1901MA104	Mathematics –I (Linear Algebra, Calculus and Partial differentiation) (ECE,MECH & BME)	L	T	P	C
		3	1	0	4

Aim of the course:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

PREREQUISITES: BASIC MATHEMATICS

Module 1: Matrices

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigen values and Eigen vectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Module 2:Differential Calculus

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature-Evolutes and involutes.

Module 3: Integral Calculus

Double integration – Cartesian and polar coordinates – Change the order of Integration – Applications: Area of a curved surface using double integral – Triple integration in Cartesian co-ordinates – Volume as triple integral.

Module 3: Sequences and series:

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, Seriesfor exponential, trigonometric and logarithm functions.

Module 5: Partial Differentiation:

Partial derivatives, total derivative; Maxima, minima and saddle points; Method of Lagrange multipliers.

COURSE OUTCOMES Employability

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

CO1: Calculate the nature of the matrix using Orthogonal Transformation.

CO2: Develop the evolutes and envelopes of given curves by means of radius and centre of curvature.

CO3: Calculate the area and volume of a curve using double and triple integration.

CO4: Determine the nature of series using comparison, Ratio, Leibnitz tests.

CO5:Examine the maxima/minima for the given function with several variables by finding stationary points.

TEXT BOOKS:

REFERENCES (BOOKS):

1.Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2018.

2.G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

3. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.

4.Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

5.D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

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1901PH101	INTRODUCTION TO MECHANICS (for Civil and Mechanical Engineering)	L	T	P	C
		3	0	0	3

Aim of the course: To make students understand and apply the knowledge in mechanics for engineering applications

PREREQUISITES:

Introduction to mechanics

Forces in Nature; Newton's laws and its completeness in describing particle motion; Solving Newton's equations of motion in polar coordinates and related problems

Vector mechanics of particles

Central forces: Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits, Application: Satellite manoeuvres

Five-term acceleration formula — Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum; Harmonic oscillator; Damped harmonic motion

Rigid body mechanics

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion;

Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples; Introduction to three-dimensional rigid body motion — (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor

Statics

Free body diagrams with examples on modelling of typical supports and joints; Condition for equilibrium in three- and two- dimensions; Friction: limiting and non-limiting cases.

COURSE OUTCOMES Employability | Entrepreneurship

Upon completion of this course, students will be able to

CO1: Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems

CO2: Extend all of concepts of linear kinetics to systems in general plane motion

CO3: Apply basic dynamics concepts of force, momentum, work and energy to apply in Newton's laws of motion

CO4: Apply Euler's Equation and considering energy of a system in general plane motion, and the work of couples and moments of forces

CO5: Apply the concepts of friction and conditions of equilibrium in two and three dimensions.

REFERENCES (BOOKS):

(i) Engineering Mechanics, 2nd ed. — MK Harbola
(ii) Introduction to Mechanics — MK Verma
(iii) An Introduction to Mechanics — D Kleppner & R Kolenkow
(iv) Principles of Mechanics — JL Synge & BA Gri*ths*
(v) Mechanics — JP Den Hartog
(vi) Engineering Mechanics - Dynamics, 7th ed. - JL Meriam
(vii) Mechanical Vibrations — JP Den Hartog
(viii) Theory of Vibrations with Applications — WT Thomson
(ix) An Introduction to the Mechanics of Solids, 2nd ed. with SI Units — SH Crandall, NC Dahl & TJ Lardner
(x) Engineering Mechanics: Statics, 7th ed. — JL Meriam
(xi)Engineering Mechanics of Solids — EP Popov

REFERENCES (WEBSITES):

1. https://www.edx.org/course/introduction-mechanics-part-1-ricex-phys-101-1x
2. https://learn.saylor.org/course/PHYS101
3. https://www.slideshare.net/KhanSaif2/1-introduction-to-mechanics-71503843

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1901GEX01	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (Common for all UG programmes, except BE- EEE)	L	T	P	C
		3	0	0	3

Aim of the course: To study about the fundamentals of Electrical, Electronics and Communication Engineering

PREREQUISITES:

COURSE CONTENTS

Introduction to DC and AC circuits: Ohms law - Kirchhoff's laws - Mesh analysis - Nodal analysis - Generation of AC waveforms - Analysis of R-L, R-C, R-L-C circuits - Introduction to three phase systems - Types of connections.

Electrical Machines: DC Generator, DC Motor, Transformer, Induction Motor: Working principle, construction and applications.

Measuring instruments: Classification of instruments; Voltmeter, Ammeter, Wattmeter, Energy meter, Multimeter, CRO: Principles and operation.

Semiconductor devices: V-I characteristics of PN junction diode and Zener diode; Rectifiers - Half wave and full wave rectifiers; BJT - configurations; Amplifiers & Oscillators: classification, operation and applications; SCR: Construction and V-I characteristics; Basic power converters (Block diagram approach only).

Digital systems: Boolean algebra - Reduction of Boolean expressions - De-Morgan's theorem - Logic gates - Implementation of Boolean expressions.

Communication Systems: Model of communication system - Analog and digital, Wired and wireless channel - Block diagram of various communication systems - Microwave, satellite, optical fiber and cellular mobile system.

Electrical safety and wiring: Safety measures in electrical system - Safety devices - types of wiring - Wiring accessories-staircase, fluorescent lamps and corridor wiring - Basic principles of earthing - Types of earthing - layout of generation, transmission and distribution of power (Single line diagram).

COURSE OUTCOMES

Upon completion of this course, students will be able to

1. Solve very simple problems in DC and AC circuits
2. Explain the construction and principle of operation of DC and AC machines
3. Describe the operation of simple electrical measuring instruments
4. Elucidate the characteristics of diode, Zener diode, BJT, SCR and their applications
5. Implement Boolean expressions using logic gates
6. Explain the operation of functional blocks of various communication systems
7. Summarize the electrical safety systems and electrical wiring procedures

Employibility | Entrepreneurship

REFERENCES (BOOKS):

1. Smarajit Ghosh, —Fundamentals of Electrical and Electronics Engineering‖, 2nd Edition, PHI Learning, 2010.
2. R. Muthusubramaniam, S. Salaivahanan and K.A. Mureleedharan, —Basic Electrical Electronics and Computer Engineering‖, Tata McGraw Hill, 2004.
3. D.P. Kothari and I.J. Nagrath, -Theory and Problems of Basic Electrical Engineering‖, PHI learning, New Delhi, 2004.
4. J.B. Gupta, —Fundamentals of Electrical Engineering and Electronics‖, S.K. Kataria and Sons, Reprint 2012 Edition.
5. R.L. Boylestad and L. Nashelsky, —Electronic Devices and Circuit Theory‖, Pearson, 11th Edition, 2013.
6. George Kennedy and Bernard Davis, —Kennedy's Electronic communication Systems‖, McGraw Hill Education, 5th Edition, 2011.
7. Donald P. Leach, Albert Paul Malvino and Goutam Saha, —Digital Principles and Applications‖, McGraw-Hill Education, 8th Edition, 2014.

REFERENCES (WEBSITES):

4. https://nptel.ac.in/courses/108108076/
5. https://nptel.ac.in/downloads/108105053/

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1901GEX02	ENGINEERING GRAPHICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

1. To develop in students, graphic skills for communication of concepts, ideas and design ofEngineering products.
2. To expose them to existing national standards related to technical drawings

MODULE I	CONCEPTS AND CONVENTIONS (Not for Examination)		5 Hours

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

MODULEII	PLANE CURVES AND FREE HAND SKETCHING			9 Hours

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of Objects.

MODULEIII	PROJECTION OF POINTS, LINES AND PLANE SURFACES		9 Hours

Orthographic projection- principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

MODULEIV	PROJECTION OF SOLIDS			9 Hours

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

MODULE V	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	9 Hours

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

MODULE VI	ISOMETRIC AND PERSPECTIVE PROJECTIONS		9 Hours

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

TOTAL: 45+5 HOURS

COURSE OUTCOMES:

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

CO1: Perform free hand sketching of basic geometrical constructions and multiple views of objects.

CO2: Do orthographic projection of lines and plane surfaces. Employibility / Entrepreneurship.

CO3: Draw projections and solids and development of surfaces.

CO4: Prepare isometric and perspective sections of simple solids.

CO5: Demonstrate computer aided drafting

REFERENCES:

1. Gopalakrishna K.R., —Engineering Drawing‖ (Vol. I&II combined), Subhas Stores, Bangalore,2016.

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1901GEX51	**CAD (COMPUTER AIDED DRAFTING) LAB** **(Common for all B.E./B.Tech. Programme)**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

List of Experiments: Employibility / Entrepreneurship.

Basics commands of a CAD software- two-dimensional drawing, editing, layering and dimensioning - coordinate Systems-Drawing practice - orthographic views of simple solids using CAD software.

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using B-spline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
7. Drawing isometric projection of simple objects.
8. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

Total: 45 Hours

References:

1. N.D. Bhatt, Machine Drawing, Charotar Publishing House Pvt. Ltd., 2014.
2. P.S. Gill, A Textbook of Machine Drawing, Katson books, 2013.
3. R.K. Dhawan, A Textbook of Machine Drawing, S. Chand,2012.
4. K.C. John, Textbook of Machine Drawing, PHI Learning Pvt. Ltd.,2009.

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1901GEX52	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY (Common for all UG programmes)	L	T	P	C
		-	-	2	1

Aim of the course : To apply the fundamentals of Electrical and Electronics Engineering

PREREQUISITES:

1. Experiments related to verification of Ohm's law and Kirchhoff's laws
2. Experiments involving logic gates
3. Fan and light control using regulators
4. Design of 6V regulated power supply
5. Energy conservation demonstration experiment using energy meter
6. Waveform generation and calculation of rms and average values
7. IC 555 and IC 741 based experiments
8. Experiments in earthing
9. Staircase wiring and residential building wiring
10. Speed control of DC shunt motor

COURSE OUTCOMES

Upon completion of this course, students will be able to

CO1: Design and analyze electronic circuits
CO2: Test digital logic gates
CO3: Control lights and speed of motors
CO4: Measure electrical parameters using instruments
CO5: Generate waveforms
CO6: Construct different wiring schemes.

Employability / Entrepreneurship.

REFERENCES (BOOKS):

1. Edward Hughes, — Electrical Technology,‖, Pearson Education
2. D.P. Kothari and Nagrath — Basic Electronics‖,MH Education 2013.
3. Paul Scherz and Simon Monk —Practical Electronics for inventors‖ Mc Graw Hill Publications 2013.

REFERENCES (WEBSITES):

1. https://nptel.ac.in/courses/122106025/

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1901HSX51	COMMUNICATION SKILLS LAB (Common for all B.E./B.Tech. Programme)	L	T	P	C
		0	0	2	1

Course Overview:

English- being the foremost global language has its domination in internationally sensitive domains such as science and technology, business and commercial relation, education and diplomatic relationships, politics and administration and so on. It is the language of corporate India, a passport for better career, better pay, and advanced knowledge and for communication with the entire world. In higher education, English is the prevalent prestigious language. Careers in any area of business communication or within the government, or in science and technology require fluency in English

The basic idea behind offering English as a practical subject at the undergraduate level is to acquaint students with a language that enjoys currency as a lingua franca of the globe. For prospective engineers nothing could be more useful or productive than being able to reach out to the world of technology. In the ELCS lab the students are trained in Communicative English Skills, phonetics, word accent, word stress, rhythm and intonation, making effective oral presentations - both extempore and Prepared-seminars, group discussions, presenting techniques of writing, role play, telephonic skills, asking and giving directions, information transfer , debates, description of person, place, objects etc; . The lab encourages students to work in a group, engage in peer-reviews and inculcate team spirit through various exercises on grammar, vocabulary, listening and pronunciation games, etc

Objectives :

- To facilitate computer-aided multi-media instruction enabling individualized and independent language learning
- To bring about a consistent accent and intelligibility in their pronunciation of English by providing an opportunity for practice in speaking.
- To train students to use language appropriately for interviews, group discussion and public speaking
- To help the students to cultivate the habit of reading passages from the computer monitor, thus provides them the required facility to face computer-based competitive exams such as GRE, TOEFL, GMAT etc.
- To train them to face interviews with confidence and enable them to prepare resume with cover letter.
- To prepare them to use communicative language and participate in public speaking.
- To initiate them into greater use of the computer in power point presentation preparation, report Writing and e-mail writing etc.
- To initiate them into greater use of the computer in power point presentation preparation, report Writing and e-mail writing etc.
- To expose the Students to participate in group discussions, debates with ease.

List of Exercises :

I	**Activities on Fundamentals of Listening and Inter-personal Communication**			**6 Hours**
	Listening to conversation, listening to technical presentation- listening to online video conferencing ,interviews and webinars -starting a conversation - responding appropriately and relevantly - using appropriate body language - Role Play in different situations & Discourse			
II	**Activities on Reading Comprehension**			**6 Hours**
	General Vs Local comprehension- reading for facts- guessing meanings from context-Scanning-skimming and inferring meaning- critical reading & effective googling- TOFEL,IELTS-reading online journals.			

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III	**Activities on Writing Skills**			**6 Hours**
	Structure and presentation of different types of writing - letter writing - Resume writing- e- correspondence - Proposal writing - Technical report writing - Portfolio writing - planning for writing - improving one's writing			
IV	**Activities on Presentation Skills**			**6 Hours**
	Oral presentations (individual and group) through JAM sessions – presentation on online platform (webinars, online meeting) - seminars -PPTs and written presentations through posters- projects- report- e-mails- assignments etc.- creative and critical thinking.			
V	**Activities on Soft Skills**			**6 Hours**
	Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation-Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conferencing and Mock Interviews-Time management-stress management –paralinguistic features- Multiple intelligences – emotional intelligence – spiritual quotient (ethics) – intercultural communication – creative and critical.			
				TOTAL: 30 HOURS

Course Outcomes (COs): Skill Development

After successful completion of the course, students will be able to

CO1: Compose grammatically correct sentences for oral as well as written communication.
CO2: Interpret perfectly after paying attention to an audio on any theme.
CO3: Organize formal presentations effectively.
CO4: Explain the content of any written or visual material.
CO5: Generate technical and non-technical documents with appropriate contents and context.
CO6: Monitor, analyse and adjust their own communication.

REFERENCES:

1. Raman, Meenakshi and Sangeetha Sharma, —Technical Communication: Principles and Practice‖, Oxford University Press, New Delhi, 2011.
2. Sudha Rani, D , —Advanced Communication Skills Laboratory Manual‖ , Pearson Education 2011.
3. Paul V. Anderson ,—Technical Communication‖,. Cengage Learning pvt. Ltd. New Delhi,2007.
4. —English Vocabulary in Use series‖, Cambridge University Press 2008.
5. —Management Shapers Series‖ ,Universities Press (India) Pvt Ltd., Himayatnagar, Hyderabad 2008.
6. Rizvi and Ashraf M., —Effective Technical Communication‖, Tata McGrawHill,New Delhi, 2005.
7. Jones, D, -The Pronunciation of English‖, CUP, . Cambridge,2002.

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1901PHX51	**ENGINEERING PHYSICS LAB**	L	T	P	C
	,Employability	0	0	2	1

List of Experiments:

1. Determination of wavelength of various colours of mercury spectrum using Laser grating
2. Determination of velocity of liquids using ultrasonic interferometer
3. Determine the dispersive power of a prism using spectrometer
4. Determine the unknown resistance of the given wire using Carey-Foster"s Bridge
5. Determine the band gap of the given semiconductor
6. Determine the acceptance angle and particle size using Laser
7. Torsional pendulum – Rigidity modulus of a steel wire
8. Thickness of a thin wire – Air Wedge
9. Measurement of Young"s modulus – Uniform and Non-uniform bending
10. Thermal conductivity –Lee"s Disc method

Total: 30 Hours

References:

1. „Practical Physics", R.K. Shukla, Anchal Srivastava, New age international (2011)
2. „B.Sc. Practical Physics", C.L Arora, S. Chand &Co. (2012)

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1901MA204	ENGINEERING MATHEMATICS – II (Calculus, Ordinary Differential Equations and Complex Variable)	L	T	P	C
		3	2	0	4

Aim of the course: This course focuses on acquiring sound knowledge of techniques involved in application of differentiation, form through Laplace transforms acquaint with the concepts of multiple integrals, needed for problems in all engineering disciplines, develop an understanding of the standard techniques of Analytic functions by satisfying CR equations so as to enable the student to apply them with confidence, in application areas such as Computer Graphics, Robotic Automations, Computer Vision Problems, Simulations and also make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

PREREQUISITES: Laplace Transforms, solving differential equations

MODULE I LAPLACE TRANSFORM **12Hours**

Laplace Transform – Conditions for existence – Transform of Elementary Functions – Basic Properties – Transform of Unit step function and Impulse function – Transform of Periodic function – Inverse Laplace Transform – Convolution Theorem (excluding Proof) – Initial and Final value Theorems – Solution of Linear ODE of Second order with constant coefficient using Laplace Transform techniques.

MODULE II VECTOR CALCULAS **12 Hours**

Gradient, Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration: Green"s theorem in a plane, Gauss divergence theorem and Stokes" theorem (excluding proofs) –Applications of the above theorems to find surface area of a closed region and volume of cube and parallel piped.

MODULE III ORDINARY DIFFERENTIAL EQUATIONS **12 Hours**

Second order linear differential equations with variable coefficients, method of variation of parameters.

MODULE IV COMPLEX VARIABLE – DIFFERENTIATION **12 Hours**

Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; Conformal mappings, Mobius transformations.

MODULE V COMPLEX VARIABLE– INTEGRATION **12 Hours**

Contour integrals, Cauchy Integral formula (without proof), Taylor"s series, zeros of analytic functions, singularities, Laurent"s series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

TOTAL: 60 HOURS

COURSE OUTCOMES

Employibility | Entrepreneurship

CO1 : Apply Laplace Transform in solving Boundary value problems of second order ODE(K3)
CO2 :Compute surface and volume integral in vector field (K3)
CO3 : Solve the higher order differential equations (K3)
CO4 : Construct Analytic functions and trace the image of a region using transformation (K3)
CO5 : Solve complex integrals (K3)

TEXT BOOKS:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
4. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
5. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill, 2004.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

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1901CH203	MATERIAL CHEMISTRY (for MECHANICAL ENGINEERING)	L	T	P	C
		3	0	0	3

Aim of the course: Material chemistry course is designed to provide chemistry and its application to the mechanical engineering students. The course is a combination of the theoretical concepts and its application in lab. It includes the study of applications of boilers and its effects, thermodynamics, corrosion principles, alloys and fuels and engineering materials as their theoretical parts. The course is designed very efficiently, specifically to support the mechanical programme through chemistry .

PREREQUISITES: Knowledge of chemistry in higher secondary level

MODULE-I BOILER

Boiler - Boiler Types, boiler compounds - boiler troubles- Sources, hard & soft water-Degree of hardness and its estimation (EDTA method)– Water Quality Parameters. boiler feed water-requirements - softening of hard water -external treatment –demineralization, Zeolite process internal treatment- desalination of sea water –reverse osmosis- Domestic water treatment

MODULE-II THERMODYNAMICS

Thermodynamics- – terms, Entropy as a thermodynamic quantity, entropy changes in isothermal expansion of an ideal gas, reversible and irreversible processes, physical transformations, work & free energy functions, Helmholtz and Gibbs free energy functions, Gibbs-Helmholtz equation, Clapeyron-Clausius equation & its applications, Van't Hoff isotherm and applications

MODULE-III CORROSION AND PROTECTIVE COATING

Corrosion And Protective Coating- Corrosion – types-chemical, electrochemical corrosion (galvanic, differential aeration) - Factors influencing corrosion -corrosion control – material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method. Protective coatings: Thermal Spray, Electroplating of gold and electroless plating of nickel. Paints - Constituents and Functions. Estimation of iron.

MODULE-IV ALLOYS AND PHASE RULE

Alloys and Phase Rule -Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process

MODULE-V FUELS AND ENGINEERING MATERIALS

Fuels and Engineering Materials- Fuel-Introduction- classification of fuels, carbonization-manufacture of metallurgical coke (Otto Hoffmann method)-Refining of petroleum- manufacture of synthetic petrol (Bergius process)- natural gas- compressed natural gas (CNG)- producer gas- water gas. Combustion- calorific value - Flue gas analysis (ORSAT Method). Fundamentals of nano chemistry, nano materials, synthesis, properties and application. Lubricants –types- application

COURSE OUTCOMES

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

CO1: Describe the boiler troubles in terms of water quality Employability | Entrepreneurship

CO2: Describe the principles thermodynamics to predict the feasibility of a reaction in thermal engineering.

