School of Engineering and Applied Sciences

B. Tech Mechanical Engineering

Syllabus

AY: 2018-2022

Department of Mechanical Engineering
SRM University-AP, Andhra Pradesh.

Semester-I					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ENL 101	Communicative English	3	0	0	3
CDC 111	Soft Skills I	1	0	0	1
MAT 112	Mathematics-I	3	0	0	3
PHY 112	Classical Mechanics	2	0	2	3
BIO 101	Introduction To Biology	2	0	2	3
ENG 111	Basic Electronics	3	0	2	4
CSE 102	Basic Computer Science and Programming	3	0	2	4
TOTAL		**17**	**0**	**8**	**21**

Semester-II					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ECO 121	Principles Of Economics	3	0	0	3
CDC 102	Soft Skills-II	1	0	0	1
CHE 101	Principles Of Chemistry	2	0	2	3
ENG 105	Engineering Graphics	2	0	2	3
ENG 101	Engineering Fundamentals	3	0	0	3
ME 103	Mechanical Engineering Tools	0	0	2	1
MAT 121	Multi Variable Calculus	3	0	0	3
PHY 221	Electricity And Magnetism	2	0	2	3
TOTAL		**16**	**0**	**8**	**20**

Semester-III					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ENG 115	Engineering Mechanics	3	0	0	3
MAT 211	Linear Algebra	3	0	0	3
CDC 204	Quantitative Aptitude	1	0	0	1
ME 141	Introduction To Thermodynamics	3	0	2	4
ME 121	Material Science and Metallurgy	2	0	2	3
ENV 111	Environmental Science	2	0	2	3
ME 225	3D Printing	0	0	2	1
BME 001	Hs Elective- Industrial Organization & Management	3	0	0	3
TOTAL		**17**	**0**	**8**	**21**

Semester-IV					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ME 221	Strength Of Materials	3	0	2	4
ME 172	Kinematic And Mechanisms	3	0	2	4
ME 222	Fluid Mechanics	3	0	2	4
CSE 230	Industry Standard Coding Practice-I	0	0	4	1
MAT 131	Differential Equations	3	0	0	3
ME 230	Alternative Energy Sources	3	0	0	3
MAT 221	Probability And Statistics	3	0	0	3
CDC 203	Verbal Ability	1	0	0	1
TOTAL		**20**	**0**	**8**	**23**

Semester-V					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ME 224	Machine Design	3	0	2	4
ME 226	Measurement And Instrumentation	3	0	2	4
ME 132	Numerical Methods	3	0	2	4
	Open Elective	3	0	0	3
	Open Elective	3	0	0	3
ME 201	University Research Opportunity	0	0	4	2
CSE 330	Industry Standard Coding Practice-2	0	0	4	1
CDC 331	Employability Skills	1	1	0	0
	TOTAL	**16**	**1**	**14**	**21**

Semester-VI					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ME 230	Heat And Mass Transfer	3	0	2	4
ME 322	Manufacturing Technology	3	0	2	4
ME 272	Dynamics And Control	3	0	2	4
ME 321	Fluid Machinery	3	0	2	4
ISES 312	Industry Specific Employability Skills-VI	1	1	0	0
CSE 331	Industry Standard Coding Practice-3	0	0	4	1
ME ME 405 ME 417 ME 406	**ME ELECTIVE** Mechanics Of Composite Materials Compressible Flow Computational Fluid Dynamics	3	0	0	3
	Open Elective	3	0	0	3
	TOTAL	**19**	**1**	**12**	**23**

Semester-VII					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ME 450	Multidisciplinary Design Project	0	0	4	2
ME ME 409 ME 430 ME 410 ME 415	**ME ELECTIVE** Thermal Design of Electronic Equipment's Mechatronics Thermal Power Engineering Refrigeration And Air Conditioning	 3 3 3 3	 0 0 0 0	 0 0 0 0	 6
	Open Elective	3	0	0	3
	Open Elective	3	0	0	3
ME 451	Seminar	0	0	2	1
	TOTAL	**12**	**0**	**6**	**15**

Students need to select 2 ME Electives out of 4

Semester-VIII					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ME 602	Design Project/Industrial Project	0	0	30	15
	TOTAL	**0**	**0**	**30**	**15**

List of Open Electives in V-Semester					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CSE 205	Object Oriented programming with Java	3	0	0	3
CSE 205 L	Object Oriented Programming with Java Lab	0	0	2	1
ECE 313	Microprocessors and Interfacing	3	0	2	4
EEE 101	Fundamentals of Electrical Engineering	3	0	0	3
ME 401	Computer Aided Design and Manufacturing	3	0	0	3
CHE 123	Polymer Materials	4	0	0	4
CSE 311	Introduction to Machine Learning	3	0	2	4
ME 407	Thermal Power Engineering	3	0	0	3
PHY 303	Solid-state Physics	3	0	2	4
MAT 304	Partial Differential Equations	4	0	0	4
BIO 110	Microbiology	3	0	0	3
CHE 202	Renewable Energy	3	0	0	3
BIO 310	Biochemistry	3	0	0	3
HIS 102A	Human Civilizations	4	0	0	4
JOU 406	Basics of Media and Nationalism	3	0	0	3
EGL 102	Technical Writing	4	0	0	4
PSY 111	Psychology for Everyday Living	4	0	0	4
PHY 302	Electrodynamics	3	0	2	4
MAT 305	Introduction to Science and Technology studies	4	0	0	4
BIO 111	Evolution and Organismal Biology	3	0	0	3
CHE 201	Fundamentals of Nanoscience	3	0	0	3
HIS100	Idea of India	4	0	0	4
IDEA 101	Entrepreneurship Lecture Series	3	0	0	3
IDEA 102	Design Thinking	3	0	0	3

List of Open Electives in VI Semester					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CSE 202	Web Technology	3	0	0	3
CSE 202 L	Web Technology Lab	0	0	2	1
ME 228	Manufacturing Science	3	0	0	3
ME 416	Surface Engineering	3	0	0	3
ME 562	Mechanical Behavior of Materials	3	0	0	3
ME 223	Alternate Energy Sources	3	0	0	3
PHY 307M	Special Theory of Relativity	3	0	2	4
PSY 111	Psychology for Everyday Living	4	0	0	4
HIS 200	India and Its People	4	0	0	4
HIS 005	Introduction to Gender	4	0	0	4
MAT 355	Calculus of Variation	4	0	0	4
IDEA 103	User Experienced Design	3	0	0	3
IDEA 104	Dream-Discover-Disrupt	3	0	0	3
MOOC100	Introduction to Robotics	3	0	0	3
MOOC101	Psychology of Stress, Health and Well-being	3	0	0	3
MOOC102	Introduction to Film Studies	3	0	0	3
MOOC103	German - I	3	0	0	3

List of Open Electives in VII-Semester					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
CSE 202	Web Technology	3	0	0	3
CSE 202 L	Web Technology lab	0	0	2	1
ECE 418	Machine Learning	3	0	2	4
EEE 422	Optimization Techniques	3	0	0	3
ME 418	Introduction to Electric Vehicles	3	0	0	3
IDEA 102	Design Thinking	3	0	0	3
MAT 305	Introduction to Science and Technology	4	0	0	4
PSY 116	Neuro Linguistic Programming - Level I	3	0	0	3
BIO 112	Basic Microbiology	4	0	0	4
PHY 223	Introduction to Quantum Computations	3	1	0	4
HIS 005	Introduction to Gender	3	0	0	3
ECO 251	Indian economy	4	0	0	4
EGL 167	Code Name Language	4	0	0	4
TLC 101	Cognitive Learning Theories	2	1	0	3
EEE 305	Advanced Control Systems	3	0	0	3
EEE 305 L	Advanced Control Systems lab	0	0	2	1
MAT 307	Combinatorics and graph theory	4	0	0	4
PHY 301	Atomic and Molecular Physics	3	0	0	3
COM 101	Business Organization and Management	3	0	0	3
COM 107	Finance for Engineering	3	0	0	3
JOU 001	Media through the ages: From print to social	3	0	0	3
CSE 411	Big Data Analytics	3	0	2	4
EEE 421	Linear Systems	3	0	0	3
ME 433	Introduction to High Performance Computing	3	0	0	3
MAT 355	Calculus of Variation	4	0	0	4
MAT 306	First course in cryptography	4	0	0	4
BBA 606	Corporate Social Responsibility	3	0	0	3
BIO 113	Biochemistry I - Biomolecules	4	0	0	4
PHY 224	Introduction to Optics	3	0	0	3
HIS 100	Idea of India	4	0	0	4
TLC 102	Teaching and Learning	3	0	0	3
EGL 333	Thing Theory	4	0	0	4
COM 108	Investment Analysis	3	0	0	3
BBA 304	Human Resource Management	4	0	0	4
IDEA 104	Dream Discover Disrupt	3	0	0	3

List of Electives					
Course Code	**Course Name**	**L**	**T**	**P**	**C**
ME 401	CAD-CAM	3	0	0	3
ME 402	Multibody Dynamics	3	0	0	3
ME 405	Mechanics of composite materials	3	0	0	3
ME 406	Computational fluid dynamics	3	0	0	3
ME 408	Advanced materials	3	0	0	3
ME 409	Thermal design of electronic equipment's	3	0	0	3
ME 410	Thermal Power Engineering	3	0	0	3
ME 411	Artificial intelligence and expert systems	3	0	0	3
ME 412	Additive manufacturing process	3	0	0	3
ME 413	Design and modeling aspects of am	3	0	0	3
ME 415	Refrigeration and air conditioning	3	0	0	3
ME 416	Surface engineering	3	0	0	3
ME 417	Compressible flow	3	0	0	3
ME 418	Introduction to electric vehicles	3	0	0	3
ME 427	Robotics	3	0	0	3
ME 430	Mechatronics	3	0	0	3
ME 433	Introduction to high performance computing	3	0	0	3
ME 434	Elements of mechatronics	3	0	0	3
ME 435	Fundamentals of hydraulics and pneumatics	3	0	0	3
ME 436	Industrial tribology	3	0	0	3
ME 437	Process planning and cost estimation	3	0	0	3
ME 438	Internal combustion engines	3	0	0	3
ME 439	Industrial engineering	3	0	0	3
ME 440	Advanced fluid mechanics	3	0	0	3
ME 441	Operations Research	3	0	0	3
ME 442	Advanced Engineering Thermodynamics	3	0	0	3
ME 443	Finite element methods	3	0	0	3
ME 444	Micro controller and its application in robotics	3	0	0	3
ME 445	Machinery fault diagnostics and signal processing	3	0	0	3
ME 446	Advanced strength of materials	3	0	0	3
ME 447	Computer Graphics	3	0	0	3
ME 448	Automotive engineering	3	0	0	3
ME 449	Fatigue, fracture mechanics and creep	3	0	0	3
ME 452	Flexible manufacturing systems	3	0	0	3
ME 453	Combustion engineering	3	0	0	3
ME 454	Gas turbine technology	3	0	0	3
ME 455	Fuel cell technology	3	0	0	3
ME 456	Advanced thermodynamics	3	0	0	3
ME 457	Fundamentals of Vibration and Noise	3	0	0	3
ME 458	Gas Dynamics and Space Propulsion	3	0	0	3
ME 459	Design of Transmission Systems	3	0	0	3
ME 460	Additive manufacturing technology	3	0	0	3

SEMESTER-I

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ENL 101	Communicative English	HS	3	0	0	3

UNIT I: RHETORIC AND PUBLIC SPEAKING
Rhetoric, Critical Thinking and Public Speaking; Thinking Outside the Box; How to Deliver a Speech; Fundamentals of Persuasion.

UNIT II: NONVERBAL COMMUNICATION
Nonverbal Communication; Spatial distance, Eye contact and appearances; How nonverbal communication is more important than words.

UNIT III: COMMUNICATION AND THE MEDIA
Persuasion and the media; Radio, television, film, social media and the internet; How the media sells ideas, images. Products and lifestyles; Fundamentals of Informative/Scientific. Speeches and Research; The Heart of the Speech – Powerful Narratives; The Power of Narrative.

UNIT IV: SMALL GROUP COMMUNICATION
Small group communication; Leadership, Conflict and persuasion in groups. The importance of small groups in business. Dr. A. Fisher's Fundamentals of Small Groups; Group Problem Solving; Learning to say no – don't say you will when you won't. Don't say yes and then don't do it, be true to your word.

UNIT V: PERSUASION, IDEOLOGY AND MEDIA BIAS
Advanced Rhetoric, Ideology, Persuasive Fallacies, How to Construct a Persuasive Speech, How to Present Scientific Data in a Speech, Unmasking Media Bias and Ideology, Full circle – the dangers of rhetoric and ideology.

TEXTBOOKS/REFERENCES

1. Communication: Principles for a Lifetime. Beebe, Beebe and Ivy, 6th Edition, Pearson Publishing.
2. Qualitative Communication Research Methods (2011) Bryan C. Taylor and Thomas R. Lindlof. Sage Publications, New Delhi, India, 3rd Edition.
3. The Fundamentals of Small Group Communication (2008) Scott A. Myers and Carolyn M. Anderson. Sage Publications, New Delhi, India.

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CDC 111	Soft Skills-I	HS	1	0	0	1

UNIT I: KNOW THYSELF
Grooming & Social etiquette.

UNIT II: PERSONALITY DEVELOPMENT
Personality construct, The KSAB Model, Components of perception, perceptual errors, perception as a precursor of attitude and behavior.

UNIT III: COMMUNICATION
The 3 Vs of communication: Visual or Kinesics, Vocal (Articulation), Verbal, Active listening, Barriers to listening, GARF (Giving and Receiving Feedback).

UNIT IV: PRESENTATION SKILLS
The four Ps of presentation, Handling different types of target audience. Techniques and Tips to give an effective presentation. Activity.

UNIT V: TIME MANAGEMENT & GOAL SETTING
Pressure Cooker (Activity based on Planning, Organizing and Prioritization), Roller Coaster (Activity on setting SMARTER goals, planning & organizing, short- & long-term goals). Activity.

TEXTBOOKS

1. The Perception of Deception, David Icke, David Icke Books, 2014,
2. Eye and Brain: The Psychology of Seeing, Richard, Langton Gregory, Princeton University Press, 1997.
3. Awaken the Giant Within, Anthony Robbins, Pocket Books, 2001

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 112	Mathematics-I	BS	3	0	0	3

UNIT I: LIMIT AND CONTINUITY
Limit of a function at a point, one-sided limits, continuity, limits involving infinity.

UNIT II: DIFFERENTIATION
Derivative at a point, derivative as a function, product rule, quotient rule and chain rule, implicit differentiation, Rolle's theorem, mean value theorem.

UNIT III: INTEGRATION
Area as a limit of finite sums, definite and indefinite integral, fundamental theorem of calculus, integration by substitution, integration by parts, integration by partial fractions.

UNIT IV: APPLICATION OF CALCULUS
Maxima and minima, concavity and curve sketching, optimization problems in physics, economics & mathematics, area between curves, volumes, arc length, moments and centers of mass, newton's method to find roots.

UNIT V: SEQUENCE AND SERIES
Sequences, sum of a series, comparison test, root test, ratio test, leibniz theorem on alternating series, power series, taylor's and maclaurin series, absolute and conditional convergence.

TEXTBOOKS/REFERENCES

1. Thomas' Calculus, 14th Edition, Joel R. Hass,Christopher E. Heil, Maurice D. Weir, 2018.
2. Introduction to Real Analysis 4th Edition, Robert G. Bartle, Donald R. Sherbert, 2014.
3. Calculus and Analytic Geometry, 9th Edition, George B. Thomas, Jr. Ross L. Finney. 2017.

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PHY 112	Classical Mechanics	BS	2	0	2	3

UNIT I: REVIEW OF NEWTONIAN MECHANICS

Review of Scalars, Vectors, Kinematics: Equations of motion for constant acceleration and non-constant acceleration, Dynamics: Contact forces, Static friction, kinetic friction and worked examples, Free body force diagram; Applications of Newton's law. Worked examples, Tension, Pulley systems, worked examples, solving various pulley systems using free body force diagram and Newton's law.

UNIT II: CIRCULAR MOTION

Polar Coordinates; conversion between Cartesian and polar coordinates, Angular position, velocity and acceleration. Angular motion for a constant angular acceleration, Radial and tangential acceleration, uniform Circular Motion, Period and Frequency, Free body force diagrams; Application of Newton's law in circular motion with worked examples. Worked examples, conversion from revolution per minute to angular velocity. Worked examples, Flat curved roads and Banking, Conical pendulum, circular motion in vertical plane.

UNIT III: MOMENTUM AND IMPULSE

Momentum and Impulse, Impulse momentum theorem, Average force, worked examples, Conservation of Momentum, Momentum Diagrams, worked examples, Center of Mass of point objects and continuous systems, worked examples, Center of Mass of a Uniform Rod, rectangular sheet and different objects, Motion of the Center of Mass; Velocity and Acceleration of the Center of Mass, Reduction of a System to a Point Particle, Center of Mass Trajectory, projectile blast problem.

UNIT IV: WORK ENERGY AND COLLISION

Kinetic Energy and Work in 1D, 2D and 3D; Work by a Constant and a non- Constant Force, Work-Kinetic Energy Theorem and worked examples, Conservative and Non-conservative Forces with examples, Potential Energy due to gravity and Potential Energy of a spring, Principle of energy conservation; worked examples, Collision and its type. Collision in 1D and 2D, Elastic and inelastic collision; worked examples.

UNIT V: ROTATIONAL MOTIONS, GRAVITATION

Rigid body, Rotational Motion, moment of inertia, Moment of inertia of various objects, worked examples, Parallel and perpendicular axis theorem, Torque and Angular momentum, conservation of angular momentum, worked examples, rolling motion, worked examples, Conservation of energy in rotational motion, Central forces, Newton's Law of Gravitation, Acceleration due to gravity and its variation, Gravitational Potential Energy.

TEXTBOOKS/REFERENCES

1. MIT-- 8.01X online course material.
2. Physics for Scientist and Engineers, Ninth edition (2017) - Raymond A. Serway, John W. Jewett (Publisher - Cengage India Private Limited).
3. University Physics with Modern Physics with Mastering Physics, (12th Edition) - Hugh D. Young, Roger A. Freedman and Lewis Ford (Publisher – Pearson Education).
4. Laboratory manuals.

LIST OF EXPERIMENTS

1. Experimental data analysis.
2. Error Analysis.
3. Revisions of Vernier caliper.
4. Revisions of Screw Gauge.
5. Determination of Young's modulus of the material.
6. Determination of rigidity modulus of the material - torsional pendulum.
7. Determine moment of inertia of a flywheel.
8. Determination of spring constant.
9. Compound Pendulum.
10. Determination of velocity of Sound in a medium.
11. Determination of thermal conductivity of a given material.
12. Measurement of specific heat capacity of any given material.
13. Verification of Stefan`s Law.
14. Determination of Joule's Constant.

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
BIO 101	Introduction to Biology	BS	2	0	2	3

UNIT I: BASIS OF LIFE AND DIVERSITY

Molecular evolution, elements to molecules: water, carbohydrates, lipids, proteins, nucleic acids, vitamins and minerals. Diversity of life: virus, bacteria, archea and eukarya. Concept of terrestrial, aquatic and amphibians. Mode of energy & carbon utilization-auto, hetero and lithotrophs.

UNIT II: CELL BIOLOGY

cell: Morphology, cell organelles and functions. concept of unicellular and multicellular organisms. Cell cycle and cell division: mitosis and meiosis. basis of cell-cell communication and signaling.

UNIT III: MOLECULAR BIOLOGY

DNA and chromosomes: structure and organization, DNA replication, transcription, translation. Introduction to genetic engineering.

UNIT IV: ENZYMES AND APPLICATIONS

Introduction to enzymes; classification, parameters influencing the enzyme activity, mechanism of enzyme action and enzyme inhibition. Commercial applications of microorganisms and enzymes.

UNIT V: BIOLOGICAL SEQUENCES AND DATABASES

DNA and Protein sequences, Concept of genomics, transcriptomics, proteomics and metabolomics. File formats of sequence storage: FASTA file, GenBank. Biological databases – NCBI and EMBL browsers, KEGG and UniProt databases. Usefulness of biological Metadata-Array expression and 1000 genomes. Application of BLAST and Protein/Gene ID conversion.

TEXTBOOKS

1. Thrives in Biochemistry and Molecular Biology, Edition 1, 2014, Cox, Harris, Pears, Oxford University Press.
2. Exploring Proteins, Ed. 1, 2014, Price and Nairn,Oxford University Press.
3. Thrives in Cell Biology, Ed. 1, 2013, Qiuyu Wang, Cris Smith and Davis, Oxford University Press.

REFERENCES

1. Lehninger,A. L., Nelson, D.L., &Cox, M. M. Lehninger principles of biochemistry. (2000). Worth Publishers, New York.
2. Wilson, K.,Walker, Principle and techniques of biochemistry and molecular biology,(2005). 6thedn. Cambridge University Press, Cambridge.
3. Harvey Lodish, Arnold Berk and Chris A. Kaiser, Molecular Cell Biology, Ed. 8, 2016, W. H Freeman & Co (Sd).
4. Bruce Alberts, Alexander D. Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter. 2014. Molecular Biology of the Cell. (Sixth Edition). W. W. Norton & Company.

5. Scott Freeman, Kim Quillin, Lizabeth Allison, Michael Black, Emily Taylor, Greg Podgorski and Jeff Carmichael. 2016. Biological Science. (6th Edition). Pearson.
6. Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander D. Johnson, Julian Lewis, Martin Raff, Keith Robert and Peter Walter. 2014. Essential Cell Biology. (4th Edition). W. W. Norton & Company.
7. Lisa A. Urry , Michael L. Cain , Steven A. Wasserman , Peter V. Minorsky , Jane B. Reece. 2016. Campbell Biology (11th Edition). Pearson.
8. Peter H Raven, George B Johnson, Kenneth A. Mason, Jonathan Losos and Susan Singer. 2016. Biology. (11th Edition). McGraw-Hill Education.

LIST OF EXPERIMENTS

1. Isolation of starch from potato.
2. Estimation of carbohydrates.
3. Determination of enzyme activity (amylase assay).
4. Observation of various stages of mitosis in onion root tips.
5. Isolation, purification and observation of microbes from different sources.
6. Microbial gram staining.
7. Purification of DNA, restriction digestion, agarose gel electrophoresis and visualization.
8. Isolation of proteins and determination of protein concentration using Bradford's method.
9. Separation of proteins using SDS-PAGE and Coomassie staining.

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ENG 111	Basic Electronics	ES	3	0	2	4

UNIT I: ELECTRICAL QUANTITIES AND THEIR MEASUREMENTS

Ohm's law, Permanent magnet, ammeter, voltmeter, Measurement of resistance using Wheatstone bridge, Measurement of capacitance using different methods, Measurement of inductance using different methods.

UNIT II: SEMICONDUCTOR DEVICES

Forward and reverse bias of PN junction diode, Half wave, full wave bridge rectifiers, Bipolar junction transistors, Transistor as amplifier and buffer, photodiode/phototransistor.

UNIT III: AC CIRCUITS AND AMPLIFIERS

Phasor analysis, impedance, reactance, resonance, RLC, characteristics of amplifiers, Integrator and differentiator design, Differential operational amplifier, Parallel and series reactance Common mode rejection ratio.

UNIT IV: ELECTRONIC FILTERS

Low and high frequency noise in electronic circuits, Low pass, high pass, band pass filters, Fourier transform, bode plot, bandwidth, Higher order filters, Applications of filters.

UNIT V: DIGITAL LOGIC FUNDAMENTALS

Different number systems, Logic gates AND OR NOT NOR X-OR X-NOR, Adders/subtractors, multiplexers, D'morgan laws.

TEXTBOOKS/REFERENCES

1. Principles of electronics by V K Mehta & Rohit Mehta, 2010 edition, S Chand and Co. Publisher, ISBN: 9788121924504.
2. Electronic devices and circuits by David A. Bell, 2008 edition, Oxford University Press, ISBN: 9780195693409.
3. Introduction to digital logic design by John P. Hayes, 1993 edition, Pearson Edition, ISBN: 9780201154610.
4. Electronic measurements and Instrumentation by A K Sawhney, 2015 edition, Dhanpat Rai and Co., ISBN: 9788177001006.

LIST OF EXPERIMENTS

1. Verification of KCL, KVL and Ohm's Laws.
2. Analysis of a Given Circuit with Resistors and Sources and Verification.
3. Verification of PN Junction Diode I-V Characteristics in FB and RB Operation.
4. Diode based Rectifier Circuits.
5. Introduction to PCB design.
6. Diode based Clipper and Clamper Circuits.
7. Zener Diode as Voltage Regulator.
8. BJT CE Configuration Input and Output Characteristics.
9. MOSFET CS Configuration Input and Output Characteristics.
10. MOSFET Single stage CS Amplifier Frequency Response.

SEMESTER-I

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 102	Basic Computer Science and Programming	ES	3	0	2	4

UNIT I: INTRODUCTION TO PYTHON

Knowledge, Machines, Languages, Types, Variables Operators and Branching -– Core elements of programs: Bindings, Strings, Input/Output, IDEs, Control Flow, Iteration, Guess and Check – Simple Programs: Approximate Solutions, Bisection Search, Floats and Fractions, Newton-Raphson.

UNIT II: FUNCTIONS

Decomposition and Abstraction, Functions and Scope, Keyword Arguments, Specifications, Iteration vs Recursion, Inductive Reasoning, Towers of Hanoi, Fibonacci, Recursion on non-numeric, Files.

UNIT III: TUPLES AND LISTS

Tuples, Lists, List Operations, Mutation, Aliasing, Cloning – Dictionaries: Functions as Objects, Dictionaries, Example with a Dictionary, Fibonacci and Dictionaries, Global Variables – Debugging: Programming Challenges, Classes of Tests, Bugs, Debugging, Debugging Examples– Assertions and Exceptions, Assertions, Exceptions, Exception Examples.

UNIT IV: CLASSES AND INHERITANCE

Object Oriented Programming, Class Instances, Methods Classes Examples, Why OOP, Hierarchies, Your Own Types – An Extended Example: Building a Class, Visualizing the Hierarchy, adding another Class, Using Inherited Methods, Gradebook Example, Generators.

UNIT V: COMPUTATIONAL COMPLEXITY

Program Efficiency, Big Oh Notation, Complexity Classes Analyzing Complexity – Searching and Sorting Algorithms: Indirection, Linear Search, Bisection Search, Bogo and Bubble Sort, Selection Sort, Merge Sort.

TEXTBOOKS/REFERENCES

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher, Revised and Expanded version (Referred by MIT)
2. Python Programming using problem solving Approach by Reema Thareja, Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173.
3. Data Structures and Algorithms in Python by Michael T Goodrich and Robertto Thamassia, Micheal S Goldwasser, Wiley Publisher (2016).

LIST OF EXPERIMENTS

1. A company decided to give bonus of 5% to employee if his/her year of service is more than 5 years. Ask user for their salary and year of service and print the net bonus amount.
2. Write a program that computes the real roots of a quadratic function. Your program should begin by prompting the user for the values of a, b and c. Then it should display a message indicating the nature of real roots, along with the values of the real roots (if any).
3. Write a Python program to find the factorial of the given number (Example: 5!= 5*4*3*2*1 =120)
4. Write a Python program to read the numbers from the keyboard using a loop, perform the sum and average of all the input numbers until "-10" is encountered.
5. Write a Python program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings.
6. Write a python program for bubble sort algorithm. What is the best case and worst-case time complexity of Bubble sort algorithm? Explain with an example, where the list of elements is not sorted then what would be the output after each iteration/pass.
7. Write a python program for Selection sort algorithm. What is the worst case or average case time complexity of selection sort algorithm?
8. Write a Program in python using object-oriented concept to make calculator which has the following operations: Addition, Subtraction, Multiplications, Divisions, Exponentials, Modulus.
9. Define is inheritance? Explain with suitable example: Single level inheritance, Multiple Inheritance, Multi-level Inheritance.
10. Write a Program in python using object-oriented concept to create a base class called Polygon and there are three derived classes named as triangle, rectangle and square. The base class consists of the input function for accepting sides length and the derived classes must have output function for displaying area of triangle, rectangle and square.

SEMESTER-II

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECO 121	Principles of Economics	HS	3	0	0	3

UNIT I: INTRODUCTION TO ECONOMICS

Why study economics? Scope and method of economics; the economic problem: scarcity and choice; the question of what to produce, how to produce and how to distribute output, Science of economics; the basic competitive model; prices, Property rights and profits; incentives and information; rationing, Opportunity sets; economic systems; reading and working with graphs.

UNIT II: DEMAND AND SUPPLY

Determinants of individual demand/supply; demand/supply schedule and demand/supply curve; market versus individual demand/supply. Shifts in the demand/supply curve, demand and supply together. How prices allocate resources, elasticity and its application. Controls on prices; taxes and the costs of taxation. Consumer surplus; producer surplus and the efficiency of the markets.

UNIT III: CONSUMER THEORY

The consumption decision - budget constraint, the consumption decision - budget constraint, consumption and income/price changes, Demand for all other goods and price changes, Utility and preferences (indifference curves); properties of indifference curves, Consumer ‘s optimum choice, Income and substitution effects, Applying consumer theory: Labour.

UNIT IV: PRODUCER THEORY

Production, short- run production function and returns to factor, Average-marginal relationship, Long– run production function and laws of return to scale- role of technology, Cost function and cost structure of a firm in the short- run, Long run cost function and cost structure.

UNIT V: TYPES OF MARKET

Perfect competition -features, Perfect competition- profit maximization, Shut-down and break-even points. Monopoly: marginal revenue; marginal cost; profit maximization. Shutdown rule; market power; price discrimination. Monopolistic competition and product differentiation.

TEXTBOOKS/REFERENCES

1. Principles of microeconomics, N. Gregory Mankiw, Publisher: Cengage Learning fifth edition.
2. Perloff, Jeffrey M. Microeconomics. 5th ed. Addison Wesley, 2008. ISBN: 9780321558497.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CDC 102	Soft Skills-II	HS	1	0	0	1

UNIT I: MOTIVATION
Maslow's theory of Motivation Soldiers' Walk and The Japanese Fan (Activities on factors of motivation), Steps to ward off de-motivation.

UNIT II: CREATIVITY AND INNOVATION
Short Film: Students would be encouraged to make at en-minute documentary on various topics to enhance the power of aesthetics and precision, this activity is aimed at creating an interest in research and think out of the box.

UNIT III: CRITICAL AND LATERAL THINKING
Fill Me Up, Stimulating Lateral Thinking. The Curious Case of Mary and Kevin (Activities triggering the different types of thinking), The Creative Collage. Critical and lateral thinking can be inculcated with a structured re programming of the neural pathways, these specially designed activities will enhance critical and lateral thinking.

UNIT IV: TEAM DYNAMICS
Story boarding, Frenzy. Come to my Island, Striking Cars. Defend the Egg, Tallest Tower: Activities on the different stages of team building, Team communication, coordination and collaboration.

UNIT V: MINI PROJECT
Individual projects on topics provided by faculties.

TEXTBOOKS/REFERENCES

1. Maslow, A. H. (1943) A Theory of Human motivation. In R. J. Lowry (1973) Dominance, Self-Esteem, Self-Actualization: Germinal Papers of A.H. Maslow (pp. 153-173). Belmont, California: Wadsworth Publishing Company, Inc.
2. Sparking Student Creativity, Practical ways to promote innovative and problem solving, Patti Drapeau.
3. Teach yourself to think, Edward de Bono, 1995.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CHE 101	Principles of Chemistry	BS	2	0	2	3

UNIT I: CHEMICAL BONDING

Ionic, covalent, metallic bonds and hydrogen bonding, Theories of bonding: Hybridization: Types of hybridization, sp, sp2, sp3, sp3d, d2sp3. Shapes of molecules (VSEPR Theory): BeCl2, CO2, BF3, H2O, NH3, CH4, PCl5, XeF2,SF6, XeF4. Molecular orbital theory: Linear combination of atomic orbitals (LCAO Method), bond order, homo-nuclear diatomic molecules such as H2, O2, N2.

UNIT II: PHASE RULE, THERMOCHEMISTRY, AND KINETICS

Definition of the terms used in phase rule with examples, Application of phase rule to one component system (eg Water), Application of phase rule to two component system (eg Pb-Sn), Standard terms in thermochemistry and their significance, Heat of combustion, formation and sublimation (with examples in fuels and propellants), Order and molecularity of reactions, zero order, first order rate equations, Problems associated with Zero & First order reactions.

UNIT III: CRYSTALLINE MATERIALS

Introduction to solid state materials, difference between crystalline and amorphous systems, Properties of crystalline materials, Crystal lattice, unit cells, types of crystal systems, types of unit cells (Bravais lattices), Miller indices, Bragg's law, Problems associated theoretical density of crystals and Bragg's equation, Introduction to Band theory, metals, insulators, and semiconductors with examples, Classification of semiconductors, imperfections in crystals, Frenkel and Schottky defects, doping and devices.

UNIT IV: MATERIALS CHEMISTRY

Introduction to Polymers, Classification of polymers, Thermoplastic and Thermosetting polymers with examples, Tacticity of polymers, Properties of polymers: Glass transition temperature (Tg), Properties of polymers: Molecular weight, weight average, Problems associated with Molecular weight, weight average, Degradation of polymers and biodegradable polymers, Common Polymers: Elastomer, Conducting polymer, Hardness in water, demineralization of water, Water treatment: Zeolite process.

UNIT V: ELECTROCHEMICAL DEVICES

Introduction to Electrochemical cells and classification of Electrochemical cells, Primary and secondary cells with examples, Lead-acid battery and Li+ batteries, Li+batteries and Fuel cells.

LIST OF EXPERIMENTS

1. Volumetric titration of HCl vs NaOH.
2. Conductometric titration of HCl vs NaOH.
3. Standardization of potassium permanganate by Oxalic acid.
4. Iodometric Determination of Ascorbic Acid (Vitamin C).
5. Determination of hardness of water by EDTA method.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Estimation of iron content of the given solution using potentiometer.
8. Determination of sodium and potassium by flame photometry.

TEXTBOOKS/REFERENCES

1. A. Bahl, B.S. Bahl, G.D. Tuli, Essentials of Physical Chemistry, (2016), S Chand Publishing Company.
2. B. R. Puri, L. R. Sharma & M. S. Pathania, Principles of Physical Chemistry, 46th Edition (2013), Vishal Publication Company.
3. D. F. Shriver, P. W. Atkins and C. H. Langford, Inorganic Chemistry, 3rd Ed., Oxford University Press, London, 2001.
4. V. R. Gowariker, N. V. Viswanathan, J. Sreedhar, Polymer Science, New Age International, 1986. ISBN: 0-85226-307-4.
5. Atkins, P.W.; de Paula, J. (2006). Physical chemistry (8th ed.). Oxford University Press. ISBN 0-19-870072-5.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ENG 105	ENGINEERING GRAPHICS	ES	2	0	2	3

UNIT I: PROJECTION OF POINTS, LINES, PLANES, SOLIDS
Projection of points, Projection of lines, Projection of planes, Projection of solids, Use of software tool to create projections.

UNIT II: SECTIONS AND DEVELOPMENTS
Sections of solids, True shape of the section, Development of surfaces of sectioned solids, CAD exercises.

UNIT III: ISOMETRIC VIEWS
Isometric projections of simple and truncated solids, Isometric to orthographic and vice versa, Perspective projection, CAD exercises.

UNIT IV: GEOMETRIC DIMENSIONING AND TOLERANCES
GD and T rules and concepts, Geometric characteristics and modifiers, Fourier transform, bode plot, bandwidth, Datums and datum references, CAD exercises.

UNIT V: FREE HAND SKETCHING AND CAD
Free hand sketching of real objects, Free hand sketching of multiple views from pictorial views, CAD exercises, Assignments of 2D and 3D drawings.

TEXTBOOKS/REFERENCES

1. Bhatt, N.D, Engineering Drawing, Charotar Publishers, 2014.
2. Bhatt, N.D, Machine Drawing, Charotar Publishers, 2014.
3. Venugopal, K. and Prabhu Raja, V., Engineering Graphics, Eighth Edition (Revised), New Age International Publishers, Chennai, 2007.
4. Narayanan, K. L. and Kannaiah, P., Engineering Graphics, Scitech Publications, Chennai, 1999.

LIST OF EXPERIMENTS

1. GUI familiarity, features, commands.
2. Shortcuts, mouse features, drop down menus etc.
3. Sketch entities Inference line, centreline, line, circle, arc, ellipse.
4. Rectangle, slots, polygon, spline, points, text, snap, grid Sketch Tools Fillet, chamfer, offset, trim.
5. Extend, mirror, copy, rotate, scale, sketch.
6. Blocks, create blocks, add/remove, explode
7. Relations, dimensioning
8. Part modeling, extrude, revolve, swept, extruded cut.
9. Loft, reference, curves, fillet, pattern.
10. Assembly modeling, mating.
11. Manipulating components
12. Surface modeling tools.
13. All views of the object, dimensions.
14. Drafting tools.
15. Simulation express, stress-strain analysis.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ENG 101	Engineering Fundamentals	ES	3	0	0	3

UNIT I

Sources of Energy, Types of Prime Movers, Force, Mass, Pressure, Work, Power, Energy, Heat, Temperature, Internal Energy, Enthalpy, Efficiency, Zeroth Law, First Law, Thermo dynamic System, Different Types of Fuels, Non-Conventional Energy -Wind, Solar, Bio, Global Warming.

UNIT II

Introduction-Fluids, Physical Properties of Fluids, Relationship Between Stress and Strain-Rate for Newtonian and Non-Newtonian Fluids, Description of Fluid Flow, Classification of Flows- Laminar and Turbulent Flows, Measurement of Flow.

UNIT III

Heat Engines-External, Internal, Carnot, Rankine, Otto, Diesel Cycles; Steam Boilers- Fire Tube, Water Tube Boilers, Valves; IC Engine-Components, 2 Stroke,4 Stroke, Engine Performance, Efficiency.

UNIT IV

Pumps Reciprocating, Rotary, Pump Efficiency; Air Compressors-Reciprocating/Rotary; Refrigeration and Air Conditioning-Principles of Working; Brakes, Clutches and Couplings, Drives-Transmission of Power-Belt Drive, Gear Drive, Chain Drive.

UNIT V

Mechanics of Materials-Engineering Materials, Material Properties- Tensile Strength, Toughness, Malleability, Hardness, Ductility, Stiffness, Brittleness, Elasticity, Plasticity, Creep, Fatigue, Failure, Stress-strain splots, failures.

TEXTBOOKS/REFERENCES

1. Fatigue, Failure, Stress-strain plots, failures.
2. Elements of Mechanical Engineering, R K Rajput, Laxmi Publications Ltd,2005.
3. Elements of Mechanical Engineering, V.K .Manglik, PHI Publications,2013.
4. Elements of Mechanical Engineering, B. L. Theraja, S.Chand Ltd.1999.
5. Elements of Mechanical Engineering, Sadhu Singh, S.Chand and Company Ltd.2013.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 103	Mechanical Engineering Tools	ES	0	0	2	1

LIST OF EXPERIMENTS

1. Step fitting of two metal plates using fitting tools.
2. Drilling & tapping for generating hole and internal thread on a metal plate.
3. Simple turning of cylindrical surface on MS rod using lathe machine tool.
4. Plumbing of bathroom/kitchen fitting using various plumbing components and tools.
5. Butt joint of two metal plates using arc welding process.
6. Lap joint of two metal plates overlapping on one another using arc welding process.
7. T-joint of a metal plate at perpendicular direction over another plate using arc welding process.
8. MIG welding of metal plates.
9. Cross halving joint of two wooden pieces at perpendicular direction.
10. Dovetail halving joint of two wooden pieces in the shape of dovetail.
11. To make circular shapes, grooving in wood piece using wood turning lathe.
12. To make duster from wooden piece using carpentry tools.
13. To make rectangular shaped tray using GI sheet.
14. To make geometrical shape like frustum, cone and prisms using GI sheet.
15. To make bigger size scoop using GI sheet. To forge chisel from MS rod using black smithy.

REFERENCES

1. Lab Manual.
2. Kannaiah.P and Narayanan.K.C, “Manual on Workshop Practice”, Scitech Publications, Chennai, 1999.
3. Gopal.T.V, Kumar.T, and Murali.G, “A first course on workshop practice – Theory, Practice and Work Book”, Suma Publications, Chennai, 2005.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 121	Multivariable Calculus	BS	3	0	0	3

UNIT I: VECTORS AND MATRICES
Three-dimensional coordinate system, vectors, dot products, vector products, lines and planes.

UNIT II: PARTIAL DERIVATIVES
Functions of several variables, Limits and continuity for several variable functions, Partial derivatives, The chain rule, Directional derivatives, Gradient.

UNIT- III DOUBLE INTEGRAL AND LINE, INTEGRAL IN PLANES
Extreme values, saddle points, lagrange multipliers.

