venture capital and private equity fund.

UNIT-4 Sources of business ideas and tests of feasibility (9 Lectures)

Significance of writing the business plan/ project proposal; Contents of business plan/ project proposal; Designing business processes, location, layout, operation, planning & control; preparation of project report (various aspects of the project report such as size of investment, nature of product, market potential may be covered); Project submission/ presentation and appraisal thereof by external agencies, such as financial/non-financial institutions

UNIT 5 Mobilizing Resources (7 Lectures)

Mobilizing resources for start-up, Accommodation and utilities; Preliminary contracts with the vendors, suppliers, bankers, principal customers; Contract management: Basic start-up problems

Suggested Text/Reference Books:

1. Kuratko and Rao, Entrepreneurship: A South Asian Perspective, Cengage Learning.
2. Robert Hisrich, Michael Peters, Dean Shepherd, Entrepreneurship, McGraw-Hill Education
3. Desai, Vasant. Dynamics of Entrepreneurial Development and Management. Mumbai,
4. Himalaya Publishing House.
5. Dollinger, Mare J. Entrepreneurship: Strategies and Resources. Illinois, Irwin.
6. Holt, David H. Entrepreneurship: New Venture Creation. Prentice-Hall of India, New Delhi.
7. Plesk, Paul E. Creativity, Innovation and Quality. (Eastern Economic Edition), New Delhi:
8. Prentice-Hall of India. ISBN-81-203-1690-8.
9. Singh, Nagendra P. Emerging Trends in Entrepreneurship Development. New Delhi: ASEED.
10. SS Khanka, Entrepreneurial Development, S. Chand & Co, Delhi.
11. K Ramachandran, Entrepreneurship Development, McGraw

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

- Students will be oriented towards entrepreneurship as a career option and creative thinking and behavior.

MECB5031	PROFESSIONAL COMMUNICATION & ETHICS	2L:0T:2P	2 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**2 Hrs/Week**	**Term Work**	**15 Marks**
Tutorial	**-**		
Practical	**2 Hrs/Week**		**35 Marks**
Total Credits	**2**	**Total**	**50 Marks**

Course Objective:

1 To inculcate in students professional and ethical attitude, effective communication skills, teamwork, skills, multidisciplinary approach and an ability to understand engineer's social responsibilities.
2 To provide students with an academic environment where they will be aware of the excellence, leadership and lifelong learning needed for a successful professional career.
3 To inculcate professional ethics and codes of professional practice
4 To prepare students for successful careers that meets the global Industrial and Corporate requirement' provide an environment for students to work on Multidisciplinary projects as part of different teams to enhance their team building capabilities like leadership, motivation, teamwork etc.

Contents

UNIT 1: Report Writing (7 Hours)
Objectives of report writing, Language and Style in a report, Types of reports, Formats of reports: Memo, letter, project and survey based
UNIT 2: Technical Proposals (2 Hours)
Objective of technical proposals, Parts of proposal
UNIT 3: Introduction to Interpersonal Skills (7 Hours)
Emotional Intelligence, Leadership, Team Building, Assertiveness, Conflict Resolution, Negotiation Skills, Motivation, Time Management
UNIT 4: Meetings and Documentation (2 Hours)
Strategies for conducting effective meetings, Notice, Agenda, Minutes of the meeting
UNIT 5: Introduction to Corporate Ethics and etiquettes (2 Hours)
Business Meeting etiquettes, Interview etiquettes, Professional and work etiquettes, Social skills, Greetings and Art of Conversation, Dressing and Grooming, Dinning etiquette, Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response, the process of making ethical decisions)
UNIT 6: Employment Skills (6 Hours)

Cover letter, Resume, Group Discussion, Presentation Skills, Interview Skills

Suggested Text/Reference Books:

1. Fred Luthans, "Organizational Behavior" , Mc Graw Hill, edition
2. Lesiker and Petit, "Report Writing for Business" , Mc Graw Hill, edition
3. Huckin and Olsen, "Technical Writing and Professional Communication", McGraw Hill
4. Wallace and Masters, "Personal Development for Life and Work" , Thomson Learning, 12th edition
5. R.C Sharma and Krishna Mohan, "Business Correspondence and Report Writing",
6. B N Ghosh, "Managing Soft Skills for Personality Development", Tata McGraw Hill. Lehman,
7. Dufrene, Sinha, "BCOM", Cengage Learning, 2nd edition
8. Dr. K. Alex ,"Soft Skills", S Chand and Company

List of Assignments

1. Report Writing (Synopsis or the first draft of the Report)
2. Technical Proposal (Group activity, document of the proposal)
3. Interpersonal Skills (Group activity and Role play)
4. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
5. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
6. Corporate ethics and etiquettes (Case study, Role play)
7. Cover Letter and Resume
8. Printout of the PowerPoint presentation

Term Work

Term work shall consist of all assignments from the list.
The distribution of marks for term work shall be as follows:

- Assignments: 20 marks
- Project Report Presentation: 15 marks
- Group Discussion: 10 marks
- Attendance: 05 marks

The final certification and acceptance of term work ensures the satisfactory performance of work assigned and minimum passing in the term work.

SEMESTER VI

Course Type	Course Code	Course Title	Hours/ Week			Theory Marks		Practical Marks		Total Marks	Credit
			L	T	P	IA	ESE	IA	ESE		
DC	MECB6000	Design of Machine Element	3	1	--	30	70	--	--	100	4
DC	MECB6310	Internal Combustion Engine	3	--	--	30	70	--	--	100	3
DE	MECB6320	Elective – I	3	--	--	30	70	--	--	100	3
DE	MECB6330	Elective – II	3	--	--	30	70	--	--	100	3
OE	---	Open Elective-I	3	--	--	30	70	--	--	100	3
DC	MECB6001	Design of Machine Elements Lab	--	--	2	--	--	15	35	50	1
DC	MECB6002	Mini Project	--	--	6	--	--	50	50	100	3
	TOTAL		**15**	**1**	**10**	**150**	**350**	**115**	**135**	**650**	**20**

MECB6000	DESIGN OF MACHINE ELEMENTS	3L:1T:2P	5 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**45 Marks**
Tutorial	**1 Hr/Week**		
Practical	**2 Hrs/Week**		
Total Credits	**5**	**End-Semester Examination**	**105 Marks**

Course Objective:

1. To study basic principles of machine design
2. To acquaint with the concepts of design based on strength & rigidity
3. To familiarize with use of design data books & various codes of practice
4. To make conversant with preparation of working drawings based on designs

Course Contents

UNIT 1: Introduction (10 Lectures)

Definition, Methods, Standards in design & selection of preferred size Selection of materials, BIS system of designation of steels, steel & alloys, plastics & rubbers. Mechanical Engineering Design, Design methods, Aesthetic and Ergonomics consideration in design, Material properties and their uses in design, Manufacturing consideration in design, Design consideration of casting and forging, Basic principle of Machine Design, Modes of failures, Factor of safety, Design stresses, Theories of failures (Selection in the process of designing), Standards, I.S. Codes, Preferred Series and Numbers

UNIT 2: Curved Beams: (8 Lectures)

Assumptions made in the analysis of curved beams, Design of curved beams: Bending stresses in curved beams, such as crane hook, C-frame, etc.