CO3: Discuss the corrosion , its mechanism and preventive measures.

CO4: Describe the principles phase rule in alloys in manufacturing procedures.

CO5: Discuss of combustion of fuels and its calorific value

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TEXT BOOKS:

1. 1 Dara.S, Umare.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2010.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New delhi 2010.
3. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, "Polymer Science", New Age
4. Kumar Mehta P. and Paulo J. M. Monteiro, (2014), Concrete: Microstructure, Properties and Materials, 4th Edition, McGraw-Hill, New Delhi.
5. Shetty. M. S., (2017), Concrete Technology, S. Chand and Company Ltd, New Delhi.
6. Neville. A. M, (2012), Properties of Concrete, Pearson, New Delhi.
7. ACI 211.1-91 Reapproved 2009, Standard Practice for selecting Proportions for Normal, Heavyweight, and Mass Concrete, USA

REFERENCES (WEBSITES):

1. https://www.ccdc.cam.ac.uk/solutions/csd-system/components/csd/
2. onlinelibrary.wiley.com/doi/10.1002/9780470661345.smc107/pdf

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1901GEX03	PROGRAMMING FOR PROBLEM SOLVING (Common for all B.E./B.Tech Programme)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.To prepare students to comprehend the fundamental concepts
2.To demonstrate fine grained operations in number system
3.To gain exposure in programming language using C
4.To develop programming skills using the fundamentals and basics of C Language

MODULE I	INTODUCTION TO PROGRAMMING	9 Hours

Components of Computers and its Classifications- Problem Solving Techniques – Algorithm- Flowchart– Pseudo code – Program-Compilation -Execution

MODULE II	BASICS OF C PROGRAMMING	9 Hours

Structure of C program - C programming: Data Types – Storage classes - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/output statements – Decision making statements - Switch statement - Looping statements – Pre-processor directives.

MODULE III	ARRAYS AND STRINGS	9 Hours

Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays – Example Program: Matrix Operations - String operations

MODULE IV	FUNCTIONS AND POINTERS	9 Hours

Introduction to functions: Function prototype, function definition, function call, Built-in functions – Recursion – Example Program – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Example Program: Sorting of names – Parameter passing: Pass by value, Pass by reference – Example Program: Swapping of two numbers and changing the value of a variable using pass by reference

MODULE V	STRUCTURES & FILE PROCESSING	9 Hours

Structure - Nested structures – Pointer and Structures – Array of structures – Example Program using structures and pointers – Dynamic memory allocation -Files – Types - File processing: Sequential access, Random access -Command line arguments

TOTAL: 45 HOURS

FURTHER READING:

Object Oriented Programming Approach.

COURSE OUTCOMES:

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

CO1: Describe basic concepts of computers
CO2: Paraphrase the operations of number system
CO3: Describe about basic concepts of C-Language
CO4: Understand the code reusability with the help of user defined functions
CO5: Analyze the structure concept, union, file management and preprocessor in C language

Employibility / Entrepreneurship.

REFERENCES:

1. Paul Deitel and Harvey Deitel, —C How to Program‖, Seventh edition, Pearson Publication
2. Juneja, B. L and Anita Seth, —Programming in C‖, CENGAGE Learning India pvt. Ltd., 2011
3. Pradip Dey, Manas Ghosh, —Fundamentals of Computing and Programming in C‖, First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, —Computer Fundamentals and Programming in C‖, Dorling Kindersley(India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C",McGraw-Hill Education, 1996.

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1901ENX01	ENGLISH FOR ENGINEERS Skill Development	L	T	P	C
	(Common for all B.E./B.Tech. Programme)	3	0	0	3

MODULE I FOCUS ON LANGUAGE (Vocabulary and Grammar) 9 Hours

Vocabulary -The Concept of Word Formation - Prefixes- Suffixes- Synonyms – Antonyms - Grammar - Articles- Preposition- Adjective-Adverb-Connectives -Tenses (present, past & future) - Conditional Clauses - Active voice –passive voice and Impersonal passive voice - Wh- Questions.

MODULE II LISTENING SKILLS 9 Hours

Listening-Types of Listening -listening to short or longer texts- listening and Note taking- -formal and informal conversations- telephonic etiquettes- narratives from different sources. - Correlative verbal and nonverbal communication - listening to panel members (how to response to panel members after listening panel members) – listening to facing online interviews (or) interviews on video conferencing mode - listening webinars.

MODULE III SPEAKING SKILL 9 Hours

Speaking - Stress and intonation –Communication skills- Role of ICT in Communication, -Process of communication- oral presentation skills- verbal and non verbal communication-individual and group presentations- impromptu presentation- public speaking- Group discussion- speaking to the panel members (online interviews , video conferencing, online meeting and webinars.

MODULE IV READING SKILLS 9 Hours

Reading– Intensive Reading –Predicting the content -Comprehending general and technical articles -Cloze reading - Inductive reading- Short narrative and descriptions from newspapers – Skimming and scanning-reading and interpretation-critical reading interpreting and transferring graphical information- sequencing of sentences-analytical reading on various Projects.

MODULE V WRITING SKILLS 9 Hours

Writing- Precise writing –Summarizing- Interpreting visual texts (pie chart, bar chart, picture, advertisements etc., - Proposal writing (launching new units or department in a institution or industry & to get loan from bank) -Report writing (accident, progress, project, survey, Industrial visit)- job application- e- mail drafting- letter writing (permission, accepting and decaling)- e.mail drafting instructions – recommendations –checklist- uses of Print and electronic media (internet, fax, mobile, interactive video and teleconferencing, computer) e-governance.

TOTAL: 45 HOURS

REFERENCES:

1. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: Principles and Practice", Oxford University Press, New Delhi, 2011.
2. Rizvi and Ashraf M., "Effective Technical Communication", Tata McGraw-Hill, New Delhi, 2005.
3. G. Radhakrishna Pillai, "English for Success", Central Institute of English and Foreign Languages", Emerald Publishers ,Hyderabad, 2003
4. Jones, D, "The Pronunciation of English", CUP, . Cambridge,2002.

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1901GE201	ENGINEERING EXPLORATION	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- Build mindsets & foundations essential for designers
- Learn about the Human-Centered Design methodology and understand their real-world applications
- Use Design Thinking for problem solving methodology for investigating ill-defined problems.
- Undergo several design challenges and work towards the final design challenge
- **Apply Design Thinking on the following Streams to**
  Project Stream 1: Electronics, Robotics, IOT and SensorsProject Stream 2: Computer Science and IT ApplicationsProject Stream 3: Mechanical and Electrical tools
  Project Stream4: Eco-friendly solutions for waste management, infrastructure, safety, alternative energy sources, Agriculture, Environmental science and other fields of engineering.

HOW TO PURSUE THE PROJECT WORK?

- The first part will be learning-based-masking students to embrace the methodology byexploring all the phases of design thinking through the wallet/ bag challenge and podcasts.
- The second part will be more discussion-based and will focus on building some necessaryskills as designers and learning about complementary material for human-centered design.
- The class will then divide into teams and they will be working with one another for about 2 – 3 weeks. These teams and design challenges will be the basis for the final project and finalpresentation to be presented.
- The teams start with **Design Challenge** and go through all the phases more in depth fromcoming up with the right question to empathizing to ideating to prototyping and to testing.
- Outside of class, students will also be gathering the requirements, identifying the challenges,usability, importance etc
- At the end, Students are required to submit the final reports, and will be evaluated by thefaculty.

TASKS TO BE DONE:

Task 1: Everyone is a Designer

- Understand class objectives & harness the designer mindset

Task 2: The Wallet/Bag Challenge and Podcast

- Gain a quick introduction to the design thinking methodology
- Go through all stages of the methodology through a simple design challenge
- Podcast: Observe, Listen and Engage with the surrounding environment and identify adesign challenge.

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1901CHX51	ENGINEERING CHEMISTRY LAB	L	T	P	C
		0	0	2	1

Aim of the course: Engineering Chemistry laboratory course is designed to provide basic chemistry and its application to the first year engineering students. The course includes the study of applications of water quality chemistry, identification of acidic and alkaline nature of water,molecular weight determination and explaining the principles behind each experiments.

List of Practical Experiments

1. Determination of total, temporary & permanent hardness of water by EDTA method
2. Determination of strength of given hydrochloric acid using pH meter
3. Estimation of iron content of the given solution using potentiometer
4. Estimation of sodium present in water using flame photometer
5. Corrosion experiment – weight loss method
6. Determination of molecular weight of a polymer by viscometry method
7. Conductometric titration of strong acid Vs strong Base
8. Estimation of dissolved oxygen in a water sample/sewage by Winklers method.
9. Comparison of alkalinities of the given water samples
10. Determination of concentration of unknown colored solution using spectrophotometer
11. Determination of percentage of copper in alloy
12. Determination of ferrous iron in cement by Spectrophotometry method
13. Adsorption of acetic acid on charcoal
14. Determination the flash point and fire point of a given oil using Pensky martine closed cup apparatus
15. Determination the calorific value of solid fuels
16. Determination the structural of the compound using chemo software.

COURSE OUTCOMES Employibility / Entrepreneurship / Skill Development

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

CO1: Measure the hardness and alkalinity of given water sample
CO2: Find the amount and percentage of iron in unknown sample using EMF and photometric methods
CO3: Determine the amount of strong acid present in the given sample using PH metric and conductometric methods
CO4: Determine the amount of dissolved oxygen and heavy metal present in the given sample
CO5: Determine the molecular weight of the given polymer

TEXT BOOKS:

1. Experimental organic chemistry, Daniel R. Palleros, John Wiley & Sons, Inc., New Yor (2001)
2. "Engineering Chemistry", Jain & Jain, 15th edition, Dhanpat Rai Publishing company, New Delhi.
3. Vogel"s Textbook of practical organic chemistry, Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R LBS Singapore (1994).
4. LBS Singapore (1994). Kolthoff I.M., Sandell E.B. et al Mcmillan, Madras 1980.

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1901GE253	BASIC WORKSHOP AND MANUFACTURING PRACTICES LAB (Common to Civil, EEE and MECH.)	L	T	P	C
		0	0	2	1

List of Experiments Employibility | Entrepreneurship.

1. Forming of simple object in sheet metal using suitable tools.(Example: Dust Pan, Rectangular tray and Cone making)
2. Prepare V (or) Half round (or) Square (or) Dovetail joint from the given mild Steel flat.
3. Fabrication of a simple component using thin and thick plates using arc welding. (Example: Butt , Lap and T - Joints)
4. Making a simple component using carpentry power tools.(Example: Cross Lap, T-Lap and Dove tail joints)
5. Construct a household pipe line connections using pipes, Tee joint, four way joint, elbow, union, bend, Gate valve and Taps.

TOTAL: 30 Hours

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1901GEX52	COMPUTER PROGRAMMING LAB	L T P C 0 0 2 1

(Common for all B.E./B.Tech. Programme)

Employability | Entrepreneurship

List of Experiments:

1. Working with word and style sheets
2. Write a C program to implement basic concepts
3. Write a C program to implement Decision Making and Branching statements
4. Write a C program to implement looping statements
5. Write a C program to implement Arrays
6. Write a C program to implement Strings
7. Write a C program to implement pointers
8. Write a C program to implement Structures
9. Write a C program to work with files in C

References:

Total: 45 Hours

1. Paul Deitel and Harvey Deitel, —C How to Program‖, Seventh edition, Pearson Publication
2. Juneja, B. L and Anita Seth, —Programming in C‖, CENGAGE Learning India pvt. Ltd., 2011
3. Pradip Dey, Manas Ghosh, —Fundamentals of Computing and Programming in C‖, First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, —Computer Fundamentals and Programming in C‖, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C",McGraw- Hill Education, 1996.

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1901HSX51	COMMUNICATION SKILLS LAB (Common to all B.E./B.Tech. Programme)	L	T	P	C
		0	0	2	1

Skill Development

List of Experiments:

1. **Activities on Fundamentals of Listening and Inter-personal Communication (6)**
   Listening to conversation, listening to technical presentation- listening to online video conferencing ,interviews and webinars -starting a conversation - responding appropriately and relevantly - using appropriate body language - Role Play in different situations & Discourse Skills- using visuals.
2. **Activities on Reading Comprehension (6)**
   General Vs Local comprehension- reading for facts- guessing meanings from context- Scanning- skimming and inferring meaning- critical reading & effective googling- TOFEL,IELTS-reading online journals.
3. **Activities on Writing Skills (6)**
   Structure and presentation of different types of writing - letter writing - Resume writing-e-correspondence - Proposal writing - Technical report writing - Portfolio writing - planning for writing - improving one's writing.
4. **Activities on Presentation Skills (6)**
   Oral presentations (individual and group) through JAM sessions – presentation on online platform (webinars, online meeting) - seminars -PPTs and written presentations through posters- projects- report- e-mails- assignments etc.- creative and critical thinking.
5. **Activities on Soft Skills (6)**
   Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation-Concept and process, pre- interview planning, opening strategies, answering strategies, interview through tele-conference & video-conferencing and Mock Interviews-Time management-stress management –paralinguistic features- Multiple intelligences – emotional intelligence – spiritual quotient (ethics) – intercultural communication – creative and critical.

Total: 30 Hours

References:

1. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: Principles and Practice", Oxford University Press, New Delhi, 2011.
2. Sudha Rani, D , "Advanced Communication Skills Laboratory Manual" , Pearson Education 2011.
3. Paul V. Anderson ,"Technical Communication",. Cengage Learning pvt. Ltd. New Delhi, 2007.
4. "English Vocabulary in Use series", Cambridge University Press 2008.
5. "Management Shapers Series" ,Universities Press (India) Pvt Ltd., Himayatnagar, Hyderabad 2008.
6. Rizvi and Ashraf M., "Effective Technical Communication", Tata McGrawHill, New Delhi, 2005.

Jones, D, "The Pronunciation of English", CUP, . Cambridge,2002.

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1901GE252	ENGINEERING INTELLIGENCE II	L	T	P	C
		0	0	2	1

Prerequisite: Engineering Intelligence - I

MODULE I	**VOCABULARY BULIDING**	**6 Hours**
Parts of Grammar- SVA- Art of Writing- word building activities		
MODULEII	**COMMUNICATION WORKSHOP**	**6 Hours**
Story Telling- Newspaper Reading-Extempore.		
MODULEIII	**INTERPERSONAL SKILLS**	**6 Hours**
Personality Development - Creativity and innovation –Critical Thinking and Problem Solving – Work Ethics-Technical Skill Vs Interpersonal Skills		
MODULEIV	**LEADERSHIP& EMPLOYABILITY SKILLS**	**6 Hours**
Levels of Leadership-Making of leader-Types of leadership-Transactions Vs Transformational Leadership – Exercises - Industry Expectations & Career Opportunities- Recruitment patterns.		
MODULE V	**RESUME BUILDING**	**6 Hours**
Importance of Resume- Resume Preparation - introducing onself		
TOTAL: 30 HOURS		

SKILL DEVELOPMENT

Course Outcomes:

On the successful completion of the course, students will be able to CO1: Understand various vocabulary building activites

CO2: Use various communication skill workshop for reading and writing. CO3: Apply interpersonal skill to motivate creating and innovating skills

CO4: Apply various leadership and employability skill to get career opportunities CO5: Prepare resume with necessary components

REFERENCES:

1. Barun K. Mitra; (2011), "Personality Development & Soft Skills", First Edition; Oxfor Publishers.

2. Raymond Murphy, Essential English Grammar in Use, Cambridge University press, New Delhi, Third Edition , 2007.

3. Arun Sharma and Meenakshi Upadhyav, How to Prepare for Verbal Ability and Reading Comprehension for CAT, McGrawHill Publication, Seventh Edition 2017.

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1902ME301	ENGINEERING MECHANICS	L	T	P	C
		3	2	0	4

MODULE I **BASIC CONCEPTS AND FORCE SYSTEM** 12 **Hours**

Introduction to mechanics - idealization of mechanics - laws of mechanics - principle of transmissibility - vector - addition, subtraction and product. Force- types - system of forces - resultant forces - composition of forces - resolution of force-free body diagram for real world systems.

MODULE II **STATICS OF PARTICLES AND FORCE SYSTEM** 12 **Hours**

Equilibrium of particle in space, moment of couple-equilibrant Moment about point and specific axis-moment at couple- simplification of force and couple systems.

MODUE III **STATICS OF RIGID BODIES** 12 **Hours**

Equilibrium of rigid bodies in two and three dimensions - beams - types of loads, supports and their reactions Two and three force Members-Static determinacy.

MDULE IV **PROPERTIES OF SURFACES AND SOLIDS** 12 **Hours**

Determination of centroid of areas, volumes and mass - Pappus and Guldinus theorems - moment of inertia of plane and areas Parallel axis theorem radius of gyration of area- product of inertia- mass moment of inertia.

MDULE V **FRICTION** 12 **Hours**

Introduction - mechanism of friction-types -laws of friction - friction on horizontal and inclined planes, ladder and wedge friction - rolling resistance.

COURSE OUTCOMES Employability / Entrepreneurship **TOTAL: 60 HOURS**

After successful completion of the course, students will be able to

	Competency	Cognitive level
CO1	Determine various forces using free body diagrams	Understand
CO2	Determine various forces in equilibrium condition of objects	Understand
CO3	Calculate moment of a couple about any specified area by simplification of couple system	Understand
CO4	Measure various loads and their reactions in beam.	Apply
CO5	Measure moment of inertia and radius of gyration of various surfaces and solids	Apply
CO6	Classify types of friction based on horizontal, inclined and rolling surfaces.	Understand

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1902ME302	MANUFACTURING TECHNOLOGY – I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To study the sand casting and few special casting processes.
2. To learn various metal joining processes.
3. To provide the knowledge on various bulk deformation processes.
4. To expose knowledge on sheet metal and special forming processes
5. To learn the various moulding and forming processes of plastics

MODULE I CASTING PROCESSES **09 Hours**

Introduction to production processes and its classifications - Pattern - Types, Materials and Allowances. Moulding sand - Types, Properties and Testing. Moulding machines and its types. Melting furnaces - Cupola and Induction. Fettling and cleaning. Sand casting defects. Special casting processes - Shell moulding, Die casting, Centrifugal casting and Investment casting.

MODULE II METAL JOINING PROCESSES **09 Hours**

Introduction to welding processes and its classifications - Principle of Gas welding and its flames - Principle of arc welding - Electrodes, Fluxes and filler materials. Principle of Resistance welding - Spot, butt and seam. Principle of Gas metal arc welding, Submerged arc welding, Tungsten Inert Gas welding, Plasma arc welding, Thermit welding, Electron beam welding and Friction welding - Weld defects - Brazing and soldering.

MODULE III BULK DEFORMATION PROCESSES **09 Hours**

Introduction - Hot and cold working of metals - Forging processes - Open and close die forging, Forging equipment and operations. Rolling - Types of Rolling mills, shape rolling operations, Tube piercing and Defects. Principle of Extrusion and its types. Principle of rod and wire drawing.

MODULE IV SHEET METAL FORMING AND SPECIAL FORMING PROCESSES **09 Hours**

Introduction - Shearing, bending and drawing operations - Stretch forming operations - Principle of special forming processes - Hydro forming, Rubber pad forming, Metal spinning, Explosive forming, Magnetic pulse forming, Peen forming and Super plastic forming.

MODULE V MOULDING AND FORMING OF PLASTICS **09 Hours**

Introduction to plastics - Moulding of Thermoplastics - Principle and applications of Injection moulding and its types, Blow moulding, Rotational moulding, Thermoforming and Extrusion. Moulding of Thermosets - Principle and applications of Compression moulding and Transfer moulding Bonding of Thermoplastics - Fusion and solvent methods

TOTAL: 45 HOURS

Employability / Entrepreneurship.

COURSE OUTCOMES

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

CO1 Produce simple components using sand casting process, moulding machines and melting furnaces.

CO2 Explain the principle of special casting processes and defects in sand casting.