UNIT IV: TRIPLE INTEGRALS IN 3D
Double and integrated integrals, area by double integration.

UNIT V: SURFACE INTEGRALS IN 3D
Triple integration and applications.

TEXTBOOKS/REFERENCES

1. Edwards, Henry C Thomas- Calculus, 14th edition. Chapters 12 to 16 relevant sections.
2. G. B. Thomas, Jr. and R. L. Finney, Calculus and Analytic Geometry, 9th Edn., Pearson Education India, 1996.
3. T. M. Aposol, Calculus - Vol.2, 2nd Edn., Wiley India, 2003.

SEMESTER-II

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PHY 221	Electricity and Magnetism	BS	2	0	2	3

UNIT I: INTRODUCTION TO VECTOR ALGEBRA

Introduction to vectors, scalar and vector product. Gradient of a scalar field. Divergence and Curl of vector fields and their physical significance. Gauss and Stokes theorems. Coordinate systems–introduction to Cartesian system. Spherical and Cylindrical coordinate systems.

UNIT II: ELECTROSTATICS

Coulomb's law and electric field. Gauss Law, Electric Potential, Potential Energy, Conductors under Electrostatic Equilibrium, Capacitors.

UNIT III: DIELECTRICS AND POLARIZATION

Introduction to Electric Dipole and dipole Moment. Potential and field due to electric dipole. Polarization in dielectrics. Modification of Gauss's Law in terms of electric displacement. Electric Susceptibility and dielectric constant. Bound charges.

UNIT IV: MAGNETOSTATICS

Magnetic force and cyclotron, Biot-Savart Law for magnetic fields, Magnetic field due to various current loops, Ampere's circuital law. Equation of Continuity, Magnetization in Materials.

UNIT V: INTRODUCTION TO ELECTRODYNAMICS

Introduction to time-varying fields, Faraday's law of induction, Generalization of Ampere's law. Maxwell's equations. Derivation of wave equation. Planar Waves in free space.

TEXTBOOKS/REFERENCES

1. Introduction to Electrodynamics –David J. Griffiths; 4th Edition, 2012, PHI Eastern economy editions.
2. Electricity and Magnetism- A. S. Mahajan and A. A. Rangwala, 1st Revised Edition, 2007, McGraw-Hill Education.

LIST OF EXPERIMENTS

1. To find the dielectric constant of the medium using parallel plate capacitor.
2. To find the band gap energy of a semi-conductor using Four-probe method.
3. To find the band gap energy of a semi-conductor using Four-probe method.
4. Find the magnetic field due to Helmholtz coils and verify its relation by varying the distance.
5. Use Faraday's law for finding the total magnetic flux through the coil.
6. To find the type and concentration of charge carriers using hall probe.
7. Verify the Biot-Savart law for a given circular coil.
8. To find the fill factor of a given solar cell using I-V characteristics.
9. To find the type of material using the deflection in magnetic field.
10. To study the Hysteresis curve for a given magnetic material.
11. Practice session I and remedial session.
12. Practice session II and remedial session
13. Model Exam.
14. Model Exam.
15. Model Exam.

SEMESTER-III

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ENG 115	Engineering Mechanics	ES	3	0	0	3

UNIT I: STATICS OF PARTICLES AND RIGID BODIES

Forces on particles, Resolution of forces, Free body diagrams, Equilibrium of particles, Equilibrium of particles (Numerical Problems), Forces in a plane, Forces in space (Numerical Problems), Force equivalence, Force equivalence (Numerical Problems), Rigid body equilibrium, Rigid Body equilibrium (Numerical Problems).

UNIT II: FRICTION

Laws of friction, dry friction, wedge friction, rolling friction, Ladder friction.

UNIT III: ANALYSIS OF TRUSSES AND CENTROIDS

Types of loads, type of supports, reaction, Simple trusses, method of joints, Method of joints, Method of sections (Numerical Problems), Method of Joints (Numerical Problems), Center of gravity-lines, areas, Volumes, Determination of centroid-integration method, Determination of centroid-integration method (Numerical Problems).

UNIT IV: MOMENT OF INERTIAS OF SURFACE AND VOLUMES

Determination of moment of inertia using area integration method, Analytical method, radius of gyration, Polar moment of inertia, Moment of inertia of different sections.

UNIT V: DYNAMICS

Rectilinear motion, Projectile motion, Newtons second law of motion, Alembert's principle, Work, energy, Impulse momentum, Impact/collision of elastic bodies, Oblique impact, Curvilinear motion.

TEXTBOOKS/REFERENCES

1. Ferdinand. P. Beer. E, Russell Johnston Jr., David Mazurek, Philip J Cornwell, Vector. Mechanics for Engineers: Statics and Dynamics, McGraw - Hill, New Delhi, 10th Edition, 2013.
2. R.K.Bansal, Engineering Mechanics, Laxmi Publications Ltd, 2005.
3. Meriam J.L and Kraige L.G., Engineering Mechanics, Volume I - statics, Volume II - dynamics, John Wiley & Sons, New York,7th Edition, 2012.
4. Timoshenko, Young, Engineering Mechanics, Tata Mc-Graw Hill Book Company, 5th Edition, New Delhi.

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 211	LINEAR ALGEBRA	BS	3	0	0	3

UNIT I: MATRICES AND GAUSSIAN ELIMINATION
Introduction, Geometry of Linear Equations, Gaussian Elimination, Matrix Notation and Matrix Multiplication, Triangular Factors and Row Exchanges, Inverses and Transposes.

UNIT II: VECTOR SPACES
Vector spaces and Subspaces, Solving Ax = 0 and Ax = b, Linear Independence, Basis and Dimension, The Four Fundamental Subspaces, Graphs and Networks, Linear Transformations.

UNIT III: ORTHOGONALITY
Orthogonal Vectors and Subspaces, Cosines and Projections onto Lines, Projections and Least Squares, Orthogonal Bases and Gram-Schmidt.

UNIT IV: DETERMINANTS
Introduction, Properties of the Determinant, Formulas for the Determinant, Applications of Determinants.

UNIT V: EIGENVALUES AND EIGENVECTORS
Introduction, Diagonalization of a Matrix, Difference Equations and Powers A^k, Differential Equations and e^{At}, Complex Matrices, Similarity Transformations.

TEXTBOOKS/REFERENCES

1. Gilbert Strang, Linear Algebra and Its applications, Nelson Engineering, 4th Edn., 2007.
2. S. Axler, Linear Algebra Done Right, 2nd Edn., UTM, Springer, Indian edition, 2010.
3. K. Hoffman and R. Kunze, Linear Algebra, Prentice Hall of India, 1996.

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CDC 204	Quantitative Aptitude	HS	1	0	0	1

UNIT I: MOTIVATION
Maslow's theory of Motivation Soldiers' Walk and The Japanese Fan (Activities on factors of motivation), Steps to ward off de-motivation.

UNIT II: CREATIVITY AND INNOVATION
Short Film: Students would be encouraged to make at en-minute documentary on various topics to enhance the power of aesthetics and precision, this activity is aimed at creating an interest in research and think out of the box.

UNIT III: CRITICAL AND LATERAL THINKING
Fill Me Up, Stimulating Lateral Thinking. The Curious Case of Mary and Kevin (Activities triggering the different types of thinking) The Creative Collage. Critical and lateral thinking can be inculcated with a structured re programming of the neural pathways, These specially designed activities will enhance critical and lateral thinking.

UNIT IV: TEAM DYNAMICS
Story boarding, Frenzy. Come to my Island, Striking Cars. Defend the Egg, Tallest Tower: Activities on the different stages of team building, Team communication, coordination and collaboration.

UNIT V: MINI PROJECT
Individual projects on topics provided by faculties.

TEXTBOOKS/REFERENCES

1. Maslow, A. H. (1943) A Theory of Human motivation. In R. J. Lowry (1973) Dominance, Self-Esteem, Self-Actualization: Germinal Papers of A.H. Maslow (pp. 153-173). Belmont, California: Wadsworth Publishing Company, Inc.
2. Sparking Student Creativity, Practical ways to promote innovative and problem solving, Patti Drapeau.
3. Teach yourself to think, Edward de Bono, 1995.

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 141	Introduction to Thermodynamics	C	3	0	2	4

UNIT I: BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS

Basic concepts, Microscopic and macroscopic approach. Thermodynamic system and surrounding, Properties of a system, Intensive and extensive, Specific and total quantities, Path and point functions, Thermodynamic process, cycle and equilibrium, Quasi-static, Reversible and Irreversible processes, Heat and work transfer, displacement work, flow work and other modes of work, p-V diagram, Zeroth law of thermodynamics, concept of temperature, First law of thermodynamics, energy, enthalpy, specific heats, Application of first law, Tutorials, Control volume analysis, steady flow energy equation and its applications, Tutorials on steady flow energy equation.

UNIT II: SECOND LAW OF THERMODYNAMICS AND ENTROPY

Limitations of first law, cyclic heat engine, energy reservoirs, refrigerator and heat pump, Statements of second law and their equivalence, Reversibility and Irreversibility, causes of irreversibility, Carnot cycle, Reversed Carnot cycle, Carnot theorem, Tutorials based on second law of thermodynamics, Clausius theorem, Clausius inequality, Concept of entropy, T-s diagram, principle of increase of entropy, Entropy change of ideal gases and its evaluation, Introduction to exergy.

UNIT III: PROPERTIES OF STEAM AND VAPOUR POWER CYCLE

Steam formation, properties of steam, Calculation of steam properties using steam tables and Mollier chart, Simple Rankine cycle. Flow diagram, p-v, T-s and h-s diagrams. Tutorials Reheat cycle. Flow diagram, T-s and h-s diagrams. Tutorials, Regenerative cycle. Flow diagram, T-s and h-s diagrams. Tutorials, Dryness fraction measurements.

UNIT IV: FUELS AND COMBUSTION

Classification of fuels, combustion equations: theoretical and excess air, stoichiometric air fuel ratio. Tutorials on combustion, Volumetric analysis and gravimetric analysis, Tutorials on air-fuel ratio and analysis of products of combustion, Analysis of exhaust gas, Calorific value of fuels, Determination of calorific values.

UNIT V: THERMODYNAMIC RELATIONS

Maxwell equations, Tds equations. Equations for dH and dU, Tds equations. Equations for dH and dU, Difference in heat capacities, Joule-Thomson Co-efficient, Clausius-Clapeyron equation, Properties of Gas mixtures, Dalton's law of partial pressures, Properties of Gas mixtures- Tutorials.

TEXTBOOKS/REFERENCES

1. Kenneth A. Kroos, and Merle C. Potter, "Thermodynamics for Engineers", SI Edition, 1st Edition, Cengage Learning India Pvt. Ltd., Delhi, 2015.
2. Mahesh M. Rathore, "Thermal Engineering", Tata McGraw Hill Education Private Ltd., New Delhi, Reprint 2012.
3. Yunus. A Cengel and Michael A Boles, "Thermodynamics – An Engineering Approach, 8th Edition", Tata McGraw Hill- Education, New Delhi, 2015.
4. Rayner Joel, "Basic Engineering Thermodynamics", 5th Edition, Addison Wesley

Longman Limited, First ISE reprint 1999.
5. William Z. Black, James G. Hartley, “Thermodynamics”, Pearson,3rdEdition, 2010.
6. Michael J Moran, and Howard N Shapiro, “Fundamentals of Engineering Thermodynamics”, John Wiley & Sons, New York, 8th Edition, 2015.
7. Nag.P.K, “Engineering Thermodynamics”, Tata McGraw Hill Education, New Delhi, 5th Edition, 2013.

LIST OF EXPERIMENTS

1. Valve timing diagram for four stroke diesel or petrol engines
2. Port timing of a two-stroke petrol engine
3. Reciprocating air compressor
4. Determination of cop of a refrigeration system
5. Study of steam boilers
   Part I: introduction to the types of steam boilers
   Part II: study of various types of boilers
   Part III: study of boiler mountings & accessories
6. Performance test on ac test rig
7. Demonstration of various parts of bmw engine

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 121	Material Science and Metallurgy	C	2	0	2	3

UNIT I: METAL STRUCTURE

Crystal structures, Elastic-plastic behavior, Deformation mechanisms, Slip, twinning Imperfections, Types of fracture, Three Stages in creep, Fatigue mechanism.

UNIT II: MATERIAL PROPERTIES

Testing of metals, Properties, strength, plasticity, stiffness, Properties, toughness, brittleness, ductility, Hardness, Creep and fatigue tests.

UNIT III: HEAT TREATMENT

Solidification, crystal growth, rule, Phase diagram, Gibbs Phase rule, Equilibrium diagrams, lever rule, Iron Carbon diagram, solidification of steel and cast irons. Heat treatment, TTT curves, annealing, normalizing, hardening, tempering, induction hardening, age hardening. Martempering, austempering, carburising, cyaniding, nitriding, flame and induction harening, age hardening. Ferrous, Non-ferrous metals, Cast Iron, Steel, Copper, Aluminium alloys.

UNIT IV: COMPOSITE MATERIALS

Composites, Fibre reinforced composites, Manufacturing methods, Metal matrix composites.

UNIT V: POWDER METALLURGY

Powder metallurgy: Powder characterization, size analysis, compaction and sintering, Manufacturing methods: Mechanical, chemical and physical, Additive manufacturing.

TEXTBOOKS/REFERENCES

1. Willium D Callister, “Material Science and Engineering” John Wiley and Sons, 2014 edition.
2. U.C.Jindal , “Material Science and Metallurgy “ U.C.Jindal, Pearson Publication, 2011 edition.
3. Allen Cottrell “Introduction to Metallurgy” University Press, 2000 edition.
4. R. Srinivasan “Engineering materials and metallurgy”, McGraw Hill, 2009 edition.
5. Anish Upadhya and G S Upadhaya, “Powder Metallurgy: Science, Technology and Materials, Universities Press, 2011.

LIST OF EXPERIMENTS

1. Introduction.
2. Polish the samples until one can see the microscopic phases clearly.
3. To determine the hardness of the given Specimen using Vicker‟s hardness test.
4. To find the Brinell Hardness number for the given metal specimen.
5. To determine the Rockwell hardness number of the given specimen.
6. Heat treats given materials at different levels.
7. Study micrographs of differently heat-treated materials and compare them.
8. Measure the hardness of given materials using End Quench hardness tester.
9. Mini project-Design of heat cycle to improve properties of given alloy.

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ENV 111	Environmental Science	BS	2	0	2	3

UNIT I: ENVIRONMENTAL EDUCATION & SUSTAINABILITY
What is environmental education (EE)? The evolution of EE, Principles of Sustainability, Sustainable technologies.

UNIT II: ECOLOGICAL SYSTEM
Earth Systems – atmosphere, Earth Systems – Hydrosphere, Earth Systems – Lithosphere, Earth Systems – Biosphere, Ecosystems - Structure and Function, Major Biomes, Water, nutrients (phosphorous, nitrogen) and Carbon cycles.

UNIT III: ENVIRONMENTAL POLLUTION- ITS ROLE ON GLOBAL CLIMATE CHANGE AND HUMAN HEALTH
Air pollution – composition of air, sources of pollution and their classification, Air pollutants – classifications, Air Quality Index (AQI), Air pollution control devices, Water pollution - Water sources, use and classifications, Water pollutants, Water pollution control devices.

UNIT IV: BIODIVERSITY & ITS CONSERVATION
Biodiversity – definition and types, Concepts of species richness, evenness, and their regulation. Species diversity cline, Island biogeography – equilibrium model, Vulnerability of island species, Conservation Biology – Historical perspective of extinction, Difference between past extinction and present, Biodiversity Hotspots – global distribution, Values of Biodiversity – Why do we care? World's Biodiversity is in serious trouble – frogs as global "canaries of mines" Human impacts on biodiversity – Habitat destruction, Pollution, Ecosystem disruption, Habitat fragmentation, over exploitation, and introduction of invasive species, Preservation of endangered species.

UNIT V: ENVIRONMENTAL ETHICS, ECONOMICS, AND POLICY
Concepts of Sustainable ethics – Frontierism, Leopold's Land Ethics, and transition to Sustainable ethics, Principles of Sustainable ethics, Frontier ethics vs sustainable ethics, Developing and implementing sustainable ethics and overcoming the obstacles of sustainable ethics, utilitarianism and natural rights, Fundamentals of Environmental Economics – concepts of resources, Capital, Supply, Demand, and Market equilibrium, Classical Economics, Neoclassical economics, Ecological Economics and Externalization of costs, Ecosystem Services – Can we internalize all costs? Resource depletion, Hubbert Curve, and Carbon bubble, Scarcity and innovation, Economic models for growth, Measuring growth – GNP, GDP, GPI, Cost-Benefit Analysis. Can market reduce pollution? – Carbon credit, Environmental Policies – international laws and policies. Environmental Laws and Policies of India.

TEXTBOOKS/REFERENCES

1. Basu. M, Xavier. S. "Fundamentals of Environmental Studies", 1st edition, Cambridge University Press, 2016.
2. Danial. D. C. "Environmental Science", 8th edition, Jones and Barlett Publishers, MA, 2010.
3. Raven P. Biology – 11th Edition, McGraw hill.
4. Cunningham and Cunningham. Environmental Science – A global concern Tata McGraw-Hill Education India.

LIST OF EXPERIMENTS

1. Water parameters- Test for alkalinity and turbidity of water.
2. Determination of dissolved oxygen in water.
3. Test for total suspended solids and total dissolved solids.
4. Determination of total hardness of water by EDTA titration.
5. Determination of biological oxygen demand of wastewater.
6. Test for iron content in river water.

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 225	3D Printing	C	0	0	2	1

UNIT I: CAD MODELLING

Concepts of CAD, Algorithms used in design, Design of Assembly (Spur gear, Helical screw, simple design), Introduction to G Code. Lab practice of Solid works software.

UNIT II: INTRODUCTION TO 3DP

What is a Mesh?, Historical Review of 3DP, From CAD to CAM, CAD Overview, Introductory lecture on 3D printer and Rapid Prototyping, Introduction to Rapid prototype, Introduction to different types of 3D Printers, Introduction to RepRap, Materials used for printing.

UNIT III: CTRL+P

Design for 3DP, Understand the basics of G code generation, CAM Skills, Mesh Repair, Get to Know the 3D Printer, Weekly Assignments (3DP).

UNIT IV: HANDS ON EXPERIENCE WITH AND TROUBLE SHOOTING

Installation of 3DP, bed levelling, filament loading and unloading, pre heating, nozzle cleaning and various techniques while printing the complex shapes.

TEXTBOOKS

1. 3D Printing and Additive Manufacturing (Principles and Applications), By Chee Kai Chua and Kah Fai Leong.

REFERENCES

1. Getting Started with 3D Printing: A Hands-on Guide to the Hardware, Software, and Services Behind the New Manufacturing Revolution by Liza and Nick.

SEMESTER-III

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
BME 001	Industrial Organization & Management	HS	0	0	2	1

UNIT I: CONCEPT OF BUSINESS & UNDERSTANDING INDUSTRIAL ORGANIZATION

Nature & Scope of Business, what is industry? Classification of Industry, types of business organization, Functions of Industry, Definitions, Characteristics & Need of Organizations.

UNIT II: DYNAMICS OF INDUSTRY

Location and Layout of Industry, Size & Scale of Industry, State & Industry, Ownership Restructuring, Product Life Cycle.

UNIT III: INTRODUCTION TO MANAGEMENT

Nature, Scope & Importance of Management, Levels, Skills, Evolution of Management Thought, Hawthorne Experimentation, Principles of Management.

UNIT IV: FUNCTIONS OF MANAGEMENT

PLANNING

Nature, Scope & Steps in Planning, Strategic & Operational Planning, Types of Plans & Barriers to Planning.

ORGANIZING AND STAFFING

Division of Work, Elements of Organization Structure, Departmentalization, Factors Shaping Hierarchy, Line/Staff, Authority & Decentralization, HR Concepts, Case Study.

LEADING & MOTIVATING

Understanding Leading, Leading and Managing, Skills sets of Leading, Styles of Leading, Motivating, Importance of Motivating, Research in Motivation.

MANAGEMENT CONTROL

Definition, Importance, Process & Types of Control, Methods of Control.

TEXTBOOKS/REFERENCES

1. Essentials of Management: International and Leadership Perspective 9th Edition (English, Paperback, Koontz)
2. Principles and Practice of Management, LM Prasad, Sultan Chand & sons
3. Organization & Management by Gupta C B, S Chand & Sons
4. General and Industrial Management by Henry Fayol, Pitman & Sons.
5. Production management, Martand T. Telsang - S. Chand Publishing
6. The Art of Administration by Ordway Team, McGraw-Hill
7. Fundamentals of Management by Terry and Franklin, Pearson Education
8. Organisational behaviour, Stephen P Robbins, Pearson

SEMESTER-IV

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 221	Strength of Materials	C	3	0	2	4

UNIT I: CONCEPT OF STRESSES AND STRAINS

Concept of stress and strain, Hooke's law, Tensile, compressive, and shear stresses, Poisson's ratio. Elastic constants and their relationship, volumetric strain, bars of uniform and varying sections subjected to single load and varying loads. Tutorial on stress, stress, Hooke's law, elastic constants and volumetric strain, bars of uniform and varying sections subjected to single load and varying loads. Analysis of bars of composite sections& Tutorial. Concept of Thermal stresses in simple and composite bars & Tutorial. Principal plane, principal stress, Analytical method: Direct stress in two mutually perpendicular directions accompanied by a simple shear stress& Tutorial. Mohr's circle: direct stress in two mutually perpendicular directions with and without shear stress & Tutorial.

UNIT II: ANALYSIS OF BEAMS

Introduction to types of beams and loads, Shear force and bending moment diagrams for cantilever beam due to pure point load, pure Uniformly Distributed Load (UDL), pure Uniformly Varying Load (UVL) & Tutorial. Shear force and bending moment diagrams for simply supported beam due to pure point load, pure UDL, pure UVL& Tutorial. Shear force and bending moment diagrams for overhanging beam due to pure point load, pure UDL, pure UVL & Tutorial. Theory of pure bending derivation and bending stress in simple beams of sections having at-least one axis of symmetry& Tutorial. Tutorial on bending stress in simple beams sections having at-least one axis of symmetry & Tutorial. Derivation of shear stress distribution in beams of different sections (rectangular, circular), having at-least one axis of symmetry& Tutorial.

UNIT III: TORSION OF SHAFTS

Theory of pure torsion, derivation of shear stress produced in terms of torque in a circular shaft. Strength, stiffness of shaft and Torsional rigidity & power transmitted. Tutorial on solid shaft, finding the dimensions. Expression for torque in terms of polar moment of inertia in a circular shaft subjected to torsion. Tutorial on hollow shaft, finding dimensions, percentage of material savings. Circular shafts in series and parallel& Tutorial. Concepts on Strain energy due to torsion& Tutorial. Circular shaft subjected to combined bending and torsion& Tutorial. Composite Shaft & Tutorial.

UNIT IV: DEFLECTION OF BEAMS

Relationship between deflection, slope, radius of curvature, shear force and bending moment& Tutorial. Slope and deflection of cantilever beam with a point load, UDL by Double integration method& tutorial. Slope and deflection of simply supported beam with a point load, UDL by Double integration method& tutorial. Slope and deflection of simply supported beam with an eccentric, point load, UDL by Macaulay's method& tutorial. Slope and deflection of cantilever beam and simply supported beam with point load and UDL by moment area method & tutorial. Castigliano's theorem & tutorial.

UNIT V: COLUMNS AND CYLINDERS

Columns and struts, Members subjected to combined bending and axial loads, Expression for crippling load with different end conditions based on Euler's theory & tutorial. Rankine's theory & tutorial. Thin cylindrical shells subjected to internal pressure, change in dimensions of thin cylindrical shells due to internal pressure & tutorial. Thin spherical shells subjected internal pressure, change in dimensions of thin spherical shells due to internal pressure & tutorial. Lame's theory on stresses in Thick cylinders & tutorial. Stresses in compound thick cylinder and Shrink fit& tutorial.

TEXTBOOKS/REFERENCES

1. Ferdinand P. Beer, E. Russell Johnston Jr., John T. DeWolf, David F. Mazurek," Mechanics of Materials", 7th Edition, McGraw Hill, 2014.
2. William A. Nash, "Theory and Problems of Strength of Materials", Schaum's Outline Series, McGraw Hill International Edition, 3rd Edition, 2007.
3. Egor P. Popov, "Engineering Mechanics of Solids", 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2009.
4. James M. Gere,"Mechanics of Materials", Eighth Edition, Brooks/Cole, USA, 2013.
5. Shigley. J. E, "Applied Mechanics of Materials", International Student Edition, McGraw Hill KoyakushaLimited, 2000.

LIST OF EXPERIMENTS

1. Tensile test on Mild steel rod.
2. Compression test of Concrete cubes and cylinders.
3. Test on open coil and closed coil Helical springs.
4. Izod & charpy impact test.
5. Torsion test on Graded steels.
6. Deflection test on beams of different materials using Maxwell reciprocal theorem.
7. Double shear test on metallic materials.
8. Rockwell &Brinell hardness test of metallic materials.
9. Bend test of metallic rods.
10. Fatigue testing of materials under notched and unnotched conditions.
11. Comparison of mechanical properties of Unhardened, Quenched and tempered specimen.
12. Strain measurement on rods and beams.
13. Study on photo elasticity.
14. Buckling analysis.
15. Creep Test.

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 172	Kinematics and Mechanisms	C	3	0	2	4

UNIT I: MECHANISMS

Introduction to mechanism and its elements. Degrees of freedom, its application in different mechanism. Four Bar Chain, Grashof's law, Kutzback's and Gruebler'scriterion, Inversion of kinematic chain: Four bar chain, Single and double slider crank chain, Velocity analysis of Four bar mechanism by relative velocity (RV) method. Tutorial on velocity analysis of single slider crank mechanism. Tutorial on velocity analysis of six bar linkages. Acceleration analysis of Four bar mechanism by relative velocity method. Tutorial on acceleration analysis of single slider crank and six bar linkages. Instantaneous center (IC) method, Kennedy's theorem. Tutorial on velocity analysis for different mechanisms by IC method.

UNIT II: FORCE ANALYSIS AND FLYWHEELS

Inertia forces, D-Alembert's principle, Velocity and acceleration of the reciprocating parts in Engines, Tutorial on derivation and calculation of gas forces, dynamically equivalent systems, Tutorial on determination of equivalent system for connecting rod, turning moment diagram (TMD) for different engines, Fluctuation of energy(□E), coefficient of fluctuation of energy, Tutorial on calculation of □E using TMD and torque equations, Tutorial on flywheel applications.

UNIT III: BALANCING

Need for balancing, Static and dynamic balancing of rotating masses. Tutorial on balancing of several masses rotating in same plane by analytical and graphical methods, Construction of force and couple polygon, Tutorial on balancing of several masses rotating in different planes using couple and force polygon, Partial balancing of reciprocating masses, Tutorial on effects of partial balancing in locomotives, balancing of in-line engines, Balancing of V engines, Balancing of radial engines.

UNIT IV: CAMS

Cam terminology, types of cams and followers, Types of follower motion and its derivatives, under cutting, Displacement, velocity and acceleration for different follower motion, Tutorial on construction of cam profile for radial follower with different motion, Tutorial on construction of cam profile for offset follower, with different motion, Cams with special contours, Tutorial on velocity and acceleration for cams with specified contours.

UNIT V: GEAR, GEAR TRAINS AND GYROSCOPES

Gear terminology, types, law of gearing, Tutorial on path of contact, arc of contact, sliding velocity, Minimum number of teeth, Interference and under cutting, Gear train, types and applications, Tutorial on velocity ratio, torque calculations in epicyclic gear train, Introduction to automobile differential, Gyroscopic forces, couple, processional angular motion, Gyroscopic effects on airplane and ship, Tutorial on gyroscopic effect on two and four wheelers.

TEXTBOOKS/REFERENCES

1. Rattan, S. S, "Theory of Machines",McGrawHill Education, 4th edition, 2015.
2. John J Uicker, Gordon R Pennock, Joseph E Shigley, "Theory of Machines and Mechanisms", Oxford University Press, 4thEdition, 2014.
3. Thomas Bevan, "The Theory of Machines", Pearson India Education Services Pvt. Ltd., 3rd Edition, 2010.
4. Robert L Norton, "Design of machinery - An introduction to the synthesis and analysis of mechanisms and machines", McGrawHill Education, 5th edition, 2011.
5. William Cleghorn, Nikolai Dechev, "Mechanics of Machines", Oxford University Press, 2nd Edition, 2014.
6. George H Martin, "Kinematics and Dynamics of Machines", Waveland Press, Inc., 2nd Edition, 2002.
7. G H Ryder, MDBennett, "Mechanics of Machines", Macmillan Education Ltd., 2nd Edition,1990.

LIST OF EXPERIMENTS

1. Identification of various types of kinematic pairs and kinematic links.

2. Displacement analysis of mechanisms through forward kinematics.

3. Displacement analysis of mechanisms through inverse kinematics.

Types of mechanisms

(a) Watts linkage mechanism.

(b) Pantograph mechanism.

(c) Chebyshev's mechanism.

(d) Hart straight line mechanism.

(e) Peaucellier mechanism.

1. Velocity analysis of mechanisms.
2. Demonstration of various types of clutch mechanisms.

(a) Single plate clutch.

(b) Multiple clutch.

(c) Cone clutch.

(d) Centrifugal clutch.

(e) Claw clutch.

3. Demonstration of different types of mechanisms.

(a) Slider crank mechanism.

(b) Whitworth quick return motion mechanism.

(c) Scotch yoke mechanism.

(d) Elliptical trammel mechanism.

(e) Double slider mechanism.

4. Demonstration of various types of drives mechanisms.

(a) Belt drive mechanism.

(b) Rope drive mechanism.

(c) Stepped or cone pulley drive.

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 222	Fluid Mechanics	C	3	0	2	4

UNIT I: PROPERTIES OF FLUIDS AND FLUID STATICS

Properties of fluids: density, specific weight, specific, volume, specific gravity, vapour pressure. Viscosity: Dynamic and Kinematic viscosity, Newton's law of viscosity, factors affecting viscosity. Types of fluids, Tutorial-Problems on fluid properties. Surface tension, compressibility and bulk modulus concepts. Fluid statics- Pascal's law, Hydrostatic law. Manometry: Types of manometers, Piezometer, U-tube Manometer. Tutorials on manometers.

UNIT II: FLUID KINEMATICS AND DYNAMICS

Types of flow, Lagrangian and Eulerian approach Velocity and Acceleration of fluid particle, Tutorial problems on Velocity and Acceleration of fluid particle. Fluid flow pattern: Streamline, streak line, path line. Continuity equation Fluid dynamics: Euler's equation of motion, Bernoulli's Equation. Applications of Bernoulli's equation in flow measurement Devices: Venturi meter, Orifice meter, Pitot tube, nozzle flow meter, Impulse momentum equation.

UNIT III: DIMENSIONAL ANALYSIS AND FLOW THROUGH PIPES

Dimensional analysis: Dimensions Dimensional homogeneity. Rayleigh method, Buckingham's Pi-theorem, non- dimensional analysis. Model analysis: Advantages and applications of model testing, Similitude. Dimensionless number: Reynold's number, Froude's number, Euler's number, Weber number, Mach number. Reynold's model law – Problems, Froude's model law – Problems Euler's model law, Weber model law and Mach model law Laminar and Turbulent flow, Reynold's experiment, Flow through circular pipes –Hagen Poiseuille law. Turbulent flow – Derivation of Darcy Welsbach equation, Tutorial – Problems on Darcy Welsbach equation. Minor loss due to sudden enlargement, sudden contraction, inlet and exit of pipes, problems. Flow through pipes in series and parallel – problems.

UNIT IV: HYDRAULIC MACHINES

Hydraulic turbines- classification, Impulse and reaction turbine. Design parameters and performance of Pelton turbine. Design parameters and performance of Francis turbine. Design parameters and performance of Kaplan turbine. Classification of pumps; Positive-displacement and non- positive pumps. Centrifugal pump, Performance curves and velocity triangles. Cavitation's in pumps, Thomas's cavitation number.

UNIT V: BOUNDARY LAYER THEORY

Boundary layer theory: laminar and turbulent boundary layer over a flat plate. Displacement, Momentum, Energy thickness: derivations and problems. Momentum integral equation derivation Separation of flow over bodies: stream lined and bluff bodies, Flow over cylinders. Aerofoil description, definition of parameters involved in aerofoil, velocity and pressure acting over the aerofoil.

TEXTBOOKS/REFERENCES

1. Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, "Introduction to Fluid Mechanics", Wiley, 8th Edition, 2013.
2. Frank M.White, "Fluid Mechanics", McGraw-Hill, 7th Edition, New Delhi, 2011.
3. Irving H.Shames, "Mechanics of Fluids", McGraw Hill, 3rd Edition, 2014.
4. Yunus A Cengel& John M. Cimbala, Fluid Mechanics, Tata McGraw Hill Edition, New Delhi, 3rd Edition, 2015.
5. Modi P.N, & Seth S.M, "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 20th Edition, 2015.

LIST OF EXPERIMENTS

1. Experiment on venturi meter
2. Reynolds flow apparatus
3. Experiment on orifice meter
4. Experiment on loss of head in pipe fittings - minor losses
5. Experiment on friction in pipes – major losses
6. Impact of jet on vanes
7. Free vortex flow experimental setup
8. Pitot tube
9. Bernoulli's theorem apparatus

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 230	Industry Standard Coding Practice-I	ES	0	0	4	1

UNIT I
Problem Solving with - Basic coding practices, Expression Evaluation, Operators Usage, Expressions, Control Structures, Loop & Iterations for all test case scenarios.

UNIT II
Problem Solving using time efficient logics, linear list data, Array problems, 2D Arrays and Matrix Data for all test case scenarios.

UNIT III
Problem Solving with - Pointers &Memory referencing, String Handling, functions for all test case scenarios.

UNIT IV
Problem Solving with - parameter passing, Recursions, Recursion Analysis, Structures and unions, Enumerations & Memory allocation for all test case scenarios.

UNIT V
Problem solving with - String manipulations. Lists, display patterns, strings, matrix, tuples, dictionaries, modules, packages, exception handling using Python.

TEXTBOOKS/REFERENCES

1. Problem solving with C++ -9e- Walter Savitch – Pearson.
2. The complete Reference C, Fourth REdition – Herbert Schildt – MC Graw Hill.
3. Programming in Python 3, A complete introduction to Python language - 2e - Mark Summerfield – Addison-Wiley.

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 131	Differential Equations	BS	3	0	0	3

UNIT I: FIRST ORDER DIFFERENTIAL EQUATIONS
Geometric meaning of $y' = f(x, y)$, Direction Fields, Euler's Method, Classification of ODEs (Linear, Non-linear, Exact, Separable), Integrating Factor, Bernoulli Equations, Initial Value Problem, Modelling (Free falling object, Radioactivity, RL-circuit).

UNIT II: SECOND AND HIGHER ORDER LINEAR ODES
Homogeneous Linear ODEs, Modelling of Free Oscillations of a Mass-Spring System, Euler-Cauchy Equations, Non-homogeneous ODEs, Variation of Parameters, Modelling (Forced Oscillations, Electric Circuits).

UNIT III: SYSTEM OF ODES
Modelling Engineering problems (Electric Network, Mixing problem in two tanks etc.) as systems of ODEs, Wronskian, Phase-Plane Method, Critical Points & Stability, Qualitative Methods for Nonlinear Systems, Nonhomogeneous Linear Systems of ODEs.

UNIT IV: SERIES SOLUTIONS OF ODES
Introduction to power series method, Legendre's equation & polynomials, Frobenius Method, Bessel's Equations & Functions.

UNIT V: LAPLACE TRANSFORMS
Laplace transforms of standard functions, Shifting Theorems, transforms of derivatives and integrals, Unit step function, Dirac's delta function, Inverse Laplace transforms, Convolution theorem (without proof), Application: Solutions of ordinary differential equations using Laplace transforms.

TEXTBOOKS

1. William Boyce and Richard DiPrima, Elementary Differential Equations and Boundary Value Problems, 11th Edition, Wiley-India.
2. Erwin Kreyszig Advanced Engineering Mathematics, 10th Edition, Wiley-India.
3. Mary L. Boas, Mathematical Methods in Physical Sciences, 3rd Edition, Wiley-India.

REFERENCES

1. Mary L. Boas, Mathematical Methods in Physical Sciences, 3rd Edition, Wiley-India.
2. S. Vaidyanathan, Advanced Applicable Engineering Mathematics, CBS Publishers.

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 230	Alternate Energy Sources	TE	3	0	0	3

UNIT I: SOLAR ENERGY

Solar radiation and its measurements, Types of solar thermal collectors, Solar thermal applications for water heaters, solar stills and solar pond. Solar thermal applications for refrigeration and air- conditioning system. Solar thermal applications for solar dryer, solar cookers and solar furnaces. Sensible and latent heat thermal energy storage systems. Solar thermal power generation systems, Solar photovoltaic systems: basic working principle and components, Applications of solar photovoltaic systems.

UNIT II: WIND ENERGY

Basic principle of wind energy conversion system. Wind data, site selection and energy estimation. Components of wind energy conversion systems. Types of Horizontal axis and Vertical axis wind turbine. Design consideration of horizontal axis wind turbine. Aerofoil theory Analysis of aerodynamic forces acting on the blade. Performance of wind turbines. Introduction to solar and wind hybrid energy systems, environmental issues of wind energy.

UNIT III: OCEAN, HYDRO AND GEOTHERMAL ENERGY

Wave characteristics and wave energy, Tidal energy and its types, Estimation of energy and power in single basin tidal system, Ocean thermal energy conversion for open system. Ocean thermal energy conversion for closed system. Hydro power plants for small, mini and micro system. Exploration of geothermal energy. Geothermal power plants. Challenges, availability, geographical distribution, scope and economics for geothermal plant.

UNIT IV: BIOMASS

Sources of biomass, Pyrolysis, combustion and gasification process, Updraft and downdraft gasifier. Fluidized bed gasifier. Fermentation and digestion process. Fixed and floating digester biogas plants. Design considerations of digester. Operational parameter of biogas plants. Economics of biomass power generation.

UNIT V: DIRECT ENERGY CONVERSION SYSTEMS

Basic principle of thermo electric and thermionic power generations, Fuel cell principles and its classification, Phosphoric acid fuel cell, polymer electrolyte membrane fuel cell, molten carbonate fuel cell and solid oxide fuel cell, Fuel cell conversion efficiency, applications of fuel cell, Magneto hydrodynamic power generation for open cycle, Magneto hydrodynamic power generation for closed cycle, Hydrogen energy: properties and its production methods, Electrolysis, thermo-chemical methods, fossil fuel methods and solar energy methods, Hydrogen storage, transportation and applications.

TEXTBOOKS/REFERENCES

1. Tiwari.G.N, Ghosal.M.K, "Fundamentals of renewable energy sources",1st Edition, UK, Alpha Science International Ltd, 2007.
2. Godfrey Boyle, "Renewable energy", 2nd Edition, Oxford University Press, 2010.
3. Twidell.J.W and Weir.A.D, "Renewable Energy Resources",1st Edition, UK,E.&F.N. Spon Ltd, 2006.
4. Domkundwar.V.M, Domkundwar. A.V, "Solar energy and non-conventional sources of energy", Dhanpat rai & Co. (P) Ltd, 1st Edition, New Delhi, 2010.
5. G.D Rai, "Non-Conventional Energy Sources", Khanna Publishers, 5th Edition, New Delhi, 2011.
6. B.H Khan, "Non-conventional Energy Resources", 2nd Edition, New Delhi, Tata McGraw Hill, 2009.
7. S.P. Sukatme, J.K. Mayak, "Solar Energy-Principles of thermal collection and storage", 3rd edition, New delhi, McGraw Hill,2008.

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 221	Probability & Statistics	ES	3	0	0	3

UNIT I

Basic principle of counting, permutations, combinations, Multinomial coefficients, sample space and events, Axioms of probability, sample spaces having equally likely outcomes, Conditional probability, Bayes` theorem, independent events.

UNIT II

Random variable, discrete random variable, expected value, Expectation of a function of a random variable, variance, Discrete probability distributions- Bernoulli, Binomial, Poisson, Geometric, negative. Binomial distributions expected value of sums of random variables. Cumulative distribution function and its properties.

UNIT III

Continuous random variables, Expectation and variance – their properties, Continuous probability distributions – uniform, normal, exponential distributions, Distribution functions.

UNIT IV

Joint distribution functions, Independent random variables and their sums, conditional distributions, Joint probability distribution of functions of random variables, Covariance, correlation.

UNIT V

Definition of statistics, population and sample, Representative sample, Descriptive statistics – classification and tabulation of univariate data, Graphical representation, frequency curves.

TEXTBOOKS/REFERENCES

1. Sheldon Ross, A First course in probability (Ninth edition)
2. Michael Baron, Probability and Statistics for computer scientists.