Thick Cylinders**:** Design of thick cylinders subjected to an internal pressure using Lame's equation

UNIT 3: Design against static loads: (8 Lectures)

Cotter joint, knuckle joint, turn buckle, Bolted and welded joints under eccentric loading; Power Screw – screw presses, C-clamps along with the Frame, Screw Jack Design against fluctuating loads**:** variables stresses, reversed, repeated, fluctuating stresses. Fatigue failure: static and fatigue stress concentration factors, Endurance limit- estimation of endurance limit, Design for finite and infinite life, Soderberg and Goodman design criteria, Fatigue design under combined stresses

UNIT 4: Design of Shaft: (8 Lectures)

power transmitting, power distribution shafts, Module (excluding crank shaft) under static and fatigue criteria Keys: Types of Keys and their selection based on shafting condition

Couplings**:** Classification of coupling, Design of Flange couplings, Bush pin type flexible couplings

UNIT 5: Design of springs: (6 Lectures)

Helical compression, Tension Springs under Static and Variable loads, Leaf springs.

Suggested Text/Reference Books:

1. V.B. Banadari, Design of Machine Elements, Tata McGraw Hill Publication
2. Sharma, Purohil, Design of Machine Elements, Prentice Hall India Publication
3. Robert L. Norton, Machine Design -An Integrated Approach, Pearson Education
4. Pandya & Shah, Machine Design, Charotar Publishing
5. J.E. Shigley, Mechanical Engineering Design, McGraw Hill
6. Recommended Data Books - PSG
7. Reshetov, Machine Design, Mir Publication
8. Black Adams, Machine Design, McGraw Hill
9. Hawrock, Fundamentals of Machine Elements, Jacobson McGraw Hill
10. R.C. Patel, Pandya, Sikh, Machine Design, Vol-I & II C. Jamnadas & Co

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

CO1: Demonstrate understanding of various design considerations

CO2: Illustrate basic principles of machine design

CO3: Design machine elements for static as well as dynamic loading

CO4: Design machine elements on the basis of strength/ rigidity concepts

CO5: Use design data books in designing various components

CO6: Acquire skill in preparing production drawings pertaining to various designs

MECB6310	INTERNAL COMBUSTION ENGINE	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**-**		
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objectives

1. To familiarize with the working of S.I. and C.I. engines and its important systems
2. To acquaint with the various methods for measurement of engine performance
3. To provide insight into the harmful effects of engine pollutants and its control
4. To familiarize with the latest technological developments in engine technology

Course Contents

UNIT 1: Introduction (6 Lectures)

Classification of I.C. Engines; Parts of I.C. Engine and their materials, Cycle of operation in Four stroke and Two-stroke IC engines and their comparative study; Fuel air cycles and their analysis, Actual working cycle, Valve Timing Diagram.

LHRS Engines, Homogeneous charge compression Ignition, Rotary Engine-Six stroke engine concept

UNIT 2: S.I. Engines & Fuel Supply System (10 Lectures)

Spark ignition Engine mixture requirements, Fuel-Air ratio, Simple carburetor and auxiliary circuits (excluding mathematical analysis of carburetors) Injection systems: Single-point and Multipoint injection, Gasoline Direct Injection

Ignition System

Battery Ignition System, Magneto Ignition System, Functions and working of ignition coil, spark plug, contact breaker point, Requirements and working of Ignition advance mechanisms; mechanical and vacuum, Electronic Ignition Systems; Capacitor Discharge Ignition System, Transistorized Coil Assisted Ignition System, Transistor Ignition system with contactless breaker

Combustion:

Combustion phenomenon in SI Engines, Ignition delay, Flame propagation, Pressure-Crank angle diagram, Abnormal combustion, Auto ignition, Detonation and Knocking, Factors affecting combustion and detonation, Types of combustion chambers

UNIT 3: Compression Ignition Engines (8 Lectures)

Fuel Injection Systems: Air injection systems, Airless/solid injection systems, Common rail, individual pump, distributor and unit systems. Injection pumps, Fuel injector, Types of nozzles, electronically controlled unit fuel injection system

Combustion: Combustion phenomenon in C I engines, Stages of combustion, Delay period, Knocking, Pressure-Crank angle diagram, Factors affecting combustion and knocking, Types of combustion chambers

UNIT 4: Engine lubrication: (8 Lectures)

Types of lubricants and their properties, SAE rating of lubricants, Types of lubrication systems

Engine Cooling: Necessity of engine cooling, disadvantages of overcooling, Cooling systems and their comparison: Air cooling, Liquid cooling

Supercharging/Turbo-charging: Objectives, Limitations, Methods and Types, Different arrangements of turbochargers and superchargers

UNIT 5: Engine Testing and Performance (8 Lectures)

Measurement of Brake Power, Indicated Power, Frictional Power, Fuel Consumption, Air flow, BMEP, Performance characteristic of SI and CI Engine Effect of load and speed on Mechanical, Indicated Thermal, Brake Thermal and Volumetric efficiencies, Heat balance sheet.

Engine Exhaust Emission and its control

Constituents of exhaust emission at its harmful effect on environment and human health, Formation of NOx, HC, CO and particulate emissions, Methods of controlling emissions; Catalytic convertors, particulate traps, Exhaust Gas Recirculation, EURO and BHARAT norms.

Suggested Text/Reference Books:

1. Willard W. Pulkrabek, Internal Combustion Engines, Pearson Education.
2. Shyam Agrawal, Internal Combustion Engines, New Age International
3. John B. Heywood, Internal Combustion Engines Fundamentals, , TMH
4. Gupta H N, Internal Combustion Engines, 2nd ed, PHI
5. V Ganesan, Internal Combustion Engine, TMH
6. Richard Stone, Introduction to Internal Combustion Engines, Palgrave Publication, 4th Edition

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

CO1: Demonstrate the working of different systems and processes of S.I. engines

CO2: Demonstrate the working of different systems and processes of C.I. engines

CO3: Illustrate the working of lubrication, cooling and supercharging systems.

CO4: Analyze engine performance

CO5: Illustrate emission norms and emission control

CO6: Comprehend the different technological advances in engines and alternate fuels.

MECB6320	PRODUCTION PLANNING CONTROL	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**-**		
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objectives

1. To provide a comprehensive exposure to Production Planning & Control (PPC) and its significance in Industries.
2. To acquaint students with various activities of PPC.
3. To give insight into the ongoing & futuristic trends in the control of inventory.
4. To appraise about need and benefits of planning functions related to products and processes.
5. To give exposure to production scheduling and sequencing

Course Contents

UNIT 1: Concepts of PPC (6 Lectures)

Manufacturing systems- components and types, need for PPC, functions of PPC, relationship of PPC with other departments., Factors influencing PPC in the organization, manufacturing methods projects & jobbing products, batch, mass / flow production, continuous / process production., Management policies- planning for meeting demands, work distribution, centralization, Organization of PPC- status of PPC department, internal structure, degree of centralization, PPC as an integrated approach.