CO3 Use various metal joining processes (Arc welding, Gas welding, Brazing and Soldering).

CO4 Explain the various metal forming processes (forging, rolling, drawing and extrusion).

CO5 Produce simple sheet metal components using sheet metal operations and also describe the principle of advanced sheet metal processes.

CO6 Elaborate concepts of advanced moulding techniques to manufacture plastic components.

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1902ME303	FLUID MECHANICS AND MACHINES	L	T	P	C
		2	2	0	3

UNIT I INTRODUCTION TO FLUID AND FLUID MOTION **7 Hours**

Fluid- Fluid mechanics -Laws of Fluid Mechanics-Properties of fluid and its Application-Types of fluid Types of fluid Flow-Measurement of Pressure-U-tube and differential manometer- Measurement of velocity using Discharge -Flow characteristics-Momentum -continuity equation.

UNIT II FLUID DYNAMICS AND FLUID FLOW OVER CONDUITS **11 Hours**

Forces acting on a fluid element- Eulers and Bernoulli theorem Application in internal and external flows measuring instruments - Major losses and Minor losses in pipes using standard charts and tables pipes in series and pipes in parallel. - Darcy Weisbach equation. Identification of laminar and turbulent flow in closed conduits, flow in circular pipe.

UNIT III DIMENSIONAL AND MODEL ANALYSIS **9 Hours**

Need for dimensional analysis dimensional analysis using Buckingham pi theorem - Similitude types of similitude - Dimensionless parameters- application of dimensionless parameters Model analysis through Reynolds and Froudes Model law.

UNIT IV HYDRAULIC TURBINES **9 Hours**

Definition of turbine Classification -Types of head and efficiencies of turbine-Impulse turbine - Reaction turbine-Francis turbine, Kaplan turbine - working principles and velocity triangle- Work done by water on the runner Specific speed - unit quantities performance curves.

UNIT V HYDRAULIC PUMPS **9 Hours**

Definition -Centrifugal pump Classification Construction working principle and velocity Triangle Definition of heads-Losses and efficiencies-Multistage Centrifugal pump-Specific speed Priming and cavitation effects of centrifugal pump. Reciprocating pump Classification Working Principle Coefficient of discharge and slip-Indicator diagram (Descriptive treatment only).

Total: 45 Hours

REFERENCES:

1. R.K.Bansal, A Textbook of Fluid Mechanics and Machinery, Laxmi Publications Ltd., New Delhi, Revised Tenth edition, 2018.
2. Bruce R Munson , Donald F Young, Theodore H Okiishi and Wade W. Huebsch, Fundamentals of Fluid Mechanics, John Wiley & Sons, Sixth edition 2009.
3. Pijush K Kundu and Ira M Cohen, Fluid Machines, Academic Press, Burlington, United states of america, 2010.
4. YunusCengel and John Cimbala, Fluid Mechanics Fundamentals and Application, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi 2009.
5. Robert and W Fox, Introduction to Fluid Machines, John Wiley Eastern Pvt. Ltd., New Delhi, 6th edition ,2006.
6. http://nptel.ac.in/courses/112105182/

COURSE OUTCOMES Employability

After successful completion of the course, students will be able to

	Competency	Cognitive level
CO1	Explain various properties of fluids and flow measurements.	Understand
CO2	Calculate the energy losses in pipes.	Apply
CO3	Explain the dimensional analysis of fluids.	Understand
CO4	Determine the performance characteristics of hydraulic turbines.	Apply
CO5	Calculate the performance characteristics of hydraulic pumps.	Apply

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1902ME304	STRENGTH OF MATERIALS	L	T	P	C
		3	2	0	4

Course Outcomes (COs): Employibility.
After successful completion of the course, students will be able to

	Competency	Cognitive level
CO1	Calculate various stresses and strain of rigid and deformable bodies.	Understanding
CO2	Determine shear force and bending moments for various beams.	Understanding CO3
	Measure torsional strength of a circular shaft	Applying CO4
	Measure stiffness and modulus of rigidity for helical springs.	Applying CO5
	Measure the slope and deflection of beams.	Applying CO6
	Calculate the strssses of cylinderical and spherical shells.	Understanding

MODULE I STRESS, STRAIN AND DEFORMATION OF SOLIDS **12 Hours**

Introduction to material properties. Stresses and strains due to axial force, shear force, impact force and thermal effect-stepped and composite bars-uniformly varying cross section. Stress-strain curve for ductile and brittle materials Hooke-law - Factor of safety Poisson-ratio. Elastic constants and their relationship.

MODULE II ANALYSIS OF STRESSES IN TWO DIMENSIONS **12 Hours**

State of stresses at a point- Normal and shear stresses on inclined planes - Principal planes and stresses Plane of maximum shear stress - Mohrs -circle for biaxial stress with shear stress. Hoop and longitudinal stresses in thin cylindrical and spherical shells - Changes in dimensions and volume.

MODULE III LOADS AND STRESSES IN BEAMS **12 Hours**

Types of beams- Supports and Loads, Shear force and Bending Moment in beams, Cantilever, simply supported and overhanging beams - Point of contra flexure. Theory of simple bending - bending and shear stress - stress variation along the length and section of the beam, Section modulus.

MODULE IV DEFLECTION OF BEAMS AND COLUMNS **12 Hours**

Slope and Deflection of cantilever, simply supported ,Double integration method and Macaulay"s method. Columns-types- Equivalent length Euler and Rankine formulae- Slenderness.

MODULE V TORSION IN SHAFT AND HELICAL SPRING **12 Hours**

Analysis of torsion of circular solid and hollow shafts-stepped shaft-compound shaft- Shear stress distribution, angle of twist and torsional stiffness. Closed coil helical spring- stresses and deflection under axial load-Maximum shear stress in spring section.

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FOR FURTHER READING – SEMINAR – CPS **Total: 60 Hour**

1902ME305 **THERMODYNAMICS** **L T P C**
3 2 0 4

UNIT I INTRODUCTION AND ZEROTH LAW OF THERMODYNAMICS 12 Hours

Macroscopic and Microscopic approaches, Definitions and concepts- heat, work, thermodynamic equilibrium, system and types, surroundings, Properties- intensive and extensive properties, Path and point functions, Energy- macroscopic and microscopic modes of energy, Thermodynamic processes and cycle, State postulate, Zeroth law of thermodynamics- temperature scale, perfect gas scale.

UNIT II FIRST LAW OF THERMODYNAMICS 12 Hours

First law of thermodynamics, I law for Closed systems - constant pressure process, constant volume process, constant temperature process, adiabatic process, polytropic process, throttling process. I law for open systems -Steady state flow processes, Steady flow energy equation (SFEE), Application of SFEE-turbines and compressors, nozzles and diffusers, throttling valves, heat exchangers.

UNIT III SECOND LAW OF THERMODYNAMICS 12 Hours

Limitations of I law of thermodynamics, Second law of thermodynamics- Kelvin - Planck and Clausius statements, Heat Engine, heat pump and refrigerator, Reversibility and irreversibility- irreversible and reversible processes, Carnot's principles, Carnot cycle, Carnot engine, Thermodynamic temperature scale, Clausius inequality, Entropy- principle of entropy increase, Availability & irreversibility – Introduction about third law of thermodynamics.

UNIT IV PROPERTIES OF PURE SUBSTANCES 12 Hours

Thermodynamic properties of fluids. Pure substance-phases - Phase change processes, Property diagrams - pressure-volume (P-v), pressure-temperature (P-T), temperature volume (T-v), temperature entropy (T-s) and enthalpy-entropy (h-s) diagrams. Steam tables - Problems on flow and non-flow processes.

UNIT V GAS MIXTURES AND PSYCHROMETRIC PROPERTIES 12 Hours

Thermodynamics of ideal gas mixture- mixture of ideal gas, mixture of perfect gases, Dalton's law ofpartial pressure, Amagat's law, Thermodynamics properties, Ideal gas – equation of state, Van derWaals equation and compressibility chart.Psychrometric properties and processes – Psychrometric chart.

FOR FURTHER READING – SEMINAR – CPS **Total: 60 Hours**

Thermodynamic property relations- Maxwell relations, TDS equations, The Clapeyron equation, Joule- Thompson expansion.

COURSE OUTCOMES

Employibility | Entrepreneurship.

	Competency	Cognitive level
CO1	Understand concepts and principles of thermodynamics.	**Understand**
CO2	Utilize first law of thermodynamics for closed and open systems.	**Apply**
CO3	Use second law of thermodynamics for heat Engine, heat pump and refrigerator.	**Apply**
CO4	Explain thermodynamic properties of pure substances and its phase change processes.	**Understand**
CO5	Determine properties of gas mixtures.	**Understand**
CO6	Make use of psychometric properties in Air conditioning process.	**Apply**

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1702ME354 FLUID MECHANICS AND MACHINERY LAB

L	T	P	C
0	0	2	1

PRE REQUISITE :

Fundamentals of Mechanical Engineering

COURSE OBJECTIVES:

1. To demonstrate the principles of fluid mechanics
2. To measure the energy losses in a pipe flow.
3. To perform characteristic study on impulse, reaction and axial flow turbines.
4. To perform characteristic study on positive displacement pumps.
5. To perform characteristic study on non-positive displacement pumps.

LIST OF EXPERIMENTS:

1. Experimental verification of Bernoulli"s theorem in a pipe flow.
2. Measurement of flow rate using venturimeter and calculate the coefficient of discharge
3. Measurement of flow rate using orificemeter and calculate the coefficient of Discharge.
4. Performance test on tangiantial flow impulse (Pelton wheel) turbine against constant head
5. Performance test on Francis turbine against constant head.
6. Performance test on reaction (Kaplan) turbine against constant head.
7. Performance characteristics of a reciprocating pump
8. Performance characteristics of a gear pump
9. Performance test on centrifugal pump
10. Performance test on submersible pump
11. Determination of loss of head in different pipes (major loss) and fittings (minor loss) for various flow rates.

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ADDITIONAL EXPERIMENTS / INNOVATIVE EXPERIMENTS:

1. Measurement of coefficient of friction in flow through pipes.

COURSE OUTCOMES: Employibility -

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

1. Understand the various basic experience in flow of measurements.
2. Measure the major and minor losses associated in a pipe flow.
3. Experimental verification of Bernoulli"s theorem in a pipe flow.
4. Perform the characteristics study on impulse ,reaction and axial turbine.
5. Perform the characteristics study on different types of water pumps.
6. Perform the characteristics study on gear oil pump.

REFERENCES:

1. R.K.Bansal, A Textbook of Fluid Mechanics and Machinery, Laxmi Publications Ltd., New Delhi, Revised Ninth edition, 2014.

2. Bruce R Munson , Donald F Young, Theodore H Okiishi and Wade W. Huebsch, Fundamentals of Fluid Mechanics, John Wiley & Sons, Sixth edition 2009.

3. Pijush K Kundu and Ira M Cohen, Fluid Machines, Academic Press, Burlington, United states of america, 2010.

4. Yunus Cengel and John Cimbala, Fluid Mechanics Fundamentals and Application, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi 2009.

5. Robert and W Fox, Introduction to Fluid Machines, John Wiley Eastern Pvt. Ltd., New Delhi, 6th edition ,2006.

6. http://nptel.ac.in/courses/112105182/

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1902ME352 **STRENGTH OF MATERIALS LABORATORY**

L	T	P	C
0	0	2	1

Employability | Entrepreneurship.

Course Outcomes (COs):

After successful completion of the course, students will be able to

	Competency	Cognitive level
CO1	Calculate various stresses and strain of rigid and deformable bodies.	Understanding
CO2	Determine shear force and bending moments for various beams.	Understanding
CO3	Measure torsional strength of a circular shaft	Applying
CO4	Measure stiffness and modulus of rigidity for helical springs.	Applying
CO5	Measure the slope and deflection of beams.	Applying
CO6	Calculate the strssses of cylinderical and spherical shells.	Understanding

EXPERIMENT 1		**2 Hours**
Find the hardness of the material using Rockwell hardness tester.		
EXPERIMENT 2		**2 Hours**
Calculate the hardness of the material using Brinell hardness tester.		
EXPERIMENT 3		**2 Hours**
Experimentally calculate the strain energy of a material subjected to impact loading.(Izod testing)		
EXPERIMENT 4		**4 Hours**
Experimental analysis of an axial bar under tension to obtain the stress strain curve and the strength.		
EXPERIMENT 5		**2 Hours**
Determine the Young-modulus and stiffness of a metal beam through load deflection curve.		
EXPERIMENT 6		**4 Hours**
Experimentally calculate the compressive strength of the materials.		
EXPERIMENT 7		**2 Hours**
Experimental analysis of a bar under shear stress strain curve and the strength.		
EXPERIMENT 8		**4 Hours**
Experimentally calculate the strain energy of a material subjected to impact loading.(Charpy testing)		
EXPERIMENT 9		**4 Hours**
Determination of spring constant through load vs deflection curve.		
EXPERIMENT 10		**4 Hours**
Experimental analysis of a bar under torsion to obtain stiffness and angle of twist.		

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1902ME353 MANUFACTURING TECHNOLOGY LAB - I	L T P C 0 0 2 1
PREREQUISITE :	
Fundamentals of Mechanical Engineering	
COURSE OBJECTIVES:	
1. To provide exposure to the students with hands on experience of centre lathe and Capstan lathe.	
2. To provide exposure to the students with hands on experience of various taper, thread cutting and eccentric operations.	
3. To provide exposure to the students with hands on experience of various fit, (push, pull, clearance) operations and measurement of cutting forces.	
LIST OF EXPERIMENTS:	
1. Taper Turning using Tailstock set over method	
2. Taper Turning using Compound rest method	
3. External Thread cutting	
4. Internal Thread Cutting	
5. Eccentric Turning	
6. Knurling	
7. Push fit	
8. Clearance fit	
9. Force fit	
10. Measurement of cutting forces in turning process	
11. Simple turning using capstan lathe.	
TOTAL: 30 HOURS	
ADDITIONAL EXPERIMENTS / INNOVATIVE EXPERIMENTS:	
1. Drilling and tapping	
2. Grooving operation	
COURSE OUTCOMES: Employibility/ Entrepreneurship.	
On the successful completion of the course, students will be able to	
CO1	Use lathe machine to manufacturing eccentric turning operations.
CO2	Use lathe machine to manufacturing Various tapper turning operations.
CO3	Use various different machine tools for finishing operations of simple step turning in capstan lathe.
CO4	Use lathe machine to manufacturing thread cutting operations.
CO5	Experience on various fits operations in lathe machines.
CO6	Lathe tool dynamometer for measuring the cutting forces.

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1901MCX01- ENVIRONMENTAL SCIENCE

L	T	P	C
3	0	0	0

2019- REGULATION
(Common to all B.E/B.Tech programmes)

Objectives

To create the awareness about environmental problems and its consequences among people. To impart basic knowledge about the environment and its allied problems. It aims to develope an attitude of concern for the environment. Motivating public to participate in environment protection and environment improvement. Acquiring skills to help the concerned individuals in identifying and solving environmental problems. Striving to attain harmony with nature.

Prerequisite

Basic knowledge about environmental studies

MODULE I ECOSYSTEMS AND BIODIVERSITY — 10 Hours

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers- Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – hot-spots 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. Documentation of the medicinal plants in your native place

MODULE II NATURAL RESOURCES — 10 Hours

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – 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.

Documentation of the effect of modern Agriculture in your nearby Village

MODULE III ENVIRONMENTAL POLLUTION **9 Hours**

Definition – Source, causes, effects and control measures of: (a) Air pollution - Mitigation procedures- Control of particulate and gaseous emission, Control of SO_X, NO_x, CO and HC) -Technology for capturing CO_2 (metallo- organic frame works) (b) Water pollution – Waste water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies.Documentation study of local polluted site – Urban / Rural / Industrial / Agricultural

MODULE IV SOCIAL ISSUES AND ENVIRONME **8 Hours**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management -environmental ethics: Issues and possible solutions – 12 Principles of green chemistry – consumerism and waste products – environment protection act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark) central and state pollution control boards- disaster management: floods, earthquake- Public awareness.
Analyze the recent steps taken by government of India to prevent pollution (Green India and Clean India)

MODULE V HUMAN POPULATION AND THE ENVIRONMEN **8 Hours**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA) -GIS-remote sensing-role of information technology in environment and human health – Case studies.Documentation study of the Human health and the environment in nearby Hospital (Statistical report).

Course Outcomes (COs): Employibility.

After successful completion of the course, students will be able to

CO	Competency	Cognitive level
CO1	Describe the physical, chemical and biological components of the ecosystem and their function	Understand
CO2	Describe the water quality parameters and removal of pollutants	Understand
CO3	Describe the scientific principles to analysis various environment implications in day to day life.	Understand
CO4	Describe the various environmental protection acts for key social system affecting the environment.	Understand
CO5	Summarise the major diseases, women welfare, child development and the impacts of population explosion.	Understand

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1904GE351	LIFE SKILLS: SOFT SKILLS	L	T	P	C
	Skill Development	0	0	2	1

COURSE OBJECTIVES:

1. To develop the students basic soft skills and enable them to get a job.
2. To develop the students „interpersonal skills and to enable them to respond effectively.
3. To develop the students selling skills and to enable them to apply in their interview process.
4. To develop the students „Corporate Etiquettes and enable them to respond effectively.
5. To develop the students „learning by practice of giving different situations.

COURSE OUTCOMES:

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

- **CO1** Communicate effectively in their business environment.
- **CO2** Improve their interpersonal skills, which are mandatory in a corporate world.
- **CO3** Brand themselves to acquire a job.
- **CO4** Involve in corporate etiquettes.
- **CO5** Survive in the different situations.

MODULE I INTRODUCTION TO SOFT SKILLS **6 Hours**

Soft Skills an Overview - Basics of Communication – Body Language – Positive attitude –Improving Perception and forming values – Communicating with others.

MODULE II TEAM VS TRUST **6 Hours**

Interpersonal skills – Understanding others – Art of Listening - Group Dynamics –Essential of an effective team - Individual and group presentations - Group interactions – Improved work Relationship .

MODULE III SELLING ONESELF **6 Hours**

How to brand oneself – social media – job hunting – Resume writing – Group Discussion – Mock G.D - .Interview skills – Mock Interview

MODULE IV CORPORATE ETIQUETTE **6 Hours**

What is Etiquette – Key Factors – Greetings – Meeting etiquette – Telephone etiquette – email etiquette – Dining etiquette – Dressing etiquette .

MODULE V LEARNING BY PRACTICE **6 Hours**

My family-Myself-Meeting people-Making Contacts.-A city-Getting about town-Our flat-Home life-Travelling - Going abroad- Going through Customs-At a hotel-Shopping- Eating out- Making a phone call- A modern office-Discussing business.