SEMESTER-IV

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CDC 203	Verbal Ability	HS	1	0	0	1

UNIT I: QUANTITATIVE REASONING

Number properties Speed, Time and work, Powers and roots Pipes, cisterns Problems on Clock, Calendar and Cubes Height and Distance Logarithms.

UNIT II: NON-VERBAL REASONING

Alpha-numerical sequence puzzle, Symbols and their relationships, Blood Relations, Seating Arrangement Coding-Decoding, Input- Output, test Direction Sense Test.

UNIT III: DATA ANALYSIS AND INTERPRETATION

Sets and Functions Data Sufficiency, Statistics: Average, Median, Mode, Range, Standard deviation Graphical and Numerical Methods for Describing Data, Interpretation of data in tables and graphs Permutations and Venn diagrams Counting Methods, Probability.

UNIT IV: EMOTIONAL INTELLIGENCE II

Self-Awareness, Self-Regulation, Social Skills, Empathy and Motivation.

TEXTBOOKS/REFERENCES

1. R.S.Agarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publication.
2. P. Anand, Quantitative Aptitude, Wiley,2015.
3. The Games People Play, Eric Berne; Grove Press;1964.
4. Of Human Interaction; Joseph Luft; Mayfield Publishing.1969.
5. Emotional Intelligence; Daniel Goleman; Bantam Books,1995.

SEMESTER-V

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 224	Machine Design	C	3	0	2	4

UNIT I: FUNDAMENTALS OF MECHANICAL DESIGN

Basic definitions, types of design, Criteria for Design based on strength, fatigue, stiffness, wear, resistance, vibration resistance, heat resistance and reliability. Overview of Engineering materials, Theories of failure, Rankine theory, Guests theory, St.Venants theory, Maximum strain, energy theory and Distortion energy theory. Problems on Theories of failure, Design of members subjected to combined stresses with eccentric load, Problems on combined stresses with eccentric load, Eccentric loading in curved beams, crane hooks, frames, clamps.

UNIT II: DESIGN FOR VARIABLE STRESSES

Members subjected to variable stresses, Failure and endurance limit. Stress concentration, Methods of reducing stress concentration, Notch sensitivity. Combined steady and variable stresses. Problems on variable stresses using Soderberg method. Problems on variable stresses using Gerber method. Problems on variable stresses using Goodman method. Members subjected to impact loads; Members subjected to dynamic loads.

UNIT III: DESIGN OF SHAFTS AND TEMPORARY JOINTS

Shafts: Types, Materials, Manufacturing and stresses, Design for Strength based on twisting moment, bending moment and combination of axial, bending and torsional loads, Cotter joints: Types, design procedure and problems on Socket and spigot cotter joint. Knuckle joints: Design procedure and problems on knuckle joint. Bolted joints: Design procedure and problems on bolted joints with eccentric load parallel to axis of bolt. Design procedure and problems on bolted joints with eccentric load perpendicular to axis of bolt.

UNIT IV: DESIGN OF PERMANENT JOINTS

Riveted joints: Types, materials, failures, Design procedure and problems on riveted joints for pressure vessels, Design procedure and problems on riveted joints for structural applications. Design procedure and problems on eccentric loaded riveted joint. Welded joints: Types and strength Design procedure and problems on axially loaded welded joints. Design procedure and problems on eccentric loaded welded joints.

UNIT V: DESIGN OF GEARS AND SPRINGS

Design of spur gears, Design helical gears, Design bevel gears, Design of work gears, Springs: Stresses and deflections in helical springs, Design procedure and problems on helical springs, Design procedure and problems on helical springs with fatigue load. Leaf springs: Construction, Nipping, Materials. Design procedure and problems on leaf springs.

TEXTBOOKS/REFERENCES

1. Robert C.Juvinalland Kurt M. Marshek "*Fundamentals of Machine Component Design",* John wiley& sons, 5th Edition, 2011.
2. Spotts.M.F, ShoupT.E, "*Design of Machine Elements"*, Prentice Hall of India Eighth Edition, 2006.
3. Joseph Edward Shigley and Charles ,R.Mischke, *"Mechanical Engineering Design"*,McGraw-Hill International Editions, 8th edition., 2008.
4. William Orthwein, "*Machine Component Design"*, Vol. I and II, JaicoPublishing house, New Edition, 2006.
5. Khurmi, R.S. and Gupta J.K, "Machine design ", S.Chand publishing , 14th Edition, 2014.
6. P.S.G Tech..,*"Design Data Book",* KalaikathirAchchagam, 2012.
7. Gitin M Maitra, , "*Handbook of Gear Design"*, Tata Mcgraw-Hill, 2010.

LIST OF EXPERIMENTS

1. Critical speed of shaft or whirling of shaft
2. Cam analysis apparatus
3. Journal bearing test rig
4. Motorised gyroscope apparatus
5. Universal governor apparatus
6. Balancing of rotating masses
7. Universal vibration apparatus
8. Photo elastic test bench

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 226	Measurement and Instrumentation	C	3	0	2	4

UNIT I: TYPES OF MEASUREMENTS, COMPARATOR AND GAUGE DESIGN

Introduction to Metrology, Need for inspection, Physical Measurement, Methods of measurements, Classification and characteristics of Measuring instruments, Role of NPL, Sources of Errors, Types of Errors, Statistical treatment of Errors, tutorial, Standards of Measurements, Calibration, Classification of standards. Limits, Fits, and Tolerances: Tutorial. Interchangeability and Selective Assembly. Inspection Gauges, Types of Gauges, Taylor's Principle, Gauge Design, Introduction to Comparators, Mechanical (Sigma), Electrical, Pneumatic comparator.

UNIT II: MEASUREMENTS OF SCREW THREAD, GEAR AND SURFACE FINISH

Measurements of various elements of external and internal thread, Measurement of Major, Minor diameter, Effective diameter, Two and three wire method, Best Wire Size, Measurements of various elements of Gear, Gear tooth Vernier, Constant chord method, Derivation, tutorial, Base tangent method, Derivation, tutorial, Circular pitch and Composite error measurement, Surface Finish: Surface topography definitions, Measurement of Surface Texture parameters, Methods for the evaluation of Surface finish.

UNIT III: OPTICAL METROLOGY AND FORM MEASUREMENT

Principle of light wave interference, Light sources, Measurements with optical flat, Types of Interferometers, Michelson, Twyman Green Specialization of Michelson, NPL flatness Interferometers, The Pitter NPL gauge. Laser interferometer, Laser micrometer, Surface Roughness measurement using Laser. Measurement of straightness using Autocollimator, Tutorial, Measurement of flatness using Autocollimator, Measurement of squareness, parallelism, circularity, roundness and run out.

UNIT IV: COORDINATEANDMACHINETOOLMETROLOGY

Introduction to Coordinate Metrology, difference between conventional and coordinate metrology, Components, types and construction of CMM, Types of measuring head and probes in CMM, measuring accuracy, causes of error and calibration of CMM, Tutorial, performance of CMM and its applications, Alignment Tests in machine tools.

UNIT V: THEORY OF CONTROL CHARTS & ACCEPTANCE SAMPLING

Definition of Quality, Chance Causes and assignable Causes, SQC, Benefits and Limitations, Theory of Control Charts, Control Charts for Variables - X bar andR charts, Control Charts for attributes – P chart, np chart, Control charts for Non-Conformities - C and U chart, Basic Concepts of acceptance sampling and OC curve, AQL, LTPD, AOQL. Sampling Plans,Simple, Double and Multiple, tutorial. Sequential sampling plan, tutorial.

LIST OF EXPERIMENTS

1. Use of Precision Measuring Instrument (linear and angular) and Gauges.
2. Gear tooth measurement using Gear tooth Vernier.
3. Gear parameter measurement using Parkinson Gear Tester.
4. Thread Parameter measurement using floating carriage micrometer, thread micrometer.
5. Calibration of Measuring Instruments (Micrometer, Vernier Caliper, Vernier Height gauge and Dial Gauge).
6. Indirect method of measurement using standard balls and rollers.
7. Usage of various comparator mechanical electrical, pneumatic.
8. Circularity measurement using mechanical, Comparator, MM.
9. Attribute Control Charts using Go, No-Go gauges.
10. Variable Control Charts (x bar-R chart) and process capability studies.
11. Various parameter measurement using Computerized profile projector.
12. Gear and Thread measurement using Computerized profile projector.
13. Straightness, flatness measurement using autocollimator.
14. Engine Bore Straightness using bore dial gauge.
15. Nomenclature of single point cutting tool using tool makers microscope.
16. Surface roughness measurement.
17. Demo on Interferometers and measurements using laser.
18. Fundamental measurement using CMM, automatic probing.
19. Angle measurements using Sine bar, Sine Center.
20. Measurement using Machine Vision system.

TEXTBOOKS

1. Jain.R.K, "*Engineering Metrology"*, Khanna Publishers, New Delhi, 2012.
2. Gupta.R.C, "*Statistical Quality Control"*, Khanna Publishers, New Delhi, 1994.

REFERENCES

1. Kevin Harding," Handbook of Optical Dimensional Metrology", CRC Press, A Taylor & Francis group, 2013.
2. Robert. J Hocken, Paulo H. Pereira, "Coordinate Measuring Machines and Systems", CRC Press, Taylor & Francis Group, 2011.
3. Connie Dotson, Roger Harlow and Richard L. Thompson, "Fundamentals of Dimensional Metrology", Thomson Delmar Learning", 4th edition, 2005.
4. Toru Yoshizawa, "Handbook of Optical Metrology: Principles and Applications", CRC Press, 2009.
5. Grant E. L., "Statistical Quality Control", McGraw Hill, New York, 1972.
6. Statistical Quality Control, M.Mahajan , Dhanpat Rai & co. Gagankapur ,2010.

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 132	Numerical Methods	C	3	0	2	4

UNIT I: CURVE FITTING/ NUMERICALSOLUTIONS
Curve fitting, straight line, parabola, Newton Raphson method, Bisection method, Iterative methods, Power methods.

UNIT II: FINITE DIFFERENES AND INTEGATION
Forward difference and backward difference, Central difference, interpolation, Divided differences, Inverse interpolation.

UNIT III: NUMERICAL DIFFERENTIAION AND INTEGRATION
Numerical differentiation, applications, Numerical integration, applications, Simpsons rule, Trapezoidal rule.

UNIT IV: NUMERICAL SOLUTIONS OF FIST ORDER ODE
Taylor series method, Euler's methods and applications, Runge kurta method, Predictor corrector method.

UNIT V: NUMERICAL SOLUTION OF PDE
Solution of elliptic equations, Solution of Laplace equations, Solution of parabolic equations, Solutions of hyperbolic equations.

TEXTBOOKS/REFERENCES

1. B.S.Grewal, Numerical methods in engineering and science, Khanna publisher, 2012.
2. M.K.Venkatraman, Numerical methods in engineering, National publishing, 2005.
3. S.S.Sastri, Numerical methods analysis, 2005.

LIST OF EXPERIMENTS

1. Introduction to Numpy and Python.
2. Python plotting (line plots and contour plots) using Matplotlib.
3. Solution of linear algebraic equations using Direct methods
   Solution of linear algebraic equations using Iterative methods, Jacobi, SOR, SUR
4. Solution of the equations using Iterative solvers Newton Raphson and Bisection.
5. Curve fitting using least squares regression (linear and quadratic)
6. Solution of ordinary differential Equation using Euler, RK2 – (Heun and midpoint), RK4
7. Differentiation of a function using central, forward, backward Finite difference methods/.
8. Solution of the Partial differential equations (Laplace equation of temperature distribution) using the Finite difference method.

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 201	UNIVERSITY GRADUATE RESEARCH OPPORTUNITY	PR	0	0	4	2

DESCRIPTION OF TOPIC

A Multidisciplinary project to be taken up by a team of maximum of ten students. Development of prototype product, a 3D model, simulation, blueprint for a larger project and any other development work are permitted. The contribution of the individuals in the project should be clearly brought out. A combined report is to be submitted. A presentation is to be made for the reviewers on the work done by the candidate.

Assessment component	Expected outcome	Evaluators	Criteria or basis	Marks
Project proposal (Review – I)	A short presentation to be delivered on: • A brief, descriptive project title (2-4 words). This iscritical! • The 3 nearest competitors (existing solutions) and price. • Team members name, phone number, email, department/degree program, and year. • A description of the product opportunity that has been identified. To include: Documentation of the market need, shortcomings of existing competitive products, and definition of the target market and its size. • Proposed supervisor /guide	Panel of reviewers	Viability / feasibility of the project Extent of preliminary work done.	**0**
Review II	• Mission Statement /Techniques • Concept Sketches, Design	Panel of reviewers	Originality, Multi-disciplinary	**20**
	Specifications / Modules & Techniques along with System architecture		componen t, clarity of idea and	

	• Coding		presentation, team work, handling Q&A.	
Review III	• Final Concept and Model / Algorithm/ Technique • Drawings, Plans / programmed output • Financial Model / costing • Prototype /Coding • Final Presentation and Demonstration.	Panel of reviewers	Originality, Multi-disciplinary component, clarity of idea and presentation, teamwork, handling Q&A.	**50**
Final technical Report	A good technical report.	Supervisor / Guide	Regularity, systematic progress, extent of work and quality of Work.	**30**
			Total	**100**

SEMESTER-V

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 330	Industry Standard Coding Practice-2	ES	0	0	4	1

UNIT I

Problems Solving with: Structure Pointers, formation of links, Operations on Linked lists, Operations on a circular linked list, Operations on a double linked list & Industry Standard Practice Questions.

UNIT II

Problem Solving with - Stack Operations, Queue data structure Implementation, Linear / Binary Search Algorithms, Sorting Algorithms, Industry Standard Practice Questions.

UNIT III

Problem Solving with - Nonlinear data structures, trees operations, application of search property on a binary tree, tree balancing.

UNIT IV

Problem Solving with - Multiway search structures, Operations on a 2-4 tree, nonlinear structures, red, black trees & operations, Tries, String Algorithms &Industry Standard Practice Questions.

UNIT V

Problem Solving with – features of Object-oriented programming, leveraging Standard Template Libraries. Industry Standards of leveraging DBMS concepts, SQL Queries, Entity Relationship Models, Query Optimization, Transactions & Concurrency, Normalization & Industry Standard Practice Questions.

TEXTBOOKS/REFERENCES

1. Fundamentals of Data Structures in C++ - 2e- Sahni Horowitz - Universities Press.
2. Algorithms -4e- Robert Sedgewick & Kevin Wayne - Addison-Wesley Professional.
3. C++ Standard Library A Tutorial and Reference – 2e - Nicolai M. Josuttis - Addison Wesley Longman
4. An Introduction to Database Systems – 8e - C.J. Date – Pearson.
5. Competitive Programming – 3e – Steven Halim, Felix Halim

SEMESTER-V

COURSE CODE	COURSE NAME	CORE CATEGORY	CREDITS			
			L	T	P	C
CDC 331	Employability Skills	HS	1	1	0	0

UNIT I
Types and Properties of Numbers and Remainders, LCM, GCD, Fractions and decimals, Surds and Progressions.

UNIT II
Permutations, Combinations and Probability, Data Interpretation.

UNIT III
Geometry and Coordinate Geometry, Trigonometry and Mensuration.

UNIT IV: REASONING
Syllogism and Non-Verbal Reasoning, analytical Reasoning.

TEXTBOOKS/REFERENCES

1. Arun Sharma – How to prepare for Quantitative Aptitude, Tata Mcgraw Hill.
2. R.S Agarwal, A Modern Approach to Verbal and Non Verbal Reasoning, S.Chand Publications.
3. Arun Sharma– How to Prepare for Data Interpretation & Logical Reasoning for the CAT.

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SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 230	Heat and Mass Transfer	C	3	0	2	4

UNIT I: INTRODUCTION

Definitions of heat and heat transfer. Difference between heat transfer and thermodynamics. Basic Modes and Laws of Heat Transfer. Examples of Heat and Mass Transfer. Engineering Applications of Heat Transfer.

UNIT II: CONDUCTION

Fourier's law of heat conduction for homogeneous, isotropic media in Cartesian coordinates and its extension to heterogeneous, isotropic media (differential form). Vectorial form of Fourier's law for heterogeneous, isotropic continua. Fourier's law in cylindrical and spherical coordinates. Derivation of heat conduction equation in Cartesian coordinates for heterogeneous, isotropic materials. Heat conduction equation in Cartesian coordinates for (Case of constant thermal conductivity). Significance of thermal diffusivity. Heat conduction equations in cylindrical and spherical coordinates for constant thermal conductivity. Simple One-dimensional (1D) Steady Heat Conduction Problems: Plane Wall, Cylinder, and Sphere, Hollow (cylinder and sphere). Temperature distribution and heat transfer. Concepts of conductive and convective resistances. Conductive and Convective Resistances in Series. Special one-dimensional steady state situations – Heat generation, pin fins, Other fin configurations, Two-dimensional steady state situations (brief). Transient conduction: Lumped capacitance model, One dimensional transient problem analytical solution, One dimensional Heisler charts, Product solutions.

UNIT III: CONVECTION

Forced Convection: Review of fluid mechanics (brief) fundamentals, order of magnitude analysis of momentum and energy equations. Laminar flow heat transfer in circular pipe – constant heat flux and constant wall temperature, thermal entrance region. Turbulent flow heat transfer in circular pipe, pipes of other cross sections. Heat transfer in laminar flow and turbulent flow over a flat plate, Reynolds analogy. Flow across a cylinder and sphere, flow across banks of tubes. Natural Convection: Introduction, governing equations. Natural Convection: Vertical plate, horizontal cylinder, horizontal plate, enclosed spaces.

UNIT IV: RADIATION

Basic ideas, spectrum, basic definitions, Laws of radiation. Black body radiation, Planck's law, Stefan Boltzmann law, Wien's Displacement law, Lambert cosine law. Radiation exchange between black surfaces, shape factor. Radiation exchange between gray surfaces – Radiosity-Irradiation method Parallel plates, Enclosures (non-participating gas), Gas radiation.

UNITV: HEAT EXCHANGERS, CONDENSATION AND BOILING

Heat Exchangers: Types of heat exchangers, LMTD approach – parallel, counter-flow. Heat Exchangers: Multi-pass and cross flow heat exchanger, NTU approach – parallel and counterflow, shell and tube, cross flow heat exchanger. Condensation and Boiling: Dimensionless parameters, boiling modes. Condensation and Boiling: Correlations Forced convection boiling, laminar film condensation on a vertical plate, turbulent film condensation.

UNIT VI: MASS TRANSFER

Analogy between heat and mass transfer, mass diffusion, Fick's law of diffusion, boundary conditions. Steady mass diffusion through a wall, transient mass diffusion, mass convection, limitations of heat and mass transfer analogy.

TEXTBOOKS/REFERENCES

1. F. P. Incorporeal, D. P. Dewitt, T. L. Bergman and A. S. Lavine, "Fundamentals of Heat and Mass Transfer", 7th Ed., John Wiley and Sons, 2011.
2. J. P. Holman, "Heat Transfer", 10th Ed., McGraw Hill, 2009.
3. Yunus A. Çengel, Afshin J. Ghajar, "Heat and mass transfer: fundamentals and applications", McGraw-Hill Education, 2015.
4. P. K. Nag, "Heat and Mass Transfer", 3rd Ed., McGraw Hill.
5. M. N. Ozisik, Heat Transfer-A Basic Approach, McGraw Hill, 1985.
6. Frank Kreith, Raj M. Manglik and Mark S. Bohn, "Principles of Heat Transfer", 7th Ed., Cengage Learning, 2011.
7. A. Bejan, Convective Heat Transfer, 3rd Ed., John Wiley and Sons, 2004.
8. C. P. Kothandaraman and S. Subramanyan, "Heat and Mass transfer data book 6th Ed. (Multi-color, edition) ",, New Age International Publishers, 2018.

LIST OF EXPERIMENTS

1. Thermal conductivity of insulating powder.
2. Critical radius of insulating material.
3. Cross flow experiment with heated cylinder.
4. Heat transfer in natural convection.
5. Heat transfer in forced convection.
6. Pin – fin apparatus.
7. Emissivity measurement apparatus.
8. Heat pipe demonstration.
9. Unsteady state heat transfer apparatus.
10. Critical heat flux apparatus.
11. Parallel / counter flow heat exchanger.
12. Condensation in drop and film forms.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 322	Manufacturing Technology	C	3	0	2	4

UNIT I: CASTING

Introduction to Casting, Patterns and its types and materials, Pattern Allowances, Molding and its types, Molding sand, Gates and Risers, Numerical problems on pouring time and Caine's rule, Cores, Core making, Shell casting, Investment Casting, Die casting, Centrifugal Casting, Casting defects and remedies.

UNIT II: MECHANICAL WORKING OF METALS

Introduction to Hot and Cold Working, Hot and Cold Rolling, Types of rolling viz. Two, three, four, multi and Universal rolling, Open die and Closed die forging, Wire drawing, Hot, Cold, Forward, backward and tube extrusion, Shearing, Piercing, Trimming and Stretch forming, Theory of Bending, bending length and Bending force calculations, Drawing, Blank size and drawing force calculations, Tube forming, Embossing and coining, Progressive, Compound and Combination dies and defects informing.

UNIT III: THEORY OF METAL CUTTING

Orthogonal and oblique cutting, Classification of cutting tools namely single point, and multipoint, Tool signature for single point cutting tool, Mechanics of orthogonal cutting and Force relationship, Merchant Circle and Determination of shear angle, Chip formation, cutting tool materials, Tool wear and Taylor's tool life calculation, Machinability and Cutting Fluids.

UNIT IV: GEAR MANUFACTURING AND SURFACE FINISHING PROCESS

Gear Manufacturing viz Extrusion, Stamping and Powder Metallurgy, Gear Machining, Forming, Spur and Helical in milling machine, Gear Generating: Gear shaping, Gear hobbling, Grinding process, Types of Grinding machines viz. Surface, Cylindrical and Centerless, Grinding Wheel and its types, Grinding specifications and type of abrasive bonds, Selection of Cutting speed and work speed, dressing and truing, Lapping, Buffing, Honing, and Super finishing.

UNIT V: MACHINE TOOLS

Classification of Milling Machines and its basic Construction, Types of cutters in Milling machines, Types of milling operations (up and down, peripheral, face milling), Simple and differential Indexing methods and its calculations, shaping and slotting Machine, Its description and operations. Planers: Double house and open side, Quick return Mechanism, Work and tool holding Devices, Boring machine and its Specification, operations, Jig boring machine. Specification of Broaching machine, its types and operations (internal, surface), Tool nomenclature of broaching tool.

LIST OF EXPERIMENTS

1. Performing plain turning, step turning and chamfering in Lathe.
2. Performing taper turning by compound rest/offset method and drilling in Lathe.
3. Performing External threading, Internal thread cutting and eccentric turning in Lathe.
4. Performing Taper boring and knurling in Lathe.
5. Performing V block shaping in shaper machine.
6. Performing Polygon milling in milling machine.
7. Spur Gear cutting in milling machine.
8. Spur Gear cutting in milling machine.
9. Performing surface grinding in Grinding machine.
10. Performing cylindrical grinding in Grinding machine.
11. Grinding of single point cutting tool in Tool and Cutter grinding machine.
12. Preparation of Sand mold using solid/split pattern with loose-piece pattern.

TEXTBOOKS

1. Mikell P. Groover, *"Fundamentals of Modern Manufacturing Materials, Processes, and Systems*,4th Edition, John Wiley & Sons, Inc., 2010.
2. E.PaulDeGarmo, Black J.T and Ronald A. Kosher, **"***Materials and Processes, in Manufacturing*", 8th Edition, Prentice – Hall of India, 1997.
3. Roy A. Lindberg, "*Processes and materials of manufacture*" Prentice Hall,1998.
4. John A. Schey, *"Introduction to manufacturing processes*",McGraw-Hill, 3rd Edition, 2000.
5. James S Campbell, "*Principles of manufacturing materials and processes*" New Delhi: Tata McGraw Hill ,1983.
6. Serope Kalpakjian, Steven R Schmid "*Manufacturing Engineering and Technology*" Pearson India, 4th Edition, 2002.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 272	Dynamics and Control	C	3	0	2	4

UNIT I: FREE VIBRATION

Introduction to vibration terminologies and types of vibration, Equation of motion for free undamped single Degree of freedom system by Newton's and energy method, Tutorials on single Degree of Freedom undamped free vibration systems. Equation of motion for free damped single Degree of freedom systems. Tutorials on free damped single Degree of freedom systems. Torsional Vibration of Two Rotor and three rotor Systems. Tutorials on Torsional Vibration of Two Rotor and three rotor Systems. Torsional Vibration of Geared Systems with Two and three rotor System.

UNIT II: FORCED VIBRATION

Equation of motion for harmonically excited single Degree of Freedom system, Tutorials on harmonically excited single Degree of Freedom system, Forced vibration due to unbalanced rotating and reciprocating systems, Tutorials on Forced vibration due to unbalanced rotating and reciprocating systems, Forced vibration due to Base excitation by Absolute and relative amplitude Method. Tutorials on Forced vibration due to Base excitation by absolute and Relative amplitude Method. Force Transmissibility and Vibration isolation. Tutorials on Force Transmissibility and Vibration isolation, Whirling of shaft and tutorials.

UNIT III: MULTI DEGREE OF FREEDOM

Equation of motion for free undamped two and three degrees of Freedom systems and tutorials, Equation of motion for two and three DOF using Lagrangian energy method for Un-damped free vibration, Co-ordinate Coupling and tutorials, Concept of Linear and torsional undamped Vibration absorber, Tutorials on Linear and torsional undamped Vibration Absorber.

UNIT IV: LANGARANGIAN DYNAMICS

Virtual work, generalized forces, Derivation of langaragian equations, Eigen value problems, Equilibrium analysis.

UNIT V: VIBRATION MESUREMENT

Vibration measuring devices and Vibration exciters, Free and Forced vibration Tests, Balancing Machines, single plane and two plane balancing, Condition monitoring techniques and signal analysis, Basics of Noise terminologies and their relations, Noise Control Methods at source, along Path and at receiver.

TEXTBOOKS

1. Gian carlogenta, Vibration dynamics and control, 1993, Springer.
2. Leonard meirovitch , Dynamics and Control, Abe books, 1985.
3. Lazlo Kevizsky, Control Engineering, 2018.
4. Gopal, Control Systems, 1997.
5. Iyengar, Mechanical vibrations, 2010.

LIST OF EXPERIMENTS

1. Motor control using 4dof development platform.
2. Control of magnetic levitation system.
3. Control of cartwheel inverted pendulum.
4. Kinematic analysis of 3dof robot.
5. Control of 3dof robot.
6. Speed control of dc motor.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 321	Fluid Machinery	C	3	0	2	4

UNIT I: HYDRAULIC POWER GENERATING AND UTILIZING SYSTEMS

Introduction to fluid power system, Hydraulic fluids functions, types, properties, selection and application. POWER GENERATING ELEMENTS: Construction, operation, characteristics of External Gear pump, internal Gear pump. Construction, operation, characteristics of Lobe, Gerotor and Screw pumps. Construction, operation, characteristics of Un balanced and balanced vane pump. Construction, operation, characteristics of pressure compensated vane pump. Construction, operation, characteristics of bent axis piston pump, swash plate piston pump and Radial Piston Pump. Construction and working of single acting, double acting hydraulic linear actuators. Special cylinders: Tandem, Rodless, Telescopic, Cushioning arrangement for cylinders to reduce the impacton the cylinders, Various cylinder mountings, Construction and working of Gear, Vane, Piston motors to obtain rotary motion.

UNIT II: HYDRAULIC VALVES AND ACCESSORIES

Construction and working of manually operated 2/2, 3/2, 4/2,4/3, directional control valves, construction and working of pilot and solenoid operated 2/2, 3/2, 4/2, 4/3, directional control valves. Construction and working of pressure relief, compound pressure relief, pressure sequence valves. Construction and working of pressure reducing, counterbalance valves. Working principle of check valve, throttle valve, one way FCV, pressure compensated FCV, and their applications. Importance of proportional valves, Servo valves and its applications. Need for intensifier in hydraulic systems, applications. Different switches, filters, seals, fittings and other accessories used in hydraulic systems, Functions, types and applications of accumulators in Hydraulics.

UNIT III: PNEUMATIC SYSTEMS

Introduction, comparison with hydraulic systems and electrical systems, Construction, operation, characteristics and symbols of reciprocating and rotary compressors. Construction, operation, characteristics and symbols of 3/2, 5/2, 5/3 manual operated, pilot operated and solenoid operated DCVs. Need for air treatment, Filter, Regulator, Lubricator, Muffler and Dryers. Introduction to fluidic devices, working of Bi-stable, mono- stable devices and application circuits. Introduction to Electro Pneumatics, logic circuits, constructing electrical ladder diagrams for various fluid power applications.

UNIT IV: DESIGN OF FLUID POWER SYSTEMS

Speed, force and time calculations in fluid power systems, Calculation of pressure and pressure drop across components in fluid power circuits, Sizing of actuators, pumps, reservoirs for specific requirement Finding the capacity (Sizing) of accumulators required for hydraulic systems, Calculations on Heat generation in fluid. Design of hydraulic/pneumatic circuit for a practical application Selection of different components such as reservoir, various valves, actuators, filters, pumps based on design. Design of hydraulic/pneumatic circuits for simple reciprocation, regenerative, speed control of actuators. Design of hydraulic/pneumatic circuits for sequencing, synchronization and transverse. Cascading circuits for two and three cylinders, Fail-safe circuit, counterbalance circuit, actuator locking.

UNIT V: APPLICATIONS, MAINTENANCE AND TROUBLE SHOOTING

Industrial hydraulic circuits for riveting machine, actuator locking Working of hydraulic press and pump unloading circuits, Hydraulic/ pneumatic circuits for material handling systems. Preventive and breakdown, maintenance procedures in fluid power systems. Trouble shooting of fluid power systems, fault finding process equipment's / tools used, causes and remedies. Safety aspects involved fluid power systems.

TEXTBOOKS/REFERENCES

1. Anthony Esposito, "*Fluid Power with applications"*, Prentice Hall International, 2009.
2. Majumdar.S.R, "*Oil Hydraulic Systems: Principles and Maintenance"*, Tata McGraw Hill, 2006.
3. Majumdar.S.R, "*Pneumatic systems – principles and maintenance"*, Tata McGraw-Hill, New Delhi, 2006.
4. Werner Deppert / Kurt Stoll, "*Pneumatic Application: Mechanization and Automation by Pneumatic Control"*, Vogel verlag, 1986.
5. John Pippenger, Tyler Hicks, "*Industrial Hydraulics"*, McGraw Hill International Edition, 1987.
6. Andrew Parr, "*Hydraulics and Pneumatics: A technician's and engineer's guide"*, Elsevier Ltd, 2011.
7. FESTO manual, "*Fundamentals of Pneumatics"*, Vol I, II and III.
8. Hehn Anton, H., "*Fluid Power Trouble Shooting",* Marcel Dekker Inc., NewYork, 1995.
9. Thomson, "*Introduction to Fluid power",* Prentice Hall, 2004.

LIST OF EXPERIMENTS

1. Performance test on axial flow fan.
2. Performance test on centrifugal pump (variable speed) test rig.
3. Performance test on centrifugal pump for series operation.
4. Performance test on centrifugal pump for parallel operation.
5. Performance test on reciprocating pump operation.
6. Performance test on pelton wheel turbine.
7. Performance test on francis turbine.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ISES 312	Industry Specific Employability Skills-VI	HS	1	1	0	0

UNIT I
Antonyms, synonyms, odd words, Idioms and phrasal verbs, same word with different part of speech, Word analogy. Sentence completion.

UNIT II
Text completion, Sentence equivalence, Introduction to Different Parts of an Argument in Reasoning, Assumption of an Argument, strengthening of an Argument, Weakening of an argument.

UNIT III
Para jumbles, Sentence Completion & Text Completion, Reading Comprehension, Identification of errors, Sentence correction.

UNIT IV
Resume writing, Cover letter.

UNIT V
GD, PI.

TEXTBOOKS/REFERENCES

1. Verbal Ability and Reading comprehension-Sharma and Upadhyay.
2. Charles Harrington Elstor, Verbal Advantage: Ten Easy Steps to a Powerful Vocabulary, Large Print, September 2000.
3. GRE Word List 3861 – GRE Words for High Verbal Score, 2016 Edition.
4. The Official Guide to the GRE-General Revised Test, 2nd Edition, Mc Graw Hill Publication.
5. Soft Skills Training: A Workbook to Develop Skills for Employment Book by Frederick H. Wentz.
6. The Resume Writing Guide: A Step-by-Step Workbook for Writing ...Book by Lisa McGrimmon.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 331	Industry Standard Coding Practice-3	ES	0	0	4	1

UNIT I

Problem solving with - Descriptive statistics, Mean/median/mode, Measures of dispersion/range variance, deviations, mean/median/mode problems, Random variables, Univariate & Bivariate random variables.

UNIT II

Problem solving with - Graphs, Handshaking Lemma, Simple Graphs, DFS/BFS, connected components, coloring, Introduction to DAGs, Spanning Trees, Articulation Points/ Connected points.

UNIT III

Problem solving with - Greedy Methods: Coin change, Fractional Knapsack, Activity Selections/ Job sequencing with Deadlines, Spanning Trees, Dynamic Programming: 0/1 Knapsack, Substructures, longest common substring/subsequence, Longest Increasing sub sequence, Grid based Problems.

UNIT IV

Problem solving with - Divide & Conquer Strategies: Quick/Merge Sort, Min/Power functions, Backtracking, N Queens problem, Finding the path & Grid based problems, iterative/loop free approaches.

UNIT V

R Language Constructs, calculations, Operators, vectors, lists, Practice problems implementing R language, Matrices and data frame, Conditional statements and loops, Problem Solving on R language examples.

TEXTBOOKS/REFERENCES

1. An Introduction to Statistical Learning: with Applications in R - Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani.
2. Introduction to Algorithms by Thomas H. Corman, The MIT Press, 3rd Edition.
3. Introduction to Algorithms: A Creative Approach by Udi Mander, Pearson.
4. R Cookbook - Paul Teetor, O'reilly.
5. Competitive Programming – 3e – Steven Halim, Felix Halim.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 406	Computational Fluid Dynamics	TE	3	0	0	3

UNIT I: GOVERNING EQUATIONS AND MATHEMATICAL BEHAVIOR OF PARTIAL DIFFERENTIAL EQUATIONS

Introduction to computational fluid dynamics, Types of model flow, substantial derivative, Divergence of velocity. Continuity equation in conservation form, integral and differential form, Continuity equation in non-conservation form, integral and differential form, Manipulation of continuity equation, Three-dimensional momentum equation, Navier's Stokes equation, Energy equation, Different boundary conditions, Classification of PDE, Classification of PDE, Mathematical behavior of PDE, Well posed problems.

UNIT II: DISCRITIZATION TECHNIQUES

Explanation of finite difference method, Discretisation of wave equation, Discretisation of laplace equation, Numerical error types and stability criterion, One dimensional transient heat conduction equation discretization. Explicit, crank Nicholson and pure implicit method. Numerical error and stability of One-dimensional transient heat conduction equation. Grid independence test, Optimum step size.

UNIT III: SOLUTUION TECHNIQUES

Laxwendroff Technique, Maccormack Technique, Relaxation Technique and its significance, TDMA Algorithm, Alternative Direction Implicit method, Pressure correction Technique, Staggered Grid, Numerical SIMPLE Algorithm, Stream function and Vorticity method.

UNIT IV: GRID GENERATION

Grid transformation of equations, Transformation of aerofoil from physical plane to Computational plane, Transformation of continuity and Laplace equation, Metrices and Jacobians, Stretched grid, Compressed grid, Adaptive grids , Body fitted coordinate system, Grid generation in irregular geometry, Modern development in grid generation.

UNIT V: FINITE VOLUME METHOD

Finite Volume methods of discretisation-Central differencing scheme, Upwind scheme, hybrid scheme, One dimensional conduction problem, One dimensional convection problem, One dimensional convection and diffusion problem with different boundary conditions, Steady state heat conduction problems, Transient heat conduction problems.

TEXTBOOKS

1. Anderson J.D., "*Computational Fluid dynamics"*, McGraw Hill Int., New York, 2010.
2. Versteeg H.K., and Malalasekera W., "*An introduction to computational fluid dynamics, The finite volume method"*, Longman, 2007.
3. Suhas.V. Patankar, "*Numerical Heat Transfer and Fluid Fl*ow", Hemisphere Publishing Corporation, 2009.
4. Muralidhar.K, and Sundararajan.T, "*Computational Fluid Flow and Heat Transfer"*, Narosa Publishing House, New Delhi, Second Edition, 2008.
5. Ghoshdasdidar.P.S, "*Computer simulation of fluid flow and heat transfer"*, Tata McGraw Hill Publishing Company Ltd., 1998.
6. Anil W. Date, "*Introduction to computational fluid dynamics",*Cambridge University Press, Cambridge,2009.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 405	Mechanics of Composite Materials	TE	3	0	0	3

UNIT I: INTRODUCTION
Definition, Need, General characteristics, Applications, Fibers-Glass, Carbon, Ceramic and Aramid fibers, Polymer Matrices, Ceramic Matrices, Metal Matrices, Characteristics of fibers and matrices, Smart materials, types and characteristics.

UNIT II: MECHANICS AND PERFORMANCE
Characteristics of fiber reinforced Lamina, Laminates, Interlaminar stresses, Static Mechanical Properties, Fatigue and Impact properties, Environmental effects, Fracture Behavior and Damage Tolerance.

UNIT III: MANUFACTURING
Bag Moulding, Compression moulding, Pultrusion, Filament winding, Other Manufacturing Processes, Quality Inspection method.

UNIT IV: ANALYSIS
Analysis of an orthographic lamina, Hooke's law, stiffness and compliance matrices, Strengths of orthographic lamina, Stress analysis of laminated composite Beams, Stress analysis of laminated composite Plates, Stress analysis of laminated composite Shells, Free vibration.

UNIT V: DESIGN
Failure predictions in a Unidirectional Lamina, Failure predictions for Unnotched Laminates, Laminated Design Consideration, Bolted and Bonded Joints, Design examples.

TEXTBOOKS

1. Mallick, P.K., "*Fibre Reinforced composites: Materials*", Manufacturing and Design: Marcel DekkerInc., 1993.
2. Halpin, J.C., "*Primer on Composite Materials, Analysis*", Techomic Publishing Co., 1984.
3. Agarwal, B.D., and Broutman L.J., "*Analysis and Performance of Fibre Composites*", John Wiley andSons, New York, 1990.
4. Malick, P.K. and Newman S., (eds), "*Composite Materials Technology: Processes and Properties*",Hansen Publisher, Munich, 1990.

SEMESTER-VI

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 417	Compressible Flow	TE	3	0	0	3

UNIT I
Review of fluid Mechanics, Thermodynamics and Navier Stokes equation.

UNIT II
Wave propagation in compressible flows, Isentropic and quasi 1D flows.

UNIT III
Normal, oblique and bow shocks, Theta-Beta-M relation.

UNIT IV
Expansion fans and interaction of shock waves.

UNIT V
Compressible flows with friction.

TEXTBOOKS

1. John D. Anderson Jr (1990), Modern Compressible Flow with Historical Perspective, McGraw-Hill, Singapore.
2. E. Rathakrishnan (2012), Gas Dynamics, 4TH Edition, PHI Learning Private Limited, New Delhi.

REFERENCES

1. Gas Dynamics Volume 1, Maurice J Zucrow and Joe D Hoffman.

SEMESTER-VII

SEMESTER-VII

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 450	Multi-Disciplinary Design Project	PR	0	0	4	2

DESCRIPTION OF TOPIC

1. Introduction: Facilitating Multidisciplinary Projects.
2. Identifying and formulating a problem.
3. System Modelling.
4. Thinking perspectives: Decomposition–Composition Thinking, Hierarchical Thinking, Organizational. Thinking, Lifecycle Thinking, Safety Thinking, Risk Thinking, Socio-politico-cultural thinking, Environment thinking.
5. Decomposing a system – Identifying the major sub- Systems.
6. Mathematical Modeling and Governing equations for each sub systems.
7. Objectives, Constraints and Design Variables.
8. Conceptual Design.
9. Collaborative Design – Disciplinary teams satisfy the local constraints while trying to match the global constraints set by the project coordinator.
10. Tools for modeling, designing, analysis, data interpretation, decision making etc.
11. Design Analysis, evaluation and selection.
12. Costing and Financial model.
13. Documentation, reviewing and presentation.

SEMESTER-VII

COURSE CODE	COURSE NAME	COURSE CATEROGY	CREDITS			
			L	T	P	C
ME 409	Thermal Design for Electronic Equipment's	TE	3	0	0	3

UNIT I: FUNDAMENTALS OF HEAT TRANSFER

Review of Conduction, Convection and Radiation heat transfer. Introduction to electronics packaging: Basic definitions of electronics packaging, classification of electronics packaging and self- heating in electronics packaging.