UNIT 2: Activities of PPC (4 Lectures)

Prerequisites of PPC- data pertaining to design, equipment, raw materials, tooling, performance standards, labor& operating systems, Order preparation- works order preparation for various manufacturing methods, subsidiary orders, shop or production orders, inspection orders and stores issue orders

UNIT 3: Inventory Control (8 Lectures)

Basic concepts of inventory, purpose of holding stock and influence of demand on inventory., Ordering procedures, Two Bin system, ordering cycle, economical order quantity and economical lot size, ABC analysis and reorder procedures., Recent trends- computer integrated PP systems, JIT system and MRPI, MRP-II and ERP (only theory).

UNIT 4: Product Planning and Process Planning (10 Lectures)

Product Planning and Process Planning, Product planning: product information and its relevance. Problems in lack of product planning, Process planning: Prerequisite information requirement, steps in process planning, process planning in different situations, documents in process planning, machine / process selection & Computer Aided Process Planning, Forecasting: Various Qualitative and Quantitative models, their advantages and disadvantages

UNIT 5: Production Scheduling and Sequencing (12 Lectures)

Inputs for scheduling, loading and scheduling devices, factors influencing scheduling, scheduling techniques, use of Gantt Charts and basic scheduling problems, Product sequencing, dispatching: progress report & expectation of manufacturing lead time technique for aligning completion time &due dates. Project management: concepts of project planning, monitoring and control, elements of network analysis –PERT & CPM, cost analysis & crashing.

Suggested Text/Reference Books:

1. Production Planning and Control, L. C. Jhamb –Everest Publishing House.
2. Production Planning and Control, W. Boltan-Longman Scientific & Technical.
3. Production Systems- Planning, Analysis& Control, James. L. Riggs-John Wiley & Sons.
4. Manufacturing Planning and Control Systems, Thomas E. Vollman, Willam L. Berry& Others-Galgotia Publishers.
5. Manufacturing Process Planning and Systems Engineering, Anand BewoorDreamtech Press.
6. Production and Operations Management, S.N.Chary- TMH publishing company.
7. Modernization & Manufacturing Management, L.C. Jhamb - Everest Publishing House

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

CO1: Illustrate production planning functions and manage manufacturing functions in a better way.

CO2: Develop competency in scheduling and sequencing in manufacturing operations and effect affordable manufacturing lead time.

CO3: Manage and control inventory with cost effectiveness.

CO4: Get conversant with various documents procedural aspects and preparation of orders for various manufacturing methods.

MECB6330	POWER PLANT ENGINEERING	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**-**		
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objectives

1. Study basic working principles of different power plants
2. Study power plant economics

Course Contents

UNIT 1: Introduction: (4 Lectures)

Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants.

UNIT 2: Hydro Electric Power Plants (6 Lectures)

Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants.

UNIT 3: Steam Power Plants (8 Lectures)

Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator.

UNIT 4: Combined Cycles (6 Lectures)

Constant pressure gas turbine power plants, Arrangements of combined plants (steam & gas turbine power plants), repowering systems with gas production from coal, using PFBC systems, with organic fluids, parameters affecting thermodynamic efficiency of combined cycles. Problems.

UNIT 5: Nuclear Power Plants (6 Lectures)

Students in a group will carry out micro project on design and implementation of an automatic modular system which can be useful in contemporary automation industries. The methodologies will be followed as first design and simulation of automated systems using Festo Fluid SIM, SIROS, PLC software and then implementation by using pneumatic controls, electro-pneumatic controls, PLC and motion controls

UNIT 6: Power Plant Economics (6 Lectures)

Load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance & operating characteristics of power plants- incremental rate theory, input-out put curves, efficiency, heat rate, economic load sharing, Problems

Suggested Text/Reference Books:

1. Power Plant Engineering, A K Raja, Amit Praksh Shrivastava, Manish Dwivedi, New Age International Publishers
2. Power Plant Familiarization, Manual of Central Training Resources Unit of NTPC India, 1991
3. Power Plant Engineering, 2nd ed, P.K. Nag , Tata McGraw-Hill Pub. Com., New Delhi.
4. Hydro-Electric and Pumped Storage Plants, M G Jog, New Age International Publishers
5. A Text Book of Power Plant Engineering, R.K. Rajput, Laxmi Publications
6. A Course in Power Plant Engineering, Arora, Domkundwar, DhanpatRai & Co.
7. Power Plant Engineering, P.C. Sharma, S.K. Kataria& Sons.
8. Power Plant Engineering, G.R. Nagpal, Khanna Publishers
9. Power station Engineering and Economy by Bernhardt G.A. Skrotzki and William A. Vopat, Tata Mc Graw Hill Publishing Campany Ltd., New Delhi
10. Nuclear Energy An Introduction to the Concepts, Systems and Applications of Nuclear Processes, 6th Edition, Raymond L Murray, , ELSEVIER
11. Power Plant Engineering, Manoj Kumar Gupta, PHI Learning
12. Nuclear Power Plant Engineering, James Rust, Haralson Publishing Company
13. Nuclear Power Plants, Edited by Soon Heung Chang, InTech Publishers, 2012

Course Outcomes: Students will be able to

CO1: Comprehend various equipment's/systems utilized in power plants

CO2: Discuss types of reactors, waste disposal issues in nuclear power plants

CO3: Illustrate power plant economics

MECB6320	LOGISTIC AND SUPPLY CHAIN MANAGEMENT	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**-**		
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objective:

1. To understand the fundamentals of supply chain management and Logistics
2. To develop an understanding related to Supply Chain Performance and related aspects
3. To understand Inventory management in supply chain
4. To learn tools and techniques used in logistics, transportation, warehousing and outsourcing decisions.
5. To develop critical understanding towards digitization in supply chain management and sustainability
6. To develop analytical and critical understanding for planning and designing supply chain network.

Course Contents

UNIT 1: Introduction (6 Lectures)

Objectives of a Supply Chain Management, Stages of Supply chain, Value Chain Process, Cycle view of Supply Chain Process, Key issues in SCM, logistics & SCM, Supply Chain Drivers /decisions and obstacles, Supply chain strategies, strategic fit, Best practices in SCM, Obstacles of streamlined SCM. Supplier Selection, Supplier quality audits, Contract management, Non-Disclosure Agreement (NDA), Make & Buy Decision while in-out sourcing

UNIT 2: Supply Chain Performance (10 Lectures)

Bullwhip effect and reduction, Performance measurement: Dimension, Tools of performance measurement, SCOR Model. Demand chain management, Global Supply chain- Challenges in establishing Global Supply Chain, Factors that influences designing Global Supply Chain Network. Supply Chain Risk Management (Risks involved in supply chain which includes – Supplier Financial Risk, Performance Risk, Compliance Risk, Country specific Risk, Cyber Security. Supplier performance measurement – (Delivery & Quality performance, schedule adherence, Goods receipt compliance etc), Supplier Capacity Analysis, Supplier Score card.