TOTAL: 30 HOURS

REFERENCES:

1 Dr.K.Alex, "soft skills "Third Edition, S. Chand & Publishing Pvt Limited, 2009
2. Aruna koneru, „Professional Communication" Second Edition, Tata McGraw-Hill Education, 2008
3. D.K.Sarma,"You & Your Career „First Edition Wheeler Publishing & Co Ltd, 1999
4. Shiv Khera „You Can Win" Third Edition Mac Millan Publisher India Pvt Limited, 2005

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1901MA403	ENGINEERING MATHEMATICS III	L	T	P	C
		3	2	0	4

MODULE I	**FOURIER SERIES**	**12 Hours**
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic analysis.		
MODULE II	**FOURIER TRANSFORMS**	**12 Hours**
Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity		
MODULE III	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**	**12 Hours**
Classification of PDE – Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.		
MODULE IV	**NUMERICAL DIFFERENTIATION**	**12 Hours**
Approximation of derivatives using interpolation polynomials-Taylor's series method – Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order equations		
MODULE V	**NUMERICAL INTEGRATION**	**12 Hours**
Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.		
	TOTAL	**60 Hours**

Course outcomes:	After completion of this course, students can able to Employability.
	CO1: Use Fourier series analysis which is central to many applications in engineering (K2)
	CO2: Apply Fourier transform techniques used in wide variety of situations. (K3)
	CO3: Solve boundary value problem using partial differential equation. (K3)
	CO4: Perform Integration using Numerical methods
	CO5: To solve algebraic and transcendental Equations numerically

REFERENCES:

1. Veerarajan. T., "Transforms and Partial Differential Equations", Second reprint, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012
2. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.
3. Narayanan.S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" Vol. II & III, S.Viswanathan Publishers Pvt Ltd. 1998.
4. Grewal B.S and Grewal J.S, Nummerical methods in Engineering and Science, 6 th edition,Khanna puplishers,2004
5. Ramana.B.V., "Higher Engineering Mathematics", Tata Mc-GrawHill Publishing Company Limited, New Delhi, 2008.
6. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
7. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
8. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata Mc Graw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
9. nptel.ac.in/courses/111105035, www.nptelvideos.in/2012/11/Mathematics.html
10. www.learnerstv.com/Free-maths-video lectures - ltv348-page1.html

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1902ME401	ENGINEERING METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	0	3

MODULE I	**CONCEPT OF MEASUREMENT**	**9 Hours**

Introduction: Definition, Objectives, Elements of Measuring System, Accuracy and Precision - Units and Standards - Characteristics of measuring instrument: Sensitivity, Stability, Interchangeability, Range of accuracy, Readability, Reliability, Backlash, Repeatability and Reproducibility – Calibration - Errors in Measurement: Static and dynamic errors - Care of Measuring Instruments

MODULE II	**LINEAR AND ANGULAR MEASUREMENTS**	**9 Hours**

Linear Measurements: Vernier Caliper, Vernier Height and Depth Gauges, Micrometer and depth micrometer, Slip gauge, limit gauge and its classification - Comparator: Mechanical, Pneumatic and Electrical types - Angular Measurements: Bevel protractor, Sine bar, Angle Decker, Autocollimator.

MODULE III	**FORM MEASUREMENT**	**9 Hours**

Thread Measurement: Terminologies, Errors - External Thread Measurement: Pitch Gauge, Tool Maker's microscope, Floating carriage micrometer with One, Two and Three wires - Internal Thread Measurement: Taper Parallels and Rollers method. Gear Measurement: Terminologies, Errors, Gear Tooth Vernier caliper, Profile Projector, Base pitch measuring instrument, Involutes tester, Parkinson Gear Tester - External and Internal Radius measurements - Roundness measurement: Circumferential confining gauge, Assessment using V block and Rotating cages.

MODULE IV	**LASER AND ADVANCES IN METROLOGY**	**9 Hours**

Interferometer: NPL flatness, Laser, Michelson - Computer Aided Inspection - Digital Devices - Machine Vision System - Coordinate Measuring Machine: Basic concept, Types, Constructional features, Probes, Accessories - Surface Roughness Measurement - Straightness Measurement - Squareness Measurement - Machine Tool Metrology.

MODULE V	**MEASUREMENT OF MECHANICAL PARAMETERS**	**9 Hours**

Measurement of Force - Principle, analytical balance, platform balance, proving ring. Torque - Prony brake, hydraulic dynamometer. Measurement of Power: Linear and Rotational - Pressure Measurement: Principle, use of elastic members, Bridgeman gauge, Mcleod gauge, Pirani gauge - Temperature Measurement: bimetallic strip, thermocouples, metal resistance thermometer, pyrometers.

TOTAL	**45 Hours**

employability.

Course outcomes: On completion of this course, students can able to

CO1: Explain the basic concept of measurement and characteristics of measuring instruments.
CO2: Make use of precision instruments for linear and angular measurements.
CO3: Determine the gear and thread parameters using suitable instruments.
CO4: Demonstrate the advanced techniques in metrology for linear geometric dimensions.
CO5: Perform different machine alignment and surface roughness tests.
CO6: Measure the mechanical parameters using suitable instruments.

REFERENCES:

1. Jain R.K. —Engineering Metrology|, Khanna Publishers, 2005.
2. Gupta. I.C., -Engineering Metrology|, Dhanpatrai Publications, 2005.
3. Charles Reginald Ambolt, -Metrology for Engineers|, 5th edition, Cengage Learning EMEA, 1990.
4. Backwith, Marangoni, Lienhard, -Mechanical Measurements|, Pearson Education, 2006.
5. https://nptel.ac.in/courses/112106179/

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1902ME402 **THERMAL ENGINEERING** **L T P C**
2 2 0 3

MODULE I GAS POWER CYCLES **12 Hours**

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure, and air standard efficiency - Comparison of cycles.

MODULE II INTERNAL COMBUSTION ENGINES **9 Hours**

Classification - Components and their function. Valve timing diagram and port timing diagram - actual and theoretical p-V diagram of four stroke and two stroke engines. Simple and complete Carburettor.MPFI, Diesel pump and injector system.Battery and Magneto Ignition System - Principles of Combustion and knocking in SI and CI Engines.Lubrication and Cooling systems.Performance calculation

MODULE III STEAM NOZZLES AND TURBINES **9 Hours**

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow.Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations – Governors

MODULE IV AIR COMPRESSOR **9 Hours**

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling –work of multistage air compressor

MODULE V REFRIGERATION AND AIR-CONDITIONING **9 Hours**

Refrigerants - Vapour compression refrigeration cycle- super heat, sub cooling – Performance calculations - working principle of vapour absorption system, Ammonia –Water, Lithium bromide – water systems (Description only) .Air conditioning system - Processes, Types and Working Principles. - Concept of RSHF, GSHF, ESHF- Cooling Load calculations

Reference(s) **Total: 45 Hours**

1. Rajput. R. K., "Thermal Engineering" S.Chand Publishers, Ninth edition
2.Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers, 2007
3. Arora.C.P, "Refrigeration and Air Conditioning ," Tata McGraw-Hill Publishers 1994
4. Ganesan V.." Internal Combustion Engines" , Third Edition, Tata Mcgraw-Hill 2007
5.Rudramoorthy, R, "Thermal Engineering ",Tata McGraw-Hill, New Delhi,2003

COURSE OUTCOMES

Employability.

After successful completion of the course, students will be able to

Cos	Competency	Cognitive level
CO1	Calculate mean effective pressure and air standard efficiency of various gas power cycles.	Apply
CO2	Determine the performance characteristics of internal combustion engines.	Apply
CO3	Describe the performance characteristics of steam nozzles and steam turbines.	Understand
CO4	Calculate the performance characteristics of air compressors.	Apply
CO5	Calculate the performance characteristics of refrigeration and air conditioning systems.	Apply
CO6	Design a suitable air conditioning system by cooling load calculation.	Apply

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1902ME403 **MANUFACTURING TECHNOLOGY -II**

L T P C
3 0 0 3

PREREQUISITE:
1. Engineering Physics
2. Engineering Chemistry
3. Fundamentals of Mechanical Engineering
4. Manufacturing Technology-1

COURSE OBJECTIVES:
1. To learn the metal cutting theory and calculate the forces involved in it.
2. To study construction, working and operations of centre, semi-automatic and automatic lathes.
3. To provide the knowledge on construction, working of milling and gear cutting machines.
4. To impart knowledge on construction, working and operations of reciprocating, drilling and boring machines.
5. To provide knowledge on construction, working of broaching, grinding and few fine finishing processes.

UNIT I METAL CUTTING THEORY **9 Hours**

Introduction - Orthogonal, Oblique Cutting and types of chip formation. Mechanisms of metal cutting - Shear plane, Stress, Strain and cutting forces. Merchants Circle - Deriving the forces, calculations. Cutting tool - Properties, materials, wear, single point tool nomenclature, tool life and its calculations. cutting fluids - Types and its properties.

UNIT II LATHE, SEMI AUTOMATS AND AUTOMATS **9 Hours**

Introduction - Types- Centre Lathe - Construction, specification, operations. Mechanisms - Head stock driven using all geared type and thread cutting. Work holding devices - Centres, chucks, carrier with catch plate and face plates. Calculation of machining time - Capstan and turret lathes - Introduction, turret indexing and bar feeding mechanism. Automats - single spindle, multi spindle and their types

UNIT III MILLING MACHINE AND GEAR CUTTING MACHINES **9 Hours**

Milling - Introduction, types, up milling, down milling, operations, and nomenclature of plain milling cutter. Indexing - simple and differential indexing methods. Gear cutting-gear milling, gear shaper and gear hobber.

UNIT IV RECIPROCATING MACHINES, DRILLING AND BORING MACHINES 9 Hours

Shaper, Planer and Slotter - Introduction, types, specification and quick return mechanisms. Drilling - Introduction, types, construction of universal drilling machine, specification, types of drills and nomenclature of twist drill. Introduction to horizontal boring machine.

UNIT V BROACHING AND FINISHING PROCESSES **9 Hours**

Broaching - Introduction, types and tool nomenclature. Finishing processes - Grinding -Introduction, types, grinding wheel- specification, selection, glazing, loading, dressing and truing. Fine finishing processes - Honing, lapping, polishing, buffing and super finishing.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

Select proper Machines and list the sequence of operations to produce the components – External threaded shafts with key way, Hexagonal bolt and Hexagonal nut.

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COURSE OUTCOMES: Employability / Entrepreneurship.

After completion of the course, Students will be able to

CO1: Explain the mechanisms of metal cutting, cutting tool materials, tool wear and cutting fluids.
CO2: Discuss about the constructional features of different types of lathe parts and their operations.
CO3: Describe the construction and working of milling and gear cutting machine.
CO4: Illustrate the various types of reciprocating, drilling and boring machines.
CO5: Describe the construction and working of broaching and finishing process.
CO6: Measure the metal removal rate of the work piece in various speeds.

REFERENCES:

1. J. P. Kaushish, Manufacturing Processes, Prentice Hall India Learning Private Limited., NewDelhi, 2013.
2. Serope Kalpakjian and Steven R Schmid, Manufacturing Engineering and Technology,Pearson Education Limited., New Delhi, 2013.
3. P. N. Rao, Manufacturing Technology- Metal Cutting and Machine Tools, Tata McGrawHillPublishing Company Private Limited., New Delhi, 2013
4. S. K. HajraChoudhury, Elements of Workshop Technology. Vol. II, Media Promoters Private Limited., Mumbai, 2013.
5. P.C Sharma, Manufacturing Technology - II, S. Chand & Company Limited. New Delhi, 2012

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1901GEX04	BIOLOGY FOR ENGINEERS	L	T	P	C
		3	0	0	3

Module I Biology Introduction and its Classification **7 Hours**

Introduction to Biology, fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Exciting aspect of biology - need to study biology- Discussion about biological observations of 18th Century - major discoveries. Examples from Brownian motion and the origin of thermodynamics - original observation of Robert Brown and Julius Mayor.

Classification - morphological, biochemical or ecological. Hierarchy of life forms at phenomenological level. classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes oreucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. Model organisms for the study of biology- E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Module II Genetics and Macromolecular analysis Employability **10 Hours**

Genetics - Newton's laws to Physical Sciences"- Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis - part of genetics. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Single gene disorders in humans. Complementation using human genetics.

Macromolecular analysis: analyses of biological processes at the reductionistic level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module III Biomolecules and Enzymes **10 Hours**

Biomolecules - Molecules of life. monomeric units and polymeric structures. Sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Enzymes - monitor enzyme catalyzed reactions. Enzyme catalyzereactions. Enzyme classification. Mechanism of enzyme action -two examples. Enzyme kinetics and kinetic parameters. RNA catalysis.

Information Transfer - The molecular basis of coding and decoding genetic information - universal Molecular basis of information transfer. DNA - genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Gene in terms of complementation and recombination.

Module IV Metabolism and Microbiology **8 Hours**

Metabolism: principles of energy transactions. Thermodynamics to biological systems. Exothermic andendothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP - energy currency. Breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) - synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge.

Microbiology Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

Module V Bio-inspired Engineering Employability. **10 Hours**

Introduction to biologically-inspired designs (BID for Biomedical and Non-biomedical applications): Human-organs-on-chips; Muscular Biopolymers; Bio-optics; Nanostructures for Drug Delivery; Genetic Algorithms; Artificial neural networks; Swarm intelligence algorithms; Biosensors: role in medical diagnostics (Sensium digital plaster); environmental monitoring; Bio-filters; Bio-robotics; 3D Bio- printing; Self healing concrete.

Total: 45 Hours

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REFERENCES

1. Biology for Engineers, Rajiv Singal , CBS Publishers and Distributors Pvt Ltd; FirstEdition edition (4 June 2019).
2. Biology for Engineers, Wiley Editorial, Wiley (2018).
3. Principles of Soft Computing, S. N. Sivanandam, S. N. Deepa, Wiley; Third edition (2018).
4. Computational Medicine: Tools and Challenges, Zlatko Trajanoski, Springer; 20 Nedition (19 September 2012).
5. Health Informatics - E-Book: An Interprofessional Approach, Ramona Nelson, NancyStaggers, Elsevier; 2 edition (December 8, 2016).
6. Biology for Engineers, G.K..Suraishkumar, Oxford University Press
7. Biology for Engineers, Arthur T. Johnson, CRC Press

1902ME451	THERMAL ENGG. LABORATORY	L	T	P	C
		0	0	3	1.5

LIST OF EXPERIMENTS:

1. Port timing and valve timing diagram of IC engines.
2. Determination of flash point and fire point of the given oil sample.
3. Determination of dynamic viscosity of the given oil sample using Red wood viscometer
4. Performance on 4-Stroke diesel engine with mechanical loading.
5. Performance on 4-Stroke diesel engine with electrical loading
6. Performance on 4-Stroke diesel engine with hydraulic loading.
7. Heat balance test on 4-Stroke diesel engine with mechanical loading.
8. Morse test on multi-cylinder petrol engine.
9. Retardation test on 4-Stroke diesel engine with mechanical loading.
10. Performance of two stage reciprocating air compressor.
11. Determination of Coefficient of Performance of refrigeration system
12. Determination of Coefficient of Performance of Air-conditioning system.

Total:45 Hours

REFERENCES:

1. Rajput. R. K., "Thermal Engineering" S.Chand Publishers, Ninth edition
2. Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers, 2007
3. Kothandaraman.C.P., Domkundwar.S,Domkundwar. A.V., "A course in thermalengineering,"Dhanpat Rai &sons ,Fifth edition, 2002
4. Arora.C.P, "Refrigeration and Air Conditioning ," Tata McGraw-Hill Publishers 1994

COURSE OUTCOMES Employability.

	Competency	Cognitive level
CO1	Draw the port timing and valve timing diagram of two stroke and four stroke internal Combustion Engines	Applying
CO2	Determine the flash point, fire point and Viscosity of the given oil sample.	Applying
CO3	Test the performance of four stroke IC engines with Different Loading	Applying
CO4	Assess the performance of two stage reciprocating air compressor.	Applying
CO5	Conduct Morse test on multi cylinder petrol engine.	Applying
CO6	Conduct tests to evaluate the performance of refrigeration and air-conditioning test rigs.	Applying

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1902ME452
MANUFACTURING TECHNOLOGY LABORATORY – II

L T P C
0 0 2 1

PREREQUISITE :
1. Workshop Practice Laboratory
2. Manufacturing Technology I Lab

COURSE OBJECTIVES:
1. To learn the metal cutting theory and calculate the forces involved in it.
2. To study construction, working and operations of centre, semi-automatic and automatic lathes.
3. To provide the knowledge on construction, working of milling and gear cutting machines.
4. To impart knowledge on construction, working and operations of reciprocating, drilling and boring machines.
5. To provide knowledge on construction, working of broaching, grinding and few fine finishing processes.

LIST OF EXPERIMENTS:

1. Contour milling using vertical milling matching.
2. Spur gear cutting in milling machine.
3. Gear generation in hobbing machine.
4. Gear generation in gear shaping machine.
5. Horizontal surface grinding.
6. Cylindrical grinding.
7. Tool angle grinding with tool and Cutter Grinder.
8. Measurement of cutting forces in Milling.
9. Square Head Shaping.
10. Hexagonal Head Shaping.
11. Vertical surface grinding.
12. Make a v-block using planner machine

Total: 60 Hours

ADDITIONAL EXPERIMENTS / INNOVATIVE EXPERIMENTS :

1. Select proper Machines and list the sequence of operations to produce the components.
2. External threaded shafts with key way, Hexagonal bolt and Hexagonal nut.

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COURSE OUTCOMES: Employability | Entrepreneurship.

After completion of the course, Student will be able to

CO1	Produce of spur gear by using universal milling machine, gear hobbing machine, gear shaping machine.
CO2	Do the surface grinding operation using horizontal grinding machine, vertical grinding machine, cylindrical grinding machine
CO3	Produce a single point tool using tool and cutter grinder
CO4	Use the planner machine & vertical milling machine to perform contour, key way operation.
CO5	Measure the cutting force using milling tool dynamometer.
CO6	Do the square head shaping and hexagonal head shaping using shaper machine

REFERENCES:

1. J. P. Kaushish, Manufacturing Processes, Prentice Hall India Learning Private Limited., New Delhi, 2013.

2. SeropeKalpakjian and Steven R Schmid, Manufacturing Engineering and Technology, Pearson Education Limited, New Delhi, 2013.

3. P. N. Rao, Manufacturing Technology- Metal Cutting and Machine Tools, Tata McGraw Hill Publishing Company Private Limited., New Delhi, 2013

4. S. K. HajraChoudhury, Elements of Workshop Technology. Vol. II, Media Promoters & Publishers Private Limited., Mumbai, 2013.

5. P.C Sharma, Manufacturing Technology - II, S. Chand & Company Limited. New Delhi, 2012.

6. http://nptel.ac.in/courses/112105126

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1902ME453 ENGINEERING METROLOGY & MEASUREMENTS **L T P C**

0 0 3 1.5

LABORATORY

LIST OF EXPERIMENTS:

1. Comparing the accuracy of Vernier Caliper, Vernier Height Gauge, Vernier Depth Gauge and Micrometer to check the various dimensions of a given specimen.
2. Checking the dimensional limits of ten similar components using Mechanical Comparator.
3. Measurement of taper angle of a given specimen by using Sinebar.
4. Measurement of screw thread specifications by Floating Carriage Micrometer.
5. Measurement of gear tooth specifications by using Gear Tooth Vernier Caliper.
6. Measurement of gear tooth specifications by using Tool Maker's Microscope
7. Differentiate the work piece by its Surface Roughness value
8. Measurement of Straightness of a given job by using Autocollimator
9. Temperature measurement by using Thermocouple.
10. Measurement of force using Force Measuring Setup.
11. Measurement of Torque using Torque Measuring Setup
12. Measurement of Displacement using LVDT.
13. Measurement of bore diameter using Telescopic Gauge

Employability.

Total:30 Hours

REFERENCES:

1. Jain R.K., —Engineering Metrology‖, Khanna Publishers, 2005
2. Alan S. Morris, -The Essence of Measurement‖, Prentice Hall of India, 1997
3. Beckwith, Marangoni, Lienhard, -Mechanical Measurements‖, Pearson Education,2006.

Donald Deckman, -Industrial Instrumentation‖, Wiley Eastern, 1985.

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1904GE451	LIFE SKILLS: VERBAL ABILITY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

1. To help students comprehend and use vocabulary words in their day-to-day communication.
2. To apply appropriate reading strategies for interpreting technical and non-technical
3. To ensure students will be able to use targeted grammatical structures meaningfully and
4. To enable the students to arrange the sentences in meaningful unit and to determine whether
5. To apply the principles of effective business writing to hone communication skills.

COURSE OUTCOMES Skill Development

- **CO1** Use new words in their day-to-day communication.
- **CO2** Gather information swiftly while reading passages.
- **CO3** Students are proficient during their oral and written communication.
- **CO4** Rearrange the sentences and able to identify the voice of the sentence.
- **CO5** Students use their knowledge of the best practices to craft effective business documents

MODULE1 VOCABULARY USAGE **6 hours**

Introduction - Synonyms and Antonyms based on Technical terms – Single word Substitution – Newspaper, Audio and video listening activity.

MODULE 2 COMPREHENSION ABILITY **6 hours**

Skimming and Scanning – Social Science passages – Business and Economics passages – latest political and current event based passages – Theme detection – Deriving conclusion from passages.

MODULE 3 BASIC GRAMMAR AND ERROR DETECTION **6 hours**

Parallelism – Redundancy – Ambiguity – Concord - Common Errors – Spotting Errors – Sentence improvement – Error Detection FAQ in Competitive exams.