UNIT II: INTRODUCTION TO THERMAL MANAGEMENT OF ELECTRONICS PACKAGES AND DATACENTERS

Basic definitions of thermal management, classification of thermal management of electronics packages and datacenters. Concept of Contact resistance elastic-elastic contacts and elastic plastic contacts. Conjugate heat conduction and thermal spreading: Derivation of analytical solution of heat spreading in heat sink base. Fin analysis and heat sink design: Derivation of general thermal resistance network.

UNIT III

Natural convection in electronics packaging, Radiation in electronic packages. Forced convection in electronics, Liquid cold plates for electronics, Jet impingement analytical solution derivation, Boiling and Condensation. Immersion cooling of electronics, design considerations. Introduction to heat pipes, Phase change energy storage with PCM's. Microchannel heat exchangers, Piezoelectric fans and synthetic jets.

UNIT IV

Thermoelectric modules, derivation of analytical solution, Acoustic challenges, thermal modelling of electronics packages and printed circuits. Thermal design of fan heat sinks: fan/blower curves, parallel plate fins, manufacturing processes, design for manufacturability.

UNIT V

Thermal design of smartphones and tablets: case studies. Thermal design of IT data centers Part 1 (IT equipment loop). Thermal design of IT data centers Part 2 (IT facilities loop) chip to cooling tower Thermal design.

TEXTBOOKS

1. Lian-Tuu Yeh, Richard C. Chu, Dereje Agonafer, "Thermal management of microelectronic equipment _ heat transfer theory, analysis methods and design practices", ASME press, 2002
2. F. P. Incropera, D. P. Dewitt, T. L. Bergman and A. S. Lavine, "Fundamentals of Heat and Mass Transfer", 7th Ed., John Wiley and Sons, 2011
3. Allen D. Kraus and Avram Bar Cohen, "Design and Analysis of Heat Sinks", Wiley-Interscience, 2008
4. Tummala Rao R., "Fundamentals of Microsystems packaging", McGrawHill, 2004.

REFERENCES

1. Yunus A. Çengel, Afshin J. Ghajar, “Heat and mass transfer: fundamentals and applications”, McGraw-Hill Education, 2015
2. Ho Sung Lee, “Thermal Design: Heat Sinks, Thermo-electrics, Heat Pipes, Compact Heat Exchangers, and Solar Cells”, John Wiley and Sons,2010
3. Adrian Bejan, Allan D. Kraus, “Heat Tranfer Handbook”, Wiley-Interscience, 2003
4. Ralph Remsburg, “Thermal Design of Electronic Equipment”, CRC Press LLC, 2001

SEMESTER-VII

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 430	MECHATRONICS	TE	3	0	0	3

UNIT I: INTRODUCTION TO MECHATRONICS

Introduction to Mechatronics systems, Mechatronics system components and Measurement Systems, Control Systems, Open and Closed Loops Systems temperature control, Water level controller and Shaft speed control, Transfer function: Laplace transform, system in series and System with feedback loop. Sequential Controllers: Washing machine control, Sequential Controllers: Digital camera.

UNIT II: SENSORS AND TRANSDUCERS

Introduction to sensors and transducers and classifications, Principle and working of Resistive, capacitive, inductive and resonant transducers, Optical measurement systems for absolute and incremental encoders, Photo electric sensor and vision system, Fiber optic transducers, Solid state sensors and transducers for magnetic Measurements Temperature measurements, Chemical measurements, piezoelectric sensor and Accelerometers, Ultrasonic sensors and transducers for flow and distance.

UNIT III: ELECTRICAL DRIVES AND CONTROLLERS

Introduction, Electromagnetic Principles, Solenoids and Relays, Electrical drives of stepper motors, servo motors, Operational amplifier, A/D converters & D/A converters, Signal processing, Multiplexer and Introduction to Data acquisition system, Proportional, Integral, Derivative and PID controller, Introduction to Micro controller: M68HC11 and ATMEGA328.

UNIT IV: PROGRAMMABLE LOGIC CONTROLLERS

Basic structure, Programming units and Memory of Programmable logic controller, Input and Output Modules, Mnemonics for programming, Latching and Internal relays, Timers, Counters and Shift Registers, Master relay and Jump Controls, Programming the PLC using Ladder diagram for Simple applications.

UNIT V: MECHATRONICS SYSTEM DESIGN AND APPLICATION

Mechatronics in Engineering Design, Traditional and mechatronics design, Car park barriers using PLC, Pick and Place robots and Bar code reader, Wind screen wiper using stepper motor control, Car Engine management systems, Case studies for Coin counters, Robot walking machine,Boiler control using PID.

TEXTBOOKS

1. Bolton.W, "*Mechatronics*", Addison Wesley, 4th Edition, New Delhi, 2010.
2. Bradley.D.A, Dawson.DBurdN.C.and Loader A.J, "*Mechatronics*", Chapman and Hall Publications,New York, 1993.
3. Jacob Fraden, "*Handbook of Modern Sensors Physics, Designs, and Applications*", Third Edition,Springer-Verlag New York, 2004.
4. James Harter, "*Electromechanics, Principles and Concepts and Devices*", Prentice Hall, New Delhi,1995.
5. David W. Pessen, "*Industrial Automation Circuit Design and Components*", John

Wiley, New York,1990.
6. Rohner.P, "*Automation with Programmable Logic Controllers*", Macmillan / McGraw Hill, New York,1996.
7. Brian Morris, "*Automatic Manufacturing Systems Actuators, Controls and Sensors*", McGraw Hill,New York, 1994.
8. Godfrey C. Onwubolu, "*Mechatronics Principles and applications*", Butterworth-Heinemann, NewDelhi, 2006.

SEMESTER-VII

COURSE CODE	COURSE NAME	COURSE CATEROGY	CREDITS			
			L	T	P	C
ME 410	Thermal Power Engineering	TE	3	0	0	3

UNIT I: AIR STANDARD CYCLES
Carnot, Otto, Diesel, Dual and Stirling cycles, p-v and T -s diagrams, description, efficiencies and mean effective pressures. Comparison of Otto and Diesel cycles. IC engine components, their functions, engine performance and efficiency.

UNIT II: GAS POWER CYCLES
Gas turbine (Brayton) cycle; description and analysis. Regenerative gas turbine cycle. Intercooling and reheating in gas turbine cycles. Introduction to Jet Propulsion cycles – Turbojet, Turbofan, Turboprop, Afterburner and Rockets.

UNIT III: VAPOR POWER CYCLES
Carnot vapour power cycle, drawbacks as a reference cycle. Simple Rankine cycle; description, T-S diagram, analysis for performance. Comparison of Carnot and Rankine cycles. Effects of pressure and temperature on Rankine cycle performance. Actual vapour power cycles. Ideal and practical regenerative Rankine cycles, open and closed feed water heaters. Reheat Rankine cycle, Cogeneration, Combined Gas-Vapor Cycles, Binary Vapor Cycles, Characteristics of an Ideal working fluid in vapour power cycles.

UNIT IV: STEAM GENERATOR
Boiler types, applications, and comparison; Boiler system requirements, Water Tube Boiler, Fire Tube Boiler, Mountings and Accessories. Performance calculations, Boiler trial.

UNIT V: CONDENSER
Condenser system elements; types and their advantages/disadvantages; Its effect on Rankine efficiency.

UNIT VI: STEAM TURBINE
Impulse and reaction turbine, velocity triangle, degree of reaction, efficiencies, losses, Velocity and Pressure compounding.

TEXTBOOKS

1. Thermodynamics, Yunus A, Cengel & Michael A Boles, Tata McGraw Hill, 7th Edition.
2. Engineering Thermodynamics P.K. Nag Tata McGraw Hill 6th Edition 2018.
3. P. K. Nag, Powerplant Engineering, 2nd Ed., Tata McGraw Hill, 2002.

REFERENCES

1. M. J. Moran & H N Shapiro, Fundamentals of Engineering Thermodynamics, 3rd Ed., John Wiley, 1995.
2. M. M. ElWakil, Power Plant Technology, McGraw Hill International, 1992.

SEMESTER-VII

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 415	REFRIGERATION AND AIR CONDITIONING	TE	3	0	0	3

UNIT I: VAPOUR COMPRESSION REFRIGERATION SYSTEMS

Review of thermodynamic principles of refrigeration, Simple vapour compression system, Calculation: COP of VCR system, Method for improving COP in VCR system, Multistage and multiple evaporator system, Cascade system, COP comparison with sub cooling and super heating, Tutorial: problem on sub-Cooling, and super heating.

UNIT II: ABSORPTION REFRIGERATION SYSTEMS

Absorption refrigeration cycle, Water lithium bromide systems, Tutorial:LiBr COP calculation, Ammonia Absorption Refrigeration system, Tutorial: ammonia COP calculation, COP calculation of single effect absorption system, Refrigeration absorbent combinations, Comparison of absorption system with vapor compression systems, Tutorial: COP comparison of vapor compression systems with vapor absorption system.

UNIT III: REFRIGERATION EQUIPMENTS & CONTROL

Compressors –type, Condensers type, Cooling towers type, Evaporators, Expansion devices type, Refrigerants: properties, Selection of refrigerants-alternate refrigerants, Refrigeration plant controls, Testing and charging of refrigeration units.

UNIT IV: DESIGN OF AIR CONDITIONING SYSTEMS

Different heat sources of Conduction and radiation, Load: occupants load, equipment load, fresh air load, infiltration air load, Tutorial: conduction, radiation, Tutorial: load calculation, Estimation of total heat load (SHL+LHL), Bypass factor (BPF), Effective sensible heat factor (ESHF), Tutorial: SHF& ESHF, Cooling coils and dehumidifier air washers.

UNIT V: APPLICATIONS OF REFRIGERATION AND AIR CONDITIONING SYSTEMS

Preservation of different products, Ice factory, Dairy plant refrigeration systems, Application of air conditioning in hotels, Application of air conditioning in restaurants, Application of air conditioning in theatres, Application of air conditioning in auditorium, Application of air conditioning in hospitals, Cryogenics applications.

TEXTBOOKS

1. Arora.S.C and Domkundwar.S, "*A course in Refrigeration and Air conditioning*", DhanpatRai(P) Ltd., New Delhi, 2012.
2. Ananthanarayanan.P.N, "*Basic Refrigeration and Air Conditioning*", Tata McGraw Hill, 3rd Edition, New Delhi, 2006.
3. Manohar Prasad, "*Refrigeration and Air conditioning*", New Age International (P) Ltd, New Delhi, 2010.
4. Roy J. Dossat,"*Principles of Refrigeration*", Pearson Education Asia, 4th Edition, 2001.
5. Arora, C. P., "*Refrigeration and Air Conditioning*", Tata McGraw Hill, New Delhi, 2006.

SEMESTER-VIII

SEMESTER-VIII

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 602	Design Project/Industrial Project	PR	0	0	30	15

DESCRIPTION OF TOPIC

1. It is mandatory for every student to undergo this course.
2. Every student is expected to spend a minimum of 15-days in an Industry/ Company/ Organization, during the summer vacation.
3. The type of industry must be NOT below the Medium Scale category in his / her domain of the degree programmed.
4. The student must submit the "Training Completion Certificate" issued by the industry / company / Organisation as well as a technical report not exceeding 15 pages, within the stipulated time to be eligible for making a presentation before the committee constituted by the department.
5. The committee will then assess the student based on the report submitted and the presentation made.
6. Marks will be awarded out of maximum100.
7. Appropriate grades will be assigned as per the regulations.
8. Only if a student gets a minimum of pass grade, appropriate credit will be transferred towards the degree requirements, as per the regulations.
9. It is solely the responsibility of the individual student to fulfill the above conditions to earn the credits.
10. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100%, if the credits are transferred, after satisfying the above (1) to (8) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO.
11. The committee must recommend redoing the course, if it collectively concludes, based on the assessment made from the report and presentations submitted by the student, that either the level of training received, or the skill and / or knowledge gained is NOT satisfactory.

OPEN ELECTIVES
V-SEMESTER

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 205	Object oriented programming with Java	OE	3	0	0	3

UNIT I: OBJECT-ORIENTED THINKING

A way of viewing world – Agents and Communities, Messages and methods, Responsibilities, Classes and Instances, Class Hierarchies- Inheritance, Method binding, Overriding and Exceptions, Summary of Object-Oriented concepts, Java buzzwords, An Overview of Java, Data types, Variables and Arrays, Operators, expressions, control statements, Introducing classes, Methods and Classes, String handling. Inheritance– Inheritance concept, Inheritance basics, Member access, Constructors, Creating Multilevel hierarchy, super uses, using final with inheritance, Polymorphism-ad hoc polymorphism, pure polymorphism, Method overriding, abstract classes, Object class.

UNIT II: STREAM BASED I/O(JAVA.IO)

The Stream Classes-Byte streams and Character streams, reading console Input and Writing Console Output, File class. Reading and writing Files, Random access file operations. The Console class, Serialization, Enumerations. Auto boxing, generics.

UNIT III: EXCEPTION HANDLING

Fundamentals of exception handling, Exception types, Termination or presumptive models, Uncaught exceptions, using try and catch, Multiple catch clauses, nested try statements, Throw, throws and finally, built- in exceptions. Creating own exception sub classes, Multithreading- Differences between thread-based multitasking and process-based multitasking, Java thread model. Creating threads. Thread priorities, Synchronizing threads. Inter thread communication.

UNIT IV: THE COLLECTIONS FRAMEWORK (JAVA.UTIL)

Collection's overview, Collection Interfaces, The Collection classes- Array List. Linked List, Hash Set, Tree Set, Priority Queue, Array Deque. Accessing a Collection via an Iterator, Using an Iterator, The For-Each alternative, Map Interfaces and Classes, Comparators, Collection algorithms, Arrays, The Legacy Classes and Interfaces- Dictionary, Hashtable, Properties, Stack, Vector More Utility classes, String Tokenizer, Bit Set, Date. Calendar, Random, Formatter, Scanner.

UNIT V: GUI PROGRAMMING WITH SWING

Introduction, limitations of AWT, MVC architecture, Components, containers. Understanding Layout Managers, Flow Layout, Border Layout, Grid Layout, Card Layout, Grid Bag Layout, Event Handling- The Delegation event model- Events, Event sources, Event Listeners, Event classes, Handling mouse and keyboard events, Adapter classes, Inner classes, Anonymous Inner classes, A Simple Swing Application, Applets – Applets and HTML, Security Issues, Applets and Applications, passing parameters to applets, Creating a Swing Applet, painting in Swing, A Paint example, Exploring Swing Controls- JLabel and Image Icon, jText Field, The Swing Buttons- JButton.JToggle Button, JCheck Box, JRadio Button, JTabbed Pane, JScroll Pane, JList.JCombo Box, Swing Menus, Dialogs.

TEXTBOOKS/REFERENCES

1. Java The complete reference, 9th edition, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd.
2. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education.
3. An Introduction to programming and OO design using Java, J. Nino and F.A. Hosch, John Wiley & sons.
4. Introduction to Java programming, Y. Daniel Liang, Pearson Education.
5. Object Oriented Programming through Java, P. Radha Krishna, Universities Press.
6. Programming in Java, S. Malhotra, S. Chaudhary, 2nd edition, Oxford Univ. Press.
7. Java Programming and Object-Oriented Application Development, R. A. Johnson, Cengage Learning.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 205 L	Object oriented programming with Java Lab	OE	0	0	2	1

LIST OF EXPERIMENTS

1. Declare a class named Teacher. The class will have all the data members as per your convenient. The class will have constructors. Write a function to read the values of the class variables. The values of the variable will be stored in a FILE (text file). The values will be stored in a structured format of your own choice.
2. Further, read the content of the FILE and display the content in an ordered form (First Name, Last Name).
3. Concept Learning:
    a. FILE manipulation
    b. Use try catch blocks
    c. Use multiple try catch block
    d. Finally statement
4. Create a three classes named Student, Teacher, Parents. Student and Teacher class inherits Thread class and Parent class implements Runnable interface. These three classes have run methods with statements. The task of the teacher class of the first assignment has to be synchronized.
5. Similarly, the other two classes should have run methods with few valid statements under synchronized.
6. Create two classes named Student and Teacher with required data members. Assume that the information about the Student and Teacher is stored in a text file. Read n and m number of Student and Teacher information from the File. Store the information in Arraylist of type Student and Teacher ArrayList<Student> and ArrayList<Teacher>. Print the information of Teacher who taught OOPS and Maths. Use Iterator and other functions of util in your program.
7. Watch any of the favorite movie of your choice (any language is fine, preferably English). Create a Text file to store at least 10 meaningful dialogs from the movie and store it in a text file. Process the file to remove the stop words (eg. the, is, was, …….) and 1create another file to have clean text (word).
8. 51.Write a java program to create HashTable to act as a dictionary for the word collection. The dictionary meaning of the words, including synonyms, etc has to be displayed.
9. Create GUI for the above program to upload the dialog FILE, clean the FILE. The GUI should take input from the user for invoking the dictionary for displaying dictionary meaning.
10. Declare a class named Teacher. The class will have all the data members as per your convenient. The class will have constructors. Develop a GUI to read the values of the class variables from the keyboard. Use text field to read the values. Use button to store it in a file one by one. The values will be stored in a structured format of your own choice.
11. Have an option in the GUI to search the name of the students by roll number and display the content in the test field.
12. Create two classes named Student and Teacher with required data members. Read the information about the student and teacher using text fields. Use checkbox to choose the option to feed either teacher information or student information. Store the information

about the Student and Teacher in a text file. Read n and m number of Student and Teacher information from the File. Show in the GUI about a Teacher who taught two subjects to a section. Develop at least one of the application (AWT problem) using swing package.

13. Create a Window based applications using various controls to handle subject registration for exams. Have a List Box to display the subject of semesters. Have one more List box having COURSE CODEs. Have a combo box to select the Semester, which will change the list of course and code in the list boxes. Display the subject registered for the examination on the right side of the window.
14. Declare a class named Teacher. The class will have all the data members as per your convenient. The class will have constructors. Develop a GUI to read the values of the class variables from the keyboard. Use text field to read the values. Use button to store it in a file one by one. The values will be stored in a structured format of your own choice.
15. Have an option in the GUI to search the name of the students by roll number and display the content in the test field. Develop at least one of the application (AWT problem) using swing package.
16. Create a Window based application for displaying your photo album. Create a Frame and Canvas. Change the border, foreground and background colors of canvas and other controls. Have buttons to start the image show, pause the image show and end the image show. Explore the options to play background music.
17. Create a Window application with menu bar and menu. The frame will also have a text area with scroll bar. In the menu, have File related options. Open a file and its content has to be displayed in the text area.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 313	Microprocessors and Interfacing	C	3	0	2	4

UNIT I: 8086 MICROPROCESSOR

8086 architecture- Functional Diagram, Register Organization, Memory segmentation, Memory addresses, physical memory organization, Signal descriptions of 8086-common function signals, Minimum and Maximum mode signals, Read Write cycles, Timing diagrams, Interrupt structure of 8086.

UNIT II: ASSEMBLY LANGUAGE PROGRAMMING OF 8086

Instruction formats, addressing modes, instruction set, assembler directives, Simple programs involving logical, Branch and call instructions, Sorting, evaluating arithmetic expressions, String manipulations.

UNIT III: PERIPHERAL INTERFACING WITH 8086 MICROPROCESSOR

8255 PPI, Keyboard, display controllers, Stepper motor, A/D & D/A Converter Interfacing with 8086 microprocessor, Static and Dynamic memories, Vector interrupt table, Interrupt service routine, Introduction to DOS & BIOS interrupts, Programmable Interrupt Controller 8259, DMA controller 8257 Interfacing with 8086 microprocessor.

UNIT IV: COMMUNICATION INTERFACE

Serial communication standards, serial data transfer schemes, 8251 USART architecture and Interfacing, RS232, prototyping and trouble shooting.

UNIT V: INTRODUCTION TO MICROCONTROLLERS

Overview of 8051 microcontroller, Architecture, I/O ports and Memory organization, addressing modes and instruction set of 8051, Simple programs.

TEXTBOOKS/REFERENCES

1. Ramesh S Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085", 6th edition, Penram.
2. D V Hall, "Microprocessors and Interfacing", MGH, 2nd edition.
3. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Edition.

LIST OF EXPERIMENTS

1. (a)Addition of two 8-bit numbers.
   (b)Subtraction of two 8-bit numbers.
   (c)Multiplication of two 8-bit numbers.
   (d) Division of two 8-bit numbers.
2. (a)Addition of two 16-bit numbers.
   (b)Subtraction of two 16-bit numbers.
   (c)Multiplication of two 16-bit numbers.
   (d)Division of two 16-bit numbers.
3. Logical operations using 8086 (a) and (b) or (c)x-or.
4. (a) Two digit BCD addition.
   (b) Two digit BCD subtraction.
5. (a)Sorting of data in ascending order.

(b)Sorting of data in descending order.

6. (a)Program to test whether the 5-bit is ‘0’ or ‘1’
   (b)Counting number of ‘1’s in a given data.
7. ASCII arithmetic operations.
8. (a)ALP for conversion of packed BCD to unpacked BCD.
   (b)ALP for conversion of packed BCD to ASCII.
   (c)ALP for conversion of data from BCD to HEX.
9. (a)ALP to move a block of 10 bytes.
   (b)ALP to test the parity of the given data.
10. (a) ALP to interface 8086 with 8255 for control of stepper motor.
    (b)ALP to interface 8086 with 8279 for 7-segment display.
    (c)ALP to interface 8086 with 8255 to implement traffic light model.
    (d) ALP to interface 8086 with elevator.
    (e) ALP to interface 8086 with DDAC.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EEE 101	Fundamentals of Electrical Engineering	OE	3	0	0	3

UNIT I: BASIC CIRCUIT ANALYSIS

Ohm's Law, Kirchhoff's Laws, Concept of Node, Path, Loop, Branch, Mesh, Voltage and Current Division, Ideal and Practical Voltage and Current Source, Dependent Voltage and Current Sources, Source Transformations, Nodal Analysis - Presence of independent and dependent voltage and current sources, The Super node - Presence of independent and dependent voltage and current sources, Mesh Analysis and Super mesh - Presence of independent and dependent voltage and current sources, Illustrative examples.

UNIT II: ELECTROMAGNETISM AND ELECTROSTATICS

Review of field around a conductor and coil, Magnetic flux and flux density, magneto motive force and magnetic field intensity, reluctance, and permeability, Analysis of magnetic circuit and basic analogy between electric and magnetic circuits, Faraday's law of electromagnetic induction, Fleming's right hand and left-hand rule, Lenz's Law, Statically and dynamically induced EMF, Self-inductance, mutual inductance, and coefficient of coupling. Inductors in series and parallel, Energy stored in magnetic field, Laws of Electrostatics, Electric field, Composite dielectric capacitors, Capacitors in series and parallel, Energy stored in capacitors, Illustrative examples.

UNIT III: SINGLE-PHASE AC CIRCUITS

Basic Concepts Related to Generation of Sinusoidal AC Voltage, Definition and Numerical values of Average Value, Root Mean Square Value, Form Factor and Peak Factor for sinusoidal varying quantities, Steady State Analysis of Pure R, L, C Circuits, Steady State Analysis of RL and RC Series Circuits with Phasor Diagrams, Steady State Analysis of RL and RC Parallel circuits with Phasor Diagrams, Steady State Analysis of RLC Series and Parallel circuits with Phasor Diagrams, Definitions of Real Power, Reactive Power, Apparent Power and Power Factor, Concepts of Resonance, Illustrative examples.

UNIT IV: THREE PHASE CIRCUITS

Necessity and advantages of three phase systems, generation of three phase power, Definition of Phase sequence, balanced supply, and balanced load. Relationship between line and phase values of balanced star and delta connections, Power in balanced three phase circuits, Measurement of power by two-wattmeter method, Determination of power factor using wattmeter readings, Illustrative examples.

UNIT V: DC MACHINES & SINGLE-PHASE TRANSFORMERS

DC machines: Operation of DC motor, Back EMF, Torque equation, Types of DC motors, Series, Shunt, Separately Excited, Characteristics and Applications, Significance of back EMF, Illustrative examples, Single Phase Transformers: Necessity of transformer, Principle of operation and construction of single-phase transformers (core and shell types), EMF equation, losses, various losses with respect to load.

TEXTBOOKS/REFERENCES

1. William H Hayt, J E Kemmerly and Steven M Durbin, "Engineering Circuit Analysis", McGraw Hill, 8th Edition, 2011.
2. Abhijit Chakrabarti, "Circuit Theory Analysis and Synthesis", Dhanpat Rai & Co. 7th Edition, 2017.
3. P S Bimbra, "Electrical Machinery", 7th Edition, Khanna Publishers.
4. Charles K. Alexander and Matthew N.O. Sadiku, "Fundamentals of Electric Circuits", McGraw Hill Higher Education, Third Edition, 2005.
5. B.L. Theraja and A. K Theraja, "A Textbook of Electrical Technology", S.Chand and Co. Ltd., 2000.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 401	Computer Aided Design and Manufacturing	OE	3	0	0	3

UNIT I

What is CAD. What is CAM. Applications of CAD/CAM in Engineering, Specific applications of CAD/CAM in Mechanical engineering. What is Geometric Modelling and its applications in Mechanical engineering, Introduction to c omputer graphics and it application in Mechanical engineering. Computer Graphics Software's useful for Mechanical engineers, Introduction, representation of points, transformations and matrices, transformation of points, Transformation of straight lines, midpoint transformation, Transformation of parallel lines, transformation of intersecting lines, Rotation, Reflection and Scaling, Combined transformations and Transformation of The unit square, Rigid body transformations and Translations and Homogeneous Coordinates, Rotation About an Arbitrary Point, Homogeneous Coordinate system and Overall Scaling.

UNIT II

Introduction about 3D Transformations, Three-Dimensional Scaling, Three-Dimensional Shearing, Reflection, Three-Dimensional Rotation, Translation, Three-Dimensional Combined transformations, Three-Dimensional rotations about an axis parallel to a coordinate axis, Three-Dimensional rotation about an arbitrary axis in space, Three-Dimensional reflection through an arbitrary plane, affine and perspective geometry, Introduction to orthographic projections, axonometric projections, oblique projections, perspective transformations.

UNIT III

Introduction about plane and space curves, Curve Representation, Implicit and Explicit representation of curves, Parametric and Non-parametric curves General and parametric representation for conic sections (Circle, Ellipse, Parabola, Hyperbola). Representation of space curves, Cubic Splines and Hermite cubic curve, normalized cubic splines. Representation of Bezier Curves. B-spline Curves and end conditions for periodic B-spline curves. B-spline Curve Fit, B-spline Curve Subdivision. Rational B-spline Curves, NURBS and Introduction about surfaces. Coons Bi-cubic surface, Bezier surfaces, B-spline surfaces, B-spline surface Fitting and subdivision and Rational B-spline surfaces.

UNIT IV

Introduction to conventional Manufacturing Processes, Removing, Forming, Deforming and joining, Introduction to CAD, CAM and CAD-CAM. Integration equipment's. Integrating CAD, NC and CAM. Machine tools. Role of process planning in CAD/CAM Integration, Computer Aided Process Planning.Development, Benefits, Model and Architecture. CAPP Approaches.

UNIT V

Introduction to CAM, Point to point and continuous path machining, Introduction to NC, CNC and DNC – NC Programming, Basics, Languages, G Code, M Code, APT – Tool path generation and verification. NC Programming for Rectangular and circular pockets, NC Programming for drilling, peck drilling and boring, NC Programming for circular and rectangular array, NC Programming for turning, facing, threading and knurling. Production Control – Cellular Manufacturing.

TEXTBOOKS/REFERENCES

1. Mathematical Elements for Computer Graphics by David Rogers (Author), J. Alan Adams (Author) NewYork: London, McGraw-Hill, c1990, ISBN 10: 0070535302.
2. CAD/CAM: Principles and Applications by P N Rao.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CHE 123	Polymer Materials	OE	4	0	0	4

UNIT I: INTRODUCTION TO POLYMERS

Nomenclature and classification of polymers. Types of polymers- linear, branched, crosslinked, ladder, thermoplastic, thermosetting, fibres, elastomers, natural polymers, addition and condensation polymers. Stereoregular polymers- atactic, syndiotactic and isotactic. Step-polymerization, Addition Polymers, Radical, Cationic, Anionic Living polymerization, Block copolymers.

UNIT II: MOLAR MASS AND ITS DETERMINATION

Molecular mass and molar distribution. Number average, mass average, viscosity, average molecular mass and relation between them. Molecular mass distribution. Determination of molecular mass- Osmometry (membrane and vapour phase). Light scattering, gel permeation chromatography. Sedimentation and ultracentrifuge, viscosity method and end-group analysis.

UNIT III: PHYSICAL CHARACTERISTICS OF POLYMERS

Morphology and order in crystalline polymers. Configuration of polymer chains, crystal structure of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. The glass transition temperature (Tg), relationship between Tg and Tm, Effect of molecular weight, dilments, chemical structure, chain topology, branching and cross linking. Methods of determination of glass transition and crystallinity of polymers. Dendrimers, hyperbranched polymers, random branched polymers, branching density, influence of branching on the melt, viscosity, rheological and thermal properties of polymers.

UNIT IV: COMMERCIAL POLYMERS

Organic polymers: Commercial polymers, synthesis and application of polyethylene, Cellulose Acetate, PMMA, polyamides, polyesters, Urea resins and epoxy resins. Functional polymers: Fire retarding polymers Conducting polymers, biomedical polymers.

UNIT V: POLYMER APPLICATIONS

Polymer Rheology, Liquid crystalline polymers, Ring opening polymerization, Physical and Reactive blends. Nanocomposites and synthetic-natural fiber composites. Concepts of conducting polymers and their applications in opto-electronics and sensors, one and 3D dimensional polymeric materials.

TEXTBOOKS/REFERENCES

1. Principles of Polymerization: G. Odian (**2004**) 4th edition, Wiley.
2. Textbook of Polymer Science: F.W. Billmeyer Jr. (**1984**) 3th edition, John Wiley & Sons.
3. Polymers: Chemistry and Physics of Modern Materials: J.M.G. Cowie rd (**2007**) 3th edition, CRC Press.
4. Review and research articles, communications and notes published in international journals (will be provided).
5. Polymer Science-V. Govarikar.
6. Principle of Polymer Chemistry-P. J. Flory.
7. An Outline of Polymer Chemistry-James Q. Allen.
8. Organic Polymer Chemistry-K. J. Saunders.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 311	Introduction to Machine Learning	OE	3	0	2	4

UNIT I: INTRODUCTION TO MACHINE LEARNING

Introduction, Different types of learning, Hypothesis space and inductive bias, Evaluation, Training and test sets, Cross validation Linear Regression: Introduction, Linear regression, Python exercise on linear regression.

UNIT II: DECISION TREE LEARNING

Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning, Python exercise on Decision Tree Instance based Learning: K nearest neighbor, The Curse of Dimensionality, Feature Selection: forward search, backward search, univariate, multivariate feature selection approach, Feature reduction (Principal Component Analysis), Python exercise on kNN and PCA Recommender System: Content based system, Collaborative filtering based.

UNIT III: PROBABILITY AND BAYES LEARNING

Bayesian Learning, Naïve Bayes, Python exercise on Naïve Bayes Support Vector Machine: Introduction, The Dual formulation, Maximum margin with noise, Nonlinear SVM and Kernel function, Solution to dual problem, Python exercise on SVM.

UNIT IV: ARTIFICIAL NEURAL NETWORKS

Introduction, Biological motivation, ANN representation, appropriate problem for ANN learning, Perceptron, Multilayer networks and the back-propagation algorithm, Python exercise on neural network, Introduction to Computational Learning Theory: Introduction, Sample complexity, Finite hypothesis space, VC dimension.

UNIT V: ENSEMBLES & CLUSTERING

Introduction, Bagging and boosting, Introduction, K-mean clustering, Agglomerative hierarchical clustering, Python exercise on k-mean clustering.

LIST OF EXPERIMENTS

Basic exercises on Python Machine Learning Packages such as Numpy, Pandas and matplotlib

Given a dataset. Write a program to compute the Covariance, Correlation between a pair of attributes. Extend the program to compute the Covariance Matrix and Correlation Matrix.

Given a set of sample points in N dimensional feature space. Write a program to fit the points with a hyper plane using Linear Regression. Calculate sum of residual error.

1. Write a program that provides option to compute different distance measures between two points in the N dimensional feature space. Consider some sample datasets for computing distances among sample points.
2. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
3. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML library classes can be used for this problem.

4. Write a program to implement feature reduction using Principle Component Analysis.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6. Given a dataset for classification task. Write a program to implement Support Vector Machine and estimate it test performance.
7. Write a program to implement perceptron for different learning task
8. Write programs to implement ADALINE and MADALINE for given learning task
9. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
10. Write a program to implement K means clustering algorithm. Select your own dataset to test the program. Demonstrate the nature of output with varying value of K.

TEXTBOOKS/REFERENCES

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Introduction to Machine Learning Edition 2, by Ethem Alpaydin.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
4. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2007.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 407	Thermal Power Engineering	OE	3	0	0	3

UNIT I: AIR STANDARD CYCLES

Carnot, Otto, Diesel, Dual and Stirling cycles, p-v and T -s diagrams, description, efficiencies and mean effective pressures. Comparison of Otto and Diesel cycles. IC engine components, their functions, engine performance and efficiency.

UNIT II: GAS POWER CYCLES

Gas turbine (Brayton) cycle; description and analysis. Regenerative gas turbine cycle. Intercooling and reheating in gas turbine cycles. Introduction to Jet Propulsion cycles – Turbojet, Turbofan, Turboprop, Afterburner and Rockets.

UNIT III: VAPOR POWER CYCLES

Carnot vapour power cycle, drawbacks as a reference cycle. Simple Rankine cycle; description, T-S diagram, analysis for performance. Comparison of Carnot and Rankine cycles. Effects of pressure and temperature on Rankine cycle performance. Actual vapour power cycles. Ideal and practical regenerative Rankine cycles, open and closed feed water heaters. Reheat Rankine cycle, Cogeneration, Combined Gas-Vapor Cycles, Binary Vapor Cycles, Characteristics of an Ideal working fluid in vapour power cycles.

UNIT IV: STEAM GENERATOR

Boiler types, applications, and comparison; Boiler system requirements, Water Tube Boiler, Fire Tube Boiler, Mountings and Accessories. Performance calculations, Boiler trial.

UNIT V: CONDENSER

Condenser system elements; types and their advantages/disadvantages; Its effect on Rankine efficiency.

UNIT VI: STEAM TURBINE

Impulse and reaction turbine, velocity triangle, degree of reaction, efficiencies, losses, Velocity and Pressure compounding.

TEXTBOOKS

1. Thermodynamics, Yunus A, Cengel & Michael A Boles, Tata McGraw Hill, 7th Edition. Engineering Thermodynamics P.K. Nag Tata McGraw Hill 6th Edition 2018
2. P. K. Nag, Powerplant Engineering, 2nd Ed., Tata McGraw Hill, 2002.

REFERENCES

1. M. J. Moran & H N Shapiro, Fundamentals of Engineering Thermodynamics, 3rd Ed., John Wiley, 1995.
2. M. M. ElWakil, Power Plant Technology, McGraw Hill International, 1992.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PHY 303	Solid-state Physics	OE	3	0	2	4

UNIT I: CRYSTALLOGRAPHY

Crystalline and amorphous solids, Lattice, Basis, Translational vectors, Primitive unit cell, Miller indices, Inter-planer distances, SC, BCC and FCC structures, Packing fraction, Crystal structures- NaCl, diamond, CsCl, ZnS, Concept of reciprocal lattice and its properties with proof. Ionic, covalent, molecular and metallic binding in crystalline solids, Cohesive energies of ionic and metallic crystals, Anisotropy of physical properties of a single crystal, defects in crystal structures Crystal as a grating, Bragg‟s law and Bragg‟s Diffraction condition in direct and reciprocal lattice Ewald‟s construction, Debye Schrrerer method.

UNIT II: LATTICE VIBRATIONS AND SPECIFIC HEAT OF SOLIDS

Specific heats of solids, Normal mode of frequencies coupled vibrations of atoms, Breakdown of classical theory, Linear chain frequency distribution function, Quantization of harmonic vibrations, Phonons, Debye theories of specific heat of solids, Einstein theories of specific heats of solids, Phonon vibration of diatomic linear lattice.

UNIT III: FREE ELECTRON THEORY OF METALS

Free Electron model, Energy levels and Density of orbital in 1D and 3D, Bloch function, nearly free electron model (NFE model), Fermi energy, Application of the Fermi-Dirac distribution, Specific heat due to conduction electron, Para-magnetism, thermionic emission, Photoelectric effect of metals, Origin of contact potentials between metals.

UNIT IV: BAND THEORY OF SOLIDS, ELECTRICAL AND THERMAL CONDUCTIVITY

Band theory of solids, Band formation, Fermi-sphere, example of simple cubic lattice, Idea of Brillouin zone, Density of states, overlapping on energy bands, Effective mass of electron (with derivation), Concept of hole, Distinction between metal, semiconductor and insulator.

UNIT V: ELECTRICAL AND THERMAL CONDUCTIVITY IN SOLIDS

Simple theories of electrical and thermal conductivity, The Wiedemann-Franz law, Boltzmann transport equation, Sommerfeld theory of electrical conductivity, Mean free path of electrons, Temperature dependent resistivity of metals, Temperature dependent resistivity of semiconductors, and insulators, Hall Effect in metals, Hall Effect in semiconductors.

TEXTBOOKS

1. Elementary Solid-State Physics, M Ali Omar, Revised Edition, 2015, Pearson.
2. Introduction to Solid State Physics, Charles Kittel, 8th edition, 2004, John Wiley & Sons.
3. Solid State Physics Puri R.K., Babbar V.K – 1 Edition, 2010 S Chand Publication.
4. Solid State Physics, S O Pillai, 18th edition 2018, New Age International.

REFERENCES

1. Solid State Physics, Neil W. Ashcroft, N. Mermin Reprint Edition, Brooks/Cole 1976.
2. Solid State Physics, A. J. Dekker, 2008, Laxmi Publication/Prentice Hall.

LIST OF EXPERIMENTS

1. Measurement of resistivity of a semiconductor by Four-probe method and determination of Energy Band Gap.
2. To determine the type of charge carrier, carrier density and Hall coefficient of a given semiconductor.
    a) To measure the photo current as a function of the irradiance at constant voltage.
    b) Current-voltage and current-load characteristics of a solar cell as a function of the irradiance.
3. Study optical absorption of liquid samples using UV- VIS spectrometer.
4. Determine lattice parameter of crystals using X-ray diffractometer.
5. To study optical absorption of different nanoparticles and obtain their plasmonic peaks.

TEXTBOOKS/REFERENCES

1. C. Suryanarayana, M. Grant Norton," X-Ray Diffraction, A Practical Approach" Springer US, 1998 [ISBN: 978-1-4899-0148-4].
2. Trügler, Andreas, "Optical Properties of Metallic Nanoparticles", Springer Series in Materials Science, 2016 [ISBN: 978-3-319-25074-8].
3. John Singleton, "Band Theory and Electronic Properties of Solids" Oxford University Press UK, 2014 [ISBN: 978-0198506447].

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 304	Partial Differential Equations	OE	4	0	0	4

UNIT I: MATHEMATICAL PRELIMINARIES AND FIRST-ORDER PARTIAL DIFFERENTIAL EQUATIONS(PDES)

A Review of Multivariable Calculus, Essential Ordinary Differential Equations, Integral Curves and Surfaces of Vector Fields, Solving Equations of the form: dx/P=dy/Q=dz/R, Formation and classification of first order PDEs, Linear, Quasilinear, and Nonlinear first order PDEs, The method of characteristics for the Cauchy problem, Compatible systems, and Charpit's method, Jacobi's method for nonlinear first order PDEs.

UNIT II: SECOND ORDER PDES - FOURIER SERIES (FS)

Classification of Second order PDEs, Canonical forms, Well-posed problems, Superposition principle, Introduction to FS, Pointwise Convergence of FS for piecewise continuous functions, Differentiation and integration of FS, Fourier cosine and sine series.

UNIT III: THE HEAT EQUATION

Derivation of the heat equation, The maximum and minimum principles, Uniqueness, Continuous dependence, Method of separation of variables, Time-independent boundary conditions, Time-dependent boundary conditions, Duhamel's principle.

UNIT IV: THE WAVE EQUATION

Derivation of the wave equation, The infinite string problem, The D'Alembert solution of the wave equation, The semi-infinite string problem, The finite vibrating string problem, The method of separation variables, The inhomogeneous wave equation.

UNIT V: LAPLACE'S EQUATION

Basic concepts, Types of boundary value problems, The maximum and minimum principle, Green's identity and fundamental solution, The Poisson integral formula, The method of separation of variables, The Dirichlet problem for the rectangle, The Dirichlet problem for Annuli and Disk, The exterior Dirichlet problem.