UNIT 3: Inventory management (7 Lectures)

Definition of Inventory, Inventory types & functions; EOQ Model and Buffer Stock, Assumptions, Instantaneous Replenishment case, Demand and production rate are different, when backorders are allowed, Buffer Stock and ROL. Replenishment systems (Q and P system) Inventory Control- ABC Analysis, Numerical problems on ABC analysis,VED Analysis

UNIT 4: Logistics Management and outsourcing (9 Lectures)

Evolution, Objectives, Components and Functions of Logistics Management, Distribution related Issues and Challenges; Gaining competitive advantage through Logistics Management, Transportation- Functions, Costs, and Mode; Network and Decision, Containerization, Cross docking. Warehousing: Concept and types, Warehousing strategy, Warehouse facility location & network design Part Packaging, Use of Returnable pallets, ASN – Advance Shipment Notification. Reverse logistics: Outsourcing - Nature and concept, Strategic decision to Outsourcing, Third party logistics (3PL), and Fourth party logistics (4PL), Cold chain operations in Supply chain.

UNIT 5: Supply Chain Network Design (8 Lectures)

Factors influencing distribution network design, Supply chain resilience, Design options for distribution network, Introduction to mathematical modelling, considerations in modelling SCM systems, Overview of the models, Models on transportation, Transportation problem, Vehicle routing problem, Travelling salesman problem, Capacitated transshipment problem, shortest path problem. Value Stream Mapping (VSM), Order Fulfillment Process Flow, understanding the terms related to Supply chain- Lead Time, Takt Time, Minimum Order Quantity (MOQ), Manufacturing Critical Path Time (MCT)

Suggested Text/Reference Books:

1. R.P. Mohanty, S.G. Deshmukh, “Essentials of Supply Chain management”, 1st Edition 2004, Jaico Publishing House.
2. S.K. Bhattacharya, “Logistics Management”, 3rd Edition, Pearson Publication ISBN: 9788131768624.
3. Sunil Chopra, P. Meindl, “Supply Chain Management”, 6th Edition 2016, Pearson Education Asia..
4. Bowon Kim, “Supply Chain Management in Mastering Business in Asia”, Edition 2005, John Wiley & sons (Asia) Pvt Ltd, ISBN: 978-0470821404.
5. Rahul V Altekar, “Supply Chain Management: Concepts and cases”, Edition 2009, PHI, ISBN: 9788120328594.

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

CO1: Demonstrate a sound understanding of Logistics and Supply Chain Management concepts and their role in today’s business environment.

CO2: Identify the drivers of supply chain performance and risks in supply chain management.

CO3: Apply various techniques of inventory management and rank the items using inventory management technique.

CO4: Apply various strategies and techniques to minimize overall logistics cost

CO5: Understand the role of digitization in supply chain management leading to sustainability

CO6: Apply various mathematical models/tools to design the supply chain network

MECB6002	MINI PROJECT	0L:0T:6P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures		**Term work**	**100Marks**
Tutorial	**-**		
Practical	**6 Hrs/Week**		
Total Credits	**3**	**End-Semester Mark**	**100 Marks**

Course Objectives:

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Guidelines for Mini Project

1. Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
2. Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3. Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4. Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
5. Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
6. Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
7. The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
8. With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students.

9. However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

Outcome: Learner will be able to…

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
9. Demonstrate project management principles during project work.

SEMESTER VII

Course Type	Course Code	Course Title	Hours/ Week			Theory Marks		Practical Marks		Total Marks	Credit
			L	T	P	IA	ESE	IA	ESE		
DC	MECB7000	Automation and Control Engineering	3	-	-	30	70	-	-	100	3
DC	MECB7001	Industrial Engineering and Management	3	-	-	30	70	-	-	100	
DE	MECB7310	ELECTIVE - III	3	-	-	30	70	-	-	100	3
DE	MECB7320	ELECTIVE - IV	3	-	-	30	70	-	-	100	3
DC	MECB7001	Automation and Control Engineering Lab	-	-	2	-	-	15	35	50	1
OE	---	Open Elective-II	3	-	-	30	70	-	-	100	3
DC	MECB7203	Project I	-	-	10	-	-	50	50	100	5
	TOTAL		**15**	**0**	**12**	**150**	**350**	**65**	**85**	**650**	**21**

MECB7000	AUTOMATION AND CONTROL ENGINEERING	3L:0T:2P	4 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**45 Marks**
Tutorial	**-**		
Practical	**2 Hrs/Week**		
Total Credits	**4**	**End-Semester Examination**	**105 Marks**

Course Objective: -

1. To identify significant relationship between models of competitive manufacturing and business performance.
2. To understand about sensors and actuators for mechanical system
3. To learn about product assembly
4. To know about pneumatic circuits for automatic diecasting machine.

Course Contents

UNIT 1 (9 Lectures)

Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.

UNIT 2 (9 Lectures)

Overview of Material Handling Systems - Rotary feeders, oscillating force feeder, vibratory feeder, elevator type and Centrifugal type feeders, Principles and Design Consideration, Material Transport Systems, Storage Systems.

UNIT 3 (8 Lectures)

Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Flow lines &Transfer Mechanisms, Fundamentals and Analysis of Transfer Lines, product design for automatic assembly

UNIT 4 (7 Lectures)

Industrial Control Systems, Process Industries Verses Discrete - Manufacturing, Industries Continuous Verses Discrete Control, Computer Process and its Forms. Sensors Actuators and other Control System Components.

UNIT 5 (7 Lectures)

Product manufacture's ability, orientation devices - active and passive devices, parts orientation and escapement. Boolean algebra, pneumatic sensors and amplifiers, jet destruction devices, logic devices, developing pneumatic circuits for automatic diecasting machine.

Suggested Text/Reference Books:

1. R.C. Dorf, John, Hand book of design, Manufacturing and Automation: Wiley and Sons.
2. M.P. Groover, Automation, Production Systems and Computer integrated Manufacturing, Pearson Education.
3. W. P. David, John, Industrial Automation: Wiley and Sons.
4. Krishna Kant, Computer Based Industrial Control, EEE- PHI

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

CO1: Understand modern manufacturing operations, including their capabilities, limitation and how to design for lowest cost.

CO2: Analyze, design, implement and maintaining practical, mechanical and manufacturing systems.

CO3: Understand communicate effectively and work well on team-based engineering projects.

CO4: Succeed in manufacturing and mechanical engineering technology positions.

MECB7001	INDUSTRIAL ENGINEERING AND MANAGEMENT	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**-**		
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objective:

1. To introduce the students to the concept of integration of various resources and the significance of optimizing them in manufacturing and allied Industries.
2. To acquaint the students with various productivity enhancement techniques.
3. To introduce the concepts of various cost accounting and financial management practices as applied in industries.

Course Contents

UNIT 1 Introduction to Industrial Engineering, Value Engineering and Value Analysis (11 Lectures)

History and contribution, Industrial engineering approach, techniques of industrial engineering, objectives of industrial engineering, system approach to industrial engineering, definition and concept of productivity, productivity measurements, factors influencing productivity and productivity improvement techniques. Distinction between value engineering & value analysis and their significance. Steps in value engineering & analysis and Check lists.