MODULE 4 REARRANGEMENT AND GENERAL USAGE **6 hours**

Jumble Sentences – Cloze Test - Idioms and Phrases – Active and passive voice – Spelling test.

MODULE 5 APPLICATION OF VERBAL ABILITY **6 hours**

Business Writing - Business Vocabulary - Delivering Good / Bad News - Media Communication - Email Etiquette – Report Writing - Proposal writing – Essay writing– Indexing –Market surveying.

TOTAL: 30 HOURS

REFERENCES:

1. Arun Sharma and MeenakshiUpadhyav, How to Prepare for Verbal Ability and Reading Comprehension for CAT, McGrawHill Publication, Seventh Edition 2017
2. R S Aggarwal and Vikas Aggarwal , Quick Learning Objective General English ,S.Chand Publishing House, 2017
3. Dr.K.Alex , Soft Skills, S.Chand Publishing House, Third Revise Edition, 2014
4. Raymond Murphy, Essential English Grammar in Use, Cambridge University press, New Delhi, Third Edition , 2007

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1902ME501 HEAT AND MASS TRANSFER

MODULE I CONDUCTION 12

Hours General Differential equation of Heat Conduction– Cartesian and Polar Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler"s charts.

MODULE II CONVECTION 12

Hours

Free and Forced Convection - Hydrodynamic andThermal Boundary Layer. Free and ForcedConvection during external flow over Plates and Cylinders and Internal flow through tubes .

MODULE III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS

12 Hours Nusselt"s theory of condensation - Regimes of Pool boiling and Flow boiling. Correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors - Analysis – LMTD method - NTU method.

MODULE IV RADIATION 12

Hours Black Body Radiation – Grey body radiation - Shape Factor – Electrical Analogy – Radiation Shields. Radiation through gases.

MODULE V MASS TRANSFER

12 Hours Basic Concepts – Diffusion Mass Transfer – Fick"s Law of Diffusion – Steady state Molecular Diffusion- Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy –Convective Mass Transfer Correlations. **Text / Reference Books**

Sl. No.	Title of the Book	Author(s)	Publisher
TEXT BOOKS			
T1	Fundamentals of Engineering Heat and Mass Transfer	Sachdeva R C.	New Age International, 1995.
T2	"Fundamentals of Heat and Mass Transfer		McGraw-Hill Book Co., 1994
REFERENCES			
R1	Heat and Mass Transfer	. Yadav R	Central Publishing House, 1995
R2	Heat Transfer	Ozisik M.N	McGraw-Hill Book Co., 1994

COURSE OUTCOMES Employability.

After successful completion of the course, students will be able to

	Competency	Cognitive level
CO1	Calculate heat transfer rate in steady and unsteady state of heat conduction.	K3
CO2	Calculate convective heat transfer rate for external and internal flow.	K3
CO3	Determine heat transfer rate for boiling and condensation process and heat exchangers.	K3
CO4	Calculate the emissivity and radiation heat transfer .	K3
CO5	Estimate mass transfer rate for diffusive mass transfer.	K2
CO6	Estimate mass transfer rate for convective mass transfer.	K2

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1902ME502	Design of Machine Elements	L	T	P	C
		3	2	0	4

Course Objectives

- To learn the design procedure of machine elements subjected to simple and variable loads.
- To study the design procedure of shafts and couplings.
- To provide knowledge on the design of bolted and welded joints.
- To provide knowledge on the design of helical, leaf and torsional springs subjected to constant and variable loads.
- To study the selection procedure of sliding and rolling contact bearings.

UNIT I	**STEADY AND VARIABLE STRESSES**	**12 Hrs**
	Introduction to the design process - Design of straight and curved beams – „C" Frame and Crane hook. Stress concentration - Design for variable loading - Soderberg, Goodman, Gerber methods and combined stresses - Theories of failure.	
UNITII	**DESIGN OF SHAFTS AND COUPLINGS**	**12 Hrs**
	Design of shafts based on strength, rigidity and critical speed. Design of rigid flange coupling - Design of flexible coupling.	
UNIT III	**DESIGN OF JOINTS**	**12 Hrs**
	Design of bolted joints - stresses due to static loading, eccentrically loading. Design of welded joints - Butt and Fillet welded Joints - Strength of parallel and traverse fillet welded Joints.	
UNIT IV	**DESIGN OF SPRINGS**	**12 Hrs**
	Types, End connections and design parameters. Design of helical springs - Circular and noncircular wire - Concentric springs. Design of leaf and torsional springs under constant and varying loads.	
UNIT V	**DESIGN OF BEARINGS**	**12 Hrs**
	Types and selection criteria - Design of journal bearings - Design of rolling contact bearing Ball and roller bearing.	
	Total:	**60 Hrs**

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Course Outcomes (COs): Employability.

After successful completion of the course, students will be able to

	Competency	Cognitive level
CO1	Calculate stress concentration of plate under simple and variable loadings.	Understand
CO2	Design the parameters of different types of couplings.	Apply
CO3	Design the solid and hollow shafts for various engineering applications.	Apply
CO4	Design the bolted and welded joints subjected to static and variable load conditions.	Apply
CO5	Estimate the parameters of helical, leaf and torsional springs subjected to variable loads.	Understand
CO6	Design a suitable bearing for various applications.	Apply

Text / Reference Books

Sl. No.	Title of the Book	Author(s)	Publisher
TEXT BOOKS			
T1	"Design of Machine Elements", 3rd Edition,.	Bhandari V,	Tata McGraw-Hill Book Co 2010.
T2	"Mechanical Engineering Design",	Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett	8th Edition, Tata McGraw-H 2008.
REFERENCES			
R1	"Machine Design",	Sundararajamoorthy T. V. Shanmugam .N,	Anuradha Publications, Chennai, 2003
R2	"Fundamentals of Machine Design",	Robert C. Juvinall and Kurt M. Marshek	4th Edition, Wiley, 2005
R3	"Machine Design",	Alfred Hall, Halowenko, A and Laughlin, H.,	Tata McGraw-Hill BookCo.(Schaum"s Outline) 2010
R4	"Fundamentals of Machine Elements",.	Bernard Hamrock, Steven Schmid,Bo Jacobson,	2nd Edition, Tata McGraw-I Book Co., 2006

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1902ME503	KINEMATICS OF MACHINES	L	T	P	C
		2	2	0	3

PREREQUISITE:

1. Engineering Mechanics
2. Engineering Graphics
3. Engineering Mathematics

COURSE OBJECTIVES:

1. To impart the knowledge on the concept of simple mechanisms.
2. To provide knowledge on kinematic analysis of simple mechanisms.
3. To study and construct the cam profile for the various types of follower motion.
4. To learn the kinematics terminologies of spur gear and calculate speed ratio of various types of gear train.
5. To introduce the concept of friction drives in kinematic of machines.

UNIT I FUNDAMENTALS OF MECHANISMS **12 Hours**

Basic Terminology - Kinematic link, Pair, joints, Structure, Machine, Degree of freedom, Grubler&Kutzbach Criterion - Inversions of four bar mechanism, Mechanical advantage - Transmission Angle, Inversion of single slider and double slider crank mechanisms. Common Mechanisms - Straight line mechanism, Dwell mechanism.

UNIT II KINEMATIC ANALYSIS OF MECHANISMS **12 Hours**

Relative velocity of kinematic link, Rubbing Velocity of kinematic pair, Construction of velocity and acceleration diagram by graphical method (Relative Velocity Method), Four bar mechanism, slider crank mechanisms and complex mechanism.

UNIT III CAM AND FOLLOWER MECHANISMS **12 Hours**

Introduction - Terminology, Classifications, Types of follower motion - Uniform Velocity Motion, Simple Harmonic Motion, Uniform Acceleration and Retardation Motion and Cycloidal Motion- Construction of cam profile - Knife edge follower, Roller and flat faced follower.

UNIT IV GEAR AND GEAR TRAIN **12 Hours**

Gears - Terminology, Law of gearing, Length of path of contact, Length of arc of contact, contact ratio- Interference and undercutting. Gear trains- Speed ratio, train value. Simple gear train, compound gear train, Epicyclic gear train- speed calculation by tabular method.

UNIT V FRICTION DRIVES **12 Hours**

Introduction-Friction clutch, types -single plate, Multi plate and cone clutch. Flat Belt Drives Velocity, slip, creep and Centrifugal effect of belt, length of open and cross belt drives, Maximum power transmitted, ratio of driving tension in flat belt drives - V Belt drives.

TOTAL: 60 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

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1. Intermittent motion mechanisms - calculation of velocity and acceleration of two and four-wheel vehicle.

2. Cam mechanism in milling machine - Automotive transmission gear trains - Gear train in ships and aero planes.

3. Application Ropes and chain drives.

COURSE OUTCOMES: Employability.

After completion of the course, Students will be able to

CO1:	Differentiate the basic machine mechanisms.	K2
CO2:	Calculate velocity and acceleration of machine mechanisms.	K2
CO3:	Construct the cam profile for different types of follower motion.	K3
CO4:	Describe the kinematic terminologies of spur gear and calculate speed ratio of various types of gear train.	K2
CO5:	Solve the amount of power transmitted by friction drives.	K2
CO6:	Utilize mechanism for new machine development.	K3

REFERENCES:

1. S. S. Rattan, Theory of Machines, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2014.

2. J. J. Uicker, G. R. Pennock and J. E. Shigley, Theory of Machines and Mechanisms, Oxford University Press, New York,2011.

3. Ballaney P L, Theory of Machines and Mechanisms, Khanna Publishers, New Delhi, 2005.

4. Sadhu Singh, Theory of Machines, Pearson Education, Second Edition, 2012.

5. Rao J S and Dukkipati, Mechanism and Machine Theory, Wiley- Eastern Ltd., New Delhi, 2006.

6. http://nptel.ac.in/courses/112104121/1

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1902ME504- CAD

UNIT I FUNDAMENTALS OF COMPUTER GRAPHICS 9

Product cycle, Sequential and Concurrent Engineering, CAD - Architecture, Tools, applications – Coordinate systems - Two and Three-dimensional Transformations - Translation - Scaling - Reflection - Rotation, Windowing - clipping and Viewing

UNIT II GEOMETRIC MODELING 9

Representation of curves - Hermite, Bezier, B-Spline and rational curves - Surface Modeling - surface patch - Bezier and B spline surface. Solid Modelling - Boundary representation(B-Rep) and Constructive Solid Geometry(CSG).

UNIT III VISUAL REALISM 9

Hidden line removal algorithm - Priority and Area oriented algorithms. Hidden Surface removal algorithm - Depth buffer and Warnock's algorithms. Hidden solid removal algorithm, Ray Tracing algorithm, Shading and Coloring - types. Computer Animation.

UNIT IV ASSEMBLY OF PARTS 9

Assembly modeling - Interference of Positions and orientations - CAD Tolerance Analysis - geometrical Mass Properties - degree of freedom - Constraints and Simulation concepts.

UNIT V CAD STANDARDS 9

Database Management System - CAD Standards File types - IGES, PDES, Database – Structures - Types, STEP Files. Communication Standards - File Transfer between CAD and CAM package.

TOTAL: 45 Periods

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Comp	COURSE OUTCOMES Employability.	Cognitive level
CO1	Use various concepts of CAD, computer graphics and transformations.	Apply
CO2	Prepare various geometric models using curves, surfaces and solids.	Apply
CO3	Use various visual realism methods (shading, colouring and animation).	Apply
CO4	Do assembly modeling and tolerance analysis.	Apply
CO5	Use various computer graphics standards.	Apply
CO6	Use various Data Exchange Formats.	Apply

ext / Reference Books

Sl. No.	Title of the Book	Author(s)	Publisher
TEXT BOOKS			
T1	"Mastering CAD/CAM"	Ibrahim Zeid,	Tata McGraw- Hill, 2008.
T2	"Computerraphics",	Amarendra N Sinha and Arun D Udai,	second reprint, Tata McGraw Hill Education (P) Ltd., 2009.
REFERENCES			
R1	Geometric Modeling	Michael E. Mortenson,	Third edition, Industri Press, 2006.
R2	Mathematical Elements for computer Graphics	Rogers,	Tata Mcgraw Hill Education Private Limited, 2009.
R3	"Computer Graphics: A Practical Approach, Concepts, Principles, Case Studies"	Rajiv Chopra,	First Edition, S.Chand and Company Ltd., 2011.

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1903ME001 NON-TRADITIONAL MACHINING PROCESS

MODULE I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES 09 Hours

Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes - Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations

MODULE II THERMO-ELECTRIC ENERGY BASED PROCESSES 09 Hours

Principles, equipments, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining

MODULEIII CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES 09 Hours

Principles, equipments, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring.

MODULE IV NANO FINISHING PROCESSES 09 Hours

Principles, equipments, effect of process parameters, applications, advantages and limitations of Abrasive flow machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magneto rheological finishing, Magneto rheological abrasive flow finishing

MODULE V HYBRID NON-TRADITIONAL MACHINING PROCESSES 09 Hours

Introduction - Various hybrid non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Selection and comparison of different nontraditional machining processes.

REFERENCES:

1. Benedict, G.F., "Non-traditional Manufacturing Processes", Marcel Dekker Inc., New York 1987. ISBN-13:978 0824773526.
2. Carl Sommer, "Non-Traditional Machining Handbook", Advance Publishing., United States, 2000, ISBN-13:978-1575373256.
3. GolamKibria, Bhattacharyya B. and Paulo Davim J., "Non-traditional Micromachining Processes: Fundamentals and Applications", Springer International Publishing., Switzerland, 2017,ISBN:978-3-319-52008-7.
4. Jagadeesha T., "Non-Traditional Machining Processes", I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017, ISBN-13:978-9385909122.
5. Kapil Gupta, Neelesh K. Jain and Laubscher R.F., "Hybrid Machining Processes: Perspectives on Machining and Finishing", 1st edition, Springer International Publishing., Switzerland, 2016, ISBN-13: 978-3319259208

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COURSE OUTCOMES Employability

After successful completion of the course, students will be able to

	Competency	Cognitive level
CO1	Explain the need for Mechanical energy based processes and its application.	K2
CO2	Compare various thermal energy and electrical energy based Non-traditional machining processes.	K2
CO3	Summarize various chemical and electro-chemical energy based Non-traditional machining processes.	K2
CO4	Interpret nano finishing process	K2
CO5	Distinguish recent trends in hybrid and micro machining based Non-traditional machining processes.	K2

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1902ME551 COMPUTER AIDED DESIGN AND ANALYSISLABORATORY L T P C

0 0 2 1

LIST OF EXPERIMENTS:	
Creation of 3D assembly model of following machine elements	
EXPERIMENT 1 Flange Coupling	**3 hours**
EXPERIMENT 2 Knuckle joint	**3 hours**
EXPERIMENT 3 Screw Jack	**3 hours**
EXPERIMENT 4 Universal Joint	**3 hours**
EXPERIMENT 5 Stuffing box	**3 hours**
EXPERIMENT 6 Connecting rod	**3 hours**
Creation of model and Analysis using software	
EXPERIMENT 7 Stress and deflection analysis in beams with different support conditions.	**2 hours**
EXPERIMENT 8 Stress analysis of bracket.	**2hours**
EXPERIMENT 9 Thermal stress analysis of mixed boundary.	**2 hours**
EXPERIMENT 10 Model analysis of Beams.	**2 hours**
EXPERIMENT 11 Harmonic analysis of simple systems.	**2 hours**
EXPERIMENT 12 analysis of 3D beam.	**2 hours** Stress
Total:	**30 hours**

REFERENCES:

1. Ibrahim Zeid, CAD/ CAM Theory and Practice, McGraw Hill, 2007

2. Mikell P. Groover and Emory W. Zimmer, CAD/ CAM – Computer aided design and manufacturing, Pearson Education,1987

3. T. R. Chandrupatla and A. D. Belagundu, Introduction to Finite Elements in Engineering, Pearson Education, 2012

4. Finite Element Analysis Theory and Applications with Ansys, Saeed Moaveni, Pearson

Education, 2014.

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Course Outcomes (COs): Employability

After successful completion of the course, the students will be able to

	Competency	Cognitive level
CO1	Prepare the 3D assembly model of flange coupling and Knuckle joint .	Apply
CO2	Prepare the 3D assembly model of Screw Jack and Universal Joint .	Apply
CO3	Prepare the 3D assembly model of Stuffing box and Connecting rod .	Apply
CO4	Examine Stress and deflection analysis of beams with different conditions and bracket	Apply
CO5	Establish thermal analysis of mixed boundary.	Apply
CO6	Establish modal and harmonic analysis of beams.	Apply

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1902ME552	HEAT AND MASS TRANSFER LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. `Determination of thermal conductivity of insulating powder.
2.
3. Determination of thermal conductivity of guarded hot plate.
4. Determination of thermal conductivity of materials in lagged pipe.
5.
6. Determination of heat transfer co-efficient through composite wall.
7.
8. Determination of heat transfer co-efficient by natural convection.
9.
10. Determination of heat transfer co-efficient by forced convection
11. Determination of heat transfer co-efficient in a parallel and counter flow heat exchanger.
12.

Determination of heat transfer co-efficient and effectiveness from Pin-Fin by natural convection.

Determination of heat transfer co-efficient and effectiveness from Pin-Fin by forced convection.

Determination of Stefan-Boltzmann constant.

Determination of emissivity using emissivity apparatus.

Determination of performance in a fluidized bed cooling tower

Total: 30 Hours

REFERENCES:

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 1998.

2. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 1998.

3. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2002

4. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.

5. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2009

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	COURSE OUTCOMES Employability	Cognitive level
CO1	Measure the heat transfer phenomena predict the relevant coefficient.	Applying
CO2	Experiment with mechanisms of heat transfer under steady and transient conditions.	Applying
CO3	Make use of thermal analysis and sizing of heat exchangers and also understand the basic Concepts of mass transfer.	Applying
CO4	Do experimentation heat exchanger, conduction heat transfer apparatus.	Applying
CO5	Do experimentation heat exchanger, convection and radiation heat transfer apparatus.	Applying
CO6	Perform the concepts and to design of heat transfer through extended surfaces.	Applying

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1901MCX03-ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

(Common to All Branches) Mandatory Course

Course Objectives: The course will introduce the students to

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

MODULE - I Introduction to Culture: Culture, civilization, culture and heritage, general characteristics of culture importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

MODULE - II Indian Languages, Culture and Literature: Indian Languages and Literature-I: the role of Sanskri significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south Indi Indian Languages and Literature-II: Northern Indian languages & literature.

MODULE - III Religion and Philosophy: Religion and Philosophy in ancient India, Religion and Philosophy i Medieval India, Religious Reform Movements in Modern India (selected movements only).

MODULE – IV Fine Arts in India (Art, Technology& Engineering): Indian Painting, Indian handicrafts, Music divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieva and modern), Science and Technology in India, development of science in ancient, medieval and modern India.

MODULE – V Education System in India: Education in ancient, medieval and modern India, aims of educatior subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists o Modern India

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Text / Reference Books

Sl. No.	Title of the Book	Author(s)	Publisher
REFERENCES			
R1	Text and Interpretation	Kapil Kapoor	The India Tradition", ISBN 81246033375, 2005
R2	Examinations in ancient India	S. Narain	Arya Book Depot, 1993
R3	Founders of Sciences in Ancient India	Satya Prakash	Vijay Kumar Publisher, 1989
R4	Essentials of Indian Philosophy	M. Hiriyanna,	Motilal Banarsidass Publishers, ISBN 13: 978- 8120810990, 2014

Course Outcomes (CO's) Skill Development

After successful completion of the course, students will be able to

	Competency	Cognitive level
CO1	Understand philosophy of Indian culture.	Understand
CO2	Distinguish the Indian languages and literature.	Understand
CO3	Learn the philosophy of ancient, medieval and modern India	Understand
CO4	Acquire the information about the fine arts in India.	Understand
CO5	Know the contribution of scientists of different eras.	Understand

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1904GE551	LIFE SKILLS: APTITUDE – 1	L	T	P	C
		0	0	2	1

SKILL DEVELOPMENT

MODULE I INTRODUCTION TO NUMBER SYSTEM, BASIC SHORTCUTS OF ADDITION, MULTIPLICATION, DIVISION 6 Hours

Classification of numbers – Types of Numbers - Divisibility rules - Finding the units digit - Finding remainders in divisions involving higher powers - LCM and HCF Models - Fractions and Digits – Square, Square roots – Cube, Cube roots – Shortcuts of addition, multiplication, Division.