UNIT VI: THE FOURIER TRANSFORM METHODS FOR PDES AND THE METHOD OF GREEN'S FUNCTIONS

Fourier transform, Fourier sine and cosine transform, Heat flow problem in an infinite and semi-infinite rod, Infinite string problem, Laplace equation in a half-plane, Integral formulation, The method of Green's functions for the Laplace, Heat and Wave equations.

TEXTBOOKS/REFERENCES

1. NPTEL: Mathematics: Partial Differential Equations. https://nptel.ac.in/courses/111/103/111103021/
2. Phoolan Prasad, Renuka Ravindran, Partial Differential Equations.
3. L. C. Evans, Partial Differential Equations.
4. V. I. Arnold, Lectures on Partial Differential Equations.
5. E. Kreyszig, Advanced Engineering Mathematics, Wiley.
6. I.N. Sneddon, Elements of Partial Differential Equations, Dover Publications.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
BIO 110	Microbiology	OE	3	0	0	3

UNIT I: INTRODUCTION TO MICROBIOLOGY

History of microbiology, germ theory of diseases, Microbial diversity, classification & taxonomy-Phylogenetic tree, measuring diversity by 16S/18S rRNA, Measuring diversity by RAPD, T-RFLP, Microbial physiology of bacteria, Microbial physiology of archaea, Microbial physiology of fungi, Microbial physiology of protozoa, Microbial physiology of algae.

UNIT II: MICROBIAL GROWTH AND IDENTIFICATION

Growth media types - selective and differential media; Influence of environmental factors for microbial growth; Nutritional groups of bacteria, Estimation of Microbes- Direct methods: Microscopic count/CFU, turbidometric assay, total viable count (TVC); Indirect Methods: CO2 liberation, protein estimation, Growth phases and kinetics; Maintenance and Preservation of cultures, Sterilisation and disinfection: Methods of sterilization- Physical methods (heat, filtration), radiation and chemical methods, Microbial staining - Simple, gram staining, negative staining, capsule staining, spore staining, flagellar staining, nuclear staining and acid-fast staining, Microscopy – Principles, light microscope, phase contrast, dark field, bright field, Fluorescent, interference microscope (stereo microscope), confocal, inverted microscope, Electron microscope (TEM and SEM), Cryo-EM and Scanning probe microscopy.

UNIT III: MEDICAL MICROBIOLOGY

Bacterial pathogenesis, Mycobacterium tuberculosis, Escherichia coli, Staphylococcus, Streptococcus, Salmonella.

UNIT IV: VIROLOGY

Viral structure and classification, Bacteriophage, Replication mechanism in host cells, Viral pathogenesis; Immune response to viral infections, Acute, chronic and latent viral infections, Viral vaccines; Anti-viral drugs.

UNIT V: APPLIED MICROBIOLOGY

Industrial microbiology – Microorganism of Industrial use, Industrial microbiology – Microorganism of Industrial use, Industrial production of antibiotics - penicillin, streptomycin; organic compounds- citric acid, lactic acid, acetone-butanol, Industrial production of enzymes - amylases & proteases; nucleosides & nucleotides; amino acids - L- glutamic acid, vitamin B12, Industrial production of single cell proteins, yeast/ mushrooms, Fermentation processes, Industrial fermenters, Scale up, Food microbiology – Micro-organisms in food: meats and poultry, processed meat, seafood, fermented daily products, fruits and vegetables, Food microbiology – Micro-organisms in food: meats and poultry, processed meat, seafood, fermented daily products, fruits and vegetables, Determination of micro-organisms in food, Food preservation techniques, Environmental microbiology – Bioaugmentation, bioremediation.

TEXTBOOKS/REFERENCES

1. Microbiology. 5th Edition. Prescott M. Lansing, Harley P. John, Klein A. Donald.
2. Biotechnology-A textbook of Industrial Microbiology. 2nd Edition. Wulf Crueger and Anneliese Crueger.
3. Modern food microbiology. 6th Edition. James M. Jay.
4. Environmental microbiology. 3rd Edition. Ian L. Pepper, Charles P. Gerba, Terry J. Gentry.
5. Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses. 2nd Edition. Jane S. Flint, Lynn W. Enquist, Anna Marie Shalka.
6. Bacterial Pathogenesis: A molecular approach. 3rd Edition. Brenda A. Wilson.
7. Fundamentals of light microscopy and electronic imaging. Douglas B. Murphy.
8. Introduction to Electron Microscopy. 2ndEdition. Saul Wischnitzer.
9. Single-Particle Cryo-Electron Microscopy: The Path Toward Atomic Resolution. Selected Papers of Joachim Frank with Commentaries.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CHE 202	Renewable Energy	OE	3	0	0	3

UNIT I: INTRODUCTION TO ENERGY

Definition, units, and various forms of energy. First and Second laws of thermodynamics, Conservation of energy. Flow diagrams of Energy, Conventional energy sources, Sustainability, fossil fuels. Role of energy in economic development and social transformation. Global energy production and utilization, impact on environment. Global warming, biological damage due to pollution. Importance of Renewable energy.

UNIT II: SOLAR, WIND, AND TIDEL ENERGIES

Solar Energy: Introduction. Spectral distribution of radiation, Photons, Photovoltaic effect. Solar Cells: Advantages and applications of Solar cells, Solar cooker, Solar water heating systems. Introduction of wind energy, principle of wind energy conversion. Applications of wind energy, advantage and disadvantages of wind energy. Blue economy: Principle of ocean thermal energy conversion. Energy from tidel waves, advantages and disadvantages.

UNIT III: HYDROGEN ENERGY

Hydrogen gas, different methods to generate hydrogen gas: electrolysis of water and Methane reforming. Advantages hydrogen as fuel. Challenges of hydrogen storage and transportation. Hydrogen storage methods. Hydrogen storage systems: metal hydrides and Metal organic frameworks. Fuel Cells: Types of fuel cells

UNIT IV: BIOMASS ENERGY

Difference between biomass and other fossil fuels. Conversion of biomass into methanol. Conversion of biomass into ethanol: Fisher-Tropsch Reaction, disadvantages of biomass.

UNIT V: ENERGY STORAGE DEVICES

Energy Density and Power Density. Classification of Energy Storage systems. Electrochemical Cells, Primary and Secondary Batteries. Introduction to Super capacitors. Dry Cells, Li-ion Batteries and Beyond.

TEXTBOOKS/REFERENCES

1. Energy Sources: Fundamentals of Chemical Conversion processes and Applications by B. Viswanathan, Elsevier, 2016.
2. Renewable Energy: Power for a Sustainable Future, Godfrey Boyle. Oxford University Press, 1996.
3. Renewable Energy Resources Third Edition by John Twidell and Tony Weir, 2015.
4. Ru-shiliu, Leizhang, Xueliang sun, “Electrochemical technologies for energy storage and conversion”, Wiley Publications, 2012.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
BIO 310	Biochemistry	OE	3	0	0	3

UNIT I: CHEMISTRY OF LIFE

Chemical elements and bonding in living organisms, Buffers, Concepts of pH/pKa, Water and its properties.

UNIT II: BIOMOLECULES

Carbohydrates: Structure, Classification and Function, Lipids: Structure, Classification and Function, Nucleic acids: Composition, Types and their role in living systems, Vitamins and their biological significance.

UNIT III: PROTEINS AND ENZYMES

Amino acids: structure, classification and properties, Proteins: Primary, Secondary, Tertiary and Quaternary structures; Ramachandran plot, Protein folding: Protein denaturation and renaturation, Protein folding pathways, folding accessory proteins, misfolding and disease, Introduction to biocatalysts. Enzyme chemistry, classification and nomenclature, Mechanism of enzyme action and factors affecting enzyme activity, Enzyme kinetics, catalytic and regulatory strategies of enzymes, Inhibition of enzyme action.

UNIT IV: INTRODUCTION TO CELL BIOLOGY

Cell theory, Prokaryotic and Eukaryotic cells, Cell membrane and cellular organelles, Cytoskeleton, Cellular transport.

UNIT V: CELL DIVISION CYCLE

Cell division- simple fission, budding, Mitosis and Meiosis, Cell cycle and regulation, CDKs, Cell differentiation, Types of cells: with emphasis on neuronal cells.

TEXTBOOKS/REFERENCES

1. D. Voet, J. G. Voet. Biochemistry. Wiley, 4thedition, 2010.
2. J. M. Berg, J. L. Tymoczko, L. Styrer. Biochemistry. W. H. Freeman & Co., 6thedition, 2006.
3. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh, Paul Matsudaira. Molecular Cell Biology. W. H. Freeman, 6thedition, 2007.
4. Bruce Alberts. Molecular Biology of the Cell. Garland Science, 5th edition, 2008. D. L. Nelson, M. M. Cox. Lehninger Principles of Biochemistry, W.H.Freeman, 5th edition, 2009.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
HIS 102A	Human Civilizations	OE	4	0	0	4

UNIT I

What is Civilization? Stages of Human evolution; African Origins of Humanity; overview of Hominin evolution: Sexual dimorphism, Development of Language: Patterns of lithic technological development, and stone tool technology, gathering and hunting in human evolution- social and economic structure.

UNIT II

Climate change and end of Ice- Age, towards the Mesolithic period and extension of settlement in new ecological zones, changes in subsistence strategies based on the case studies from West Asia, Europe and Meso America, changes in tool manufacture and social organization. Neolithic Period: Origin of food production; Gender Division of Labour; early farming settlements at Catal Hyuk, Abu Hureya, Jericho, Syria and Jordan; early farming societies in Europe, Asia and the Nile Valley; Neolithic sites, art and architecture; Domestication of animals; burial customs and belief.

UNIT III

Discovery of metals, science of forging metals, development of writing system; Tigris and Euphrates River valley: Emergence of Cities. Urban Revolution: Ancient Egyptian Civilization, Private life in ancient Egypt; Minion Civilization of Crete, Eastern Mediterranean World, Gender in the Mediterranean, Harappan Civilization, Origin of Chinese Civilization.

UNIT IV

Nomadic Pastoralism; pastoral people of middle east; pastoralism in central Asia: Horse, wheel, cart and chariot; impacts on the environment; socio- political interaction with the urban centres. The advent of Iron- its origin and implications.

UNIT V

Ancient Greece; emergence of polis, Athens and Sparta, myth of arcadia. Slave Mode of Production: Emergence of Slavery in ancient Greece, organization of production, nature of classical urbanism, population and forms of slavery; Private life and ancient Greece. Hellenistic Phase: Characteristic features of Hellenism, cities and rural world, art, and culture.

TEXTBOOKS

1. Amar Farooqui. Early Social Formations. Delhi: Manak Publications, 2001.
2. Bogucki, P. The Origins of Human Society. Massachusets and Oxford: Wiley Blackwell Publishers,1999
3. Fernand Braudel, The Mediterranean in the Ancient World, Penguin, 2007
4. R.J Wenke Pattern in Prehistory: Humankind's First Three Million Years, Oxford University Press, 2006.
5. Redman, C.L. The Rise of Civilisations. From Early Farmers to Urban Society in the Ancient Near East. San Fransisco: W.H. Freeeman 1978.
6. V. Gordon Childe, What Happened in History, 1942.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
JOU 406	Basics of Media and Nationalism	OE	3	0	0	3

UNIT I: INTRODUCTION TO NATIONALISM
Primordial, Constructivist and Instrumentalist understandings, Imagined community, The Invention of Tradition, Whose Imagined Community?

UNIT II: MEDIA AND THE PUBLIC SPHERE
Habermasian Concept of Public Sphere, Agenda Setting, Print Capitalism.

UNIT III: MEDIA AND IDEOLOGY
Introduction to Ideology, Ideological State Apparatus, Manufacturing Consent.

UNIT IV
Reporting on Caste, Gender, Caste and Media, Gender and Media.

UNIT V: EXPLORING MARGINALITIES: MEDIA AND THE NORTHEAST
Representation of Northeast in national media, Ethnicity and diversity, Northeast and the Rhetoric of development.

TEXTBOOKS/REFERENCES

1. Dawisha, Adeed. (2002). Nation and Nationalism Antecedents to Contemporary Debates. International Studies Review, 4 (1), 3-22.
2. Anderson, Benedict. (2006). Imagined Communities: Reflections on the Origin and Spread of Nationalism. Verso.
3. Hobsbawm, Eric. (1983). Introduction: Invention Traditions. In Hobsbawm, Eric, Ranger, Terence (Ed.) The Invention of Tradition. UK: Cambridge University Press
4. Chatterjee, Partha. (1993). The Nation and its Fragments-Colonial and Postcolonial Histories (Princeton Studies in Culture/Power/History). Princeton: Princeton University Press
5. McQuail, D. (2009) McQuail's Mass Communication Theory, Vistar Publication: New Delhi.
6. Prinsloo, Jeanne. (1999). Cheer the Beloved Country? Some Thoughts on Gendered Representations, Nationalism and the Media. Agenda: Empowering Women for Gender Equity. 40, 45-53.
7. Eccleshall, Robert. (1999). Political Ideologies: An Introduction. London: Routledge.
8. Jeffrey, R (2016). Media and Modernity, Communications, Women and the State in India. Orient Blackswan.
9. Herman, E. S., & Chomsky, N. (1988). Manufacturing consent: The political economy of the mass media. New York: Pantheon Books.
10. Kabi, K. H., Pattnaik, N. S. (2015). Media, Conflict and Peace in Northeast India. Delhi: Vij Books

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EGL 102	Technical Writing	OE	4	0	0	4

UNIT I

Sentence Structure (English), Paragraph Writing, Coherence, Cohesion, and Unity, Construction of an Argument and Counter-Argument, Deducing a Conclusion.

UNIT II

The Concept of 'BASIC' (Brief, Appropriate, Simple, Intelligible, and Complete), Writing Vs Drafting, The process of 'Technical' writing, Difference between 'General' and 'Technical' writing (the nuances of technical writing)

UNIT III

What is a Definition? The process / structure of a Definition, what is a Description? The process / structure of a Scientific Description, Describing an Object, describing a Process, what is an Explanation? The mechanism of writing an 'Explanation'

UNIT IV

Synopsis, Research Proposal, Abstract Vs Summary, Referencing and Citations, Bibliography.

UNIT V

Planning a Research Write-up, Structure of a Paper, Designing an effective Abstract, Introduction Section, Discussion, Conclusion.

TEXTBOOKS/REFERENCES

1. Dudley Evans, T. (1998). Developments in English for Specific Purposes: A multidisciplinary approach. U.K: Cambridge University Press.
2. Hutchinson, T., & Waters, A. (1987). English for Specific Purposes: A learner-centered approach. U.K: Cambridge University Press.
3. Jain, A. K. (2001). Professional Communication Skills. New Delhi: S. Chand & Company Limited.
4. Raman, Meenakshi, and Sangeetha Sharma. (2008). Technical Communication: English Skills for Engineers. New Delhi: Oxford University Press.
5. Raman, Meenakshi, and Sangeetha Sharma. (2004) Technical Communication: Principles and Practice. New Delhi: Oxford University Press.
6. Trimble, Louis. English for Science and Technology - A Discourse Approach. (1985). Cambridge: Cambridge University Press.
7. Williams, Phil. Advanced Writing Skills for Students of English. (2018). Brighton: Rumian Publishing.
8. Wilson, Paige and Teresa Ferster Glazier. (2013). The Least You Should Know About English: Writing Skills, Form C (11th Edition). Boston: Cengage Learning.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PSY 111	Psychology for Everyday Living	OE	4	0	0	4

UNIT I: MYTHS AND MISCONCEPTIONS IN PSYCHOLOGY

Definition, nature and goals of psychology, Common myths and misconceptions about psychology, Schools of psychology; Basic and applied areas of psychology

UNIT II: THE ROLE OF PERCEPTION AND ATTITUDE TOWARDS UNDERSTANDING THE WORLD

Perception: Understanding perception, Gestalt laws of organization, common illusions, Perceptual constancy - depth perception, size perception, perception of movement, Attitude formation, Attitude change.

UNIT III: INTELLIGENCE AND LEARNING

Definitions and nature of intelligence, Emotional and social intelligence; Measuring IQ, EQ and SQ, Fundamentals of learning and its applications, Memory techniques.

UNIT IV: UNDERSTANDING THE SELF

Definition; Approaches to personality – trait and type, Psychoanalytical and humanistic theory, Tests of personality – MBTI and NEO-PI, Identity; Self-concept, self-esteem and self-efficacy.

UNIT V: STRESS, COPING AND QUALITY OF LIFE

Nature, sources of stress and its reactions, Factors influencing stress, coping with and managing stress - cognitive and behavioral techniques, Improving quality of life.

TEXTBOOKS/REFERENCES

1. Baron, R. A. (2001). Psychology. New Delhi: Pearson Education India.
2. Nolen-Hoeksema, S., Fredrickson, B.L. & Loftus, G.R. (2014). Atkinson &Hilgard's Introduction to Psychology.16th Ed. United Kingdom: Cengage Learning.
3. Morgan, C. T., King, R. A., & Schopler, J. (2004). Introduction to Psychology. New Delhi: Tata McGraw Hill.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PHY 302	Electrodynamics	OE	3	0	2	4

UNIT I: MAGNETOSTATICS

Concept of magnetic field intensity (B) and flux, Definition and properties of magnetic field, Definition of B and H, Calculation of divergence and curl of B with boundary conditions, Lorentz Force law, motion of charged particles in electric and magnetic field, Cyclotron frequency, Biot – Savart‟s law, Illustration with long straight conductor, current carrying circular loop on the axis, Calculation of field on the Axis and in plane of a circular current-carrying Coil, Helmholtz Coils, Magnetic moment of a current carrying loop, The Permeability of Free Space, Ampère's Law –worked examples, Force Between Two Current-carrying Wires, Problems based on magnetic field and Magnetostatics.

UNIT II: MAGNETISM AND MAGNETIC PROPERTIES

Magnetic Materials - An Overview, Magnetic moment, Bohr magneton, Magnetisation (M), Magnetic Intensity (H) and magnetic induction (B) – their mathematical relations, Magnetisation and Susceptibility and magnetic permeability of magnetic materials, Magnetic field of magnetized objects and bound currents, Magnetic field due to a uniformly magnetized sphere, Diamagnetic, paramagnetic and ferromagnetic, Explanation of Diamagnetic, paramagnetic and ferromagnetic with the help of susceptibility and permeability Hysteresis and B-H Loops, Problems on magnetism and its properties.

UNIT III: ELECTROMAGNETIC INDUCTION

Time varying fields: Faradays law of induction, worked examples, Mutual inductance, coupled circuits and coefficient of coupling, Leakage inductance, impedance matching, Transformer circuit, reflected impedance transformation, equivalent circuit of a transformer, Lenz's Law, Worked examples, Ballistic Galvanometer and the Measurement of Magnetic Field, AC Generator, AC Power, 0 Linear Motors Generators, Rotary Motors, Generators, Rotary Motors.

UNIT IV: ELECTRODYNAMICS

Generalization of Amperes‟ law, Problems on Amperes‟ law – worked examples, Maxwell‟s equation, Maxwell‟s equation - Differential form, Maxwell‟s equation -Integral form, Problems on Maxwell‟s equation, Magnetic Vector potentials, Retarded potential, Problems on Magnetic potentials.

UNIT V: ELECTROMAGNETIC WAVES

Wave equation and plane waves in free space, Poynting theorem, Polarizations of plane wave, Plane monochromatic waves in conducting media, Reflection from a conducting plane, Skin effect, Absorption and scattering, Absorption and scattering of electromagnetic waves, Anomalous dispersion, Problems on electromagnetic waves – worked examples.

TEXTBOOKS

1. University Physics with Modern Physics, Hugh D. Young, Roger A. Freedman, A Lewis Ford, 13 Edition, 2013, Pearson India.
2. Electricity and Magnetism (In Si Units): Berkeley Physics Course - Vol.2 Edward Purcell 2017, McGraw Hill Education.
3. Introduction to Electrodynamics, David J. Griffiths, 4/e Edition, 2015, Pearson Publication.

REFERENCES

1. Classical Electrodynamics, John David Jackson, 3 Edition 2007, Wiley.
2. Physics, Volume 2 David Halliday, Robert Resnick, Kenneth S. Krane, 5 Edition, 2001, John Wiley & Sons.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 305	Introduction to Science and Technology studies	OE	4	0	0	4

UNIT I: PHILOSOPHY OF SCIENCE: ISSUES AND PERSPECTIVES

What is science? Some Historical Background, Scientific reasoning- Induction, deduction and the problem of Hume, Scientific Explanation and Causality, Popper's Philosophy of Science, Scientific Revolutions.

UNIT II: PERSPECTIVES FROM SOCIOLOGY OF SCIENCE AND TECHNOLOGY

Questioning Functionalism in the Sociology of Science, The strong program, The social construction of Scientific and technological realities, Studying laboratories.

UNIT III: SCIENCE, TECHNOLOGY AND DEVELOPMENT: A CRITICAL ENQUIRY

Medicine, Agriculture, Environment, War.

UNIT IV: EXCLUSIONS IN SCIENCE AND TECHNOLOGY INSTITUTIONS

Under presentation of women in Science and Technology Institutions in India and abroad, Autobiographical Accounts, The Caste of Merit- excerpts.

UNIT V: FEMINIST AND OTHER CRITIQUES OF SCIENCE

The Mis-measure of Man IQ tests, Craniometry, Examples of how gender figures in doing science, The Medical Construction of gender: The case of Intersex babies, Feminist epistemologies of Science, Hidden Figures Movie

TEXTBOOKS/REFERENCES

1. Samir Okasha (2003). Philosophy of science: A very short introduction.
2. Sismondo, S. (2010). An introduction to science and technology studies.
3. S G Kulkarni. Philosophy of Science: issues and Perspectives.
4. Mary Wyer et al (2000) Women Science and Technology.
5. Ajantha Subramanian (2018) The Caste of Merit.
6. Stefan Jay Gould The Mismeasure of Man.
7. Ashish Nandy Science Hegemony and Violence.
8. Gita Chadha and Asha Achuthan (Eds) Review of Women Studies, Economic and Political Weekly.
9. Jayasree Subramanian (2007) Perceiving and Producing Merit: Gender and Doing Science in India.
10. Sumi Krishna & Gita Chadha (Eds) Feminists and Science.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
BIO 111	Evolution and Organismal Biology	OE	3	0	0	3

UNIT I: BIOLOGICAL DIVERSITY AND ORIGIN OF LIFE

Origin of life; Tree of life, Prokaryotic and eukaryotic organisms, Archaea- a group distinct from bacteria and eukarya, Endosymbiotic theory of organelle biogenesis, Protozoa- the unicellular eukaryotes Slime molds; Cyanobacteria and algal life forms, Diversity of plant life- bryophyta, pterediophyta, gymnosperms and angiosperms (dicots and monocots)- a perspective from alternation of generation and anatomy, Animal life- porifera, ctenophora, chidaria, rotifers, platyhelminths, annelida, mollusca, nematoda, arthropoda, echinodermata and chordata -a perspective from body plan, embryology and anatomy, Fungi- a group distinct from pants and animals.

UNIT II: HISTORY OF LIFE ON EARTH

History of life on a geological time scale, Great oxygenation event, Paleontology and paleobotany, Evolutionary radiation-Cambrian explosion as an example, Mass extinction events in history, Taxonomy and biological classification, Specimen preparation and preservation, Brief introduction to biorepositories and their purpose.

UNIT III: EVOLUTION

Theory of evolution by natural selection; A short discussion on Darwin's "Origin of Species", The genetic and developmental basis of evolutionary change, Brief introduction to molecular evolution; Species, speciation, migration, adaptation and inbreeding, Life history evolution; Macroevolutionary trends; Experimental evolution, Modes of selection; Evolutionary developmental biology; Evolutionary psychology, Extinction and human evolution; Evolutionary medicine.

UNIT IV: MOLECULAR SYSTEMATICS AND PHYLOGENY

Methods and practices of molecular phylogenetics, Multiple sequence alignment; Clustering and construction of phylogenetic tree, Rooted and un-rooted trees, Bootsrapping method, Cladistics, The concept of phyla-monphylatic, polyphyletic and paraphylatic groups.

UNIT V: BRIEF INTRODUCTION TO ECOLOGY

Ecology of individual organisms - physiological ecology, Population ecology - population growth and regulation, Species interactions, trophic interactions, Community ecology - community structure and properties, Succession and disturbance, Ecosystem ecology, Symbiosis, mutualism, parasitism and predation.

TEXTBOOKS/REFERENCES

1. Principles of Biology: Interactive textbook from Nature Education.
2. Biology: N. Campbell and J. Reece (2005) 7 edition, Pearson, Benjamin, Cummings.
3. Biology: P.H. Raven, G.B. Johnson, J.B. Losos and S.R. Singer (2005) 7 edition, McGraw Hill.
4. Evolutionary Analysis: S. Freeman and J.C. Herron (2007) Prentice Hall.
5. Evolution: D.J. Futuyma (1997) Sinauer Associates.
6. Ecology: from individuals to ecosystems: M. Begon, C.R. Townsend, thand J.L. Harper (2006) 4 edition, Blackwell Publishing.
7. Ecology: R.E. Ricklefs and G.L. Miller (2000) 4 edition, W.H. Freeman.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CHE 201	Fundamentals of Nanoscience	OE	3	0	0	3

UNIT I: INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY

Definition of Nano. Types of nanostructure and properties of nanomaterials: One dimensional, two-dimensional and three-dimensional nanostructured materials. Quantum dots. Metal oxides, and composites materials. Mechanical, physical and chemical properties of various nanoparticles.

UNIT II: SYNTHESIS OF NANOMATERIALS

Synthesis of nanomaterial: top down and bottom-up approaches. Chemical precipitation method, Co-precipitation method, Chemical reduction method, Determination of molecular mass- Osmometry (membrane and vapour phase). Sol-gel synthesis of nanoparticles. Using reverse micelles process, Solvothermal synthesis, Thermolysis routes, Microwave heating synthesis, Sonochemical synthesis, Electrochemical synthesis, Photochemical synthesis. Chemical vapour deposition methods.

UNIT III: CHARACTERIZATION TECHNIQUES – A

Absorption and Emission Spectroscopy: Nature of electromagnetic radiation and spectrum, UV-Visible Spectroscopy, Atomic Absorption Spectroscopy (AAS), Fluorescence spectroscopy. Surface Analysis: Introduction, instrumentation and sample preparation. Introduction to Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), and Scanning Tunneling Microscopy (STM).

UNIT IV: CHARACTERIZATION TECHNIQUES – B

Molecular Analysis: Raman spectroscopy, instrumentation and sample handling. Comparison of Raman with IR spectroscopy. Elemental Analysis: X-Ray Diffraction (XRD) analysis, Inductively Coupled Plasma Mass Spectrometry (ICP-MS) analysis and X-ray photoelectron spectroscopy. Thermal, Mechanical and Structural Analysis: Differential Scanning Calorimetry, Thermogravimetric method, Nano-indendation. Dynamic Light Scattering and Zeta potential analysis.

UNIT V: APPLICATIONS OF NANOMATERIALS

Nanophononics: Optical luminescence and fluorescence from direct bandgap semiconductor nanoparticles. Surface-trap passivation in core-shell nanoparticles. Carrier injection, nanoparticle-based electroluminescence; Application of nanoparticles in the display industry.

Nanobiomaterials:

a) Diagnostic Nanobiomaterials: Intrinsic biocompatibility of nanoparticle in cellular system - Nanobiomaterial as contrast agent, photosensitizer, degradable and non-degradable polymers, and biocompatible polymer coated magnetic nanoparticles for MRI imaging, gold and silver loaded bio-conjugated carbon nanotube and graphene for optical diagnostics and imaging.

b) Therapeutic Nanobiomaterials: Nanobiomaterial as therapeutic agent - Targeted, non-targeted delivery; controlled drug release; exploiting novel delivery routes using nanoparticles, Cytotoxicity mechanisms and their potential use in therapy.

Nanomaterials for Energy Systems: Evolution of nanoparticles based solar cells. Thin films, Cadmium telluridel, Copper indium gallium selenide solar cell, Gallium arsenide multi-junction solar cell, Dye-sensitized solar cell, Quantum Dot Solar Cells (QDSCs), perovskite solar cells.

TEXTBOOKS/REFERENCES

1. A.W. Adamson and A.P. Gast, Physical Chemistry of surfaces, Wiley Interscience, NY **2004**.
2. P.C Hiemen and R. Rajgopalam, Principle of colloid and surface Chemistry, NY Marcel Dekker, **1997**.
3. M. J. Rosen, Surfactant and Interfacial phenomena, Wiley Inter Science Publication, NY **2004.**
4. Processing & properties of structural nanomaterials - Leon L. Shaw, Nano chemistry: A Chemical Approach to Nanomaterials, Royal Society of Chemistry, Cambridge UK **2005**.
5. W. Gaddand, D. Brenner, S. Lysherski and G. J. Infrate (Eds), Handbook of nanoscience, Engg. and Technology, CRC Press, **2002**.
6. G. Cao, Naostructures and Nanomaterials: Synthesis, properties and applications, Imperical College Press, **2004**.
7. C. N. R. Rao, A. Muller, A. K. Cheetham (Eds), The chemistry of nanomaterials: Synthesis, properties and applications, Wiley VCH Verlag Gmbh & Co, Weinheim, **2004.**
8. Review and research articles, communications and notes published in international journals (will be provided).

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
HIS 100	Idea of India	OE	4	0	0	4

UNIT I: THE NATION AND ITS MANY ROOTS

What is a Nation? –Theories of Nationalism, The many names of India: India, India, Aryavarta or Bharat, Mother India: Iconising a Nation

UNIT II: UNEARTHING THE PAST

The Evolutionary Past: Interbreeding Vs Replacement Theory, Out of Africa Theory, what is a civilization? Theories of Civilization, Indus Valley Civilization

UNIT III: STORIES OF GODS AND PEOPLE

The Emergence of Myths, Myth Vs Reality, Vedic Age in India, Tribes, Caste and Battles.

UNIT IV: POLITY AND GOVERNANCE

Religion, Economy and the State –Asoka, Chankya and the Buddha, Land the Economy: Exploring the Arthasastra, Social Order and the State: Through the Epics, Two millennia of pluralism: Jews, Christians and other religions in India.

UNIT V: TOWARDS UNDERSTANDING THE NATION

The Mughals in India, Multiple Identities – the same heritage, The Past as a Signifier

TEXTBOOKS

1. Y. N.Harari, A Brief History of Humankind, Harper, 2015.
2. Upinder Singh, A History of Ancient and Early Medieval India, Pearson, 2009.
3. Romila Thapar, Early India: From the Origins to AD 1300, University of California Press, 2004.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
IDEA 101	Entrepreneurship Lecture Series	OE	3	0	0	3

COURSE SUMMARY:

The students will go through the fundamental learnings about entrepreneurship. What is entrepreneurship, how to develop entrepreneurship mindset, how to identify the problems or issues in the society and come up with ideas to solve those, how to convert a simple innovative idea into a successful business proposal, what is the process of doing it and how to do it effectively…Students will learn about the basic understanding … how to prepare financial statements, how to design/evolve the marketing strategies, how to brand/advertise the product, how to study competitors, study the market potential, explore the new market, go to market strategies, long term vision, how to convince venture capitalist, how to develop and pitch your idea in front of investors, how to file patents and protect intellectual property rights….all these to be achieved through the constant interaction with budding entrepreneurs and faculty through online interactions every week. Students will be required to come up with a business idea and develop it through the week-by-week trainings by visiting entrepreneurs and faculty; and present a complete business proposal at the end of the course. This can be done individually or with a group of students (max 3)

GRADING POLICY:

Grades will be based on the weightage as shown below

Class participation/assignments every week (total 60%)- 5% every week- (12 weeks), There will be review meeting of the progress on the proposal that you have come up with, may be two times in the semester.

Final presentation – 40% (Individual students or groups (max 3 students per group) should present their business proposal)

100% internal course (no exams)

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
IDEA 102	Design Thinking	OE	3	0	0	3

UNIT I: INTRODUCTION TO DESIGN THINKING
What is Design Thinking and why is it popular? Innovative thinking, what is a wicked problem and how can we solve it? The design thinking stages overview.

UNIT II: DESIGN THINKING - EMPATHISE
Power of Empathy, Probes for context mapping, Power of stories in building empathy for the target group.
USER RESEARCH METHODS
Qualitative user research, best practices of qualitative user research, Conducting ethical user research, Basics of recruiting participants for user research.

UNIT III: DESIGN THINKING – DEFINE/REDEFINE THE CHALLENGE
Define problem, Frame insights, Understand context.

UNIT IV: DESIGN THINKING – IDEATE
Brainstorm and ideate, Divergence to Convergence, Creative confidence.

UNIT V: DESIGN THINKING – PROTOTYPE & TEST
Prototype to product, Prototyping methods, Heuristic Evaluation.

PROJECT 1 (IN TEAMS)

Applying Design thinking, Empathy & Ideation principles & tools.

PROJECT 2 (IN TEAMS)

Applying Design thinking/Innovation principles and approach using specific tools.

STORYTELLING

Role of Storytelling in Design thinking of the course delivery method will be through online platforms (Zoom is preferred due to the breakout rooms options) depend upon the requirement of content and need of students. This will be an experiential learning throughout the course.

INSTRUCTIONAL METHOD

1. The course delivery method will be through online platforms (Zoom is preferred due to the breakout rooms options) depend upon the requirement of content and need of students. This will be an experiential learning throughout the course.
2. The internal evaluation will be done based on continuous evaluation of students in the hands-on workshop assignments and classroom.
3. Practical examination will be conducted at the end of semester for evaluation of performance of students in their given projects and also through questionnaire-based exam.

OPEN ELECTIVES
VI-SEMESTER

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 202	Web Technology	OE	3	0	0	3

UNIT I: WEB ESSENTIALS

Introduction to World Wide Web (WWW) Introduction to Communication Models. Web site design principles, planning the site and navigation. Introduction to Hypertext Markup Language (HTML) Form design using HTML. Basics of Extensible Hypertext Markup Language (XHTML) Basics of W3C Markup Validation Service.

UNIT II: CLIENT-SIDE SCRIPTING

Introduction to Cascading Style Sheets (CSS) Style sheets in HTML. Introduction to Java scripts.

UNIT III: HOST OBJECTS

Syntax variables and data types in Java scripts. Operators in Java scripts. Arrays and user defined functions in Java script. Java script objects.

UNIT IV: BROWSERS AND THE DOM

XML-Documents and Vocabularies. XML Namespaces. Ajax in web development. Event based parsing in XML. XPath and XSLT. Introduction to JSP. JSP and Servlets. Standard Tag Library in JSP.

UINT V: WEB SERVICES

Web Servers (IIS, PWS and Apache). HTTP Request Types. Accessing Web Servers. Database connectivity. Applets and Servlets. JDBC connectivity. JSP and Web development Frameworks. Application programming interface (API) for Remote Procedure Calls (RPC). Simple Object Access Protocol (SOAP) and Representational State Transfer (REST) APIs

TEXTBOOKS/REFERENCES

1. Deitel, Deitel and Nieto, Internet, and Worldwide Web - How to Program, 5th Edition, PHI, 2011.
2. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education
3. Marty Hall and Larry Brown," Core Web Programming" Second Edition, Volume I and
4. II, Pearson Education, 2001. 4. Bates, "Developing Web Applications", Wiley, 2006.
5. Kalin, Martin. Java Web Services: Up and Running: A Quick, Practical, and Thorough, Introduction. " O'Reilly Media, Inc.", 2013.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 202 L	Web Technology Lab	OE	0	0	2	1

LIST OF EXPERIMENTS

1. Familiarize all the basic HTML tags.
2. Implement a static HTML personal webpage by using all the possible basic tags. [Each student can develop his own bio-data page]
3. To create an html file to link to different html page which contains images, tables, and also link within a page use Frames, Forms, etc. also.
4. Create an HTML file by applying the different styles using inline, external and internal style sheets.
5. a. Create an html page to change the background color for every click of a button using Java script. write a Java script program to define a user defined function for sorting the values in an array.
   b. Create an html page with 2 combo box populated with month & year, to display the calendar for the selected month & year from combo box using java script.
6. Develop a webpage with HTML and Java Script to read name and marks of five subjects obtained for that particular student using forms. Further, it should compute the Grade and display it as a message box.
7. Create a form to collects the name, email, user id, password and confirms password from the user. All the inputs are mandatory and email address should be entered in standard format. Also, the values entered in the password and confirm password textboxes should be the same. For the security reasons make sure that the password entered by the contains both small letters and capital letters, digits, special symbols also. If the given password does not contain all these give an error message to the user. After validating all the details using JavaScript display a message like “You have successfully entered all the details”.
8. Design an XML document to store information about the student of SRM University AP. The information must include Roll No Name, Branch, Year of Joining, and email id. Make up sample data for 3 students. Create a CSS style sheet and use it to display the document.
9. Develop a registration form with various graphical user component interfaces like Text boxes (Roll No), Text boxes (Name) option buttons (gender), Qualification (Check boxes), State (Combo), etc. and store the information given by the user into a MySql database using JSP.
10. Develop a webpage to display the details of a student. For this the user will enter Roll Number in the text box given and the details of that particular student should be retrieved from the database and display it on the same webpage. Use JSP to solve this problem.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 228	Manufacturing Science	OE	3	0	0	3

UNIT I: METAL CASTING PROCESS

Introduction to metal casting, Solidification of Metals, Characteristics of sand casting, Patterns, Pattern allowances Pattern materials, Types of patterns, Molding materials, Molding sand properties, Types of sand molds, Cores, Gating system, Casting Defects, Special casting processes, cast structures, Melting furnaces, Methods of Sand testing.

UNIT II: METAL JOINING PROCESS

Classification of joining processes, Welding technique, Different welding processes: Gas Welding, Electric Arc Welding, Tungsten Inert-gas Welding (TIG), Gas Metal-Arc Welding (GMAW), Plasma Arc Welding (PAW), Submerged Arc Welding (SAW), Resistance Welding, Friction Stir Welding (FSW), Thermite welding, Electron Beam Welding (EBW), Laser Beam Welding (LBW), Weld Defects.

UNIT III: BULK DEFORMATION PROCESS

Introduction to bulk deformation processes, Hot and cold working, Forging, Types of forging, forging defects, Rolling, Defects in rolled products, Extrusion, Metal flow in extrusion, Rod drawing, Wire and Tube drawing, Swaging, Severe plastic deformation processes: Friction stir processing, Equal channel angular extrusion and high-pressure torsion.

UNIT IV: METAL REMOVAL PROCESS

Mechanism of metal cutting, Types of tools, Tool Geometry, Tool Signature, Orthogonal and Oblique cutting, Mechanics of chip formation, Chip morphology, Tool wear and failure, Machinability, Cutting-tool materials, cutting fluids, Brief description of metal removal processes: Turning, drilling, boring and Milling, Material removal rate and machining time.

UNIT V: POWDER METALLURGY

Production of metal powders, Particle size and shape, blending of metal powders, Compaction of metal powders, shaping processes, Sintering, Finishing operations, Design considerations for powder metallurgy.

TEXTBOOKS

1. Manufacturing Science, 2nd Edition, A. Ghosh and A.K. Mallik.
2. P.N. Rao, Manufacturing Technology, 3rd Edition, Tata McGraw Hill Edu Pvt Ltd, 2012.

REFERENCES

1. S. Nagendra Parashar and R.K. Mittal, Elements of Manufacturing Processes, PHI Learning Pvt Ltd, 2011.
2. R.L. Timings, Manufacturing Technology, 2nd Edition, Pearson Edu Ltd, 2010.
3. Hajra Choudhury, Elements of Workshop Technology, Vol. I and II, Media Promotors Pvt Ltd, 2001.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 416	Surface Engineering	OE	3	0	0	3

UNIT I: INTRODUCTION TO SURFACE ENGINEERING

Differences between surface and bulk, Properties of surfaces, surface energy concepts, degradation of surfaces, wear and its type, Adhesive, Abrasive, Fretting, Erosion wear, Surface fatigue,

UNIT II: FRICTION AND LUBRICATION

Fundamentals, Types and measurement of solid, liquid and gaseous friction. Friction heat and calculation. Lubricants and additives, mechanism of solid, liquid and gaseous lubricants.

UNIT III: CORROSION

Different types of Corrosion and its prevention, Galvanic corrosion, Passivation, Pitting, Crevice, Mircobial, High-temperature corrosion, Corrosion in nonmetals, polymers and glasses, Protection from corrosion through surface modifications.