UNIT 2 Work study (10 Lectures)

Method study, micro-motion study and principles of motion economy. Work measurement: time study, work sampling, standard data, PMTS; MOST.

UNIT 3 Work system design (8 Lectures)

Introduction to ergonomics and its scope in relation to work. Outline of the discipline of anatomy, physiology and psychology, with respect to ergonomics building blocks such as anthropometry and biomechanics. Job evaluation, merit rating, incentive schemes, wage administration and business process reengineering.

UNIT 4 Facility Design (9 Lectures)

Facility location factors and evaluation of alternate locations; types of plant layout and their evaluation; computer aided layout design techniques; assembly line balancing; materials handling systems.

UNIT-5 Cost accounting (4 Lectures)

Elements of cost, cost sheet, job costing and marginal costing.

Suggested Text/Reference Books:

1. Introduction to Work study, ILO, Geneva, and Oxford & IBH Pub. Co. Pvt. Ltd.
2. Plant Layout and Material Handling, James M. Apple, John Wiley & Sons.
3. Ergonomics at Work, Murrell.
4. Modern Production / Operations Management, Elwood S. Buffa, Rakesh K. Sarin, John Wiley & Sons.
5. Production and Operations Management, Joseph G. Monks

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

CO1: To introduce the students to the concept of integration of various resources and the significance of optimizing them in manufacturing and allied Industries.

CO2: To acquaint the students with various productivity enhancement techniques.

CO3: To introduce the concepts of various cost accounting and financial management practices as applied in industries.

MECB7310	FINITE ELEMENT ANALYSIS	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**-**		
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objective:

1. To introduce the concepts of Mathematical Modeling of Engineering Problems.
2. To study the applicability of FEM to a range of Engineering Problems.
3. To acquaint with applications of numerical techniques for solving problems.

Course Contents

UNIT 1 Introduction (7 Lectures)

1Introductory Concepts: Introduction to FEM, Historical Background, General FEM procedure. Applications of FEM in various fields. Advantages and disadvantages of FEM. Mathematical Modeling of field problems in Engineering, Governing Equations, Differential Equations in different fields. Approximate solution of differential equations-- Weighted residual techniques, Least squares, Galerkin methods, Boundary Value problems.

UNIT 2 FEA Procedure (7 Lectures)

Discrete and continuous models, Weighted Residual Methods – Ritz Technique – Basic concepts of the Finite Element Method. Definitions of various terms used in FEM like element, order of the element, internal and external node/s, degree of freedom, primary and secondary variables, boundary conditions. Minimization of a functional. Principle of minimum total potential. Piecewise Rayleigh-Ritz method. Formulation of “stiffness matrix”; transformation and assembly concepts.

UNIT 3 One-Dimensional Problems (8 Lectures)

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors.
Assembly of Matrices - solution of problems in one dimensional structural analysis, heat transfer and fluid flow (Stepped and Taper Bars, Fluid Network, Spring-Cart systems)
Analysis of Plane Trusses, Analysis of Beams. Solution of one Dimensional structural and thermal problems using FE Software, Selection of suitable Element Type, Modeling, Meshing, Boundary Condition, Convergence of solution, Result analysis, Case studies.

UNIT 4 2-Dimensional Finite Element Formulations (9 Lectures)

Introduction, Three nodded triangular element, four nodded rectangular element, four nodded quadrilateral element, eight nodded quadrilateral element. Natural coordinates and coordinates

transformations: serendipity and LaGrange's methods for deriving shape functions for triangular and quadrilateral element. Sub parametric, Isoperimetric, super parametric elements. Compatibility, Patch Test, Convergence criterion, Sources of errors.

UNIT-5 Finite Element Formulation of Dynamics and Numerical Techniques (8 Lectures)
Applications to free vibration problems of rod and beam. Lumped and consistent mass matrices. Solutions Techniques to Dynamic problems, longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation, Transverse deflections and Natural frequencies of beams.

Suggested Text/Reference Books:

6. Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill, 2005.
7. Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi, 2007.
8. Rao S.S., The Finite Element Method in Engineering, 3rd ed., Butterworth Heinemann, 2004.
9. Chandraputla & Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall, 1990.

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

CO1: Solve ordinary and partial differential equations using the Galerkin method.

CO2: Develop the finite element equations to model engineering problems governed by 2nd order partial differential equations.

CO3: Apply the basic finite element formulation techniques to solve engineering problems.

CO4: Use commercial FEA software, to solve problems related to mechanical engineering.

MECB7320	REFRIGERATION AND AIR CONDITIONING	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**-**		
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objective:

1. To give fundamental knowledge of types of refrigeration, refrigeration cycles, refrigerants
2. To understand the behavior under various conditions, different air conditioning terms and load calculation
3. To learn designing of components of air distribution system.

Course Contents

UNIT 1: Introduction (6 Lectures)

Brief history and need of refrigeration and air conditioning, methods of producing cooling, ton of refrigeration, coefficient of performance, types and application of refrigeration and air condensing systems.

UNIT 2: Refrigerants (7 Lectures)

Classification, nomenclature, desirable properties, secondary refrigerants, future industrial refrigerants. Air refrigeration: Reversed Carnot cycle and its limitation, Bell-Coleman cycle, aircraft refrigeration, working and analysis of Simple; Bootstrap; Reduced ambient and Regenerative air refrigeration systems.

UNIT 3: Vapor Compression system (9 Lectures)

Simple system on P-h and T-s diagrams, analysis of the simple cycle, factors affecting the performance of the cycle, actual cycle Compound Compression System: Compound compression with intercooler, flash gas removal and flash intercooler, multiple evaporators with back pressure valves and with multiple expansion valves without flash inter cooling, analysis of two evaporators with flash intercooler and individual expansion valve and multiple expansion valve, cascade refrigeration system

UNIT 4: Absorption refrigeration system (8 Lectures)

Desirable characteristics of refrigerant, selection of pair, practical H_2O -NH_3 cycle, LiBr – H2O system and its working, h-x diagram and simple calculation of various process like adiabatic mixing and mixing with heat transfer, throttling, Electrolux refrigeration system*

Vapor Compression system: Simple system on P-h and T-s diagrams, analysis of the simple cycle, factors affecting the performance of the cycle, actual cycle.

Compound Compression System: Compound compression with intercooler, flash gas removal and flash intercooler, multiple evaporators with back pressure valves and with multiple expansion valves without flash inter cooling, analysis of two evaporators with flash intercooler and individual expansion valve and multiple expansion valve, cascade refrigeration system.

UNIT 5: Absorption refrigeration system (10 Lectures)

Human comfort: Selection of inside design conditions, thermal comfort, heat balance equation for a human being, factors affecting thermal comfort, Effective temperature, comfort chart and factors governing effective temperature, selection of outside design conditions

Duct design and air distribution: Function; classification and economic factors influencing duct layout, equal friction method of duct design, use of friction chart, dynamic losses and its determination, Requirements of air distribution system, air distribution, grills, outlets, application, location

Suggested Text/Reference Books:

1. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.
2. Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill, 1986.
3. Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000.
4. Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.