MODULE II RATIO AND PROPORTION, AVERAGES 6 Hours

Definition of Ratio - Properties of Ratios - Comparison of Ratios - Problems on Ratios - Compound Ratio - Problems on Proportion, Mean proportional and Continued Proportion Definition of Average - Rules of Average - Problems on Average - Problems on Weighted Average - Finding average using assumed mean method.

MODULE III PERCENTAGES, PROFIT AND LOSS 6 Hours

Introduction Percentage - Converting a percentage into decimals - Converting a Decimal into a percentage - Percentage equivalent of fractions - Problems on percentages - Problems on Profit and Loss percentage- Relation between Cost Price and Selling price - Discount and Marked Price - Two different articles sold at same Cost Price - Two different articles sold at same Selling Price - Gain% / Loss% on Selling Price.

MODULE IV CODING AND DECODING, DIRECTION SENSE 6 Hours

Coding using same set of letters - Coding using different set of letters - Coding into a number - Problems on R-model - Solving problems by drawing the paths - Finding the net distance travelled - Finding the direction - Problems on clocks - Problems on shadows - Problems on direction sense using symbols and notations.

MODULE V NUMBER AND LETTER SERIES NUMBER AND LETTER ANALOGIES, ODD MAN OUT 6 Hours

Difference series - Product series - Squares series - Cubes series - Alternate series - Combination series - Miscellaneous series - Place values of letters - Definition of Analogy - Problems on number analogy - Problems on letter analogy - Problems on verbal analogy - Problems on number Odd man out - Problems on letter Odd man out - Problems on verbal Odd man out

TOTAL 30 Hours

REFERENCES:

1. Arun Sharma, „How to Prepare for Quantitative Aptitude for the CAT", 7th edition, McGraw Hills publication, 2016.
2. Arun Sharma, „How to Prepare for Logical Reasoning for CAT", 4th edition, McGraw Hills publication, 2017.
3. R S Agarwal, „A modern approach to Logical reasoning", revised edition, S.Chand publication, 2017.
4. R S Agarwal, „Quantitative Aptitude for Competitive Examinations", revised edition, S.Chand publication, 2017.
5. Rajesh Verma, "Fast Track Objective Arithmetic", 3rd edition, Arihant publication, 2018.
6. B.S. Sijwalii and InduSijwali, "A New Approach to REASONING Verbal & Non-Verbal", 2nd edition, Arihnat publication, 2014.

ASSESSMENT PATTERN :

1. Two tests will be conducted (25 * 2) - 50 marks
2. Five assignments will be conducted (5*10) - 50 Marks.

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1902ME601 MATERIALS SCIENCE AND METALLURGY **L T P C**
3 0 0 3

1. Materials Science
2. Fundamentals of Mechanical Engineering

Employability.

COURSE OBJECTIVES:

1. To provide knowledge on physical metallurgy of metals through the study of phase diagrams.
2. To study the properties and applications of various metals and alloys used in engineering industries.
3. To expose various heat treatment processes of steels.
4. To study the properties and applications of polymers and ceramics.
5. To impart knowledge on mechanical properties evaluation and testing methods of engineering materials.

UNIT I PHASE DIAGRAMS AND CONSTITUTION OF ALLOYS **9Hours**

Alloys, Solid solutions - Phase diagram, phase rule, lever rule, Binary phase diagram -Isomorphous, eutectic, peritectic, eutectoid reactions - Iron-Carbon phase diagram - Metallography, microstructure.

UNIT I ENGINEERING METALS AND ALLOYS **9 Hours**

Classification of Engineering materials - Ferrous metals -Plain carbon steel (low, medium and high carbon steels), microstructure/composition, properties, applications - Alloy steels, effect of alloying additions on steels - stainless steels, High Strength Low Alloy Steels (HSLA), maraging and tool steels - Cast iron - grey, white, malleable, spheroidal graphite cast iron, microstructure, properties, applications – Non-ferrous metals - Nickel, Copper, Titanium, Aluminium, Magnesium, Zinc alloys, properties and applications - Bearing materials.

UNIT III HEAT TREATMENT OF STEELS **9 Hours**

Purpose of heat treatment - Annealing (stress relief, recrystallization, spheroidizing) -Normalizing - Hardening and Tempering, Isothermal transformation diagrams (T-T-T diagrams), Cooling curves superimposed on T-T-T diagrams (martensite and bainite phase formation) -Hardenability, Jominy end quench test, Case hardening processes, carburizing, nitriding, carbontiriding, cyaniding, flame hardening, induction hardening.

UNIT IVINTRODUCTION TO POLYMERS AND ENGINEERING CERAMICS **9 Hours**

Polymers - Plastics and elastomers - Thermoplasts and thermosets, properties and applications (polyethylene, polypropylene, polyurethane, polystyrene, poly vinylchloride, polymethyl methacrylate, polyethylene terapthalate, polycarbonate, polyamide, acrylonitrile butadiene styrene, polyamide, polyamideimide, polypropyleneoxide, polypropylene sulphide, polyetheretherketone, polytetrafluroethylene, urea formaldehyde, phenol formaldehyde, polyester, nylon, epoxy) – Rubber and its types - Types of Ceramics and applications.

UNIT V MECHANICAL PROPERTIES AND MATERIALS TESTING **9 Hours**

Elastic and plastic deformation, slip and twinning - Tensile test, stress-strain behavior of ductile and brittle materials - Stress-strain behaviour of elastomers – Visco elasticity - Compression test – Hardness and testing methods -Impact test - Fatigue test, Stress vs number of cycles (S-N) curve, endurance limit, factors affecting fatigue - Creep test, creep curves -Types of fracture - Fracture toughness – Three crack propagation modes.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

Review on Super alloys, Shape memory alloys, Composite Materials, Case studies in Metallurgical failure analysis.

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1902ME602 **DESIGN OF TRANSMISSION SYSTEMS**

L	T	P	C
3	2	0	4

Course Objectives

1. To train the students to design flexible elements.
2. To train the students to design different types of gears.
3. To train the students to design gear box, cam, clutch and break.

MODULE I **DESIGN OF FLEXIBLE ELEMENTS** **12 Hrs**

Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys - Design of Transmission chains and Sprockets.

MODULE II **SPUR GEARS AND PARALLEL AXIS HELICAL GEARS** **12 Hrs**

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor o safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces for helical gears

MODULE III **BEVEL, WORM AND CROSS HELICAL GEARS** **12 Hrs**

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating th dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits- terminology. Thermal capacity materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology helix angles-Estimating the size of the pair of cross helical gears.

MODULE IV **GEAR BOXES** **12 Hrs**

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. - Variable speed gear bohx, Fluid Couplings, Torque Converters for automotive applications.

MODULE V **CAMS, CLUTCHES AND BRAKES** **12 Hrs**

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches- Electromagnetic clutches Band and Block brakes - external shoe brakes – Internal expanding shoe brake.

Total: **60 Hrs**

Course Outcomes (COs): Employability.

After successful completion of the course, students will be able to

	Competency	Cognitive level
CO1	Design the belt drives (flat belt, V- belt), chain drive, rope drives, belt drive, pulleys and chain sprockets.	Apply
CO2	Solve the problem of spur and straight helical gear based on strength and wear consideration.	Apply
CO3	Solve the problem of bevel and worm gear based on strength and wear consideration.	Apply
CO4	Construct the various gear boxes (sliding mesh, constant mesh, multispeed) through geometric progression, standard step ratio, ray diagram, kinematics layout.	Apply
CO5	Design cam using basic knowledge acquired earlier studies.	Apply
CO6	Design clutches and internal - external shoe brakes from using basic knowledge acquired earlier studies.	Apply

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1902ME603	DYNAMICS OF MACHINES	L	T	P	C
		3	0	0	3

Course Objectives

- To impart knowledge in dynamic analysis of simple mechanism and design of flywheel.
- To provide knowledge on balancing of rotating and reciprocating masses.
- To study the working principle of governor and gyroscope.
- To learn the concept of free and forced vibration.
- To learn the concept of transverse and torsional vibration

UNIT I DYNAMIC FORCE ANALYSIS OF MECHANISMS **9 Hours**

Principle of superposition, Condition for dynamic analysis, Dynamic analysis of four bar & slider crank mechanism - Engine force analysis.Turning moment diagram for steam & IC Engine. Energy stored in flywheel, Dimension of flywheel rim, Flywheel in punching press.

UNIT II BALANCING **9 Hours**

Introduction - Static balancing and dynamic balancing, Balancing of Rotating mass several masses in same and different plane. Balancing of reciprocating mass Swaying couple, Tractive force, Hammer Blow. Balancing of coupled locomotives.

UNIT III GOVERNOR AND GYROSCOPE **9 Hours**

Governor Terminology, working principle, Types - Watt, Porter and Proell governor, Characteristics of Governor-sensitiveness, Hunting, Ichoronisn, Stability. Gyroscope- Gyroscopic effect, gyroscopic couple, gyroscopic effect on aero planes and naval ships.

UNIT IV FUNDAMENTAL OF VIBRATION **9 Hours**

Introduction-Terminology, Classification, elements of vibration, free undamped vibration, Free Damped vibration (Viscus Damping) - Damping ratio and logarithmic decrement. Force damped vibration - Magnification factor. Vibration isolation and transmissibility.

UNIT V TRANSVERSE AND TORSIONAL VIBRATION **9 Hours**

Transverse vibration of shafts and beams Shaft carrying several loads, whirling of shafts. Torsional vibration- effect of inertia on torsional vibration-Torsionally equivalent Shaft, single rotor, two rotors and three rotors system.

FOR FURTHER READING – SEMINAR – CPS **Total 45 Hours**

:

Turning moment balancing of W, V8, V12 engine, Instruments for dynamic measurements, vibration and noise standards, Mutifilar systems.

Course Outcomes (COs)

Employability.

After completion of the course students will be able to

1. Prepare the force-motion relationship in components subjected to external forces.
2. Calculate the inertia effect on standard mechanisms.
3. Determine the undesirable effects of unbalances resulting from prescribed motions in mechanism.
4. Determine the effect of dynamics of undesirable vibrations.
5. Calculate the characteristics of a mechanisms used for speed control and stability control.
6. Determine the performance of gyroscope in various applications (Automobiles, ships and planes).

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1903ME018 **GAS DYNAMICS AND JET PROPULSION** **L T P C**
3 0 0 3

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOW **9**

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers

UNIT II FLOW THROUGH DUCTS **9**

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties.

UNIT III NORMAL AND OBLIQUE SHOCKS
9

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications.

UNIT IV JET PROPULSION
9

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT V SPACE PROPULSION **9**

Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

FOR FURTHER READING **Total 45 Hours**

Case Study: Advanced Aircraft Engines, select Fuel for Air-craft engines.

Reference(s)

1. Patrick H. Oosthuizen and William E. Carscallen, Introduction to Compressible Fluid Flow, 2nd edition, CRC Press, Taylor & Francis Group, Florida,2014.
2. Robert D. Zucker, Fundamentals of Gas Dynamics, 2nd edition, John Wiley & Sons Inc., New York,2002.
3. George P. Sutton and Oscar Biblarz, Rocket Propulsion Elements, 9th edition, John Wiley &Sons Inc., New York,2016.
4. S. M. Yahya, Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion, 6th edition, New Age International private Limited,2018.

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Employabi lity

Course outcomes:

CO1: Employ the basic concepts of Isentropic flow.
CO2: Calculate the flow Properties of fanno flow & Rayleigh flow.
CO3: Determine various flow Parameters for normal shock and oblique shock.
CO4: Utilize thrust Equation for Performance Calculation.
CO5: Explain theory of Rocket Propulsion.

1901MGX03	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION TO LINEAR PROGRAMMING (LPP) **9 Hours**

Introduction to Applications of Operations Research in functional areas of Management. Linear Programming-Formulation, Solution by Graphical and Simplex methods (Primal - Penalty, Two Phase), Dual simplex method. Principles of Duality.

UNIT II TRANSPORTATION AND ASSIGNMENT MODELS **9 Hours**

Transportation Models – Initial Basic feasible solution by N-W Corner Rule, Least cost and Vogel"s approximation methods. Solution by MODI-Assignment Models- Solution by Hungarian method-Travelling Salesman problem.

UNIT III NETWORKS AND INVENTORY MODELS **9 Hours**

Scheduling by PERT and CPM - Inventory Models – EOQ and EBQ Models (With and without shortages), Quantity Discount Models.

UNIT IV GAME THEORY AND REPLACEMENT MODELS **9 Hours**

Game Theory-Two person Zero sum games-Saddle point, Dominance Rule, Methods of matrices, graphical and LP solutions. Replacement Models-Individuals replacement Models (With and without time value of money) – Group Replacement Models.

UNIT V QUEUING THEORY MODELS **9 Hours**

Queuing Theory - single and Multi-channel models – infinite number of customers and infinite calling source. (M/M/1):(∞/FCFS), (M/M/S):(∞/FCFS), (M/M/1):(N/FCFS), (M/M/S):(N/FCFS)- Simple Problems.

TOTAL: 45 HOURS

FOR FURTHER READING/SEMINAR/CBS

1. Sensitivity analysis, Transshipment problems.
2. Decision making under uncertainty, IPP.

REFERENCES:

1. Hamdy A Taha, Introduction to Operations Research, Pearson, 9th Edition, 2014.
2. Paneerselvam R., Operations Research, Prentice Hall of India, Fourth Print, 2008.
3. G. Srinivasan, Operations Research – Principles and Applications, PHI, 2007.
4. Kalavathy S, Operations Research, Second Edition, Vikas Publishing House, 2004.
5. N. D Vohra, Quantitative Techniques in Management, Tata McGraw Hill, 2010.
6. nptel.ac.in/courses/112106134/1

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Course outcomes: Employability.

After Succesful completion students will be able to

CO1: formulate linear programming problems, Interpret solutions to solve Industrial Problems.

CO2: make use of transportation and assignment techniques.

CO3: use critical Path analysis and programming evaluation review techniques to complete the project minimum in short duration.

CO4: utilize inventory models to optimize the inventory cost in business problem.

CO5: construct the home model and replacement for operational efficiency.

1902ME651	THEORY OF MACHINES LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1. To supplement the principles, learn to kinematics and Dynamics of Machinery.
2. To understand how certain measuring devices are used for dynamic testing.
3. To study the working principle of governor and gyroscope.
4. To learn the concept of free and forced vibration.
5. To learn the concept of transverse and torsion vibration.

List of Experiments:

1. Determination of mass moment of inertia of axisymmetric bodies using turn table apparatus
2. Determine the characteristics and effort of Watt, Porter Proell and Hartnell Governors
3. Exercise on Balancing of reciprocating masses.
4. Exercise on Balancing of four rotating masses placed on different plane.
5. Analyze the gyroscopic effect using Gyroscope and verify its laws.
6. Determination of critical speed of shaft with concentrated loads by Whirling of shaft & vibration table apparatus.
7. Determine the moment of inertia of object by Bifilar suspension, Trifilar & method of oscillation.
8. Kinematic analysis of cam model, Epicycle gear train and differential model.
9. Determination of natural frequency of single degree of freedom system & two rotor system.
10. Determine the frequency of forced vibration using Cantilever beam.

TOTAL – 30 Hrs

Employability

Course Outcomes:

1. Measure the mass moment of inertia of axisymmetric objects using Turn table apparatus, bi-filar suspension and compound pendulum. (K3)
2. Experiment with vibrations and balancing of rotating and reciprocating masses in dynamic balancing machine. (K3)
3. Make use of Watt, Porter, Proell and Hartnell governors for determination of range sensitivity. (K3)
4. Do experimentation of the critical speed of shaft under the given load conditions. (K3)
5. Perform the torsional natural frequency of single and double rotor systems. (K3)
6. Make use of whirling of shaft for determination of critical speed of a shaft with concentrated loads. (K3)

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1904GE651	LIFE SKILLS: APTITUDE – II (Common to All Branches)	L	T	P	C
		0	0	2	1

COURSE OUTCOMES Skill Development

:

1. To brush up problem solving skill and to improve intellectual skill of the students.
2. To be able to critically evaluate various real life situations by resorting to Analysis of key issues and factors.
3. To be able to demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.
4. To enhance analytical ability of students.
5. To augment logical and critical thinking of Students.

MODULE I PARTNERSHIP, MIXTURES AND ALLEGATIONS, PROBLEM ON AGES, SIMPLE INTEREST, COMPOUND INTEREST **6 Hours**

Introduction Partnership - Relation between capitals, Period of investments and Shares- Problems on mixtures - Allegation rule - Problems on Allegation – Problems on ages - Definitions Simple Interest - Problems on interest and amount - Problems when rate of interest and time period are numerically equal - Definition and formula for amount in compound interest - Difference between simple interest and compound interest for 2 years on the same principle and time period.

MODULE II BLOOD RELATIONS, CLOCKS, CALENDARS **6 Hours**

Defining the various relations among the members of a family - Solving Blood Relation puzzles - Solving the problems on Blood Relations using symbols and notations - Finding the angle when the time is given - Finding the time when the angle is known - Relation between Angle, Minutes and Hours - Exceptional cases in clocks - Definition of a Leap Year - Finding the number of Odd days - Framing the year code for centuries - Finding the day of any random calendar date .

MODULE III TIME AND DISTANCE, TIME AND WORK **6 Hours**

Relation between speed, distance and time - Converting kmph into m/s and vice versa - Problems on average speed - Problems on relative speed - Problems on trains - Problems on boats and streams - Problems on circular tracks - Problems on races - Problems on Unitary method - Relation between Men, Days, Hours and Work - Problems on Man-Day-Hours method - Problems on alternate days - Problems on Pipes and Cisterns.

MODULE IV DATA INTERPRETATION AND DATA SUFFICIENCY **6 Hours**

Problems on tabular form - Problems on Line Graphs - Problems on Bar Graphs - Problems on Pie Charts - Different models in Data Sufficiency - Problems on data redundancy

MODULE V ANALYTICAL AND CRITICAL REASONING **6 Hours**

Problems on Linear arrangement - Problems on Circular arrangement - Problems on Double line-up - Problems on Selections - Problems on Comparisons - Finding the Implications for compound statements - Finding the Negations for compound statements- Problems on assumption - Problems on conclusions - Problems on inferences - Problems on strengthening and weakening of arguments.

TOTAL 30 Hours

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1904ME652	MINI PROJECT (Design and fabrication Project)	L	T	P	C
		0	0	4	2

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department

Total: 60 Hours

Employability | Entrepreneurship | Skill Development

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1904ME653	INDUSTRIAL VISIT PRESENTATION	L T P C 0 0 0 1

GUIDELINE FOR REVIEW AND EVALUATION

In order to provide the experiential learning to the students, shall take efforts to arrange at least one industrial visit / field visits in a year. A presentation based on Industrial visits shall be made in this semester and suitable credit may be awarded by the Committee constituted by the Head of the Department at the end of the semester examination

Employability | Entrepreneurship | Skill Development

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1702ME701 **AUTOMOBILE ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES

To understand the construction and working principle of various parts of an automobile.
To have the practice for assembling and dismantling of engine parts and transmission system

UNIT I VEHICLE STRUCTURE AND ENGINES **9**

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines –components functions and materials, variable valve timing (VVT).

UNIT II ENGINE AUXILIARY SYSTEMS **9**

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT III TRANSMISSION SYSTEMS **9**

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, Fluid flywheel, torque converter, propeller shaft, slip joints, universal joints ,Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS **9**

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT V ALTERNATIVE ENERGY SOURCES 9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

TOTAL: 45 PERIODS

COURSE OUTCOME Employability -

CO1	Explain types of chassis, frame and engine parts of automobiles.	Understand
CO2	Describe engine auxiliary systems used in SI and CI engines.	Understand
CO3	Distinguish between manual transmission system and automatic transmission system.	Understand
CO4	Demonstrate how the steering, brakes and the suspension system operate.	Understand
CO5	Experiments differents alternative fuels in IC engines.	Apply
CO6	Make use of differential unit to calculate the gears ratio.	Apply

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1702ME702 **MECHATRONICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. To introduce the concept and working of sensors used in mechatronic system.
2. To study different types of actuators used in mechatronic system.
3. To provide knowledge on feedback mechanism for improving the reliability of mechatronic system.
4. To impart knowledge on working of microcontroller in mechatronic systems

To learn the Programmable Logic Controller (PLC) used in mechatronic systems

UNIT I SENSORS **09 Hours**

Components of mechatronics system, Sensor - terminology and Mathematical equation - Potentiometer, Linear Variable differential transformer, strain gauge, Piezoelectric sensor, Optical encoder, Hall effect sensor, Thermistor, Thermo-couple, Light sensor.