UNIT IV: CHANGING THE SURFACE METALLURGY

Localized surface hardening (flame, induction, laser, electron-beam hardening, Laser melting, shot peening), Changing the surface chemistry: Phosphating, Chromating, Anodizing (electrochemical conversion coating), Carburizing, Nitriding, Ion implantation, Laser alloying, boriding, Organic coatings (paints and polymeric or elastomeric coatings and linings), Hot-dip galvanizing (zinc coatings), Ceramic coatings (glass linings, cement linings, and porcelain enamels), Advanced surface coating methods: Gaseous State (CVD, PVD etc), Solution State (Chemical solution deposition, Electrochemical deposition, Sol gel, electroplating), Molten or semimolten State (Laser cladding and Thermal spraying)

UNIT V: CHARACTERIZATION OF SURFACE AND COATINGS

Surface Characterization (physical and chemical methods, XPS, AES, RAMAN, FTIR etc), Structural Characterization, Mechanical Characterization (Adhesion, Hardness, Elastic Properties, Toughness, Scratch and Indentation etc.), Tribological Characterization, Corrosion tests.

TEXTBOOKS/REFERENCES

1. Introduction to Surface Engineering and Functionally Engineered Materials, Peter Martin; Wiley, 2011.
2. Materials and Surface Engineering: Research and Development, J. Paulo Davim; Woodhead Publishing review, 2012.
3. Pradeep L. Menezes, “Tribology for Scientists and Engineers”, Springer, 2013.
4. Handbook, Friction, Lubrication and Wear Technology, Vol. 18, ASM.
5. Krishna, R., Anantraman, T.R., Pande, C.S., Arora, O.P., Advanced techniques for microstructural characterization (ed), Trans Tech Publication.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 562	Mechanical Behavior of Materials	OE	3	0	0	3

UNIT I
Introduction, Structure property relationship. Elasticity, Isotropic/Anisotropic.

UNIT II
Viscoelasticity. Elastic-Plastic Deformation. Mechanical testing.

UNIT III
Heat Treatment. Strain Hardening. Strain Rate and Temperature Effects on Deformation. Slip, Dislocations, Twinning, and Hardening.

UNIT IV
Ductile and Brittle Fracture. Fracture Mechanics. Creep. Fatigue. Cumulative Fatigue Damage. Wear processes.

UNIT V
Special topics: Residual Stresses, Ceramics, Glasses, Polymers, Composites, Mechanical Working, and Micromechanics

TEXTBOOKS
1. Meyers and Chawla, Mechanical Behavior of materials, Cambridge publication

REFERENCES
1. N. E. Dowling, Mechanical Behavior of Materials, Prentice-Hall.
2. R.W. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, 4th Ed., John Wiley & Sons, 1995.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 223	Alternative Sources of Energy	OE	3	0	0	3

UNIT I: SOLAR ENERGY

Solar radiation and its measurements, Types of solar thermal collectors, Solar thermal applications for water heaters, solar stills and solar pond, Solar thermal applications for refrigeration and air- conditioning system, Solar thermal applications for solar dryer, solar cookers and solar furnaces, Sensible and latent heat thermal energy storage systems, Solar thermal power generation systems, Solar photovoltaic systems: basic working principle and components, Applications of solar photovoltaic systems.

UNIT II: WIND ENERGY

Basic principle of wind energy conversion system, Wind data, site selection and energy estimation, Components of wind energy conversion systems, Types of Horizontal axis and Vertical axis wind turbine, Design consideration of horizontal axis wind turbine, Aero foil theory, Analysis of aerodynamic forces acting on the blade, Performance of wind turbines, Introduction to solar and wind hybrid energy systems, environmental issues of wind energy.

UNIT III: OCEAN, HYDRO AND GEOTHERMAL ENERGY

Wave characteristics and wave energy, Tidal energy and its types, Estimation of energy and power in single basin tidal system, Ocean thermal energy conversion for open system, Ocean thermal energy conversion for closed system, Hydro power plants for small, mini and micro system, Exploration of geothermal energy, Geothermal power plants, Challenges, availability, geographical distribution, scope and economics for geothermal plant.

UNIT IV: BIOMASS

Sources of biomass, Pyrolysis, combustion and gasification process, Updraft and downdraft gasifier, Fluidized bed gasifier, Fermentation and digestion process, Fixed and floating digester biogas plants, Design considerations of digester, Operational parameter of biogas plants, Economics of biomass power generation.

UNIT V: DIRECT ENERGY CONVERSION SYSTEMS

Basic principle of thermo electric and thermionic power generations, Fuel cell principles and its classification, Phosphoric acid fuel cell, polymer electrolyte membrane fuel cell, molten carbonate fuel cell and solid oxide fuel cell, Fuel cell conversion efficiency, applications of fuel cell, Magneto hydrodynamic power generation for open cycle, Magneto hydrodynamic power generation for closed cycle, Hydrogen energy: properties and its production methods, Electrolysis, thermo-chemical methods, fossil fuel methods and solar energy methods, Hydrogen storage, transportation and applications.

TEXTBOOKS

1. Tiwari.G.N, Ghosal.M.K, "*Fundamentals of renewable energy sources"*,1st Edition, UK, Alpha Science International Ltd, 2007.
2. Godfrey Boyle, "*Renewable energy"*, 2nd Edition, Oxford University Press, 2010.
3. Twidell.J.W and Weir.A.D, "*Renewable Energy Resources"*,1st Edition, UK,E.&F.N. Spon Ltd, 2006.
4. Domkundwar.V.M, Domkundwar. A.V, "*Solar energy and Non-conventional sources of energy"*, Dhanpat rai & Co. (P) Ltd, 1st Edition, New Delhi, 2010.
5. G.D Rai, "*Non-Conventional Energy Sources"*, Khanna Publishers, 5th Edition, New Delhi, 2011.
6. B.H Khan, "*Non-conventional Energy Resources"*, 2nd Edition, New Delhi, Tata McGraw Hill, 2009.
7. S.P. Sukatme, J.K. Mayak, "*Solar Energy-Principles of thermal collection and storage*", 3rd edition, New delhi, McGraw Hill,2008.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PHY 307M	Special Theory of Relativity	OE	3	0	2	4

UNIT I: INTRODUCTION TO RELATIVITY

Inertial Frames, Universality of Newton's second law in all inertial frames, Classical Relativity, does universal rest (ether) exists? Michelson Morley Experiment Principle, Michelson Morley Experiment, Postulates of Special Theory of Relativity, Concept of transformation, Galilean Transformation, Simultaneity of two events in different inertial frames of reference and its frame dependence, Tutorial I, Tutorial II, Tutorial III.

UNIT II: LORENTZ TRANSFORMATION

Clock Synchronization in an Inertial Frame, Lorentz Transformation, Length Contraction, Time dilation, Examples of Length Contraction and Time dilation, Simultaneity Part I, Simultaneity Part II, Transformation of Velocities Part I, Transformation of Velocities Part II, Tutorial IV, Tutorial V, Tutorial VI.

UNIT III: RELATIVISTIC VELOCITY AND MOMENTUM

Velocity Transformation, Relative velocity with examples, Time like and Space Like intervals, Causality, need to redefine Momentum, Vector and Four-Vectors, Proper time interval, Velocity and Momentum-Energy Four Vector, Example on Relativistic velocity and momentum, Tutorial VII, Tutorial VIII, Tutorial IX.

UNIT IV: MASS ENERGY RELATION

Mass-Energy Relationship, Relationship between new energy and momentum, Relativistic Dynamics Part I, Relativistic Dynamics Part II, zero mass particles, Relativistic Mass, Geometry of Space-time, Spacelike and time-like interval, Light cone, Tutorial X, Tutorial XI, Tutorial XII

UNIT V: GEOMETRY OF SPACE-TIME

Four-Dimensional form of Maxwell's equations, Four-dimensional Vector Potential.Stress-Energy Momentum Tensor, Conservation Laws, Lagrangian formulation of Electrodynamics Part I, Lagrangian formulation of Electrodynamics Part II, Relativistic treatment of Radiation, Four-Dimensional form of Maxwell's equations, Four dimensional Vector Potential, Tutorial XIII, Tutorial XIV, Tutorial XV.

TEXTBOOKS

1. Resnick, Robert. *Introduction to Special Relativity*. New York, NY: Wiley, 1968. ISBN: 9780471717256.
2. French, Anthony Philip. *Special Relativity*. New York, NY: Norton, 1968. ISBN: 9780393097931.
3. Einstein, Albert A. *Relativity: The Special and the General Theory*. New York, NY: Three Rivers Press/Random House, 1995. ISBN: 9780517884416. (recommended)

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PSY 111	Psychology for Everyday Living	OE	4	0	0	4

UNIT I: MYTHS AND MISCONCEPTIONS IN PSYCHOLOGY

Definition, nature and goals of psychology, Common myths and misconceptions about psychology, Schools of psychology; Basic and applied areas of psychology

UNIT II: THE ROLE OF PERCEPTION AND ATTITUDE TOWARDS UNDERSTANDING THE WORLD

Perception: Understanding perception, Gestalt laws of organization, common illusions, Perceptual constancy - depth perception, size perception, perception of movement, Attitude formation, Attitude change.

UNIT III: INTELLIGENCE AND LEARNING

Definitions and nature of intelligence, Emotional and social intelligence; Measuring IQ, EQ and SQ, Fundamentals of learning and its applications, Memory techniques.

UNIT IV: UNDERSTANDING THE SELF

Definition; Approaches to personality – trait and type, Psychoanalytical and humanistic theory, Tests of personality – MBTI and NEO-PI, Identity; Self-concept, self-esteem and self-efficacy.

UNIT V: STRESS, COPING AND QUALITY OF LIFE

Nature, sources of stress and its reactions, Factors influencing stress, coping with and managing stress - cognitive and behavioral techniques, Improving quality of life.

TEXTBOOKS/REFERENCES

1. Baron, R. A. (2001). Psychology. New Delhi: Pearson Education India.
2. Nolen-Hoeksema, S., Fredrickson, B.L. & Loftus, G.R. (2014). Atkinson &Hilgard's Introduction to Psychology.16th Ed. United Kingdom: Cengage Learning.
3. Morgan, C. T., King, R. A., & Schopler, J. (2004). Introduction to Psychology. New Delhi: Tata McGraw Hill.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
HIS 200	India and its People	OE	4	0	0	4

UNIT I: THE MAKING OF MODERN INDIA; THROUGH THE EYES OF THE CONSTITUTION

Why do we need a constitution? Beginning of constitutionalism in India: Colonial and Anti-colonial legacies, Locating constituent Assembly debate: Consensus and Discontent. Reading preamble of the Indian constitution.

UNIT II: FUNDAMENTAL RIGHTS AND DIRECTIVE PRINCIPLES OF STATE POLICY

The crafting of Fundamental Rights and Directive Principles and their various interpretations, the centrality of Fundamental Rights in the Indian Constitution, Counter- hegemonic imagination of justice: Defining liberty and non- discrimination, The peculiarity of the Directive Principles of State Policies, The idea of constitutional insurgency, Cultural and educational rights to minorities in the Constitution.

UNIT III: ASYMMETRICAL FEDERALISM: CENTER-STATE RELATIONS

What is federalism? Constitutional provisions related to federalism, Relationship between State and Centre, Deliberative ambiguities of Indian Federalism, Special Provisions for Jammu and Kashmir, Himachal Pradesh, Northeastern states and tribal areas.

UNIT IV: FOUNDATIONS OF GOVERNANCE

Division of Power: Legislative, Executive, and Judiciary, Parliamentary form of government in India, Government of the Union and Government of the State, Role of Supreme Court and Judicial Activism in India.

UNIT V: CONSTITUTION AS A LIVING DOCUMENT

Constitution as a dialogue, Constitutional Amendments and the basic structure of the Indian constitution, Insertion of the 9^{th} schedule in the constitution, The role of judiciary and citizen in defending, negotiating and interpreting the constitution.

TEXTBOOKS/REFERENCES

1. Arjun Thiruvengadam, Origin and Crafting of the Constitution, in The Constitution of India, a Contextual Analysis, Hart Publishing.
2. Granville Austin, The Indian Constitution: Cornerstone of a Nation, Oxford University Press, Oxford, 1966.
3. Kalpana Kannabiran, Tools of Justice: Non- discrimination and the Indian Constitution, Routledge, 2012.
4. Rajeev Bhargava (ed), Ethics and Politics of the Indian Constitution, Oxford University Press, New Delhi, 2008.
5. Subhash C. Kashyap, Our Constitution, National Book Trust, New Delhi, 2011.
6. Zoya Hassan, E. Sridharan, and R. Sudarshan (eds), India's Living Constitution: Ideas Practices, Controversies, Permanent Black, New Delhi, 2002.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
HIS 005	Introduction to Gender	OE	4	0	0	4

UNIT I: THE NATION AND ITS MANY ROOTS

What is a Nation? –Theories of Nationalism, The many names of India: India, Hindia, Aryavarta or Bharat, Mother India: Iconising a Nation

UNIT II: UNEARTHING THE PAST

The Evolutionary Past: Interbreeding Vs Replacement Theory, Out of Africa Theory, what is a civilization? Theories of Civilization, Indus Valley Civilization

UNIT III: STORIES OF GODS AND PEOPLE

The Emergence of Myths, Myth Vs Reality, Vedic Age in India, Tribes, Caste and Battles.

UNIT IV: POLITY AND GOVERNANCE

Religion, Economy and the State –Asoka, Chankya and the Buddha, Land the Economy: Exploring the Arthasastra, Social Order and the State: Through the Epics, Two millennia of pluralism: Jews, Christians and other religions in India.

UNIT V: TOWARDS UNDERSTANDING THE NATION

The Mughals in India, Multiple Identities – the same heritage, The Past as a Signifier

TEXTBOOKS

1. Y. N.Harari, A Brief History of Humankind, Harper, 2015.
2. Upinder Singh, A History of Ancient and Early Medieval India, Pearson, 2009.
3. Romila Thapar, Early India: From the Origins to AD 1300, University of California Press, 2004.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 355	Calculus of Variation	OE	4	0	0	4

UNIT I: METHOD OF VARIATIONS IN PROBLEMS WITH FIXED BOUNDARIES

Introduction – Functionals, Variation and Its Properties, Euler's Equation, Functionals Dependent on Higher-Order Derivatives, Variational Problems in Parametric Form, Some Applications.

UNIT II: VARIATIONAL PROBLEMS WITH MOVING BOUNDARIES

Elementary Problem with Moving Boundaries, One-Sided Variations.

UNIT III: SUFFICIENT CONDITIONS FOR AN EXTREMUM

Field of Extremals, The Function $E(x, y, p, y')$, Transforming the Euler Equations to the Canonical Form.

UNIT IV: VARIATIONAL PROBLEMS INVOLVING A CONDITIONAL EXTREMUM

Constraints of the Form $\varphi(x, y_1, y_2, \cdots y_n)$, Constraints of the Form $\varphi(x, y_1, y_2, \cdots y_n, y_1', y_2', \cdots y_n')$, Isoperimetric Problems.

UNIT V: DIRECT METHODS IN VARIATIONAL PROBLEMS

Introduction to Direct Methods, Euler's Finite-Difference Method, Rayleigh-Ritz Method, Kantorovich's Method.

TEXTBOOKS/REFERENCES

1. L. Elsgolts, *Differential Equations and the Calculus of Variations*, University Press of the Pacific, 2003.
2. A S Gupta, Calculus of Variations, Prentice-Hall of India Pvt. Ltd., New Delhi, 2008.
3. I. M. Gelfand and S. V. Fomin, *Calculus of Variations,* Dover Publications. 1963.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
IDEA 103	User Experienced Design	OE	3	0	0	3

WHAT IS UX DESIGN

MODULE 1: INTRODUCTION TO USABILITY, INTERACTION DESIGN, DESIGN THINKING

1. The principle of 'Visibility', 'Findability', 'Learnability'
2. Affordances
3. Mapping
4. Constraints
5. Feedback
6. Hick's law
7. Fitt's law
8. Interactive experience
9. Design thinking overview

MODULE 2: DESIGN PRINCIPLES & DESIGN GUIDELINES

1. Gestalt Principles
2. 10 rules of thumb
3. UI design failures

USER RESEARCH METHODS

1. Qualitative user research
2. Best practices of qualitative user research
3. Conducting ethical user research
4. Basics of recruiting participants for user research

MODULE 3: VISUAL PERCEPTION AND COLOR VISION

1. Visual Perception
2. Vision and Design using color
3. Color blindness
4. Context and other influences

MODULE 4: USABILITY CONSIDERATIONS

1. Task structure
2. Simplicity in design
3. Designing with experience in mind
4. Chunking
5. Banner blindness
6. Preventing errors
7. Context of use
8. Focus on users
9. The value of UX

UX DESIGN PROCESS

MODULE 5: PROJECT-I (in teams)

1. Applying Design thinking
2. Empathy & Ideation principles & tools

STORYTELLING

1. Role of Storytelling in Design thinking

INSTRUCTIONAL METHOD

- The course delivery method will be through online platforms (Zoom is preferred due to the breakout rooms options) depend upon the requirement of content and need of students. This will be an experiential learning throughout the course.
- The internal evaluation will be done based on continuous evaluation of students in the hands-on workshop assignments and classroom.
- Practical examination will be conducted at the end of semester for evaluation of performance of students in their given projects and also through questionnaire-based exam

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
IDEA 104	Dream-Discover-Disrupt	OE	3	0	0	3

MODULE 1: VENTURE IDEATION.
MODULE 2: MARKETING.
MODULE 3: CUSTOMER SEGMENTATION.
MODULE 4: CUSTOMER DISCOVERY.
MODULE 5: SOLUTION DESIGN.

OPEN ELECTIVES
VII-SEMESTER

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 202	Web Technology	OE	3	0	0	3

UNIT I: WEB ESSENTIALS

Introduction to World Wide Web (WWW) Introduction to Communication Models. Web site design principles, planning the site and navigation. Introduction to Hypertext Markup Language (HTML) Form design using HTML. Basics of Extensible Hypertext Markup Language (XHTML) Basics of W3C Markup Validation Service.

UNIT II: CLIENT-SIDE SCRIPTING

Introduction to Cascading Style Sheets (CSS) Style sheets in HTML. Introduction to Java scripts.

UNIT III: HOST OBJECTS

Syntax variables and data types in Java scripts. Operators in Java scripts. Arrays and user defined functions in Java script. Java script objects.

UNIT IV: BROWSERS AND THE DOM

XML-Documents and Vocabularies. XML Namespaces. Ajax in web development. Event based parsing in XML. XPath and XSLT. Introduction to JSP. JSP and Servlets. Standard Tag Library in JSP.

UINT V: WEB SERVICES

Web Servers (IIS, PWS and Apache). HTTP Request Types. Accessing Web Servers. Database connectivity. Applets and Servlets. JDBC connectivity. JSP and Web development Frameworks. Application programming interface (API) for Remote Procedure Calls (RPC). Simple Object Access Protocol (SOAP) and Representational State Transfer (REST) APIs.

TEXTBOOKS/REFERENCES

1. Deitel, Deitel and Nieto, Internet, and Worldwide Web - How to Program, 5th Edition, PHI, 2011.
2. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education
3. Marty Hall and Larry Brown," Core Web Programming" Second Edition, Volume I and
4. II, Pearson Education, 2001. 4. Bates, "Developing Web Applications", Wiley, 2006.
5. Kalin, Martin. Java Web Services: Up and Running: A Quick, Practical, and Thorough,Introduction. " O'Reilly Media, Inc.", 2013.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 202 L	Web Technology Lab	OE	0	0	2	1

LIST OF EXPERIMENTS

1. Familiarize all the basic HTML tags.
2. Implement a static HTML personal webpage by using all the possible basic tags. [Each student can develop his own bio-data page]
3. To create an html file to link to different html page which contains images, tables, and also link within a page use Frames, Forms, etc. also.
4. Create an HTML file by applying the different styles using inline, external and internal style sheets.
5. a. Create an html page to change the background color for every click of a button using Java script. write a Java script program to define a user defined function for sorting the values in an array.
   b. Create an html page with 2 combo box populated with month & year, to display the calendar for the selected month & year from combo box using java script.
6. Develop a webpage with HTML and Java Script to read name and marks of five subjects obtained for that particular student using forms. Further, it should compute the Grade and display it as a message box.
7. Create a form to collects the name, email, user id, password and confirms password from the user. All the inputs are mandatory and email address should be entered in standard format. Also, the values entered in the password and confirm password textboxes should be the same. For the security reasons make sure that the password entered by the contains both small letters and capital letters, digits, special symbols also. If the given password does not contain all these give an error message to the user. After validating all the details using JavaScript display a message like “You have successfully entered all the details”.
8. Design an XML document to store information about the student of SRM University AP. The information must include Roll No Name, Branch, Year of Joining, and email id. Make up sample data for 3 students. Create a CSS style sheet and use it to display the document.
9. Develop a registration form with various graphical user component interfaces like Text boxes (Roll No), Text boxes (Name) option buttons (gender), Qualification (Check boxes), State (Combo), etc. and store the information given by the user into a MySql database using JSP.
10. Develop a webpage to display the details of a student. For this the user will enter Roll Number in the text box given and the details of that particular student should be retrieved from the database and display it on the same webpage. Use JSP to solve this problem.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECE 418	Machine Learning	OE	3	0	2	4

UNIT I
Introduction to machine learning, Supervised and Unsupervised Learning, Linear Regression, Logistic Regression, Generalized Linear Models.

UNIT II
Gaussian Discriminant Analysis (GDA), Naive Bayes, Support Vector Machines, K-Nearest Neighbor, Decision Trees, Random Forest.

UNIT III
Clustering in Machine Learning, Different Types of Clustering Algorithm, K-Means Clustering, Gaussian Mixture Models, Bias-variance trade off.

UNIT IV
Introduction to Neural Networks, Feed-forward Network, Gradient descent optimization, Error Backpropagation, Evaluation of error-function derivatives, Efficiency of backpropagation, under and over fitting.

UNIT V
Introduction to Convolutional neural network (CNN), Backpropagation in CNN, Sparse Kernel Machines, Markov Chain Monte Carlo, Introduction to Reinforment learning.

TEXTBOOKS/REFERENCES

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning" by Springer, 2007.
2. Tom M. Mitchell, "Machine Learning", First Edition by Tata McGraw-Hill Education, 2013.
3. EthemAlpaydin, "Introduction to Machine Learning" 2nd Edition, The MIT Press, 2009.

LIST OF EXPERIMENTS

1. Implement Linear Regression on the given dataset using python/MATLAB.
2. Implement Naïve Bayes classifier using Python/MATLAB.
3. Implement Logistic Regression on the given dataset using python/MATLAB.
4. Implement SVM algorithm using Python/MATLAB.
5. Implement Decision tree classifier and Random Forest classifier using python/MATLAB.
6. Implement Random Forest classifier using python/MATLAB.
7. Implement K-means algorithm for clustering the data using python/MATLAB.
8. Implement K-Nearest Neighbour classifier using python/MATLAB.
9. Emulate logic gates using neural Network using python.
10. Implement single-Layer Neural Network for image/data analysis using Python/MATLAB.
11. Implement Convolution Neural Network for image/data analysis using Python/MATLAB.
12. Implement Markov model for analysis of stock market data using python/MATLAB

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EEE 422	Optimization Techniques	OE	3	0	0	3

UNIT: I UNCONSTRAINED OPTIMIZATION

Basics: Set-constrained and unconstrained optimization; conditions for local minimizers, One-dimensional search methods: golden section, Fibonacci, bisection, Newton's and Secant methods; bracketing; line search, Gradient methods: steepest descent method; analysis of gradient methods.

UNIT: II METHODS

Newton's method: analysis; Levenberg-Marquardt modification; nonlinear least squares, Conjugate Gradient method: conjugate direction algorithm; conjugate gradient algorithm; non-quadratic problems, Quasi-Newton method: approximating the inverse Hessian; rank-one correction; DFP and BFGS algorithms, Least-squares analysis; RLS; linear equation with minimum norm; Kaczmarz's algorithm; general solution.

UNIT: III LINEAR PROGRAMMING

Linear Programming: standard form; convex polyhedral; basic solutions and properties, Simplex method: canonical augmented matrix; algorithm; matrix form; two-phase; revised method, Duality: Dual linear programs and properties.

UNIT: IV EQUALITY AND INEQUALITY CONSTRAINTS

Equality constraints: Problem formulation; tangent and normal spaces; Lagrange conditions; second-order conditions; minimizing quadratics with linear constraints, Inequality constraints: Karush-Kuhn Tucker conditions; second-order conditions.

UNIT: V CONSTRAINED OPTIMIZATION

Convex optimization: convex functions, convex optimization problems; semi-definite programming, Algorithms: Projections; projected gradient with linear constraints; Lagrangian algorithms; penalty methods, Multi-objective Optimization: Pareto solutions, Pareto front computation, from multi-objective to single-objective optimization; uncertain LP problems.

TEXTBOOKS/REFERENCES

1. E. K. P. Chong and S. H. Zak, "An Introduction to Optimization," 4th edition, Wiley, 2013.
2. D. G. Luenberger and Y. Ye, "Linear and Nonlinear Programming," 4th edition, Springer, 2016.
3. D. P. Bertsekas, "Nonlinear programming," Athena Scientific, 1999.
4. S. Boyd and L. Vandenberghe, "Convex optimization," Cambridge University Press, 2004.
5. M. Fathi and H. Bevarani, "Optimization in Electrical Engineering," Springer, 2019

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 418	Introduction to Electric Vehicles	OE	3	0	0	3

UNIT I: INTRODUCTION
History, EV Benefits, EV/HEV subsystems and configurations.

UNIT II: VEHICLE DYNAMICS
Vehicle dynamics, forces acting, power and torque calculations, Simulations, Drive cycles.

UNIT III: BATTERIES
Battery parameters, why Li, SoH & SoC estimation/self-discharge, Battery pack design/development, battery computations, Charging, BMS and its design, future batteries.

UNIT IV: ELECTRICAL COMPONENTS FOR EV AND HEV
EV Motors (IM, PM etc,) D-q circuit, DC-DC converters, DC-AC converters, control system overview.

UNIT V: EV DESIGN
Mechanical, Electrical and Thermal design consideration, Sample design calculations for EV and HEV's.

TEXTBOOKS
1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuel cell vehicles by John G. Hayes and A. Goodarzi, Wiley Publication.

REFERENCES

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2018.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
IDEA 102	Design Thinking	OE	3	0	0	3

UNIT I: INTRODUCTION TO DESIGN THINKING

Design Thinker's mindset, what is Design Thinking and why is it popular? Innovative thinking, what is a wicked problem and how can we solve it? The design thinking stages overview.

UNIT II: DESIGN THINKING - EMPATHISE

Power of Empathy, Probes for context mapping, Power of stories in building empathy for the target group, User Research methods -Qualitative user research, best practices of qualitative user research, best practices of qualitative user research. Conducting ethical user research. Basics of recruiting participants for user research.

UNIT III: DESIGN THINKING – DEFINE/REDEFINE THE CHALLENGE

Define problem, Frame insights, Understand context.

UNIT IV: DESIGN THINKING – IDEATE

Brainstorm and ideate, Divergence to Convergence, Creative confidence.

UNIT V: DESIGN THINKING – PROTOTYPE & TEST

Prototype to product, Prototyping methods, Heuristic Evaluation, Project 1 (in teams)-Applying Design thinking, Empathy & Ideation, principles & tools. Project 2 (in teams)-Applying Design thinking/Innovation principles and approach using specific tools. Storytelling -Role of Storytelling in Design thinking.

INSTRUCTIONAL METHOD

1. The course delivery method will be through online platforms (Zoom is preferred due to the breakout rooms options) depend upon the requirement of content and need of students. This will be an experiential learning throughout the course.
2. The internal evaluation will be done based on continuous evaluation of students in the hands-on workshop assignments and classroom.
3. Practical examination will be conducted at the end of semester for evaluation of performance of students in their given projects and also through questionnaire-based exam.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 305	Introduction to Science and Technology Studies	OE	4	0	0	4

UNIT I: PHILOSOPHY OF SCIENCE: ISSUES AND PERSPECTIVES

What is science? Some Historical Background, Scientific reasoning- Induction, deduction and the problem of Hume, Scientific Explanation and Causality, Popper's Philosophy of Science, Scientific Revolutions.

UNIT II: PERSPECTIVES FROM SOCIOLOGY OF SCIENCE AND TECHNOLOGY

Questioning Functionalism in the Sociology of Science, the strong program, the social construction of Scientific and technological realities, Studying laboratories.

UNIT III: SCIENCE, TECHNOLOGY AND DEVELOPMENT: A CRITICAL ENQUIRY

Medicine, Agriculture, Environment, War.

UNIT IV: EXCLUSIONS IN SCIENCE AND TECHNOLOGY INSTITUTIONS

Under presentation of women in Science and Technology Institutions in India and abroad, Autobiographical Accounts, The Caste of Merit- excerpts.

UNIT V: FEMINIST AND OTHER CRITIQUES OF SCIENCE

The Mis-measure of Man IQ tests, Craniometry, Examples of how gender figures in doing science, The Medical Construction of gender: The case of Intersex babies, Feminist epistemologies of Science, Hidden Figures Movie

TEXTBOOKS/REFERENCES

1. Samir Okasha (2003). Philosophy of science: A very short introduction.
2. Sismondo, S. (2010). An introduction to science and technology studies.
3. S G Kulkarni. Philosophy of Science: issues and Perspectives.
4. Mary Wyer et al (2000) Women Science and Technology.
5. Ajantha Subramanian (2018) The Caste of Merit.
6. Stefan Jay Gould The Mismeasure of Man.
7. Ashish Nandy Science Hegemony and Violence.
8. Gita Chadha and Asha Achuthan (Eds) Review of Women Studies, Economic and Political Weekly.
9. Jayasree Subramanian (2007) Perceiving and Producing Merit: Gender and Doing Science in India.
10. Sumi Krishna & Gita Chadha (Eds) Feminists and Science

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PSY 116	Fundamentals of Neuro Linguistic Programming-Level 1	OE	3	0	0	3

UNIT I: WHAT IS NLP?

Introduction to NLP, NLP Frames, NLP Presuppositions – Beliefs of Excellence. The Communication Model (Deletion, Distortion and Generalization) Components of the NLP Communication Model.

UNIT II: META PROGRAMS

Sensory Acuity and Calibration, Representation System (Modalities), Sub modalities Practicing Sub modalities, Identifying your primary representational system.

UNIT III: ANCHORING

Eye Accessing Cues Rapport – Unconscious responsiveness. State: Introduction to states, Anchoring Process, State Elicitation Summary, Stacking Anchors, Stacking Anchors Summary (X, Y, Z state).

UNIT IV: WELL-FORMED / WELL-DEFINED OUTCOMES

Pain and Pleasure exercise, Wellness Vision Planning (Wheel of Life) Ardell's model for Wellness Coaching. T-F-A-R Coaching Model Timeline Coaching.

UNIT V: COACHING PATTERNS

New Behaviour Generator, Circle of Excellence – Resourceful States. Walt Disney Strategy, Reframing Coaching using values Perceptual Positions (Relationship Coaching / Leadership Coaching).

TEXTBOOKS/REFERENCES

1. NLP The New Technology of Achievement – Edited by Steve Andreas and Charles Faulkner.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
BIO 112	Basic Microbiology	OE	4	0	0	4

UNIT I: INTRODUCTION TO MICROBIOLOGY

History of microbiology, Essential methods to study microbes: sterilization and disinfection: Methods of sterilization- physical methods (heat, filtration), radiation and chemical methods, Principles of microscopy, Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur-germ theory of disease, Robert Koch- Koch's postulates, Joseph Lister, Alexander Fleming, Microbial growth, Growth media types - selective and differential media; Influence of environmental factors for microbial growth. Growth phases and kinetics; Maintenance and preservation of bacterial cultures.

UNIT II: BACTERIAL CELLS - STRUCTURE AND FUNCTION

Different groups of microorganisms and their general characteristics, Ultrastructure of Gram positive and Gram-negative bacterial cell wall, Size, shape and arrangement of bacterial cells. cell membrane, cytoplasmic matrix, pili, capsule, flagella Classification & molecular taxonomy-Phylogenetic tree; measuring diversity by 16S/18S rRNA, RAPD, T-RFLP.

UNIT III: MOLECULAR PATHOGENS

Viral structure and classification; Bacteriophage and its life cycle; Viral pathogenesis; Immune response to viral infections; Acute, chronic and latent viral infections; Viral vaccines, Viroid, Prions, Plasmid and transposable elements.

UNIT IV: MICROBIAL DISEASE AND ANTIMICROBIAL AGENTS

Microbial disease: - Tuberculosis, Typhoid, Infection caused by *E. coli*, *Staphylococcus*, *Sterptococcus*, Role of quorum sensing and biofilm in microbial disease, Action of antimicrobial drugs: inhibitors of cell wall synthesis, inhibitors of protein synthesis, inhibitors of nucleic acid synthesis, competitive inhibitors, antifungal, antiviral, anti- protozoan drugs, Mechanism of antibiotic resistance.

UNIT V: APPLIED MICROBIOLOGY

Microorganism of Industrial use, Basics of fermenter design, Primary and secondary metabolites, Strains-screening, adaptation and strain improvement Industrial production of antibiotics – penicillin; alcohol- ethanol. Food microbiology – Microorganisms in food, Introduction to probiotics and prebiotics, Food preservation Environmental microbiology – Bioremediation, Bioleaching, Microbial degradation of textile waste.

TEXTBOOKS/REFERENCES

1. Microbiology, 6th edition (1993), Pelczar, Chan and Krieg; McGraw Hill International
2. Prescott, Harley, and Klein's Microbiology, 8th edition, (2011), Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton, McGraw Hill International.
3. Stainer R. Y., Ingraham. J. L., Wheelis M. J., Painter P. R. (1999). General microbiology. MacMillan Educational Ltd. London.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PHY 223	Introduction to Quantum Computation	OE	3	1	0	4

UNIT I: MATRIX, TENSOR AND DIRAC NOTATION

Basis vectors and orthogonality, Matrices Hilbert spaces, Inner and outer products, Tensors in index notation, Metric tensors, covariant and contravariant tensors, Unitary operators and projectors, Hermetian operator, Adjoint of operator, Wavefunction as vector and operator as metrics, Dirac notation, Tutorial 1, Tutorial 2, Tutorial 3.

UNIT II: INTRODUCTION AND OVERVIEW OF QUANTUM MECHANICS

Photon, Concept of Planck Constant, Photoelectric effect, Wave particle duality, Wave packet, Davisson and Germer Experiment, Superposition Principle, Young Double slit experiment, Qubits and pieces, Concept of Bloch sphere, Derivation on Bloch sphere representation, Tutorial 4, Tutorial 5, Tutorial 6.

UNIT III: FUNDAMENTALS OF QUANTUM COMMUNICATION

No-cloning theorem, Hidden Information of state, Einstein-Podolsky-Rosen Paradox, Bell states, Bell inequalities, Bell inequalities – Examples, Quantum entanglement, Quantum entanglement considering Heisenberg principal, Quantum teleportation, Tutorial 7, Tutorial 8, Tutorial 9.

UNIT IV: QUANTUM GATE

Pauli Gates, Phase Gate, Controlled phase shift, Hadamard gates, SWAP Gates, CNOT Gates, Toffoli gates, Combination of Gates, Circuit of Gates, Tutorial 10, Tutorial 11, Tutorial 12.

UNIT V: QUANTUM ALGORITHM, KEY DISTRIBUTION AND ERROR

Deutsch algorithm, Deutsch-Josza algorithm, Shor's Algorithm – Periodicity, Shor's period-finding algorithm, Introduction to Quantum key distribution, BB84 protocol, Quantum Error Correction, Quantum Error Correction Example, Physical Qubits, Tutorial 13, Tutorial 14, Tutorial 15.

TEXTBOOKS/REFERENCES

1. Phillip Kaye, Raymond Laflamme, and Michele Mosca (2007). An Introduction to Quantum Computing. Oxford University Press.
2. Michael A. Nielsen and Isaac L. Chuang (2000). Quantum Computation and Quantum information. Cambridge University Press.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
HIS 005	Introduction to Gender	OE	4	0	0	4

UNIT I: THE NATION AND ITS MANY ROOTS

What is a Nation? –Theories of Nationalism, The many names of India: India, Hindia, Aryavarta or Bharat, Mother India: Iconising a Nation.

UNIT II: UNEARTHING THE PAST

The Evolutionary Past: Interbreeding Vs Replacement Theory, Out of Africa Theory, what is a civilization? Theories of Civilization, Indus Valley Civilization.

UNIT III: STORIES OF GODS AND PEOPLE

The Emergence of Myths, Myth Vs Reality, Vedic Age in India, Tribes, Caste and Battles.

UNIT IV: POLITY AND GOVERNANCE

Religion, Economy and the State –Asoka, Chankya and the Buddha, Land the Economy: Exploring the Arthasastra, Social Order and the State: Through the Epics, Two millennia of pluralism: Jews, Christians and other religions in India.

UNIT V: TOWARDS UNDERSTANDING THE NATION

The Mughals in India, Multiple Identities – the same heritage, The Past as a Signifier

TEXTBOOKS

1. Y. N.Harari, A Brief History of Humankind, Harper, 2015.
2. Upinder Singh, A History of Ancient and Early Medieval India, Pearson, 2009.
3. Romila Thapar, Early India: From the Origins to AD 1300, University of California Press, 2004.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ECO 251	Indian Economy	OE	4	0	0	4

UNIT I: PERFORMANCE OF INDIAN ECONOMY SINCE 1947

Growth and Structural Changes, Features/characteristics of Indian economy, Human Development Index Traditional Methodology, Human Development Index: New Methodology, Sustainable Development, Capital Formation, Demographic Transition, Economic Planning in India, Reforms in Indian Economy.

UNIT II: KEY ISSUES OF INDIAN ECONOMY

Issues and Trends of Unemployment, Poverty in India, Problem of Inequality, Issues of Education, Gender Issues in India.

UNIT III: STRUCTURAL PERFORMANCE OF INDIAN ECONOMY

Importance and Features of Indian Agricultural, Trends in Performance and Productivity, Agricultural Markets and Institutions, Land Reforms, Green Revolution in Indian Agriculture, Agricultural Labour, Food Security, Public Distribution System, Trends, Productivity, and Growth of Industries, Industrial Policy in India, Industrial Sickness Small Scale Industries, Foreign Direct Investment in India.

UNIT IV

Trends and Performance in Services, WTO, India Foreign Trade, Monetary Policy, Fiscal Policy, Total contact hours.

TEXTBOOKS/REFERENCES

1. Jean Dreze and Amartya Sen, 2013. An Uncertain Glory: India and its Contradictions, Princeton University Press.
2. Himanshu, 2010, Towards New Poverty Lines for India, Economic and Political Weekly, January.
3. Kaushik Basu, 2009, ―China and India: Idiosyncratic Paths to High Growth, Economic and Political Weekly, September.
4. Gaurav Datt and Ashwani Mahajan, 2019- Indian Economy. S Chand and Company Limited, New Delhi 2019.
5. Puri, V.K. & Mishra S.K, 2019- Indian Economy. Himalaya Publishing House, New Delhi 2019.
6. Jalan, Bimal. Indian Economy: Problems and Prospects. Penguin India; New edition, 2004.
7. Jean Dreze and Angus Deaton, 2009, Food and Nutrition in India: Facts and Interpretations, Economic and Political Weekly, February.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EGL 167	Code Name Language	OE	4	0	0	4

UNIT I: THE REPRESENTATIONAL HIERARCHY

Introduction to the Triune Brain Model, Information Processing by the triune brain, The Visual, Auditory and Kinesthetic Learning Styles. The impact of belief & perception on language.

UNIT II: THE MAP IS NOT THE TERRITORY

The Beliefs of Excellence, Identifying the inner map, Asking Clean question, Arriving at well-formed outcome.

UNIT III: DECODING THE MAP

Introduction to the meta programs, Comprehending the thirteen filters, Sub modalities – an insight, Using sub modalities as a tool for change.

UNIT IV: REPROGRAMMING LANGUAGE

Meta Modelling – an overview, the three critical filters: Deletion, Distortion, Generalization, The Filter and Need connect, The Milton Model: Language to influence.

UNIT V: FROM PROGRAMMING TO REPROGRAMMING

The Role of Tools & Techniques in Language Re programming, The archetypes and corresponding metaphors, Demonstration of a few tools & techniques like Swish, Perceptual Positions, Coach & Crash, and Tetralema, Hands on sessions.

TEXTBOOKS/REFERENCES

1. Brandler Richard, John Grinder. *Frogs into Princes*. US: Eden Grove Editions, 1990.
2. Mukherjee Sudip. *Two Steps Ahead. India*: Notion Press, 2020.
3. Sullivan Wendy and Judy Rees. *Clean Language: Revealing Metaphors and Opening Minds*.UK: Crown House Publishing, 2008.
4. Dilts Robert.Neuro Linguistic Programming: The Study of the structure of subjective experience. USA: Meta Publications, 2009.
5. Brothers Jo Barbara (ed.) *Virginia Satir: Foundational Ideas*. USA: Haworth Press, 1991.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
TLC 101	Cognitive Learning Theories	OE	2	1	0	3

UNIT I: METACOGNITION, BRAIN, MEMORY AND LEARNING

The 3 Cos, where does learning happen? Actions pertaining to learning. What does the brain do? How does the brain learn? Memory, Intelligence, Thinking Levels.