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

CO1: To understand the basic concepts of refrigeration and air conditioning systems.

CO2: To understand and analysis of various refrigeration cycles.

CO3: To make basic calculation of psychometric properties and process.

CO4: To do basic calculations of heating and cooling load requirements of a room.

CO5: To Apply scientific and engineering principles to analyze and design aspects of engineering systems that relate to refrigeration and air conditioning.

MECB7020	RENEWABLE ENERGY SOURCES	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**-**		
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objective: -

1. To study working principles of various renewable energy sources and their utilities.
2. To study design and installation criteria of various equipment's to convert the renewable energy into useful energy.
3. To study economics of harnessing energy from renewable energy sources

Course Contents

UNIT 1 Introduction to Energy Sources (5 Lectures)

Renewable and non-renewable energy sources, Need for Renewable Energy Sources, Energy Consumption as a measure of Nation's development, Strategy for meeting the future energy requirements, Global and National current energy scenarios, Prospects of renewable energy sources and renewable energies role in developing sustainable model.

UNIT 2 Solar Thermal Energy (9 Lectures)

Merits and demerits, Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, Local solar time, derived solar angles, sunrise, sunset and day length, Methods of Solar Radiation estimation, Solar thermal devices- Solar air heater and different types of solar air heaters, solar water heater, Different types of solar water heaters, solar dryers, solar pond, solar distillation, solar still, solar cooker, Solar space heating & cooling, solar refrigerator, solar thermal energy storage systems., Case Study: Solar thermal power plant working operation

UNIT 3 Wind Energy (6 Lectures)

Principle of wind energy conversion; Basic components of wind energy conversion systems, wind mill components, various types and their constructional features, wind mill components, various types and their constructional features, design considerations of horizontal and vertical axis wind machines, analysis of Aerodynamic forces acting on wind mill blades and estimation of power output, wind data and site selection considerations

UNIT 4 Hydrogen Energy and Energy from Biomass: **(10 Lectures)**

Introduction and application, General introduction to infrastructure requirement for hydrogen production storage, dispensing & utilization, Principles of fuel cells, types of fuel cells, Power generation by fuel cells, applications of fuel cells, Introduction of bioenergy, conversion technologies, Types of biogas generation plants, design and construction details of biogas plant (KVIC), site selection, constructional details, site selection, digester design consideration,

digester design consideration, filling a digester for starting, maintaining biogas production, utilization of biogas

UNIT 5 Geothermal Energy and Energy from the ocean: (9 Lectures)

Introduction to geothermal technologies, methods of extracting geothermal energy, Prospects of geothermal energy in India, Wave energy characteristics, wave energy conversion devices, Tide energy conversion devices, Ocean Thermal Energy Conversion (OTEC) systems

Suggested Text/Reference Books:

1. "Non-conventional Energy Sources", G.D. Rai, 6th Edition, Khanna Publishers, ISBN: 978-81-7409- 073-7
2. "Renewable Energy: Power for a Sustainable Future", Edited by Godfrey Boyle, 3rd Edition 2012, Oxford University Press, ISBN: 978-0199681273n
3. "Solar Energy: Principles of Thermal Collection and Storage", SP Sukhatme and J K Nayak, 4th Edition, Tata Mcgraw Hill Publishing Co. Ltd.
4. "Solar Energy: Fundamentals and Applications", H.P. Garg& Jai Prakash, First Revised Edition, Tata McGraw-Hill Education.
5. "Wind Power Technology", Joshua Earnest, 2nd Edition, PHI Learning, 2015.
6. "Renewable Energy Sources", J W Twidell& Anthony D. Weir, 3rd Edition 2015,ELBS Pub, ISBN: : 978-1-315-76641-6

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

CO1: Describe the need for renewable energy and its potential for the development of a sustainable environment.

CO2: Analyze different solar collectors using geometrical parameters and photovoltaic for generation of solar energy.

CO3: Identify and analyze various wind turbine energy harnessment techniques.

CO4: Design biogas plant for harnessing energy from organic waste.

CO4: Describe significance of hydrogen energy to fulfill present and future energy needs.

CO4: Describe the operating principle of geothermal energy and ocean energy and their role in sustainable development.

MECB7203	PROJECT I	0L:0T:10P	5 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	-	**Term Work**	**50 Marks**
Tutorial	-		
Practical	**10 Hrs /Week**		
Total Credits	**5**	**End-Semester Marks**	**50Marks**

Course Objective: -
The Project work facilitates the students to develop and prove Technical, Professional and Ethical skills and knowledge gained during graduation program by applying them from problem identification, analyzing the problem and designing solutions.

Guidelines of Project I

1. Project topic selection Process to be defined and followed:

   - Students should be informed about the domain and domain experts whose guidance can be taken before selecting projects.
   - Student's should be recommended to refer papers from reputed conferences/ journals like IEEE, Elsevier, ACM etc. which are not more than 3 years old for review of literature.
   - Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements. Students can be informed to refer Digital India portal, SIH portal or any other hackathon portal for problem selection.

2. Topics can be finalized with respect to following criterion
   - Topic Selection: The topics selected should be novel in nature (Product based, Application based or Research based) or should work towards removing the lacuna in currently existing systems.
   - Technology Used: Use of latest technology or modern tools can be encouraged.
   - Students should not repeat work done previously

3. Project work must be carried out by the group of at least 2 students and maximum 4.
4. The project work can be undertaken in a research institute or organization/Industry/any business establishment. (out-house projects)
5. The project proposal presentations can be scheduled according to the domains and should be judged by faculty who are expert in the domain.
6. Head of department and senior staff along with project coordinators will take decision regarding final selection of projects.

7. Guide allocation should be done and students have to submit weekly progress report to the internal guide.

Project Report Format:

At the end of semester, each group need to prepare a project report as per the guidelines issued by the University of Mumbai. A project report should preferably contain at least following details:
Abstract
Introduction
Literature Survey
• Survey of Existing systems
• Limitations of Existing systems or research gaps
• Motivation (Challenges that are encouraging to choose the problem)
• Problem Statement and Proposed Solution
• Scope of the system
Proposed System o General Workflow/Block diagram
Analysis and Modeling (only applicable diagrams)
Design o Architectural View o Algorithms/ Methodology
Experimental Set up o Details of Database or details about input to systemsor selected data o Performance Evaluation Parameters (for Validation) o Software and Hardware Set up
Summary
References

Suggested quality evaluation parameters are as follows

1. Quality of problem selected
2. Clarity of problem definition and feasibility of problem solution
3. Relevance to the specialization / industrial trends
4. Originality
5. Clarity of objective and scope
6. Quality of analysis and design
7. Quality of written and oral presentation
8. Individual as well as team work

Outcomes:

CO1: Students will be able to develop the understanding of the problem domain through extensive review of literature.
CO2: Students will be able to identify and analyze the problem in detail to define its scope with problem specific data.
CO3: Students will be able to identify various techniques to be implemented for the selected problem and related technical skills through feasibility analysis.