UNIT II ACTUATOR **09 Hours**

Terminology, mathematical equation of Mechanical Actuation system - cam, gear, belt & chain, Ball screw, Mechanical aspects of motor selection. Pneumatic & hydraulic Actuation system. Electrical actuation system -relay & solenoid, working & control of Brush & brushless DC motor, working & control of Stepper & servo motor.

UNIT III FEEDBACK CONTROL **09 Hours**

Transfer Function, Mathematical Modeling of Mechanical & Electrical system, Electrical analogy, Electromechanical system, First order system, second order system, Proportional control, derivative control, Integral control, PID control, Controller tuning, Concept of stability.

UNIT IV MICROCONTROLLER **09 Hours**

Architecture of 8051- I/O Pins, Ports and Circuits, memory, counter, Timer, Interrupt, Instruction set- Movingdata, Logical, arithmetic operation, Jump & call instruction, LCD & Keyboard Interfacing. Examples -Windscreen wiper motion, Car engine management.

UNIT V PROGRAMMABLE LOGIC CONTROLLER **09 Hours**

Basic Structure - Input / Output Processing - Programming - Mnemonics - Timers, Internal relays and counters - Shift Registers - Master and Jump Controls - Data Handling - Analogue Input / Output - Selection of PLC. Examples -Pick and place robot. Car Park barrier system.

TOTAL: 45 HOURS

Employabi lity.

COURSE OUTCOMES): After successful completion of the course, students will be able to

	Competency	Cognitive level
CO1	Describe various concepts of mechatronic systems and sensors.	Understand
CO2	Use hydraulic and pneumatic simulation software for various applications.	Apply
CO3	Describe the working principle of 8255 program peripheral interface and its applications.	Apply
CO4	Measure torque variance of servo motor for different speeds.	Apply
CO5	Use 8085 microprocessor and 8051 microcontrollers for doing various operations.	Apply
CO6	Use PLC for actuating pneumatic, hydraulic and electrical circuits.	Apply

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1702ME703 COMPUTER AIDED MANUFACTURING

L	T	P	C
3	0	0	3

UNIT I CONSTRUCTION OF CNC AND MOTION CONTROL **9 Hours**

Evolution of CNC Technology - CNC machine -Concept, classification, features and applications - Constructional features and applications - Linear motion and Recirculating ball bearings - CNC controller and Interpolator - Maintenance and retrofitting

UNIT II DRIVES AND CONTROL **9 Hours**

Spindle and feed drives - Sensors -Position, Encoders, Proximity, Limit switch -Interfacing system - Microcontroller and PLC based -Introduction to Graphical User interface -Communication protocol - RS232, RS 485, USB, Ethernet -PLC -Ladder diagram -Peripherals -Timer, Counter, Encoder interface, Human Machine Interface

UNIT III PROGRAMMING OF CNC LATHE **9 Hours**

Coordinate system - structure of a part program -G & M Codes -Programming for FANUC and SIEMENS controller -Single pass and canned cycle -Turning, facing and threading -Multi-pass canned cycle -Rough and Finish turning, facing, pattern repeating, grooving, threading, drilling, boring, peck drilling, high speed drilling cycle -Subprogram and Macro programming -Tool length and nose radius compensation - offset -Tool, work and coordinate -Insert -Materials, Classification, Nomenclature and Selection -Tool and Work holding devices - Automatic tool changer -Turret and drum type -Tool holder nomenclature and selection -CNC part programming using CAD/CAM software and interfacing with CNC machine

UNIT IV PROGRAMMING OF CNC MACHINING CENTRE **9 Hours**

Coordinate system - G & M Codes for machining centre - Programming for FANUC and SIEMENS controller - Machining cycles - Linear and circular interpolation, Contouring, rectangular and circular pocketing, drilling, peck drilling, high speed drilling, Back boring, counter boring and tapping cycle - Cutter diameter compensation - Nomenclature of multi-point cutting tool and tool holder -Tool and work holding devices -Automatic Pallet changer.

UNIT V ADDITIVE MANUFACTURING **9 Hours**

Introduction to additive manufacturing - Applications of AM in Automotive, Aerospace, Business, Consumer Electronics, Die & Mould, Jewellery and Medical industries -Generic process chain - Classification -Components, working principle, Materials processed and Applications - Stereolithography (SLA), Fusion Deposition Modelling (FDM), 3D Printing (3DP), Selective Laser Sintering (SLS), Electron Beam Additive Manufacturing (EBAM)

TOTAL: 45 HOURS

Text / Reference Books

Sl. No.	Title of the Book	Author(s)	Publisher
TEXT BOOKS			
T1	Computer Aided Manufacturing	Dr.V.Jayakumar	Suchitra Publications (A Group of Lakshmi Publications), 2017
T2	Computer Aided Manufacturing	T.K.Kundra	Tata McGraw Hill,2010
REFERENCES			
R1	Computer Numerical Control Machines	P.Radhakrishnan	New Central Book Agency, 2004.
R2	Computer Control of Machine Tools	G. E. Thyer	Butterworth-Heinemann Ltd, 1991.
R3	Automation, Production System and Computer Integrated Manufacturing	Mikell P. Groover	Prentice Hall of India, New Delhi, 2008

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REFERENCE WEBSITES	
1	http://nptel.ac.in/courses/Webcourse-contents
2	https://freevideolectures.com/course/2678/computer aided manufacturing
3	https://swayam.gov.in/nd1_noc20_ma23/preview
4	https://swayam.gov.in/nd2_cec20_ma10/preview

Course Outcomes (COs): Employability.

After successful completion of the course, students will be able to

	Competency	Cognitive level
CO1	Understand evolution, principle of CNC machine tools, and constructional features of CNC machine tools	Understand
CO2	Explain drives, feedback devices used in CNC machine tools namely programmable logic control (PLC) and other peripherals.	Understand
CO3	Prepare programs for CNC turning center by selecting suitable tool, work holding devices, etc.	Apply
CO4	Prepare programs for CNC machining center by considering popular controllers.	Apply
CO5	Understand various technologies of Additive Manufacturing to manufacture a prototype.	Understand
CO6	Explain the processes used in additive manufacturing for a range of materials and applications	Understand

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1701MGX02 **INDUSTRIAL ECONOMICS**

L	T	P	C
3	2	0	4

UNIT I INTRODUCTION **9 hrs**

Introduction to Industrial economics- Micro and Macro economics - Kinds of Economic Systems - Production Possibility Frontier - Opportunity Cost - Objective of Organizations - Kinds of Organization.

UNIT II DEMAND AND SUPPLY **9 hrs**

Functions of Demand and Supply - Law of diminishing Marginal Utility - Law of Demand and Supply Elasticity of Demand - Demand Forecasting Methods - Indifference curve

UNIT III PRODUCTION AND COST **9 hrs**

Production Function - Returns to Scale - Law of Variable Proportion - Cost and Revenue concepts and Cost Curves - Revenue curves - Economies and Dis-Economies of scale - Break Even point.

UNIT IV MARKET STRUCTURE **9 hrs**

Market Structure - Perfect Competition - Monopoly - Monopolistic - Oligopoly - Components of Pricing - Methods f Pricing - Capital Budgeting IRR - ARR - NPV - Return on Investment - Payback Period.

UNIT V INTRODUCTION TO MACRO ECONOMICS AND FINANCIAL ACCOUNTING **9 hrs**

National Income - Calculation Methods - Problems - Inflation - Deflation - Business Cycle - Taxes - Direct and Indirect Taxes - Fiscal and monetary policies.

FOR FURTHER READING – SEMINAR – CPS **Total: 45 Hrs**

1. Nature and characteristics of Indian Economy
2. Role and functions of Central bank - LPG - GATT - WTO.

Sl. No.	Title of the Book	Author(s)	Publisher
REFERENCES			
R1	Engineering Economics and Financial Accounting	A Ramachandra Aryasri and V VRamana Murthy	Tata McGraw Hill Publishing Company Limited, New Delhi, 2006
R2	Engineering Economics and Financial Accounting	R Kesavan, C Elanchezhianand T Sunder Selwyn	Laxmi Publication Ltd, New Delhi, 2005.
R3	Managerial Economics Concepts and Cases	V L Samuel Paul and G S Gupta	Tata McGraw Hill Publishing Company Limited, New Delhi,1981.
R4	Financial and Management	S N Maheswari	Accounting, SultanChand
R5	rial Economics-Concepts and Cases.	V L Samuel Paul and G S Gupta	-
REFERENCE WEBSITES			
1	www.wikipedia.com		
2	www.NPTEL.com		
3	www.castle.net		

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Course Outcomes (COs): Employability.

After successful completion of the course, students will be able to

Cos	Competency
CO1	Understand the micro and macroeconomic environment for a favorable business environment.
CO2	Apply laws of demand and supply in engineering economy and forecast the demand.
CO3	Analyze the various costs and breakeven point for organizational profitability.
CO4	Discuss the concepts of equilibrium price in different market situations and Capital Budgeting methods.
CO5	Summarize the objectives behind micro economics and financial accounting.
CO6	Explain the concepts of taxation, and Government's economic policies.

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1702ME751 **MECHATRONICS LABORATORY** **L T P C**

0 0 2 1

COURSE OBJECTIVES:

1. To impart knowledge on modeling and simulation of mechatronics system.
2. To provide knowledge on design of fluid power circuit in mechatronic system.
3. To understand the working of microcontroller and PLC in mechatronic systems through experiments.
4. To expose knowledge on force, acceleration and displacement measurements.
5. To gain the knowledge for controlling the position, velocity and force in Mechatronics system.

LIST OF EXPERIMENTS:

1. Modeling and simulation of mechatronics system using MATLAB.
2. Modeling and design of PID controller for Mechatronics system.
3. Study and simulation of various hydraulic and pneumatic components using FLUIDSIM software.
4. Design and testing of fluid power circuits for automatic opening and closing for doors and to control its velocity and direction.
5. Position and speed control of DC Motor using Microcontroller Board.
6. Speed control of Stepper Motor using Microcontroller Interface Board.
7. Measurement of force, acceleration and displacement using Virtual instrumentation.
8. Design of Programmable logic Controller based timer controller for multiple pneumatic cylinder Sequencing in assembly operations.
9. Position and velocity control of pick and place robot arm for loading and unloading Application using robot Programming language.
10. Measurement and control of temperature of an application using Virtual instrumentation

TOTAL: 30 HOURS

Course Outcomes (COs): Employability -

After successful completion of the course, the students will be able to

	Competency	Cognitive level
CO1	1. Develop mathematical model of mechatronics system.	Apply
CO2	2. Simulate fluid power circuit using Simulation software.	Apply
CO3	3. Develop mechatronics system using microcontroller & PLC.	Apply
CO4	4. Measure the force, acceleration and displacement of a system using microcontroller program.	Apply
CO5	5. Control the position, velocity and force of mechatronics system.	Apply
CO6	Acquire about PID temperature control system	Apply

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1702ME752 COMPUTER AIDED MANUFACTURING LABORATORY

L	T	P	C
0	0	2	1

Course Objectives:

- To provide knowledge on modeling and creating tool path of machine components usingcomputeraided manufacturing software.
- To impart part programming knowledge on CNC lathe.
- To expose part programming knowledge on CNC milling.
- To impart part programming for molding die using CNC milling.
- To impart knowledge on developing the prototype by additive manufacturing process.

EXPERIMENT 1 **6 Hours**
To make a flanged coupling to transmit the power from shaft in using CNC machine.

EXPERIMENT 2 **2 Hours**
To impart part programming for a drilling operations using CNC milling software.

EXPERIMENT 3 **2 Hours**
To impart part programming for a pocketing operation using CNC milling software.

EXPERIMENT 4 **2 Hours**
To impart part programming for a contouring operation using CNC milling software.

EXPERIMENT 5 **2 Hours**
To machine a logo of EGSPEC using CNC milling

EXPERIMENT 6 **4 Hours**
To impart part programming for molding die of simple part using CNC milling software.

EXPERIMENT 7 **4 Hours**
To impart part programming for a turning operation using CNC turning software.

EXPERIMENT 8 **2 Hours**
To impart part programming for an undercut operation using CNC turning software.

EXPERIMENT 9 **6 Hours**
Exercise on reverse engineering of pump impeller using 3D printer.

FOR FURTHER READING – SEMINAR – CPS **Total: 30 Hours**

Course Outcomes (COs): Employability | Entrepreneurship

1. Simulate the tool path for circular pats using machining programs.
2. Prepare and execute a part program for the machining component using CNC lathe.
3. Prepare and execute a part program for the machining component using CNC milling.
4. Prepare and execute a part program for the molding die using CNC milling.
5. Build a model using additive manufacturing process.
6. Make use of the features and specifications of CNC machines.

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1703ME026 **SAFETY ENGINEERING** **L T P C**
3 0 0 3

Course Objectives

- To study the principles of safety management system.
- To introduce the provisions contained in the industrial laws.
- To provide knowledge on safety requirements for engineering industry.
- To learn safety requirement for chemical industry.
- To study the various safety measures adopted in construction industries.

UNIT I SAFETY MANAGEMENT **8 Hours**

Concepts - Evolution, International Labour Organization (ILO), National Safety Council, Techniques - Job Safety Analysis (JSA), Safety survey, Safety inspection, Safety Sampling, Accident Investigation and Reporting - Concept of an accident, Accident causation models, cost of accident, investigation, Safety Performance Monitoring - Safety indices.

UNIT II SAFETY AND LAW **10 Hours**

Factory Act 1948-Safety and Health chapters, Tamil Nadu Factories Rules- Safety and Health chapters, Environment and Pollution Laws, Building and other construction works act 1996, Motor Vehicle Rules, Explosive Act 1983, Boiler Act.

UNIT III SAFETY IN ENGINEERING INDUSTRIES **10 Hours**

Safety in metal working machinery and wood working machines, principles, standards and codes - Principles of machine guarding - zero mechanical state (ZMS), types of guards, Personal protective equipments- Safety in handling industrial gases, storage and handling of gas cylinders- Safety in cold forming and hot working of metals- Power press, forging, safety in furnaces, Safety in finishing, inspection and testing, heat treatment, electro plating, leak test, radiography.

UNIT IV SAFETY IN CHEMICAL INDUSTRIES **9 Hours**

Safety in process design, unit operations, pressure vessel, heat exchanger, safety valves -Plant commissioning and inspection, pressure vessel, non-destructive testing, vibration, corrosion Plant maintenance and emergency planning, management of maintenance HAZOP study, ALOHA SOFTWARE.

UNIT V SAFETY IN CONSTRUCTION INDUSTRY **8 Hours**

Causes of fatal accidents, Construction regulations, contractual clauses, permit to work, Quality assurance in construction- Education and training Hazards of construction and prevention- excavation, scaffolding, dismantling, road works, construction of high rise buildings - Working at heights, Occupational Safety and Health Administration (OSHA) requirement for working at heights- Working on fragile roofs, work permit systems- Construction machinery, inspection and testing of cranes, chain pulley blocks, earth moving equipment, conveyors- Manual handling, Safety in demolition work, keys to safe demolition, health hazards from demolition, fire and explosion hazard- Safety in confined spaces.

FOR FURTHER READING – SEMINAR – CPS **Total: 45 Hours**

Case Studies- Major accidents at Flixborough, UK, Seveso, Italy, Victoria Dock, India, Bhopal, India.

Course Outcomes (COs) Employability.

1. Understand safety management system of an industry.
2. Apply the provisions if acts and rules in industries.
3. Implement and review the safety performance followed in various industries
4. Conduct safety appraisal of various industries.
5. Generate safety reports on construction industries.

Reference(s)

1. Blake R.B., Industrial Safety, Prentice Hall, Incorporated, New Jersey,1973.
2. National Safety Council, Accident Prevention Manual for Industrial Operations, Chicago, 1988
3. Subramanian V., The Factories Act, 1948, with Tamil Nadu Factories Rules, 1950, Madras
4. Environmental Pollution Control Act, 1986
5. BOCW Act-1996, Madras Book agency, Chennai-1,1996.
6. http://nptel.ac.in/courses/112107143/40.

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1703ME018	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives

- To impart the knowledge on boilers and steam power plant.
- To learn about the various components associated with steam power plant.
- To study the working of nuclear and hydel power plant.
- To learn about the working of diesel and gas turbine power plant.
- To provide the knowledge on power plants using renewable energy and economics of power plants

UNIT I INTRODUCTION TO POWER PLANTS AND BOILERS 9 Hours

Layout of Steam power plant - Components, Selection. Steam Boilers and Cycles - High Pressure and Super Critical Bo Bed Boilers. Combined Power Cycles. Comparison and Selection.

UNIT II STEAM POWER PLANT 9 Hours

Fuel and Ash Handling - Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precip Mechanical Collectors. Draught - different types. Surface Condenser types. Cooling Towers. Pollution controls.

UNIT III NUCLEAR AND HYDEL POWER PLANTS 9 Hours

Nuclear Energy - Fission, Fusion Reaction. Layout - Types of Reactors, Pressurized Water Reactor, Boiling Water Rea Disposal and safety. Hydel Power Plant - Layout, Essential Elements, pumped storage. Selection of Turbines, Governir

UNIT IV DIESEL AND GAS TURBINE POWER PLANTS 9 Hours

Layout of Diesel Power Plant - Components, Selection of Engine Type, applications. Gas Turbine Power Plant - I ayou Turbine Material. Open and Closed Cycles - Reheating, Regeneration and Intercooling.

UNIT V OTHER POWER PLANTS AND ECONOMICS OF POWER PLANTS 9 Hours

Geo thermal power plant. Ocean thermal energy conversion (OTEC). Tidal power plant. Solar thermal power plant. Wi turbines. Magneto hydrodynamic generator (MHD). Cost of Electric Energy - Fixed and operating Costs, Economics of

FOR FURTHER READING – SEMINAR – CPS Total 45 Hours

:

Renovation and modernization of aged power plants - Maintenance aspects of power plants

Course Outcomes (COs) Employability

1. Understand the working principles of boilers and steam powe plant.
2. Explain the functioning of various components in steam power plant.
3. Understand the working of nuclear and hydel power plant.
4. Expose the working of diesel and gas turbine power plant.
5. Explain the working of renewable power plants and calculate the economics of power plants.

Reference(s)

1. S. C. Arora, S. Domkundwar, A course in Power Plant Engineering, Dhanpatrai & Sons, New Delhi, 2008.
2. K.K. Ramalingam, Power Plant Engineering, Scitech Publications (India) Private Limited, 2002.
3. P. K. Nag, Power plant Engineering, Tata McGraw Hill Company Private Limited, New Delhi, 2014.
4. G. R. Nagpal, Power Plant Engineering, Khanna Publishers, New Delhi, 2002.
5. G. D. Rai, Introduction to Power Plant Technology, Khanna Publishers, New Delhi, 2013.
6. http://nptel.ac.in/courses/108105058/8

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INDUSTRIAL ROBOTICS

L	T	P	C
3	0	0	3

1703ME011

Course Objectives

- To explain the fundamentals and working of robots.
- To describe the importance of drives and end effectors of robots.
- To explain the types of sensors and concept of machine vision system.
- To analyze kinematics of robots and its programming.
- To identify and explain the applications of robots in industries.

UNIT I FUNDAMENTAL OF ROBOTICS **6 Hours**

Robot -Definition -scope of industrial robot - Robotics and Automation - Law of robotics -Robot Anatomy - Co-ordinate Systems, Work Envelope, classification - Specifications - Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load - Need for Robots.

UNIT II ROBOT DRIVE SYSTEM AND END EFFECTORS **9 Hours**

Pneumatic Drives, Hydraulic Drive, Mechanical Drives and Electrical Drives. End Effectors - Grippers - Pneumatic gripper, Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers, and Mechanical Grippers - Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers.