UNIT II: LEARNING THEORIES

Classification of Knowledge, The "Science" of Education, Behaviourism, Cognitivism, Constructivism, Humanism, Dale's cone of Learning, Glenn's holistic thinking pyramid.

UNIT III: LEARNING INFLUENCERS

Discipline, Cognitive Factors, Self-Efficacy, Self-Regulation, Genetic Factors, External Factors, Generational Characteristics.

UNIT IV: LEARNING SUCCESS – 8 PILLARS

Beliefs, Habits, Resources, Skills & Strengths, Emotions, Motivation, Goals and Objectives, Mindset.

TEXTBOOKS

1. Schunk, D. H. (2019). Learning Theories: An Educational Perspective. United Kingdom: Pearson.

REFERENCES

1. Carey, B. (2014). How We Learn: The Surprising Truth About When, Where and Why It Happens. United Kingdom: Pan Macmillan.
2. Johnson, A. P. (2019). Essential Learning Theories: Applications to Authentic Teaching Situations. United States: Rowman & Littlefield Publishers.
3. http://www.aussieeducator.org.au/education/theories.html
4. https://sites.google.com/a/nau.edu/educationallearningtheories/home
5. https://crlt.umich.edu/tstrategies/tslt
6. https://www.researchgate.net/publication/347453692_A_Metacognition_Based_8_Pillars_Mindfulness_Model_and_Training_Strategies

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EEE 305	Advanced Control Systems	OE	3	0	0	3

UNIT: I STATE VARIABLE ANALYSIS AND DESIGN

Review of classical control system, Review of classical control system, State variables, State models for physical systems, State variables, State models for physical systems, Solution of state equations. Transfer function, Eigenvalues and eigenvectors, Jacobian linearization technique, State transformations and diagonalization, Transformation to phase-variable canonical form, Controllability and observability, Duality property, Illustrative Problems.

UNIT: II POLE PLACEMENT DESIGN AND STATE OBSERVERS

Introduction, Stability Improvements by State Feedback, Necessary and Sufficient Conditions for Arbitrary Pole Placement, State Regulator Design, Design of State Observer, Compensator Design by the Separation Principle.

UNIT: III NON-LINEAR SYSTEMS ANALYSIS

Common Nonlinear System Behaviors, Common Nonlinearities in Control Systems, Describing Functions of Common Nonlinearities, Stability Analysis by Describing Function Method, Concept of Phase Plane Analysis, Construction of Phase Portraits, System Analysis on the Phase Plane, Variable Structure Systems.

UNIT: IV LYAPUNOV'S STABILITY ANALYSIS

Introduction, Lyapunov's Stability Criteria, the direct method of Lyapunov stability, Methods of constructing Lyapunov Function for Non-linear Systems, Illustrative examples.

TEXTBOOKS/REFERENCES

1. "Modern Control Engineering," K.Ogata, Pearson Education Asia/ PHI,4 th Edition, 2002. ISBN 978 - 81 - 203 - 4010 - 7.
2. Control Systems Engineering (For the Modules 1 and 2) I.J. Nagarath and M.Gopal New Age 5 th Edition, 2007.
3. Nonlinear Control, Hassan K. Khalil Pearson Education Limited, 2015.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EEE 305 L	Advanced Control Systems Lab	OE	0	0	2	1

LIST OF PRACTICAL EXPERIMENTS

1. DC Motor modeling using LabVIEW
2. Speed control of DC Motor.
3. Position control of DC Motor.
4. Inverted pendulum control.
5. Characteristics of Brushed and Brushless DC motor.
6. Characteristics of Brushed and Brushless DC motor.
7. Position control of servo motor.
8. Tuning of PID controller gains for closed loop converter control.
9. Control system design for power systems.

TEXTBOOKS/REFERENCES

1. "Control Systems Engineering" (For the Modules 1 and 2) I.J. Nagarath and M.Gopal New Age, 5th Edition, 2007.
2. "Modern Control Engineering," K.Ogata, Pearson Education Asia/ PHI,4 th Edition, 2002. ISBN 978 - 81 - 203 - 4010 - 7.
3. "Nonlinear Control", Hassan K. Khalil Pearson Education Limited, 2015.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 307	Combinatorics and graph theory	OE	4	0	0	4

UNIT I: COUNTING PRINCIPLES AND TECHNIQUES

Combinatorics and Permutations, Binomial Coefficients and Multinomial Coefficients, The Pigeonhole Principle, the inclusion-Exclusion formula, Generating Functions: Newton's Binomial Theorem, Exponential Generating Functions, Partitions of Integers, Recurrence relations.

UNIT II: SPECIAL COUNTING NUMBERS

Partition number, Bell Numbers, Catalan numbers, Stirling numbers, Ramsey Numbers. System of distinct representatives.

UNIT III: AN INTRODUCTION TO GRAPH THEORY

Euler Circuits and Walks, Hamiltonian Cycles and Paths, Bipartile Graphs, Trees, Plane and planar graphs, Directed graphs.

UNIT IV: MORE ON GRAPH THEORY

Optimal Spanning trees, Connectivity, Colouring Planar Graphs, The Chromatic Polynomials, Graph of Symmetries, Burnside's Theorem.

UNIT V: APPLICATIONS

Problems involving scheduling and assignment, Isomer problem in Chemistry, If time permits, we also discuss a few applications in Computer Science: To prove lower bounds in computational models, Randomized algorithms, and various net- work problems.

TEXTBOOKS

1. Combinatorics and graph theory by J.M. Harris, J.L. Hirst and M.J. Mossinghoff, springer.
2. Introduction to Graph Theory by Douglas West.
3. Graph theory with applications by J. A. Bondy and U. S. R. Murty.
4. Graph Theory with Applications to Engineering and Computer Sciences by Narsingh Deo, Prentice-Hall, 1974.
5. An Introduction to Combinatorics and Graph Theory by David Guichard https://www.whitman.edu/mathematics/cgt_online/cgt.pdf.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PHY 301	Atomic and Molecular Physics	OE	3	0	0	3

UNIT I: ATOMIC STRUCTURE

Rutherford model of atom, Rutherford Model numerical, Electron orbits, Bohr atom, Energy levels and spectra, Numerical on energy level and spectra, Sommerfield's elliptic orbits, Numerical on Somerfield's theory, Relativistic Corrections of Sommerfield's Theory, Tutorial 1, Tutorial 2, Tutorial 3.

UNIT II: VECTOR ATOM MODEL

Vector atom model, Concept of space, Concept of quantization, Electron spin, Magnetic moments of atoms, Numerical on quantization, Stern-Gerlach experiment, atomic excitation and atomic spectra, Numerical on atomic excitation and atomic spectra, Tutorial 4, Tutorial 5, Tutorial 6.

UNIT III: ONE AND TWO VALENCE ELECTRON SYSTEMS

Pauli Exclusion Principle, Electron configuration, Quantum states, Electron spin, Spin-Orbit Interaction, Energy levels of Na atom, Sodium Doublet, Spectral terms of two electron atoms, Terms for equivalent electrons, L-S and J-J coupling schemes, Singlet-Triplet separation for interaction energy of L-S coupling, Landé g-factor Landé Interval rule, Spectra of Helium atom, Zeeman Effect, Tutorial 7, Tutorial 8, Tutorial 9.

UNIT IV: ATOMIC AND MOLECULAR SPECTROSCOPY

EM spectrum, X-ray, Daune and Hunt's Rule, X-ray emission spectra, Bremsstrahlung effect, Mosley's law and its applications, Auger effect, electronic spectra of molecules. Rotational spectra of diatomic molecules, Raman Effect, Molecular Polarizability, Tutorial 10, Tutorial 11, Tutorial 12.

UNIT V: LASERS

Optical absorption and emission, Einstein coefficients, Optical pumping, Masers principles, Lasers principles, Numerical of Lasers, Ruby Laser principles, He-Ne Laser Principles, Solid state and semiconductor lasers, Tutorial 13, Tutorial 14, Tutorial 15.

TEXTBOOKS

1. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, R. Eisberg and R. Resnik 2nd Edison, 2006, Wiley.
2. Concepts of Modern physics, Arthur Besier, S. Rai Choudhury, Shobhit Mahajan, 7th Edition, 2015, Mcgraw Higher Ed.

REFERENCES

1. The Fundamentals of Atomic and Molecular Physics, Brooks, Robert L. 1 Edition, 2013, Springer-Verlag New York.
2. Physics of Atoms and Molecules, B. H. Bransden, C. J. Joachain, 2 Edition, Pearson Education India.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
COM 101	Business Organization and Management	OE	3	0	0	3

UNIT I

Historical Grassroots and Genesis of Business – How to do Business? –Introduction to Business Organization – Various Forms of Business Organization – Sole Trading – Partnership – Company Form of Business – Features of Company- Incorporation of a Company – MOA & AOA - Types of Companies - Case Study Analysis.

UNIT II

Relevance of SWOT/PESTEL analysis in establishing a Business Organization – Objectives of Business – Corporate Social Responsibilities- Sustainability of Business - Corporate Governance - Case Study Analysis.

UNIT III

Introduction to Management – Development of Management Thought – Principles of Management - Professionalization of Management – Relevance of Management to Business – Role of a Manager in Business – Skills and Qualities of a Manager – Successful and Effective Managers – Challenges before today's managers - Case Study Analysis.

UNIT IV

Functions of Management - Overview of Planning – Types of Planning - Organizing (Levels of Management & Organizational Structures) – Directing – Coordinating and Control – Staffing – Reporting and Budgeting – Importance and Techniques of Control – Motivating Function of Manager - Case Study Analysis.

UNIT V

Best Practices in Management – Evidences from Indian and Western Counterpart – Contemporary Issues in Management – Knowledge Management – Innovation – Team Management - Learning Organizations – Case Study Analysis.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
COM 107	Finance for Engineering	OE	3	0	0	3

UNIT I: FINANCIAL REPORTING

Accounting Concept - Financial Records - Accounting Principles and Conventions – Preparation of Financial Statements – Profit and Loss Statement - Balance Sheet - Cash Flow Statement.

UNIT II: FINANCE FUNCTIONS

Introduction, Goals of financial management, Finance functions, Interface between Finance and Other Business Functions - Time Value of Money - Future Value - Effective Rate - Single and Multiple Payments – Discounting.

UNIT III: ENGINEERING ECONOMIC ANALYSIS

Classification of Capital Projects - Cost of Capital – Measurement of Cost of Capital - Evaluation Criteria for Capital Projects - Economic Analysis Techniques: Traditional and Discounted Cashflow methods - NPV vs. IRR.

UNIT IV: RISKS ANALYSIS AND MEASUREMENT

Concepts of Risk and Return - Types of Risks - Measurement of Return and Risk – Risk analysis in Engineering Projects: Risk-adjusted Discount Rate - Certainty Equivalent Approach - Capital Rationing: Approaches to Capital Rationing - Practical Issues in the Evaluation of Projects.

UNIT V: FINANCING OF CAPITAL PROJECTS

Sources of Finance: Lenders, Borrowers and Financial Institutions – Forms of Finance: Equity Instruments - Debt Instruments - Types of Loans - Long-term Debt - Short-term Debt - Public Issue and Private Placement of Financial Securities - Financial Markets - Equity Markets - Bond Markets - Futures and Derivatives Markets.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
JOU 001	Media Through the Ages: From Print to social media	OE	3	0	0	3

UNIT I

Introduction to Communication, Definition of Communication, Types: Intra-personal, Inter-personal, Group, Public and Mass Communication. Means of Communication, Process of Communication, Functions of Communications, Seven C's of Communication.

UNIT II

Definition of Mass Communication – Nature and process, Functions and types, Print, Electronic and Digital, Communication and Public Opinion: Nature, Meaning and Process.

UNIT III

Newspapers and Freedom Struggle, Colonial Rule and the Struggle for Press Freedom, Press and the Civil Liberties.

UNIT IV

Evolution of television, Prasar Bharati and Public Service Broadcasting, Growth of Satellite channels, 24x7 News channels.

UNIT V

Characteristics of New Media, New media as a form of communication, Evolution of Internet in India, Web Blogs, Online News Streaming.

TEXTBOOKS/REFERENCES

1. Hasan Seema., (2010), *Mass Communication: Principles and Concepts*. Chennai, India: CBS Publisher.
2. Mcquail Denis, (2010) *Mass Communication Theory* (Sixth Edition). London, England: Sage Publications.
3. Narula Uma, (2009),*Mass Communication Theory and practice*. New Delhi, India: Her-Anand Publication.
4. Chandra Bipan (2016) *India's Struggle for Independence: 1857-1947* (reprint). New Delhi, India: Penguin Random House.
5. Desai A.R, (2016) *Social Background of Indian Nationalism* (reprint). India: Sage Publication.
6. Mehta Nalin (2015) *Behind a Billion Screens: What Television Tells Us About Modern India* (2015 edition): HarperCollins.
7. Mehta Nalin (2008) *India on Television*. New Delhi, India: HarperCollins.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
CSE 411	Big Data Analytics	OE	3	0	2	4

UNIT I

Big Data introduction - definition and taxonomy - Big data value for the enterprise - The Hadoop ecosystem - Introduction to Distributed computing- Hadoop ecosystem – Hadoop Distributed File System (HDFS) Architecture - HDFS commands for loading/getting data - Accessing HDFS through Java program.

UNIT II

Introduction to Map Reduce framework - Basic Map Reduce Programming: - Advanced Map Reduce programming: Basic template of the Map Reduce program, Word count problem- Streaming in Hadoop- Improving the performance using combiners- Chaining Map Reduce jobs- Joining data from different sources.

UNIT III

Querying big data with Hive - Introduction to Hive QL- Hive QL: data definition- data manipulation.

UNIT IV

Querying big data with Hive – Hive QL queries- Hive QL Views – Hive QL indexes

UNIT V

Data Analytics using R: Introduction to R, Creating a dataset, Getting started with graphs, Basic data management, Advanced data management.

TEXTBOOKS/REFERENCES

1. Big Data Fundamentals: concepts, Drivers and Techniques: Person Education, 2016
2. Hadoop The Definitive Guide, IV edition, O'Reilly publications
3. Hadoop in Action, Chuck lam, Manning publications
4. Programming, Hive, O'Reily publications
5. Apache Hive Cookbook, PACKT publications
6. R in Action, Robert I. Kabacoff, Manning publications
7. Practical Data Science with R, Nina Zumel John Mount, Manning publications

LIST OF PRACTICAL EXPERIMENTS

1. a. Hadoop Installation
   b. Hadoop Shell Commands
2. a. Writing a file from local file system to Hadoop Distributed file system (HDFS)
   b. Reading a file from HDFS to local file system.
3. a. Implementation of Word Count program using Map Reduce without combiner logic
   b. Implementation of Word Count program using Map Reduce with combiner logic
4. Implementation of Map-Reduce program using partitioner
5. a. Implementation of Maximum temperature program using Map Reduce without combiner logic
   b. Implementation of Maximum temperature program using Map Reduce with combiner logic
6. a. Create a managed table and load the data from LFS
   b. Create a managed table and load the data from HDFS
   c. Create an external table and load the data from LFS
   d. Create an external table and load the data from HDFS
   e.Drop a managed table and check the result in HDFS
   f. Drop an external table and check the data from HDFS
7. Use HiveQL to analyse the stock exchange dataset and calculate the covariance between the stocks for each month. This will help a stock-broker in recommending the stocks to his customers.
8. a.create Hive table
   b. Load data into Hive table

c. Calculate the covariance

9. Implement JOINS using HIVE
   a. Inner Join
   b. Left outer join
   c. Right outer Join
   d) Full outer join
10. Write a R program to create student record using Vector concept.
11. Write a R program to create medical patients status using data frame

i) Patient age ii) Gender iii) Symptoms iv) Patient Status

12. Write R program to visualize student marks of various subjects using Bar-chart and Scatter plot

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EEE 421	Linear Systems	OE	3	0	0	3

UNIT I: LINEARITY, LINEAR SPACES AND LINEAR OPERATORS

Review of fields, vector spaces, basis, vector representation, linear transformations, rank and nullity, linear operators and diagonalisablity, inner and normed vector spaces, Continuity, linearity, linear systems, time invariance, characteristics, Laplace transform, generalised initial-value theorem, Dirac delta impulse, transforms, superposition integral, frequency domain perspective, Canonical forms: controller, phase variable, controllability, observer, observability, parallel and cascade, Jordan canonical forms. Markov parameters, duality, discrete-time dynamical systems; general state-space descriptions; non-uniqueness; packed matrix representations, Frequency domain: identities and resolvent formulae, transfer function, External and internal descriptions, nonlinear systems and linearization.

UNIT II: SOLUTIONS OF STATE-SPACE DESCRIPTIONS

Existence and uniqueness of solutions of CT systems; examples of nonlinear systems; fundamental theorem, Linear time-varying continuous time systems: Wronskian; state transition matrix and its properties; homogeneous and nonhomogeneous differential equations, Linear time-invariant continuous-time systems; evaluation of state transition matrices; Jordan form; matrix exponentials, Linear discrete-time systems; state transition matrix, Modes of oscillations and modal decomposition; sampled-data systems.

UNIT: III CONTROLLABILITY AND OBSERVABILITY

Determining the initial conditions: observability; setting up initial conditions: observability, Canonical forms revisited, duality, Hankel matrix revisited, connections, Definitions of controllability and observability, characteristics; joint controllability and observability, characteristics, connections; Popov Belevitch Hautus tests; Kalman decomposition, Controllability and observability of discrete-time systems; subtle issues.

UNIT IV: STABILITY OF SOLUTIONS

External and internal stability, Equilibrium points, Stability in the sense of Lyapunov for CT systems, Lyapunov equation; linearised systems; Sylvester's criterion, Stability in the sense of Lyapunov for DT systems.

UNIT V: STATE-SPACE COMPENSATOR DESIGN

Stabilisation by output feedback; stabilisation by cascade compensation, State variable feedback for CT systems: Bass-Gura formula, modal controllability, Ackermann formula, Mayne-Murdoch formula; Transfer function analysis; effect on zeros; noncontrollable modes, Regulator problem; integral-error feedback; Quadratic regulator theory for CT systems, DT systems: Modal controllability, controllability to the origin, state-variable feedback, discrete-time regulator, Asymptotic observers; Combined observer-controller compensators; Reduced-order observers; optimality criterion.

TEXTBOOKS/REFERENCES

1. T. Kailath, Linear Systems, Prentice-Hall, 1980.
2. M. Gopal, “Modern Control Systems Theory.” 3rd edition New Age International Publishers, 2014.
3. C.-T. Chen, Linear System Theory and Design, 2nd edition Holt, Rinehart and Winston, 1984.
4. P. J. Antsaklis and A. N. Michel, Linear Systems, Birkhauser, 2006.
5. W. T. Brogan, Modern Control Theory, 3rd edition, Prentice-Hall, 1990.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 433	Introduction to High Performance Computing	OE	3	0	0	3

UNIT I

Introduction to HPC Systems, architecture and OS concepts, Multi-core CPUs, GPU, systems and High-performance clusters.

UNIT II

Introduction to basic numerical methods (stencil computations (_nite di_erences),linear system solutions, integration). Sequential implementation.

UNIT III

Programming paradigms: OpenMP and MPI, Thread Management, CUDA / OpenCL.

UNIT IV

Data Dependency Reduction. Data flow, Loop reordering. Purely Parallel Algorithms, Block Decomposition Methods, Parallel Programming Packages.

TEXTBOOKS

1. Introduction to High Performance Computing for Scientists and Engineers. Chapman & Hall/CRC Computational Science Series.

REFERENCES

1. J. J. Dongarra, I. B. Du_, D. C. Sorensen and H. A. van der Vorst, Solving Linear Systems on Vector and Shared Memory Computers, SIAM, 1991.
2. K. Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw-Hill, 1993.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 355	Calculus of Variation	OE	4	0	0	4

UNIT I: METHOD OF VARIATIONS IN PROBLEMS WITH FIXED BOUNDARIES

Introduction – Functionals, Variation and Its Properties, Euler's Equation, Functionals Dependent on Higher-Order Derivatives, Variational Problems in Parametric Form, Some Applications.

UNIT II: VARIATIONAL PROBLEMS WITH MOVING BOUNDARIES

Elementary Problem with Moving Boundaries, One-Sided Variations.

UNIT III: SUFFICIENT CONDITIONS FOR AN EXTREMUM

Field of Extremals, The Function $E(x, y, p, y')$, Transforming the Euler Equations to the Canonical Form.

UNIT IV: VARIATIONAL PROBLEMS INVOLVING A CONDITIONAL EXTREMUM

Constraints of the Form $\varphi(x, y_1, y_2, \cdots y_n)$, Constraints of the Form $\varphi(x, y_1, y_2, \cdots y_n, y_1', y_2', \cdots y_n')$, Isoperimetric Problems.

UNIT V: DIRECT METHODS IN VARIATIONAL PROBLEMS

Introduction to Direct Methods, Euler's Finite-Difference Method, Rayleigh-Ritz Method, Kantorovich's Method.

TEXTBOOKS/REFERENCES

1. L. Elsgolts, *Differential Equations and the Calculus of Variations*, University Press of the Pacific, 2003.
2. A S Gupta, Calculus of Variations, Prentice-Hall of India Pvt. Ltd., New Delhi, 2008.
3. M. Gelfand and S. V. Fomin, *Calculus of Variations,* Dover Publications. 1963.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
MAT 306	First course in cryptography	OE	4	0	0	4

UNIT I: ELEMENTARY NUMBER THEORY AND ABSTRACT ALGEBRA

Group-theoretic background: Cyclic group and _nding a generator of a cyclic Group. Integer arithmetic: Basic operations, The Euclidean algorithm. Modular arithmetic: Basic operations, computing modular inverses. Chinese Remainder Theorem, Primality testing, Factoring algorithms, Elliptic curves.

UNIT II: INTRODUCTION AND CLASSICAL CIPHERS

Definition of Cryptography: Classical and Modern Cryptography, The setting of Private-key Encryption, Historical ciphers and their crypto-analysis, Basic Principles of modern Cryptography: Formation of exact definitions, Reliance on precise assumptions and Rigorous Proofs of Security.

UNIT III: PERFECTLY SECRET ENCRYPTION

Definitions and Basic Properties, The One-Time Pad (Vernams Cipher), Limitations of Perfect Secrecy.

UNIT IV: PRIVATE-KEY (SYMMETRIC) CRYPTOGRAPHY

Private-Key Encryption and Pseudo randomness, Message Authentication Codes and Collision-Resistant Hash Functions, Pseudorandom Objects in Practice: Block Ciphers, Private-Key Cryptography Necessary and Sufficient Assumptions.

UNIT V: PUBLIC KEY (ASYMMETRIC) CRYPTOGRAPHY

One-Way Functions and Permutations, Constructing Collision-Resistant Hash Functions, Private-Key Management and the Public-Key Revolution, Public-Key Encryption.

TEXTBOOKS

1. Introduction to Modern Cryptography by Jonathan Katz and Yehuda Lindell, CRC Press.
2. Lecture Notes on Cryptography by Sha_ Goldwasser and Mihir Bellare.
3. A Course in Cryptography by Rafael Pass and Abhi Shelat.
4. A Course in Number Theory and Cryptography by Neal Koblitz.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
BBA 606	Corporate Social responsibility	OE	3	0	0	3

UNIT I: INTRODUCTION TO CORPORATE SOCIAL RESPONSIBILITY
History of Corporate Social Responsibility, Definitions of CSR, Global and Indian Context of Corporate Social Responsibility.

UNIT II: PRINCIPLES OF CSR
Sustainability, Accountability and Transparency, Changing emphasis in companies, Externalizing costs, Ethical Principles of CSR, corporate behavior and reputation.

UNIT III: STAKEHOLDERS AND THE SOCIAL CONTRACT
Types and classification of stakeholders, Stakeholder theory, Regulation and its implications, Due diligence of stakeholders.

UNIT IV: ISSUES IN CSR AND CASE STUDIES
Sustainability, CSR themes and case studies.

UNIT V: CONDUCTING CSR PROJECTS
Planning CSR projects, Steps in Implementation of CSR; challenges and risks, Monitoring and evaluation, Reporting projects.

TEXTBOOKS/REFERENCES

1. Crowther, D. & Aras, G. (2008). Corporate Social Responsibility. Ventus Publishing APS.
2. Shrivastava, L.. (2014). Corporate Social Responsibility. JRU publication.
3. Bansal, P. Roth, R. 2000. Why Companies Go Green: A model of Ecological Responsiveness. The Academy of Management Journal, Vol.43, No.4, pg 717-736. [6]
4. Fry, LW. Keim.GD. Meiners, RE. 1982. Corporate Contributions: Altruistic or for Profit? The Academy of Management Journal, Vol.25, No.1, pg.94 -106.[10]
5. Grace, D, Cohen, S.2005. Business Ethics; Problems and Cases. Australia. Oxford University.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
BIO 113	Biochemistry I - Biomolecules	OE	4	0	0	4

UNIT I: Bioenergetics

Biomolecules: water- structure and properties, buffers and its biological importance's. Principles of bioenergetics- Laws of thermodynamics – entropy and enthalpy - standard free energy changes- standard reduction potentials – thermodynamics of coupled reaction.

UNIT II: Carbohydrates

Carbohydrates: definition and functions, classification, properties, monosaccharides, disaccharides, oligosaccharides, polysaccharides- homo- and hetero- polysaccharides. Quantitative and qualitative methods.

UNIT III: Lipids

Lipids- Classification- structure and properties- phospholipids- glycolipids- sphingolipids- cholesterol. Fatty acids- saturated and unsaturated fatty acids- biosynthesis and essential fatty acids.

UNIT IV: Amino acids and Proteins

Amino Acids-Classification and properties. structure and properties of amino acids, Essential and nonessential amino acids, Proteins-classification and functions, levels of protein structure, haemoglobin and myoglobin.

UNIT V: Nucleic Acids

Nucleic acids- Structure, Purine and Pyrimidine bases structure, Properties and functions of nucleic acids (DNA, RNA). Different forms of DNA and RNA.

TEXTBOOKS/REFERENCES

1. Harper's Illustrated Biochemistry, V. W. Rodwell, D. Bender, K.M. Botham, P.J. Kennelly and P.A. Weil (2018) 31st edition, McGraw Hill-Medical.
2. Lehninger Principles of Biochemistry, D. L. Nelson and M. M. Cox, (2017) 7th edition, W.H. Freeman & Company.
3. Biochemistry: D. Voet and J.G. Voet (2011), 4th edition, Wiley
4. Biochemistry, J M Berg and J.L. Tymoczko, G. J. Gatto Jr., L Stryer (2015), 8th edition, W.H. Freeman & Company.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
PHY 224	Introduction to Optics	OE	3	0	0	3

UNIT I: PHYSICAL OPTICS

The propagation of light and Rayleigh scattering, Laws of reflection and refraction, Fermat's principle, The electromagnetic approach of light propagation. The Fresnel equations. Total internal reflection and evanescent waves. Optical properties of metals, Interaction of light and matter. Stokes treatment of reflection and refraction, Photons and the laws of reflection and refraction, Tutorial 1, Tutorial 2, Tutorial 3.

UNIT II: GEOMETRICAL OPTICS

Prisms: dispersion and reflection properties, Planar and aspherical mirrors, Thick lenses and lens systems, Newton formula, lateral magnification, Analytical ray tracing and development of Matrix methods, Matrix analysis of system of two thin lenses, Unit and Nodal planes, Matrix analysis of mirror systems, Monochromatic aberrations – Spherical aberration, Coma, Astigmatism, Field curvature, Distortion, Chromatic aberrations, Thin achromatic doublets, GRIN Systems and optical glasses, Tutorial 4, Tutorial 5, Tutorial 6.

UNIT III: INTERFERENCE OF LIGHT

Coherence and Interference of Light Waves by Division of Wave Front, Interference pattern and intensity distribution, Fresnel Biprism and Interference with white light, Displacement of fringes, Interference by a plane parallel film illuminated by a plane wave and Cosine law, High reflectivity from deposited thin film and reflection by a periodic structure, Interference by a plane parallel film when illuminated by a point source, Interference by a film with two nonparallel reflecting surfaces Color of Thin Films and Newton's Rings. The Michelson Interferometer, Multiple reflections from a plane parallel film, Fabry–Perot etalon and resolving power of Fabry–Perot interferometer, Tutorial 7, Tutorial 8, Tutorial 9.

UNIT IV: DIFFRACTION OF LIGHT

Fraunhofer diffraction - single-slit diffraction pattern, Two-slit Fraunhofer diffraction pattern, N-slit Fraunhofer diffraction pattern, The Diffraction Grating and its resolution, The Fresnel diffraction integral, and Fraunhofer approximation. Fraunhofer Diffraction by a Long Narrow Slit, Rectangular Aperture and Circular Aperture, Array of Identical Apertures and Spatial Frequency Filtering. The free propagation of a spherical wave - Fresnel diffraction, half-period zones. Diffraction at circular apertures, the Zone plate. Diffraction of a plane wave by a long narrow slit and transition to the Fraunhofer region. Tutorial 10, Tutorial 11, Tutorial 12.

UNIT V: POLARIZATION OF LIGHT

The Nature of Polarized Light, Types of polarization - plane, circular Elliptical Polarization, Polarizers, Malus's Law of Polarization, Dichroism, Dichroic Crystals and Polaroid, Birefringence, Ordinary and extraordinary light, Birefringent Crystals and Birefringent Polarizers. Polarization by Reflection, The Fresnel Equations and Brewster's Law of Polarization, Circular Polarizers, Half and full wave plates, Theory of Optical Activity and Polarimetry, Induced Optical Effects—Optical Modulators, The Faraday Effect, The Kerr and Pockels Effects. Tutorial 13, Tutorial 14, Tutorial 15.

TEXTBOOKS/REFERENCES

1. Introduction to Geometrical and Physical Optics, B. K. Mathur, 7 Edition, 1967, Gopal Printing.
2. Fundamentals of Optics, Francis Jenkins, Harvey White, 4 edition, 2017 McGraw Hill Education.
3. A Textbook on Light, K G Mazumdar and B Ghosh, 3rd revised Edition, 2010, Sreedhar Publication, India.
4. Optics, Eugene Hecht, 5th Global Edition, 2017, Pearson Education Limited.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
HIS 100	Idea of India	OE	4	0	0	4

UNIT I: THE NATION AND ITS MANY ROOTS

What is a Nation? –Theories of Nationalism, The many names of India: India, India, Aryavarta or Bharat, Mother India: Iconising a Nation

UNIT II: UNEARTHING THE PAST

The Evolutionary Past: Interbreeding Vs Replacement Theory, Out of Africa Theory, what is a civilization? Theories of Civilization, Indus Valley Civilization

UNIT III: STORIES OF GODS AND PEOPLE

The Emergence of Myths, Myth Vs Reality, Vedic Age in India, Tribes, Caste and Battles.

UNIT IV: POLITY AND GOVERNANCE

Religion, Economy and the State –Asoka, Chankya and the Buddha, Land the Economy: Exploring the Arthasastra, Social Order and the State: Through the Epics, Two millennia of pluralism: Jews, Christians and other religions in India.

UNIT V: TOWARDS UNDERSTANDING THE NATION

The Mughals in India, Multiple Identities – the same heritage, The Past as a Signifier

TEXTBOOKS

1. Y. N.Harari, A Brief History of Humankind, Harper, 2015.
2. Upinder Singh, A History of Ancient and Early Medieval India, Pearson, 2009.
3. Romila Thapar, Early India: From the Origins to AD 1300, University of California Press, 2004.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
TLC 102	Teaching and Learning	OE	3	0	0	3

UNIT I: INTRODUCTION TO TEACHING AND LEARNING

Teaching Methodologies, Understanding the Learners, Learning Theories -Behaviourism, Cognitivism, Constructivism. Innovative Instructional Methods.

UNIT II: TEACHER VS STUDENT CENTRIC INSTRUCTION

Introduction to teacher centric instruction, Passive Learning- Direct Instruction, Lecture Mode and Demonstration Mode, Active Learning- Learning by doing, Interactive Mode and Seminar Mode, Learners Generations – Introduction and needs of current generation learners.

UNIT III: TEACHING METHODOLOGIES

Meaningful Learning, Zone of Proximal Development, Flipped Classroom, Deep Planning Methods, Peer Learning Method, Gagne's 9 Events of Instruction.

UNIT IV: LEARNING STRATEGIES

John Dewey's Experiential Learning, Albert Bandura's Social Learning Theory, Howard Gardner's Multiple Intelligence Theory, Ubiquitous Learning Theory.

UNIT V: ACTIVE-COOPERATIVE LEARNING TECHNIQUES

Project Based Learning, Enquiry Based Learning, Case Studies – Concept and Analysing, Role Play Method, Collaborative Learning Methods.

TEXTBOOKS/REFERENCES

1. Driscoll, M. P., & Burner, K. J. (2005). Psychology of learning for instruction.
2. VanGundy, A. B. (2008). 101 activities for teaching creativity and problem solving. John Wiley & Sons.
3. https://ocw.metu.edu.tr/pluginfile.php/9013/mod_resource/content/1/driscoll-ch10%20(1).pdf
4. https://journals.healio.com/doi/abs/10.3928/00220124-20090522-07
5. https://marcprensky.com/writing/Prensky%20-%20Ch2-Digital%20Game-based%20Learning.pdf
6. https://files.eric.ed.gov/fulltext/EJ1153685.pdf
7. https://files.eric.ed.gov/fulltext/EJ1127696.pdf

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
EGL 333	Thing Theory	OE	4	0	0	4

UNIT I: THEORETICAL FOUNDATIONS
Martin Heidegger – The Thing, Bill Brown and his work, Timothy Morton – Hyper objects, Ian Bogost – Alien Phenomenology.

UNIT II: THEORY & POPULAR CULTURE
Jane Benett – Vibrant Matter, Karin Knorr Cetina – Sociality with Objects, Understanding Consumerism, Remo Bodei – The Life of Things, the Love of Things.

UNIT III: APPLICATIONS
Sumathi Ramaswamy – Terrestrial Lessons, Victorian Studies, The History of the World in 100 Objects.

UNIT IV: LITERARY READINGS
Poetry Robert Frost, William Carlos Williams, Objects in Works of Fantasy, Detective Fiction.

UNIT V: VISUAL CULTURE
Animation Movies, Photography, Advertising and Consumerism, NFTs.

TEXTBOOKS/REFERENCES

1. Brown, Bill (ed). *Things*. University of Chicago Press, 2004.
2. Daston, Lorraine (ed). *Things that Talk: Object Lessons from Art and Science*. Zone Books (MIT Press), 2004.
3. Edwards, Elizabeth, and Janice Hart (eds). *Photographs Objects Histories: On the Materiality of Images*. Routledge, 2004.
4. Cetina, Karin Knorr. "Sociality of Objects: Social Relations in Postsocial Knowledge Societies" in *Theory, Culture and Society* 14 (1997), 4.
5. Daly, Suzanne.*The Empire Inside: Indian Commodities in Victorian Domestic Novels*. University of Michigan Press, 2011.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
COM 108	Investment Analysis	OE	3	0	0	3

UNIT I: FUNDAMENTALS OF INVESTMENTS

Meaning of Investment, Objectives of investment, Investment, and speculation, Features of a good investment, Investment Process, Elements of Investment, Investment Avenues, Scope, and Importance of investment management.

UNIT II: INVESTMENTS AVENUES

Types of Investment: Features - Physical and Financial forms of Investments - Bank Products, Bonds, Stocks - Features of Equity, Preference Shares, Debenture, Investment in Real Estates, Important features of Investment in Real Estate.

UNIT III: SECURITIES MARKET

Primary Market - Factors to be considered to enter the Primary Market, Modes of raising funds, Secondary Market- Major Players in the secondary market, Functioning of Stock Exchanges, Trading and Settlement Procedures.

UNIT IV: VALUATION OF SECURITIES

Bond and its features, Types, Determinants of interest rates, Bond Valuation, Bond Duration. Valuation of Preference Shares, Equity shares- Valuation, Dividend Valuation models.

UNIT V: MACRO-ECONOMIC AND INDUSTRY ANALYSIS

Fundamental Analysis - E I C Framework, Economy, Industry and Company Analysis - Financial Statement Analysis, Ratio Analysis. Technical Analysis – Theories - Dow Theory, Elliot Wave Theory. Charts-Types, Trend and Trend Reversal Patterns. Moving averages, ROC, RSI, and Market Indicators.

TEXTBOOKS

1. Bodie, Zvi, Alex Kane, and Alan J. Markus, Investments (2005), McGraw Hill, (Sixth Edition) or a Later Edition.
2. Prasanna Chandra, Investment Analysis and Portfolio Management, 2nd Edition, Tata McGraw Hill, New Delhi.
3. Punithavathy Pandian, Security Analysis and Portfolio Management, Vikas Publication, New Delhi.

REFERENCES

1. Curley, Anthony J., and Bear, Robert M., Investment Analysis and Management (1999), Harper & Row, New York.
2. Fischer, D.E. and Jordan, R.J. Security Analysis and Portfolio Management. Pearson Education.
3. Fuller, Russel J., and Farrell, Jr., James L., *Modern Investments and Security Analysis (1987)*, New York: McGraw-Hill Book Company.
4. Kevin. S. Security Analysis and Portfolio Management (2019), 2nd Edition, Prentice Hall of India, New Delhi.
5. V K Bhalla, Investment Management: Security Analysis and Portfolio Management (2019), 19th Edition, S Chand, New Delhi.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
BBA 304	Human Resource Management	OE	4	0	0	4

UNIT I: INTRODUCTION TO HUMAN RESOURCE MANAGEMENT
Meaning, Function, Significance & Challenges of HRM, HR Policies, Introduction to Human Resource Planning, Various Methods of HRP, Forecasting and HR Effectiveness – Case Study Analysis.

UNIT II: RECRUITING, SELECTING & SOCIALIZING INTRODUCTION
Recruitment Policy, Issues, sources of people, selection process & tests, Socialization, Internal Mobility, Career Planning – Case Study Analysis.

UNIT III: TRAINING & DEVELOPING
Workforce and Organizational Development Concept, need, method, importance & evaluation of training & development; principle of learning; Introduction to and Interventions in OD – Case Study Analysis.

UNIT IV: PERFORMANCE AND COMPENSATION MANAGEMENT SYSTEM
Definition, importance, objectives, components and methods of performance management system, Principal compensation issue, job evaluation, pay-structure, individual & group incentives – Case Study Analysis.

UNIT V: SOCIAL SECURITY AND LABOUR WELFARE
Concept of Social Security and Industrial Relations, Workers Participation in Management Significance, and various social security legislations in India – Case Study Analysis.

TEXTBOOKS

1. "Managing Human Resources" by Bohlander and Snell Thomson Publications.
2. "HumanResource Management" Gary Dessler and Biju Varkkey Pearson Publications.

REFERENCES

1. Human Resource Management, Gary Dessler, Pearson Education.
2. Human Resource Management, Casio Jaico Publishing House.
3. Human Resource Management, Ivancevich McGraw Hill.
4. The Management of People at Work Dale S.Beach Tata McGraw-Hill.
5. Personnel Management, CB Memoria, Himalaya Publishing House.
6. Human Resource Management Mizra S.Saiyadain Tata McGraw Hill.
7. Human Resource Management, VSP Rao Excell Books.
8. Human Resource Management, P.Subba Rao,Him.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
IDEA 104	Dream-Discover-Disrupt	OE	3	0	0	3

MODULE 1: VENTURE IDEATION.
MODULE 2: MARKETING.
MODULE 3: CUSTOMER SEGMENTATION.
MODULE 4: CUSTOMER DISCOVERY.
MODULE 5: SOLUTION DESIGN.

ELECTIVES

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 401	Computer Aided Design and Manufacturing	TE	3	0	0	3

UNIT I

What is CAD. What is CAM. Applications of CAD/CAM in Engineering, Specific applications of CAD/CAM in Mechanical engineering. What is Geometric Modelling and its applications in Mechanical engineering, Introduction to c omputer graphics and it application in Mechanical engineering. Computer Graphics Software's useful for Mechanical engineers, Introduction, representation of points, transformations and matrices, transformation of points, Transformation of straight lines, midpoint transformation, Transformation of parallel lines, transformation of intersecting lines, Rotation, Reflection and Scaling, Combined transformations and Transformation of The unit square, Rigid body transformations and Translations and Homogeneous Coordinates, Rotation About an Arbitrary Point, Homogeneous Coordinate system and Overall Scaling.

UNIT II

Introduction about 3D Transformations, Three-Dimensional Scaling, Three-Dimensional Shearing, Reflection, Three-Dimensional Rotation, Translation, Three-Dimensional Combined transformations, Three-Dimensional rotations about an axis parallel to a coordinate axis, Three-Dimensional rotation about an arbitrary axis in space, Three-Dimensional reflection through an arbitrary plane, affine and perspective geometry, Introduction to orthographic projections, axonometric projections, oblique projections, perspective transformations.