CO4: Students will be able to design solutions for real-time problems that will positively impact society and environment..
CO5: Students will be able to develop clarity of presentation based on communication, teamwork and leadership skills.
CO6: Students will be able to inculcate professional and ethical behavior.

SEMESTER VIII

Course Type	Course Code	Course Title	Hours/ Week			Theory Marks		Practical Marks		Total Marks	Credit
			L	T	P	IA	ESE	IA	ESE		
DC	MECB8000	Automobile Engineering	3	-	-	30	70	-	-	100	3
DE	MECB8310	ELECTIVE - V	3	-	-	30	70	-	-	100	3
DE	MECB8320	ELECTIVE - VI	3	-	-	30	70	-	-	100	3
OE	--	Open Elective-III	3	-	-	30	70	-	-	100	3
DC	MECB8203	Project II	-	-	12	-	-	100	100	200	6
	TOTAL		**12**	**0**	**12**	**120**	**280**	**100**	**100**	**600**	**18**

MECB8310	AUTOMOBILE ENGINEERING	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**-**		
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objectives

1. Study basic principles of actual automobile systems
2. Study important systems in an automobile
3. Study recent and modern trends in automobile sector

Course Contents

UNIT 1: Introduction (7 Lectures)

Transmissions: Necessity of gear box, sliding mesh, Constant mesh, Synchromesh and Epicyclic gear box, Overdrives and hydrodynamic torque converter, Trouble shooting and remedies. Live axle and differential: Final drive, spiral, bevel, Hypoid and worm drives, Types of live axles, semi, three quarter and full floating axles. Necessity of differential, Conventional and non-slip differential, Trouble shooting and remedies.

UNIT 2: Brakes (9 Lectures)

Requirement of brake, Classification of brakes, Mechanical, Hydraulic, Pneumatic, Electro and vacuum brakes. Disc brakes, braking of front wheel, Rear wheel and four-wheel brakes, Brake trouble shooting. Introduction to antilock braking system (ABS). Steering and Front axles

Steering geometry, Steering requirements, Steering linkages and steering gears, over steer and under steer, Cornering power, Reversibility of steering gears, Types of front axles and their constructions. Trouble shooting and remedies.

UNIT 3: Suspension (8 Lectures)

Objects of suspension, Basic requirements, Air suspension and its features, independent suspension, Forces acting in independent suspension, Sprung and un-sprung mass, Pitching, rolling and bouncing, Shock absorbers.

Wheels and Tyres, Requirements of wheels and Tyres, Constructional features, Types of tires, Inflation Pressure and its importance, Application to ride and stability, Trouble shooting and remedies.

UNIT4: Electrical system (8 Lectures)

Battery: Types of battery, Lead-Acid, Alkaline, ZEBRA, Sodium Sulphur and Swing, Ratings, charging, Maintenance and testing of Lead-Acid battery. Starting system: Requirements, Various torque terms used, Starter motor drives; Bendix, follow through, Barrel, Rubber compression, Compression Spring, Friction Clutch, Overrunning Clutch, Dyer. Starter motor solenoids and

switches, Glow plugs. Alternator: Principle of operation, Construction, Working, Rectification from AC to DC.

UNIT 5: Recent trends in Automobiles (8 Lectures)

Electronic Control module (ECM), operating modes of ECM (closed loop and open loop) Inputs required and output signals from ECM, Electronic Spark control, Air Management system, Idle speed control. Construction, working & application of temperature sensors, inductive sensors, Position sensors (rotary, linear). Hot wire and thin film air flow sensors, vortex flow/turbine fluid sensors, Optical sensor, Oxygen sensors, Light sensors, methanol sensors, Rain sensor, new developments in the sensor technology.

Suggested Text/Reference Books:

1. William Crouse& Donald L. Anglin, Automotive Mechanics, Tata McGraw Hill
2. Joseph Heitner, Automotive Mechanics, East-West press Pvt. Ltd
3. T. R. Banga& Nathu Singh, The Automobile Engineering, , Khanna Publishers
4. Harbans Singh Reyat, The Automobile, S. Chand & Co.
5. R. K. Rajput, Automobile Engineering, Laxmi Publication
6. C.P. Nakra, Basic Automobile Engineering, Dhanpat Rai Publishing CO.
7. Tom Denton, Automobile Electrical and Electronics,
8. J Pawlowski, Vehicle Body Engineering, Century publisher.
9. Dick King, Computerised Engine Control, Delmar publisher.

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

CO1: Demonstrate & explain various systems in an automobile

CO2: Describe importance and features of different systems like axle, differential, brakes,

CO3: steering, suspension, wheel and balancing etc.

CO4: Explain principle of operation, construction and applications of various sensors used in modern automobile

MECB8310	TOTAL QUALITY MANAGEMENT	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**-**		
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objectives:

1. To acquaint with key features of the TQS philosophy.
2. To understand and assimilate the contribution rendered by quality gurus.
3. To familiarize with various quality tools and their uses in solving the problems.
4. To impress upon the ongoing global trend of quality focus to customer delight.

Course Contents

UNIT 1 Introduction (7 Lectures)

Evolution of Quality, Definition of Quality, Dimensions of Quality, Quality Planning, Principles of TQM, Quality in Manufacturing and Service Systems, Economic Issues, Quality and Market Share, Barriers to TQM Implementation. Cost of quality: prevention, appraisal & failure costs and Hidden cost of quality.

UNIT 2 Strategic planning for quality (8 Lectures)

Need for quality policies & objectives with examples. Leadership concepts, Importance of Top Management commitment, quality council and strategic planning. Quality improvement**.** Juran's trilogy, management of controllable defects, operator controllable defects, sporadic and chronic problems of quality. Bench Marking: Introduction, definition and its significance. Collection of data for bench marking and its use.

UNIT 3 Customer relation and satisfaction: (8 Lectures)

Origin of consumerism - Product knowledge, definition and types of customers, their importance, Customer perception and quality expectations. Quality feedback and redressal. Definition and principles of reliability, reliability and product life cycle (boat curve/bath tub curve), trade-off between reliability, maintainability and availability.

UNIT 4 Supplier Relations (8 Lectures)

Treating Supplier as a partner, Principle and elements of Partnering. Selection of supplier, Performance measurement & rating of supplier. Push-Pull view of supply chain and Cycle view of supply chain management.

UNIT 5 Quality / Productivity Improvement Tools (9 Lectures)

Process Data Collection & presentation – Bar Chart, Histogram and Run Charts. Process Variability – variables & Process Variation (Measures of accuracy & Centering, precision or

spread, normal distribution and sampling averages). Process Control by Variable – using X bar and R Chart and control charts for standard deviation. Process Control by Attribute - for number of defectives or non- conforming units - np-charts, p-charts, c-charts and u-charts. Process capability, OC curve, acceptance sampling AQL, LTPD, AOQL, producers and consumers risk (Single & Double sampling plan only). (Note: Emphasize the explanation with Numerical problems).