UNIT III SENSORS AND MACHINE VISION SYSTEMS **12 Hours**

Sensors - types - tactile sensors, proximity and range sensors, contact and non contact sensors, velocity sensors, touch and slip sensors, force and torque sensors. Robotic vision systems, imaging components, image representation, picture coding, object recognition and categorization, visual inspection.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING **12 Hours**

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) - Deviations and Problems. Teach Pendant Programming, Lead through programming, Robot programming Languages - VAL Programming - Motion Commands, Sensor Commands, End effecter commands, and Simple programs.

UNIT V IMPLEMENTATION AND APPLICATION **6 Hours**

Implementation of Robots in Industries - Various Steps- Application of robots in machining – Welding Assembly - Material handling - Loading and unloading - hostile and remote environments. Inspection and future application-safety, training, maintenance and quality.

FOR FURTHER READING – SEMINAR – CPS **Total: 45 Hours**

Recent trends and developments in the field of robotics (Evolutionary robots, swarm robots, nano robots, micro robots, medical robots, space robots, wearable robots, intelligent robots, autonomous robots, medical robots, space robots, wearable robots, etc.)

Course Outcomes (COs)

Employability

1. Understand the construction and fundamentals of robots.
2. Select a suitable drive and end effector for robots.
3. Familiarize the concept of machine vision system and sensors.
4. Understand the kinematics of robots and programming of robot.
5. Summarize the usage and applications of robots in industries.

Reference(s)

1. M. P. Groover, Industrial Robotics Technology, Programming and Applications, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2001.
2. D. Richard, Klafter, A. Thomas, Chmielewski and Michael Negin, Robotics Engineering, An Integrated Approach, Prentice Hall of India, New Delhi, 2001.
3. K. S. Fu, R. C. Gonzalez and C. S. G. Lee, Robotics Control, Sensing, Vision and Intelligence, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2003
4. Yoram Koren, Robotics for Engineers, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2004.
5. James G. Keramas, Robot Technology Fundamentals, Cengage Learning, 2011.
6. http://nptel.ac.in/downloads/112101098/

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1704GE751	LIFE SKILLS: COMPETITIVE EXAM PREPARATION	L	T	P	C
		2	0	0	2

Employability | Entrepreneurship | Skill Development

COURSE OUTCOMES

1. To recollect the fundamentals of electrical and electronic systems.
2. To remember the analysis of electrical and electromagnetic theories, electrical circuits, electrical machines and other systems in electrical and electronics engineering.
3. To test the analytical skills of students in the field of electrical circuits, electronics, electrical machines and power systems.

Electric Circuit Analysis: DC Circuits and AC Circuits - Theorems, Transient Analysis of circuits, and Resonance circuits.

Analog and Digital Electronics: Diode, BJT, FET - Device Structures, Circuits and Applications; Logic Gates, Code Converters, Flip Flops, Counters, Analysis and Design of Sequential Circuits, Memory Logic Devices.

Electromagnetic Theory: Divergence Theorem, Stroke's Theorem, Coulombs Law, Gauss Law, Electric and Magnetic Field Intensity, Electric and Magnetic Flux Density, Magnetization and Permeability, Self-Inductance and Mutual Inductances, Maxwell's Equation.

Linear Integrated Circuits: Operational Amplifier – Characteristics, Applications – Inverting & Non-Inverting Amplifier, Summing & Differential Amplifier, Integrator, Differentiator, Oscillators and Signal Converters; Special Function ICs.

Electrical Machines: Generator, Motor and Transformer - Construction, Principle of Operation, Working, Characteristics and Classifications of, testing of electrical machines. Starting of electrical machines.

Electrical Drives and Control: Rectifier, Inverter, Chopper, AC Voltage Controller, Cycloconverter – Modes of Operation, V-I Characteristics, Power Converter Fed Electrical Drives, Closed Loop Operation of Electrical Drives with Speed and Current Controller. Quadrant of Operation of Electrical Drives, Microprocessor / Microcontroller – Instruction Set, Addressing Modes, Interfacing, and Applications in Drives. Linear Control Systems - Stability Analysis, Time and Frequency Response

Power Generation, Transmission and Distribution: Power Generation from Thermal Plants, Hydro Power Plants, Diesel/Gas Plants, Nuclear Plants, Renewable Energy Sources, HVDC and HVAC Transmission Systems, Types of Conductors, Skin and Proximity effects, Classification of Lines, Ferranti Effect, Types and Testing of Insulators, Underground Cables.

Power System Analysis: Load Flow Analysis, Symmetrical Components, Symmetrical and Unsymmetrical Faults, Power System Stability.

TOTAL: 30 HOURS

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1704ME753	MINI PROJECT III (Simulation and analysis)	L	T	P	C
		0	0	2	1

Course Objectives

- To develop skills to formulate a technical project.
- To give guidance on the various tasks of the project and standard procedures.
- To teach use of new tools, algorithms and techniques required to carry out the projects.
- To give guidance on the various procedures for validation of the product and analyse the cost effectiveness.
- To provide guidelines to prepare technical report of the project.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department

Total: 30 Hrs

Employability | Entrepreneurship | Skill Development.

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1703ME012 **RENEWABLE ENERGY SOURCES** **L T P C**
3 0 0 3

Course Objectives

- To learn about solar radiation and solar thermal systems.
- To provide knowledge on fundamentals of Photovoltaic systems.
- To study about the working of ocean and geothermal energy sources.
- To impart the knowledge on wind energy system.
- To learn about bio mass energy sources and its utilization.

UNIT I SOLAR RADIATION AND SOLAR THERMAL SYSTEMS **9 Hours**

Solar radiation at the Earth's surface, solar radiation measurements, solar radiation data, estimation of average solar radiation. Introduction to conversion of solar radiation into heat, flat plate collectors, concentrating collectors – Types.

UNIT II SOLAR PHOTOVOLTAIC SYSTEMS **9 Hours**

Introduction to photovoltaic system, principle of a photovoltaic cell, Voltage current characteristics of a solar cell, interconnection of solar cells, efficiency of a solar cell, configuration of solar photovoltaic panel, photovoltaic cell technology, merits and limitations and its applications.

UNIT III UNIT III OCEAN ENERGY AND GEOTHERMAL ENERGY **9 Hours**

Wave energy - Energy from waves, energy potential. Conversion devices. Tidal energy - energy potential, conversion systems. Ocean thermal energy conversion -Methodology, Applications. Geothermal energy - classification of geothermal resources, schematic of geothermal power plants, operational and environmental problems

UNIT IV WIND ENERGY **9 Hours**

Basic principles of wind energy conversion - classification of wind turbines, Types of rotors. Design of windmills - wind turbine rotor, regulating system for rotor, wind power generation curves, wind data and energy estimation. Site selection considerations - Merits and demerits of wind energy systems

UNIT V BIO-ENERGY **9 Hours**

Biomass resources - Conversion technologies - Biochemical conversion, Biomass gasification, Pyrolysis. Biogas - Production, factors affecting biogas production, biogas plants. Energy recovery from urban waste, power generation from liquid waste, biomass cogeneration, bio-fuels.

FOR FURTHER READING – SEMINAR – CPS **Total: 45 Hours**

Hydrogen energy, Solar production of hydrogen, selection of optimum wind energy generators, power generation from landfill gas, power from satellite stations

Course Outcomes (COs)

Employability.

1. Estimate solar radiation and its conversion into heat using solar collectors.
2. Understand the characteristics of solar photovoltaic system.
3. Expose the working of ocean and geothermal energy sources
4. Estimate wind energy potential and design of wind energy systems.
5. Understand the bio mass energy sources and its conversion technologies.

Reference(s)

1. D. P. Kothari, K. C. Singal and Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, Prentice Hall of India, New Delhi, 2011.
2. Godfrey Boyle, Renewable energy power for sustainable future, Oxford University Press in association with the Open University, New Delhi,2012.
3. S. A. Abbasi and Naseema Abbasi, Renewable energy sources and their environmental impact Prentice Hall of India, New Delhi,2010.
4. John W. Twidell and Anthony D. Weir, Renewable energy resources, English Language Book Society (ELBS), 2015.
5. G. D. Rai, Renewable Energy Sources, Khanna Publishers, New Delhi 2004.
6. http://nptel.ac.in/courses/121106014.

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1703ME015 COMPUTER INTEGRATED MANUFACTURING

Course Objectives

- To introduce the basic concepts of Computer Integrated Manufacturing (CIM).
- To provide knowledge on Group Technology and Computer Aided Process Planning.
- To impart knowledge on Shop Floor Control and Flexible Manufacturing Systems.
- To learn the various CIM implementation and data communication techniques.
- To provide knowledge on the concept of Manufacturing automation protocol, Technical office protocoland databa

UNIT I INTRODUCTION

The changing manufacturing and management scene, External communication, Islands of automation and software, dedicated and open systems, manufacturing automation protocol, introduction to CAD/CAM integration

UNIT II GROUP TECHNOLOGY AND COMPUTER AIDED PROCESSPLANNING

Classification and coding - DCLASS, MICLASS and OPITZ coding systems. Facility design using Benefits of G.T - cellular manufacturing. Process planning, role of process planning in - CAD/CAM integration- approaches tocomputer aided approach and generative approaches.

UNIT III SHOP FLOOR CONTROL AND FMS

Shop floor control phases -factory data collection system -automatic identification methods- Bar code technology - automated data collection system. FMS- components of FMS- types -FMS workstation- material handling andstorage systems- control systems-application and benefits

UNIT IV CIM IMPLEMENTATION AND DATA COMMUNICATION

System modeling tools- ICAM definition (IDEF) models, activity cycle diagram, CIM open system architecture (CIMOSA) wheel- CIM architecture- Product data management, implementation- software. Communication fundamentals- local area net LAN implementations - network
management and installations.

UNIT V OPEN SYSTEM AND DATABASE FOR CIM

Open systems-open system inter-connection - manufacturing automations protocol and technical office protocol- (MAP/TOP).Development of databases -database terminology- architecture of database systems- data modeling anddata associ - database operators - advantages of data base and relational database.

FOR FURTHER READING – SEMINAR – CPS **To**

Paperless factory, introduction virtual reality and applications, virtual prototypingmanufacturing Instrumentatic virtual enterprises.

Course Outcomes (COs) Employability

1. Understand the basic concepts of CIM.
2. Infer the concepts of Group Technology and Computer Aided Process Planning.
3. Identify the suitable method on Shop Floor Control and Flexible Manufacturing Systems.
4. Familiarize the CIM implementation and data communication techniques.
5. Recognize the integration of data communication at various levels of planningmanufacturing.

Reference(s)

1. Mikell P. Groover, Automation of production systems and computer integrated manufacturing, Pearson Education, United States of America, 2008.
2. Lee Kunwoo, Principles of CAD, CAM, CAE systems, Addison Wesley, United States of America, 1999
3. Kant Vajpayee. S, Principles of Computer Integrated Manufacturing, Prentice Hall, New Delhi, 2003
4. Radhakrishnan P, Subramanyan. S and Raju. V, CAD, CAM, CIM, Second Edition New Age International Pvt. Ltd, New Delhi, 2000.
5. Lee Kunwoo, Principles of CAD, CAM, CAE systems, Addison Wesley, United States of America, 1999
6. http://nptel.ac.in/courses/112102101/

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	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

bjectives

- To learn concepts, dimension quality and philosophies of TQM.
- To study the TQM principles and its strategies.
- To impart knowledge on TQM tools for continuous improvement.

INTRODUCTION — 9 Hours

of Quality - Dimensions of Quality - Quality Planning - Quality costs - Analysis Techniques for Quality ic concepts of Total Quality Management - Historical Review - Quality Statements - Strategic Planning. losophy - Crosby philosophy - Continuous Process Improvement - Juran Trilogy, PDSA Cycle, 5S, stacles to TQM Implementation

TQM PRINCIPLES — 9 Hours

t TQM, Leadership - Concepts - Role of Senior Management - Quality Council, Customer satisfaction - erception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement n, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits - Supplier - Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Basic Concepts, Strategy, Performance Measure.

STATISTICAL PROCESS CONTROL (SPC) — 9 Hours

ools of quality - Statistical Fundamentals - Measures of central Tendency and Dispersion, Population and rmal Curve, Control Charts for variables X bar and R chart and attributes P, NP, C, and u charts, samples, Process capability, Concept of six sigma - New seven Management tools

TQM TOOLS — 9 Hours

ing - Reasons to Benchmark - Benchmarking Process, Quality Function Deployment (QFD)- House QFD Process, and Benefits - Taguchi Quality Loss Function - Total Productive Maintenance (TPM) - provement Needs, and FMEA - Stages of FMEA- Case studies

QUALITY SYSTEMS — 9 Hours

equirements of ISO 9000 and Other Quality Systems - ISO 9000:2000 Quality System - Elements, tion of Quality System, Documentation, Quality Auditing, ISO 9000:2008 and 9001:2015, ISO 14000.

THER READING – SEMINAR – CPS — Total: 45 Hours

1. Case Study: TQM Quality and Environmental Concepts in real World Applications
2. Environment Management system

Outcomes

Employability .

1. Understand the concepts, dimension quality and philosophies of TQM.
2. Understand the principles of TQM and its strategies.
3. Apply seven statistical quality and management tools
4. Understand TQM tools for continuous improvement.
5. Understand the QMS and EMS

Ramakrishna. Gas Dynamics, 5th edition, PHI Learning Private Limited, 2013.
N. Gupta and B. Sukhatme, Total Quality Management, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2009.
S. Kumar, Total Quality Management, Laxmi Publications Ltd, New Delhi, 2006
P.N. Mukherjee, Total Quality Management, Prentice Hall of India, New Delhi, 2006.
Dale H. Besterfield, Total Quality Management, Pearson Education Inc., New Delhi, 2003.
https://onlinecourses.nptel.ac.in/noc17_mg18/preview

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1703ME014 **DESIGN OF JIGS, FIXTURES AND PRESS TOOLS**

Course Objectives

- To provide knowledge on design principles for desiging the jigs and fixtures.
- To impart knowledge on locating and clamping principles for designing jigs and fixtures.
- To introduce the different types of jigs for producing the part.
- To study the different types of fixtures for producing the part.
- To introduce about press working terminologies and press accessories.

UNIT I TOOL DESIGN

Objectives, Challenges and Requirements, Production and Inspection Devices. Jigs and Fixtures - Differences,Design principles, Advantages, Essential Features, Materials used. Introduction to Limits, Fits and Tolerances, International Tolerance Grades, Geometric Dimensioning and Tolerancing.

UNIT II LOCATION AND CLAMPING

Location - Principles, Basic rules, Degrees of Freedom, 3-2-1 Principle, Locating Methods, Types of Locators, Standard Parts. Clamping - Principles, Types of Mechanical Actuation Clamps, Pneumatic, Hydraulic, Magnetic,Vacuum, Electrostatic clamping, Epoxy Resin Clamping. Factors considered for Design of Jigs and Fixtures.

UNIT III JIGS

Jigs - Elements, Construction, Types and Materials for Jig Elements. Drill bushes - Types, Special Bushes, Bush Clearance. Automatic drill jig, Rack and pinion operated, Indexing, Air operated Jig components - Design of Jigs forgiven components.

UNIT IV FIXTURES

General Design Principles of Fixture. Types of Boring, Lathe, Milling and Broaching fixtures - Setting Block. Grinding, Planing and Shaping fixtures. Inspection - Gauging, Measuring and Supplement fixtures. Welding,Assembly and Modular fixtures. Design of fixtures for given component.

UNIT V PRESS TOOLS

Mechanical Presses - Working terminology, Elements, Types and Press Accessories. Types of Dies, Punches and Strippers. Pressure pad, Knockouts, Stops and Pilots. Bending, Forming, Drawing and Deep Drawing - Dies and its Types. Spring-back phenomenon and Draw Ratio. Progressive, Combination and Compound Dies. Design and Development of Dies - Blank Development, Strip Layout, Computation of capacities and tonnage requirements.

FOR FURTHER READING – SEMINAR – CPS **Total:**

Analysis of Clamping forces - Tolerance and Error Analysis - Design considerations in forging,extru n, casting and plastic dies.

Course Outcomes (COs) Employability.

1. Understand about the design principles for designing the jigs and fixtures.
2. Identify the suitable locators and clamps.
3. Choose a suitable jig for producing a part.
4. Select a suitable fixture for producing a part.
5. Design suitable Dies and Press tools for Engineering applications.

Reference(s)

1. Edward G. Hoffman, Jig and Fixture Design, Cengage Learning, New Delhi, 2004.
2. C. Elanchezhian, Design of Jigs, Fixtures and Press Tools, Eswar Press, Chennai, 2010.
3. P. H. Joshi, Jigs & Fixtures, Tata McGraw Hill Education Private Limited, New Delhi 2012.
4. Hiram E Grant, Jigs and Fixtures, Tata McGraw Hill Education Private Limited, New Delhi, 2011.
5. C. Donaldson, G. H. Lecain and V. C. Goold, Tool Design, Tata McGraw Hill Education PrivateLimited, New Delhi, 2011.
6. http://nptel.ac.in/courses/112105126/35

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1703ME007 **PROCESS PLANNING AND COST ESTIMATION** **L T P C**
3 0 0 3

Course Objectives

- To introduce the process planning concepts.
- To impart the importance of cost estimation process and procedures.
- To study the procedure to calculate direct, indirect and overhead expenses.
- To learn the procedure to estimate the various machine costs.
- To learn procedure to estimate the machining time for Lathe, drilling, boring, shaping, milling and grinding operations

UNIT I **PROCESS PLANNING** **9 Hours**

Definition - Objective - Scope - Process planning activities - Approaches - Manual, Computer Aided Process planning - Retrieval, Generative and Semi- generative - Selection processes - Machine selection - Material selection parameters - Set of documents for process planning. Production time calculation - Selection of cost optimal processes.

UNIT II **INTRODUCTION TO COST ESTIMATION** 8 Hours

Objectives and functions of Estimating - Costing - Importance and aims of Costing - Difference between Costing and Estimation - Methods of Costing - Types of estimates - Methods of estimates - Importance c Realistic Estimates - Estimating procedure.

UNIT III **ELEMENTS OF COST** **8 Hours**

Introduction - Material Cost - Direct and Indirect - Labour cost - Direct, Indirect and Determination of Direct Labour Cost - Expenses - Direct and Indirect - Analysis of overhead expenses - Administrative expenses - Selling and Distributing expenses - Allocation of overhead expenses- Depreciation - Causes and methods of depreciation.

UNIT IV **PRODUCTION COST ESTIMATION** **10 Hours**

Estimation in forging shop - Losses in forging and forging cost - Problems - Estimation in Gas cutting and welding shop - Material cost, Labour cost and Finish on cost -Problems - Estimation in foundry shop - Pattern cost, Foundry cost and casting cost - Problems

UNIT V **ESTIMATION OF MACHINING TIME** **10 Hours**

Importance of machine time calculations - Estimation of machining time for Lathe, drilling, boring, shaping, milling and grinding operations - Problems

FOR FURTHER READING – SEMINAR – CPS **Total:** 45 Hours

Case studies in Plant Layout design, Equipment selection, and process planning, Cost Evaluation of Layout - Implementation process.

Course Outcomes (COs) Employability.

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

CO1	Describe functions of production control, various production system, different aspects of product development and break even analysis.
CO2	Explain concept of Method study, Motion study and work measurement techniques.
CO3	Interpret analysis of problems in lack of product planning, quantity determination in batch production and analysis of process capabilities in a multi product system.
CO4	Discuss about production scheduling, production control systems, progress reporting and expediting and techniques for aligning completion times and due dates.
CO5	Calculate economic order quantity and economic lot size in inventory control.
CO6	Design route sheet for various machining processes.

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		L	T	P	C
1704ME851	PROJECT VIVA VOCE	0	0	18	9

Course Objectives

- To develop skills to formulate a technical project.
- To give guidance on the various tasks of the project and standard procedures.
- To teach use of new tools, algorithms and techniques required to carry out the projects.
- To give guidance on the various procedures for validation of the product and analyse the cost effectiveness.
- To provide guidelines to prepare technical report of the project.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department

Course Outcomes (COs) Employability | Entrepreneurship | Skill Development

After completion of the course students will be able to

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Perform test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Explain the acquired knowledge through preparation of report and oral presentations.

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