Suggested Text/Reference Books:

1. J M Joran, FM Gryana, Quality planning and analysis, TMH
2. Biesterfield D. H. et al, Total Quality Management, prentice hall.
3. Philip B Crossly, Quality is free, Mentor/ new American library.
4. What is Total Quality Control? The Japanese way, Ishikawa k, PH.
5. Total Quality Control, Armand V Feigenbaum.
6. HG Menon, TQM in new product manufacturing, TMH.
7. Managing for total quality, N. Logothetis / prentice hall
8. Dr. Uday K. Halder, Total quality management, Dhanpat rai & Co.

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

CO1: Identify and use proper quality tools in various manufacturing /service functions.
CO3: Integrate quality approaches for productivity improvement.
CO4: Realize the trade-off dimension of quality and cost.
CO5: Realize that quality should not be inspected, but should be inbuilt into the system.

MECB8320	PRESS TOOL DESIGN	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial			
Practical			**-**
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objectives:

1. To acquaint with various press working operations for mass production of sheet metal components
2. To familiarize with sheet metal working techniques for design of press tools
3. To inculcate knowledge about scrap minimization, safety aspects and automation in press working

Course Contents

UNIT 1 Introduction to Press Working (10 Lectures)

Classification of common Press working operations, Benefits and limitations of using Press tools. Applications of pressed parts/components. Theory of Shearing in Press Working. Optimum Cutting clearance & its effect on tolerances of pressed components. Construction of Basic shearing die. Functions of different elements of a press tool. Methods of feeding the strip/coil material.

UNIT 2 Design and Calculations (10 Lectures)

Piercing & Blanking Die– Calculations for Economic Strip Layout, Calculations of Cutting force and stripping force, recommending minimum tonnage of a press. Centre of Pressure (its importance and calculation) Design aspects of Press tool elements viz. Punches & methods of retaining punches, Die block, Stripper, Pilot, etc. Methods of reducing cutting loads on press tools. Different types Die sets and its selection.

UNIT 3 Selection of Material & Hardware (4 Lectures)

Selection and arrangement of Hardware used in Press tools. Selection of steels and its hardness for different elements of Press tools.

Miscellaneous Dies- Basic construction & working of Shaving dies, trimming dies, Compound dies, Combination dies, Coining dies, Embossing dies, Simple Progressive & Compound Progressive dies.

UNIT 4 Bending and Drawing (10 Lectures)

Theory of Bending, spring back and measures to control it, Calculations for Blank development of Simple Bent components, Minimum bend radius, Types of Bending dies. Theory of Drawing, Metal flow in Drawing & forming operations; reduction ratio and redrawing limits, draw clearance, drawing and blank holding forces for cylindrical draws only. Blank development of

Cup. Defects in drawn as well as bent parts, presses selection for drawing/forming operations. Basic construction and working of Bending and Drawing dies.

UNIT 5 Selection of Presses and its Setting (6 Lectures)

Selection of Press and Press setting for Shearing, Bending, Progressive and Drawing dies, Equipment for Sheet metal operations (Basics only), Overloading of presses (load, energy considerations) Introduction to Automation & Safety in Press shop

Suggested Text/Reference Books:

1. J. R. Paquin, Die Design Fundamentals, Industrial Press
2. D F Eary and E A Reed, Techniques of Press Working Sheet Metal, Prentice-Hall; 2nd edition
3. P H Joshi, Press Tools Design and Construction, S Chand Publishing
4. C. Donaldson and V C Gold, Tool Design, TMH
5. P. C. Sharma, Production Engineering, S Chand Publishing
6. Metal working ASM Handbook

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

CO1: Demonstrate various press working operations for mass production of sheet metal parts

CO2: Identify press tool requirements to build concepts pertaining to design of press tools

CO3: Prepare working drawings and setup for economic production of sheet metal components

CO4: Select suitable materials for different elements of press tools

CO5: Illustrate the principles and blank development in bent & drawn components

CO6: Elaborate failure mechanisms of pressed components, safety aspects and automation in press working

MECB8320	PRODUCT LIFE CYCLE MANAGEMENT	3L:0T:0P	3 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	**3 Hrs/Week**	**Internal Assessment Test**	**30 Marks**
Tutorial	**-**		
Practical	**-**		
Total Credits	**3**	**End-Semester Examination**	**70 Marks**

Course Objectives:

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Course Contents

UNIT 1 Introduction to Product Lifecycle Management (PLM) (10 Lectures)

Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications

PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM

UNIT 2 Product Design (10 Lectures)

Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process

UNIT 3 Product Data Management and Virtual Product Development Tools (10 Lectures)

Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation, For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis

UNIT 4 Integration of Environmental Aspects in Product Design (5 Lectures)

Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design

UNIT 5 Life Cycle Assessment and Life Cycle Cost Analysis (5 Lectures)

Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis.

Suggested Text/Reference Books:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105.
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229.
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314.
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

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

CO1: Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.

CO2: Illustrate various approaches and techniques for designing and developing products.

CO3: Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.

CO4: Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

MECB8302	PROJECT II	0L:0T:12P	6 Credits
Teaching Scheme		**Evaluation Scheme**	
Lectures	-	**Term Work**	**100 Marks**
Tutorial	-		
Practical	**12 Hrs /Week**		
Total Credits	**6**	**End-Semester Marks**	**100 Marks**

Objectives:
The Project work facilitates the students to develop and prove Technical, Professional and Ethical skills and knowledge gained during graduation program by applying them from problem identification to successful completion of the project by implementing the solution.

Guidelines:
Project Report Format:
At the end of semester, each group need to prepare a project report as per the guidelines issued by the University. Report should be submitted in hardcopy. Also, each group should submit softcopy of the report along with project documentation, implementation code, required utilities, software and user Manuals.
A project report should preferably contain at least following details:

- Abstract o Introduction
- Literature Survey/ Existing system
- Limitation Existing system or research gap
- Problem Statement and Objective
- Proposed System
  1. Analysis/Framework/ Algorithm
  2. Design details
  3. Methodology (your approach to solve the problem) Proposed System
- Experimental Set up
  1. Details of Database or details about input to systems or selected data
  2. Performance Evaluation Parameters (for Validation)
  3. Software and Hardware Set up
- Results and Discussion
- Conclusion and Future Work
- References
- Appendix – List of Publications or certificates

Suggested quality evaluation parameters are as following
1. Relevance to the specialization / industrial trends
2. Modern tools used
3. Innovation

4. Quality of work and completeness of the project
5. Validation of results
6. Impact and business value
7. Quality of written and oral presentation
8. Individual as well as team work

Outcomes

CO1: Students will be able to implement solutions for the selected problem by applying technical and professional skills.
CO2: Students will be able to analyze impact of solutions in societal and environmental context for sustainable development.
CO3: Students will be able to collaborate best practices along with effective use of modern tools.
CO4: Students will be able to develop proficiency in oral and written communication with effective leadership and teamwork.
CO5: Students will be able to nurture professional and ethical behavior
CO6: Students will be able to gain expertise that helps in building lifelong learning experience.