UNIT III

Introduction about plane and space curves, Curve Representation, Implicit and Explicit representation of curves, Parametric and Non-parametric curves General and parametric representation for conic sections (Circle, Ellipse, Parabola, Hyperbola). Representation of space curves, Cubic Splines and Hermite cubic curve, normalized cubic splines. Representation of Bezier Curves. B-spline Curves and end conditions for periodic B-spline curves. B-spline Curve Fit, B-spline Curve Subdivision. Rational B-spline Curves, NURBS and Introduction about surfaces. Coons Bi-cubic surface, Bezier surfaces, B-spline surfaces, B-spline surface Fitting and subdivision and Rational B-spline surfaces.

UNIT IV

Introduction to conventional Manufacturing Processes, Removing, Forming, Deforming and joining, Introduction to CAD, CAM and CAD-CAM. Integration equipment's. Integrating CAD, NC and CAM. Machine tools. Role of process planning in CAD/CAM Integration, Computer Aided Process Planning.Development, Benefits, Model and Architecture. CAPP Approaches.

UNIT V

Introduction to CAM, Point to point and continuous path machining, Introduction to NC, CNC and DNC – NC Programming, Basics, Languages, G Code, M Code, APT – Tool path generation and verification. NC Programming for Rectangular and circular pockets, NC Programming for drilling, peck drilling and boring, NC Programming for circular and rectangular array, NC Programming for turning, facing, threading and knurling. Production Control – Cellular Manufacturing.

TEXTBOOKS/REFERENCES

1. Mathematical Elements for Computer Graphics by David Rogers (Author), J. Alan Adams (Author) NewYork: London, McGraw-Hill, c1990, ISBN 10: 0070535302.
2. CAD/CAM: Principles and Applications by P N Rao.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 433	Introduction to High Performance Computing	OE	3	0	0	3

UNIT I

Introduction to HPC Systems, architecture and OS concepts, Multi-core CPUs, GPU, systems and High-performance clusters.

UNIT II

Introduction to basic numerical methods (stencil computations (_nite di_erences),linear system solutions, integration). Sequential implementation.

UNIT III

Programming paradigms: OpenMP and MPI, Thread Management, CUDA / OpenCL.

UNIT IV

Data Dependency Reduction. Data flow, Loop reordering. Purely Parallel Algorithms, Block Decomposition Methods, Parallel Programming Packages.

TEXTBOOKS

1. Introduction to High Performance Computing for Scientists and Engineers. Chapman & Hall/CRC Computational Science Series.

REFERENCES

1. J. J. Dongarra, I. B. Du_, D. C. Sorensen and H. A. van der Vorst, Solving Linear Systems on Vector and Shared Memory Computers, SIAM, 1991.
2. K. Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw-Hill, 1993.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 418	Introduction to Electric Vehicles	OE	3	0	0	3

UNIT I: INTRODUCTION
History, EV Benefits, EV/HEV subsystems and configurations.

UNIT II: VEHICLE DYNAMICS
Vehicle dynamics, forces acting, power and torque calculations, Simulations, Drive cycles.

UNIT III: BATTERIES
Battery parameters, why Li, SoH & SoC estimation/self-discharge, Battery pack design/development, battery computations, Charging, BMS and its design, future batteries.

UNIT IV: ELECTRICAL COMPONENTS FOR EV AND HEV
EV Motors (IM, PM etc,) D-q circuit, DC-DC converters, DC-AC converters, control system overview.

UNIT V: EV DESIGN
Mechanical, Electrical and Thermal design consideration, Sample design calculations for EV and HEV's.

TEXTBOOKS

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuel cell vehicles by John G. Hayes and A. Goodarzi, Wiley Publication.

REFERENCES

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2018.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 408	Advanced Materials	OE	3	0	0	3

UNIT I: SPECIAL STEELS
Metallurgical aspects, Composition, Properties and applications of: different types of Stainless steels, Dual phase steels, TRIP steels, Maraging steels, High speed steels, Hadfield steels, Free cutting steels, Ausformed steels, Tool Steels, manganese steels, chrome steels, electrical steels, bearing steels, spring steels, heat resistant steels, creep steels, HSLA steels etc.

UNIT II: ALLOY CAST IRON
Need of alloying. Silal, Nicrosilal, High silicon cast iron, Ni-hard, Heat resistant. cast iron: Composition, Properties and their applications.

UNIT III: LIGHT METALS AND THEIR ALLOYS
Aluminium, magnesium and titanium alloys: Metallurgical aspects, Properties and applications.

UNIT IV: SUPER ALLOYS
Iron base, nickel base and cobalt base super alloys: Strengthening mechanism, Composition, Properties and their applications.

UNIT IV: RAPID SOLIDIFICATION
Metallic glasses, atomic arrangement, Comparison with crystalline alloys, properties & applications, Glass transition temperature, Glass forming ability, Techniques for Production of metallic glasses.

UNIT V: SMART MATERIALS
Shape memory alloys, Piezoelectric materials, Electro-rheological fluid, Magneto- rheological fluids.

UNIT V: BIOMATERIALS
Property requirement, biocompatibility, bio functionality, Important bio metallic alloys like: Ni-Ti alloy and Co-Cr-Mo alloys. Applications.

TEXTBOOKS/REFERENCES

1. The Science and Engineering of Materials by D. R. Askeland and P. P. Phule, Thomson Publication
2. Advances in Material Science by R. K. Dogra and A. K. Sharma.
3. Material science by Van Black.
4. Engineering Materials and Applications by R. A. Flinn and P. K. Trojan
5. Materials, their Nature, Properties and Fabrication by R. A. Lindberg and S. D. Sehgal, S Chand & Co.
6. Light Alloys: Metallurgy of Light Metals by I. J. Polmear
7. Engineering Materials: Properties and applications of Metals and alloys by CP Sharma, PHI
8. Engineering Materials: Polymers, ceramics and composites by AK Bhargava, PHI.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 562	Mechanical Behavior of Materials	OE	3	0	0	3

COURSE OBJECTIVES

The central theme of this course is the mechanical behavior of engineering materials, such as metals, ceramics, polymers, and composites, subjected to different types of loading. The main objectives are to provide students with basic understanding of phase transformation by heat treating and stress-induced hardening, linear and nonlinear elastic behavior, deformation under multiaxial loading, plastic deformation and yield criteria, dislocation plasticity and strengthening mechanisms, creep, stress concentration effects, brittle versus ductile fracture, fracture mechanisms at different scales, fatigue, contact deformation, and wear.

DESIRED COURSE OUTCOMES

Understand various types of deformation and failure of engineering materials subjected to various static and dynamic loadings. Correlate microscopic and macroscopic material behaviors. Learn how to engineer the material properties to meet certain specifications. Determine the safety factor for various possible failure modes and loadings. Obtain hands-on-experience with standardized mechanical testing techniques and learn how to present/interpret the measurements in a formal report.

UNIT I

Introduction, Structure property relationship. Elasticity, Isotropic/Anisotropic.

UNIT II

Viscoelasticity. Elastic-Plastic Deformation. Mechanical testing.

UNIT III

Heat Treatment. Strain Hardening. Strain Rate and Temperature Effects on Deformation. Slip, Dislocations, Twinning, and Hardening.

UNIT IV

Ductile and Brittle Fracture. Fracture Mechanics. Creep. Fatigue. Cumulative Fatigue Damage. Wear processes.

UNIT V

Special topics: Residual Stresses, Ceramics, Glasses, Polymers, Composites, Mechanical Working, and Micromechanics

TEXTBOOKS

1. Meyers and Chawla, Mechanical Behavior of materials, Cambridge publication

REFERENCES

1. N. E. Dowling, Mechanical Behavior of Materials, Prentice-Hall.
2. R.W. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, 4th Ed., John Wiley & Sons, 1995.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 228	Manufacturing Science	OE	3	0	0	3

UNIT I: METAL CASTING PROCESS

Introduction to metal casting, Solidification of Metals, Characteristics of sand casting, Patterns, Pattern allowances Pattern materials, Types of patterns, Molding materials, Molding sand properties, Types of sand molds, Cores, Gating system, Casting Defects, Special casting processes, Cast structures, Melting furnaces, Methods of Sand testing.

UNIT II: METAL JOINING PROCESS

Classification of joining processes, Welding technique, Different welding processes: Gas Welding, Electric Arc Welding, Tungsten Inert-gas Welding (TIG), Gas Metal-Arc Welding (GMAW), Plasma Arc Welding (PAW), Submerged Arc Welding (SAW), Resistance Welding, Friction Stir Welding (FSW), Thermite welding, Electron Beam Welding (EBW), Laser Beam Welding (LBW), Weld Defects.

UNIT III: BULK DEFORMATION PROCESS

Introduction to bulk deformation processes, Hot and cold working, Forging, Types of forging, Forging defects, Rolling, Defects in rolled products, Extrusion, Metal flow in extrusion, Rod drawing, Wire and Tube drawing, Swaging, Severe plastic deformation processes: Friction stir processing, Equal channel angular extrusion and high pressure torsion.

UNIT IV: METAL REMOVAL PROCESS

Mechanism of metal cutting, Types of tools, Tool Geometry, Tool Signature, Orthogonal and Oblique cutting, Mechanics of chip formation, Chip morphology, Tool wear and failure, Machinability, Cutting-tool materials, Cutting fluids, Brief description of metal removal processes: Turning, drilling, boring and Milling, Material removal rate and machining time.

UNIT V: POWDER METALLURGY

Production of metal powders, Particle size and shape, blending of metal powders, Compaction of metal powders, Shaping processes, Sintering, Finishing operations, Design considerations for powder metallurgy.

TEXTBOOKS

1. Manufacturing Science, 2nd Edition, A. Ghosh and A.K. Mallik.
2. P.N. Rao, Manufacturing Technology, 3rd Edition, Tata McGraw Hill Edu Pvt Ltd, 2012.

REFERENCES

1. S. Nagendra Parashar and R.K. Mittal, Elements of Manufacturing Processes, PHI Learning Pvt Ltd, 2011.
2. R.L. Timings, Manufacturing Technology, 2nd Edition, Pearson Edu Ltd, 2010.
3. Hajra Choudhury, Elements of Workshop Technology, Vol. I and II, Media Promotors Pvt Ltd, 2001.
4. S.Gowri, P.Hariharan, and A.Suresh Babu, Manufacturing Technology I, Pearson Education,2008.
5. Rajput R.K, A Textbook of Manufacturing Technology, Lakshmi Publications, 2007.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 416	Surface Engineering	OE	3	0	0	3

UNIT I: INTRODUCTION TO SURFACE ENGINEERING

Differences between surface and bulk, Properties of surfaces, surface energy concepts, degradation of surfaces, wear and its type, Adhesive, Abrasive, Fretting, Erosion wear, Surface fatigue,

UNIT II: FRICTION AND LUBRICATION

Fundamentals, Types and measurement of solid, liquid and gaseous friction. Friction heat and calculation. Lubricants and additives, mechanism of solid, liquid and gaseous lubricants.

UNIT III: CORROSION

Different types of Corrosion and its prevention, Galvanic corrosion, Passivation, Pitting, Crevice, Mircobial, High-temperature corrosion, Corrosion in nonmetals, polymers and glasses, Protection from corrosion through surface modifications.

UNIT IV: CHANGING THE SURFACE METALLURGY

Localized surface hardening (flame, induction, laser, electron-beam hardening, Laser melting, shot peening), Changing the surface chemistry: Phosphating, Chromating, Anodizing (electrochemical conversion coating), Carburizing, Nitriding, Ion implantation, Laser alloying, boriding, Organic coatings (paints and polymeric or elastomeric coatings and linings), Hot-dip galvanizing (zinc coatings), Ceramic coatings (glass linings, cement linings, and porcelain enamels), Advanced surface coating methods: Gaseous State (CVD, PVD etc), Solution State (Chemical solution deposition, Electrochemical deposition, Sol gel, electroplating), Molten or semimolten State (Laser cladding and Thermal spraying)

UNIT V: CHARACTERIZATION OF SURFACE AND COATINGS

Surface Characterization (physical and chemical methods, XPS, AES, RAMAN, FTIR etc), Structural Characterization, Mechanical Characterization (Adhesion, Hardness, Elastic Properties, Toughness, Scratch and Indentation etc.), Tribological Characterization, Corrosion tests.

TEXTBOOKS/REFERENCES

1. Introduction to Surface Engineering and Functionally Engineered Materials, Peter Martin; Wiley, 2011.
2. Materials and Surface Engineering: Research and Development, J. Paulo Davim; Woodhead Publishing review, 2012.
3. Pradeep L. Menezes, “Tribology for Scientists and Engineers”, Springer, 2013
4. Hand book, Friction, Lubrication and Wear Technology, Vol. 18, ASM
5. Krishna, R., Anantraman, T.R., Pande, C.S., Arora, O.P., Advanced techniques for microstructural characterization (ed), Trans Tech Publication

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 456	Advanced Thermodynamics	TE	3	0	0	3

UNIT I: GAS POWER CYCLES

Introduction to air standard cycles. Air standard efficiency, Assumptions. Otto cycle: Air standard efficiency, mean effective pressure, Power developed. Tutorials. Diesel cycle: Air standard efficiency, mean effective pressure and power developed. Tutorials. Dual cycle: Air standard efficiency, Mean Effective pressure and power developed. Tutorials. Comparison of Otto, Diesel and Dual cycles, Brayton cycle, Concept of reheat and regeneration in brayton cycle.

UNIT II: INTERNAL COMBUSTIONENGINES

Classification of IC engines. Basic operations, Actual P-V diagram of four stroke Otto cycle engine and four stroke diesel cycle engines, Engine performance parameters. Measurements of fuel and air consumption, brake power and in-cylinder pressure. Tutorials on engine performance parameters, Heat balance sheet, Engine performance curves.

UNIT III: AIR COMPRESSORS

Reciprocating air compressors, Construction and working. Compression with and without clearance, Equation for work. Volumetric efficiency. Tutorials on single stage compressor with and without clearance. Free air delivered. Multistage compression, Conditions for minimum work, Compressor efficiencies, Tutorials on multistage compressor with and without clearance. Rotary compressors, vane compressor, roots blower - Comparison between reciprocating compressors and rotary compressors.

UNIT IV: REFRIGERATION SYSTEMS

Vapor compression refrigeration system and its working principle. Classifications of refrigerants, properties, eco- friendly Refrigerants. Analysis of vapor compression refrigeration cycle, P-h Chart. Factors affecting the performance of VCR system. Tutorials on performance of simple VCR cycle. Sub-cooling and superheating phenomena in VCR cycle, Tutorials on VCR system with sub-cooling and superheating. Simple and practical vapor absorption refrigeration System. Comparison between vapor compression refrigeration and vapour absorption refrigeration systems.

UNIT V: PSYCHROMETRY ANDAIR CONDITIONING

Properties of atmospheric air and Psychrometric chart, Psychrometric processes, Tutorials on sensible heating and cooling, Tutorials on cooling and dehumidification, heating and Humidification, Adiabatic mixing of two air streams and property calculations. Summer, Winter and Year-round air conditioning systems. Window, Split and Centralized AC systems. Introduction to heat load calculations.

TEXTBOOKS

1. Eastop.T.D, Mcconkey.A, "*Applied Thermodynamics for Engineering Technologists*", 5th Edition, Pearson Edition Publications, 2009.
2. Mahesh Rathore, "*Thermal Engineering*",Tata McGraw Hill, New Delhi-Reprint2012.
3. Yunus A Cengel; Michael A Boles,"*Thermodynamics: An Engineering Approach*",8th edition Tata McGraw Hill, New Delhi-2015.
4. Kothandaraman.C.P, Domkundwar.S, AnandDomkundwar, "*A Course in Thermal Engineering*", DhanpatRai& Co. (P) Ltd., 2010.
5. Rajput.R.K, "*Thermal Engineering*", Laxmi Publications, 10th Edition, New Delhi, 2015.
6. Sarkar.B.K, "*Thermal Engineering*", 3rd Edition, Tata McGraw Hill, New Delhi, 2009.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 457	Fundamentals of Vibration and Noise	TE	3	0	0	3

UNIT I: FREE VIBRATION

Introduction to vibration terminologies and types of vibration, equation of motion for free undamped single degree of freedom system by newton's and energy method, tutorials on single degree of freedom undamped free vibration systems. Equation of motion for free damped single degree of freedom systems. Tutorials on free damped single degree of freedom systems, torsional vibration of two rotor and three rotor systems. Tutorials on torsional vibration of two rotor and three rotor systems. Torsional vibration of geared systems with two and three rotor system.

UNIT II: FORCED VIBRATION

Equation of motion for harmonically excited single degree of freedom system, tutorials on harmonically excited single degree of freedom system, forced vibration due to unbalanced rotating and reciprocating systems. Tutorials on forced vibration due to unbalanced rotating and reciprocating systems. Forced vibration due to base excitation by absolute and relative amplitude method. Tutorials on forced vibration due to base excitation by absolute and relative amplitude method. Force transmissibility and vibration isolation. Tutorials on force transmissibility and vibration isolation, whirling of shaft and tutorials.

UNIT III: MULTI DEGREE OF FREEDOM SYSTEMS

Equation of motion for free undamped two and three degrees of freedom systems and tutorials, equation of motion for two and three. DOF using lagrangian energy method for un-damped free vibration. Tutorials on lagrangian energy method for un-damped free vibration. Co-ordinate coupling and tutorials, concept of linear and torsional undamped vibration absorber. Tutorials on linear and torsional undamped vibration absorber.

UNIT IV: NUMERICAL METHODS

Stiffness and flexibility influence coefficients and tutorials, Eigenvalue, Eigenvector and orthogonal Properties and Tutorials, Concept of Dun Kerley's and Rayleigh's method, Tutorials on Dun Kerley's and Rayleigh's method, Concept of Holzer's method for far coupled and tutorials, Concept of Holzer's method for close coupled system and tutorials. Concept of Matrix iteration method and tutorials.

UNIT V: VIBRATION AND NOISE MESUREMENT

Vibration measuring devices and Vibration exciters, Free and Forced vibration Tests, Balancing Machines, single plane and two plane balancing, Condition monitoring techniques and signal analysis. Basics of Noise terminologies and their relations, Noise Control Methods at source, along Path and at receiver.

TEXTBOOKS

1. Rao.S.S,"*MechanicalVibrations*",5thEdition,PearsonEducationInc.Delhi2009.
2. Ambekar.A.G, "*Mechanical Vibrations and Noise engineering*", PHI New Delhi, 2015.
3. Thomson.W.T, "*Theory of Vibration and its Applications*",5th Edition, Prentice Hall, New Delhi, 2001.
4. Meirovitch, L., "*Elements of Vibration Analysis*", Mc Graw – Hill Book Co., New York, 1986.
5. Rao.J.S and Gupta.K, "*Introductory course on theory and practice of mechanical vibrations*", 2nd Edition, New Age International, New Delhi, 2014.
6. Keith Mobley.R, "*Vibration Fundamentals*", Plant Engineering Maintenance Series, Elsevier, 2007.
7. Ramamurthi.V, "*Mechanical Vibration Practice with Basic Theory*", 1st edition, Narosa Publishing House, Chennai, 2000.
8. Kewelpujara, "*Vibration and noise for engineers*", Dhanpatrai& Sons, 2009.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 402	Multibody Dynamics	TE	3	0	0	3

UNIT I

INTROUCTION: What is MBD, Applications and scope of MBD, Objectives of MBD. PRELIMINARIES OF MBD: Kinematics- Position, velocity, acceleration, momentum, angular momentum. Kinetics- Force, moment, torque, equations of motion, Methods of formulations for MBD. MATHEMATICAL BACKGROUND FOR MBD: Vectors, Scalars, Arrays, Matrix, operation. Differentiation of vectors, arrays and matrices. Differential equations.

UNIT II: FUNDAMENTALS OF KINEMATICS

Kinematics of particles, Kinematics of a rigid body- position, velocity and acceleration of a rigid body, Array of coordinates, degrees of freedom, Constraint equations, Kinematics of joints, Numerical problems.

UNIT III: FUNDAMENTALS OF DYNAMICS

Newton's laws of motion- Dynamics of particle and system of particles. Dynamics of rigid body- Centroidal equations of motion, Numerical problems, Non centroidal equations of motion, Force elements, applied forces- Gravitational forces, point to point actuator, point to point spring, point to point damper, Combined elements, rotational elements, viscous friction, Reaction Force: Method of Lagrange multipliers, Coulomb friction. Numerical problems.

UNIT IV: BODY COORDINATE FORMULATION: KINEMATICS

General procedure, Formulation of kinematic joint constraints, Revolute, translational, composite and rigid joints, Numerical examples, Velocity and acceleration of joint constraints, Numerical examples, Formation of system Jacobian, Numerical examples, Numerical examples.

UNIT V: BODY COORDINATE FORMULATION: DYNAMICS

Dynamics of system of unconstrained bodies, Dynamics of two body system, Dynamics general unconstrained bodies, Numerical problems, Dynamics of System of constrained bodies, Numerical problems, Analysis of MBD system.

TEXTBOOKS/REFERENCES

1. Parviz E Nikravesh, "Planar Multibody Dynamics: Formulation, programming and applications", CRC Press, 2007.
2. Ahmed A Shabana, "Dynamics of Multibody systems", Third edition, Cambridge University Press.
3. Farid Americhem, "Fundamentals of Multibody Dynamics: Theory and Applications" , Springer Science & Business Media, 2007.
4. Ahmed A. Shabana, Railroad Vehicle Dynamics: A Computational Approach, CRC Press.
5. Parviz E Nikravesh, "Computer Aided Analyis of Mechanical Systems", Prentice Hall Publications.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 458	Gas Dynamics and Space Propulsion	TE	3	0	0	3

UNIT I: FUNDAMENTALS OF COMPRESSIBLE FLOW

Energy equation for compressible fluid flow, Stagnation state and Mach number, Various regimes of flow, reference velocities, Critical states, second kind Mach number, Crocco number. Equivalent of Bernoulli's equation for compressible flow, Effect of Mach number on compressibility. Types of waves - subsonic, sonic and supersonic waves. Mach cone, Mach angle. Problems in isentropic compressible flow.

UNIT II: FLOW THROUGH VARIABLE AREA DUCTS

Flow through variable area duct: T-S and h-s diagrams for nozzles and diffusers, Area ratio as a function of Mach number, Impulse function, Mass flow rate through nozzles and diffusers, Problems based on flow through nozzles and diffusers, Mass flow rate in terms of pressure ratio (Flinger's formula). Problems in variable area flow nozzles and diffusers. **Flow with normal shock:** Development, governing equations, Variation of flow parameters -static pressure & temperature, density, stagnation pressure and entropy across the shock, Impossibility of shock in subsonic flows, strength of a shock, Derivation of Prandtl – Meyer equation, Flow through nozzles and diffusers with shock, Wind tunnels.

UNIT III: FLOW THROUGH CONSTANT AREA DUCTS

Flow in constant area ducts with friction (Fanno flow), Fanno curves, Fanno flow equations, Variation of flow properties, Variation of Mach number with duct length, Problems in Fanno flow with and without normal shocks, Flow in constant area ducts with heat transfer – Rayleigh curve, constant entropy lines and constant enthalpy lines, Rayleigh flow equations, Flow properties and maximum heat transfer concept, Problems in Rayleigh flow.

UNIT IV: AIRCRAFT PROPULSION

Types of aircraft engines, Energy flow through Jet engines, Aircraft Propulsion Theory, thrust augmentation methods, Performance of Turbojet engines, Problems in Aircraft Engine Performance, Ramjet, pulse jet engines: Construction and working, Problems. Problems in aircraft propulsion.

UNIT V: ROCKET PROPULSION

Various types and applications of rockets, Solid, liquid propellants: Construction and fuels-oxidizers, Hybrid propellants, Different propulsion systems, Rocket Propulsion theory and performance, problems.

TEXTBOOKS

1. Robert. D. Zucker, *Oscar Biblarz*, "*Fundamentals of Gas Dynamics"*, John Wiley and Sons, 2nd Edition, 2002.
2. John D. Anderson, "*Fundamentals of Aerodynamics*", McGraw-Hill Series in Aeronautical and Aerospace Engineering, 5th Edition, 2010.
3. Mattingly. J. D, "*Elements of Gas turbine Propulsion"*, McGraw Hill, 2005.
4. James John, Theo Keith, "*Gas Dynamics*", Pearson, 3rd Edition, 2006.
5. Yahya. S. M, "*Fundamentals of compressible flow with Aircraft and Rocket Propulsion"*, New Age International (P) Ltd, New Delhi, 3rd Edition, 2005.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 459	Design of Transmission Systems	TE	3	0	0	3

UNIT I: DESIGN OF FLEXIBLE DRIVES

Belt drives: types, selection of belt drives, belt materials and applications, Design procedure and problems on flat belt drives using fundamental equations & manufacturer's data. Design procedure and problems on V-belt drives using fundamental equations & manufacturer's data. Wire ropes: types, construction and designation of wire ropes, stresses in wire ropes. Design procedure and problems on wire ropes. Power transmission chains: types and applications. Design procedure and problems on power transmission chains and sprockets.

UNIT II: DESIGN OF PARALLEL GEARS

Review of gear fundamentals, Forces and stresses in gear tooth, Equivalent number of teeth, gear tooth failures, selection of gear materials, Design procedure and problems on spur gear based on strength consideration. Design procedure and problems on spur gear based on wear consideration. Design procedure and problems on helical gear based on strength consideration, Design procedure and problems on helical gear based on wear consideration.

UNIT III: DESIGN OF NON-PARALLEL GEARS

Straight bevel gear: Terminology, Forces and stresses on gear tooth, Design procedure and problems on bevel gear based on strength consideration, Design procedure and problems on bevel gear based on wear consideration. Worm gear: Thermal capacity, efficiency, forces and stresses, Design procedure and problems on worm gear based on strength consideration, Design procedure and problems on worm gear based on wear consideration.

UNIT IV: DESIGN OF GEAR BOXES

Geometric progression, standard step ratio, structural and ray diagrams, Number of teeth calculation, Meshing arrangement. Design procedure and problems on sliding mesh gear box. Design procedure and problems on constant mesh gearbox. Design of Multi speed gear box for machine tool applications, Variable speed gear box, Fluid couplings, Torque convertor for automotive applications.

UNIT V: DESIGN OF BEARINGS, CLUTCHES AND BRAKES

Sliding contact bearings: Types, assumptions and terminology in hydrodynamic lubricated journal bearing, Design procedure and problems on journal bearing, Rolling contact bearings: types, static and dynamic load rating, life and reliability, Selection of rolling contact bearings, Clutches: Types, Design of plate clutches, Design of cone clutches and internal expanding rim clutches, Brakes: Types, Energy considerations, Temperature rise, Design of band brakes, Design of external shoe brakes and internal expanding shoe brake.

TEXTBOOKS

1. Robert. C. Juvinall, Kurt. M. Marshek, "*Fundamentals of Machine Component Design"*, John Wiley & sons, 5th Edition, 2011.
2. Joseph Edward Shigley and Charles R. Mischke, "*Mechanical Engineering Design*", McGraw –Hill International Editions, New York, 6th Edition, 2003.
3. Spotts, M.F., Shoup, T.E., Hornberger, L.E., "*Design of Machine Elements"*, Prentice Hall of India Eighth Edition, 2004.
4. Paul H Black and O. E. Adams, P., "*Machine Design"*, 3rd edition, Mc Graw Hill Book Company, Inc., New York, USA, 2007.
5. Bernard Hamrock, Steven Schmid, Bo Jacobson, "*Fundamentals of Machine Elements*", 2nd Edition, Tata McGraw-Hill Book Co., 2006.
6. Mehtha.N.K, "*Machine Tool Design and Numerical Control*", Tata Mc-Graw Hill, *Third Edition, 2012.*
7. Darle W Dudley, "*Hand Book of Practical Gear Design*", CRC Press, Florida, 2002.
8. P.S.G Tech..,*"Design Data Book",* Kalaikathir Achchagam, 2012.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 435	Fundamentals of Hydraulics And Pneumatics	TE	3	0	0	3

UNIT I: BASICS OF FLUID POWER SYSTEMS

Introduction to fluid power, Advantages of fluid power, application of fluid power system, Types of fluid power systems, Properties of hydraulic fluids, general types of fluids, Fluid power symbols, Basics of Hydraulics, Applications of Pascal's Law, seals and fittings.

UNIT II: HYDRAULIC SYSTEM AND COMPONENTS

Sources of Hydraulic Power: Pumping theory, Pump Classification, Gear pumps: construction and working of internal and external gear pumps, Vane Pump: construction and working of unbalanced, balanced vane pumps, Piston pump: construction and working of axial, radial piston pumps, Construction of Control Components: Directional control valves, types 4/2, 4/3, check valve, flow control valve, Pressure control valves: construction and working of relief valve, reducing, sequencing, counter balance valves, Solenoid operated valves, Relays, Linear actuators: construction and working of single acting, double acting, and telescopic cylinders, Rotary actuators: construction and working of gear, vane and piston motors.

UNIT III: PNEUMATIC SYSTEMS AND COMPONENTS

Introduction, comparison with hydraulic systems and electrical systems, Properties of air, Construction, operation, characteristics and symbols of reciprocating and rotary compressors, Need for air treatment, Filter, Regulator, Lubricator, Muffler and Dryers. Construction, operation of 3/2, 5/2, 5/3 manual operated, pilot operated and solenoid operated DCVs, pneumatic cactuators. Introduction to fluidic devices, working of Bi-stable, mono-stable devices. Fluidic logic application circuits. Pneumatic Sensors types and applications.

UNIT IV: DESIGN OF HYDRAULIC AND PNEUMATIC CIRCUITS

Speed, force calculations, and Sizing of actuators in fluid power systems, Design of hydraulic/pneumatic circuits for simple reciprocation, regenerative, speed control of actuators, Design of hydraulic/pneumatic circuits: synchronizing and sequencing circuits, Sequential circuit design for simple applications using cascade method, Electrohydraulic and Pneumatic logic circuits, ladder diagram design, PLC applications in fluid power control, Accumulators: Types, circuits, sizing of accumulators, Intensifier: Intensifier circuit and applications.

UNIT V APPLICATION, MAINTENANCE AND TROUBLE SHOOTING

Industrial hydraulic circuits for riveting machine, actuator locking, working of hydraulic press and pump unloading circuits, Hydraulic / pneumatic circuits for material handling systems, Preventive and breakdown, maintenance procedures in fluid power systems, Trouble shooting of fluid power systems, fault finding process equipment / tools used, causes and remedies, Safety aspects involved fluid power systems.

TEXTBOOKS

1. Anthony Esposito, "*Fluid Power with applications"*, Prentice Hall International, 2009.
2. Anthony Esposito, "*Fluid Power with applications"*, Prentice Hall International, 2009.
3. Majumdar.S.R, "*Pneumatic systems – principles and maintenance"*, Tata McGraw-Hill, New Delhi, 2006.

REFERENCES

1. Werner Deppert , Kurt Stoll, "*Pneumatic Application:Mechanization and Automation by Pneumatic Contro"l,*Vogel verlag, 1986.
2. John Pippenger, Tyler Hicks, "*Industrial Hydraulics"*, McGraw Hill International Edition, 1980.
3. Andrew Parr, "*Hydraulics and Pneumatics: A technician's and engineer's guide"*, Elsevier Ltd, 2011.
4. FESTO, "*Fundamentals of Pneumatics"*, Vol I, II and III.
5. Hehn Anton, H., "*Fluid Power Trouble Shooting",* Marcel Dekker Inc., NewYork, 1995.
6. Thomson, "*Introduction to Fluid power",* Prentice Hall, 2004.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 427	Robotics	TE	3	0	0	3

UNIT I: INTRODUCTION

Basic concepts of robotics (laws of robotics, robotic systems), ria definition. Robot anatomy (robot configurations, robot motions, joint notation scheme) , manipulators precision movement (spatial resolution, accuracy, repeatability) work volume, robot specifications. Types of robot drives, electric drive, hydraulic, pneumatic drives, basic robot motions, point to point control and continuous path control, kinematics: forward and inverse kinematics, problems on kinematics.

UNIT II: END EFFECTORS AND TRANSFORMATIONS

End effectors-introduction, classification, mechanical, magnetic grippers, vacuum and adhesive gripper, gripper force analysis and design, problems on gripper design, problems on force calculation, 2d transformation (scaling, rotation, translation), 3d transformation (scaling, rotation, translation), homogeneous transformations.

UNIT III: SENSORS AND CONTROL SYSTEMS

Sensor devices, types of sensors (contact, position and displacement sensors), force and torque sensors, proximity and range sensors, acoustic sensors, robot vision systems, sensing and digitizing, image processing and analysis, robot control system, unit control system, adaptive and optimal control.

UNIT IV: ROBOT CELL DESIGN

Robot work cell design and control, Safety considerations in cell design, Robot cell layouts, multiple, Multiple robots, Machine interface, Robot cycle time analysis.

UNIT V: ROBOT PROGRAMMING AND APPLICATIONS

Robot language, classification, Programming methods, off and online programming, Lead through method, powered and Manual lead through, Teach pendent method, VAL systems and language, Simple program. Application of Robots, Material handling, Constrains, Machine loading and unloading. Assembly Robot, Assembly operation, RCC device, Benefits-Inspection robot, used in Quality control, Welding Robot, features, sensors, Advantages, -Painting Robot, Requirement, and Spray painting, Mobile and microbots, types, mobility and application, Recent developments in robotics- safety considerations.

TEXTBOOKS

1. Mikell P. Groover, "*Industrial Robotics Technology Programming and Applications*", McGraw Hill Co.,Singapore, 2008.
2. Deb .S.R, "*Robotics technology and flexible automation*", Tata McGraw Hill publishing company limited, New Delhi, 2010.
3. Klafter R.D, Chmielewski T.A and Noggins, "*Robot Engineering: An Integrated Approach*", Prentice Hal of India Pvt. Ltd., New Delhi, 2010.
4. Fu K.S, Gonzalez, R.C., & Lee, C.S.G., "*Robotics control, sensing, vision and intelligence*", McGrawHill Book Co., Singapore, Digitized 2007.
5. Craig.J.J, "*Introduction to Robotics mechanics and control*", Addison- Wesley, London, 2008.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 436	Industrial Tribology	TE	3	0	0	3

UNIT I: SURFACES AND FRICTION

Introduction to the concept of tribology, tribological problems, nature of engineering surfaces, surface topography, contact between surfaces, sources of sliding friction, friction due to ploughing, friction due to adhesion, friction characteristics of metals and non-metals, sources of rolling friction, stick slip motion, friction of ceramic materials and polymers, measurement of friction.

UNIT II: WEAR

Wear and types of wear, simple theory of sliding wear mechanism, abrasive wear, adhesive wear, corrosive wear, surface fatigue wear situations, wear of ceramics, wear of polymers, wear measurements.

UNIT III: FILM LUBRICATION THEORY

Coefficient of viscosity, fluid film in simple shear, viscous flow between very close parallel plates: tutorials, lubricant supply, lubricant flow rate, cold jacking, couette flow, cavitation's, film rupture, oil whirl, shear stress variation within the film, lubrication theory by Osborne Reynolds: tutorials, pressure fields for full Sommerfeld, half Sommerfeld, Reynolds boundary conditions.

UNIT IV: LUBRICANTS AND LUBRICATION TYPES

Types of lubricants, properties of lubricants, testing methods, hydrodynamic lubrication, elasto-hydrodynamic lubrication, hydrostatic lubrication.

UNIT V: SURFACE ENGINEERING AND MATERIALS FOR BEARINGS

Classification of Surface modifications and Surface Coatings, Surface modifications, Transformation hardening, Surface modifications, surface fusion, Thermo chemical Processes, Surface coatings, Materials for rolling element bearings, Materials for fluid film bearings, Materials for marginally lubricated and dry bearings.

TEXTBOOKS

1. Hutchings. I.M, "*Tribology, Friction and Wear of Engineering Material,* Edward Arnold, London, 1992.
2. Williams. J.A, "*Engineering Tribology"*, Oxford University Press, 2005.
3. Gwidon Stachowiak, Andrew W Batchelor., "*Engineering tribology"*, Elsevier Butterworth –Heinemann, USA, 2005.
4. Stolarski.T.A, "*Tribology in Machine Design*", Industrial Press Inc., 1990.
5. Bowden.E.P. and Tabor.D, "*Friction and Lubrication*", Heinemann Educational Books Ltd, 1974.
6. Cameron.A, "*Basic Lubrication Theory*", Longman, U.K., 1981.
7. Neale.M.J. (Editor), "*Tribology Handbook*", Newnes Butter worth, Heinemann, U.K., 1975.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 437	Process Planning and Cost Estimation	TE	3	0	0	3

UNIT I: PROCESS PLANNING

Production system and types of production, standardization and simplification, production design and selection, process planning, selection and analysis, manual/experience-based planning, variant type capp, generative type capp, processes analysis, break even analysis.

UNIT II: COSTING AND ESTIMATION

Objectives of costing and estimation: functions and procedure, introduction to costs, computing material cost, direct labor cost, analysis of overhead costs, factory expenses, administrative expenses, selling and distributing expenses, cost ladder, cost of product, depreciation, analysis of depreciation, problems in depreciation method.

UNIT III: ESTIMATION OF COSTS IN DIFFERENT SHOPS

Estimation in foundry shop: Pattern cost, Casting cost, Cost estimation in Foundry shop, Forging: Types, Operations, Estimation of Losses and time in forging, Estimation of Forging cost, Cost estimation in Forging shop: Tutorials.

UNIT IV: ESTIMATION OF COSTS IN FABRICATION SHOPS

Welding, Types of weld joints, Gas welding, Estimation of Gas welding cost, Gas cutting, Arc welding: Equipment's, Cost Estimation, Cost estimation in Welding shop: Tutorials, Estimation in sheet metal shop, Shearing and forming, Cost estimation in Sheet metal shop.

UNIT V: ESTIMATION OF MACHINING TIMES AND COSTS

Machine shop operations, Estimation of Machining time, Estimation of machining time for turning, knurling and facing operations: Tutorials, Estimation of machining time for reaming, threading and tapping operations: Tutorials, Estimation of machining time for drilling, boring: Tutorials Estimation of machining time for shaping, planning: Tutorials, Estimation of machining time for milling and grinding operations: Tutorials, Case studies: Estimation of cost for a product.

TEXTBOOKS

1. Banga.T.R and Sharma.S.C, "*Estimating and Costing*", Khanna publishers, New Delhi, 17th Edition,2015.
2. Adithan.M.S and Pabla, "Estimating and Costing", Konark Publishers Pvt., Ltd, 1989.
3. Nanua Singh, "*System Approach to Computer Integrated Design and Manufacturing*", John Wiley &Sons, New York, 1996.
4. Joseph G. Monks, "*Operations Management, Theory and Problems*", McGraw Hill Book Company,New Delhi, 1982.
5. Narang.G.B.S and Kumar.V, "*Production and Planning*" , Khanna Publishers, New Delhi, 1995.
6. Chitale.A.K and Gupta.R.C, "*Product Design and manufacturing*", Prentice Hall of India, New Delhi,2007.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 438	Internal Combustion Engines	TE	3	0	0	3

UNIT I: COMPONENTS OF IC ENGINES AND PERFORMANCE

Classification of internal combustion engines, application of IC Engines, Function and operation of two stroke and four stroke engines, Comparison of SI and CI, two stroke and four stroke engines, Effects, limitations, and types of supercharging and scavenging process, Performance characteristics of IC engines, Numerical problems on performance and heat balance, Fuel air cycles and their significance.

UNIT II: ENGINE AUXILIARY SYSTEMS

Carburetion, mixture requirements at different loads and speeds, simple carburetor, Functional requirements and classification of an injection systems, injection pump, nozzle types, MPFI and EFI systems, Battery and magneto ignition systems, ignition timing and engine parameters, Properties of lubricants, mist, wet and dry sump lubrication systems, Liquid and air-cooled cooling system, coolant and antifreeze solutions.

UNIT III: COMBUSTION IN SI ENGINES

Homogeneous and heterogeneous mixture, combustion in spark ignition engines, stages of combustion in spark ignition engines, Flame front propagation, factors influencing flame speed, Rate of pressure rise, abnormal combustion, phenomenon of knock in SI engines, Effect of engine variables on knock, combustion chambers for SI engines, smooth engine operation, High power output and thermal efficiency, stratified charge engine.

UNIT IV: COMBUSTION IN CI ENGINES

Combustion in CI engine, stages of combustion in CI engines, Factors affecting the delay period, compression ratio, engine speed, output, atomization and duration of injection, injection timing, quality of fuel, intake temperature, intake pressure, Phenomenon of knock in CI engines, comparison of knock in SI and CI engines, Combustion chambers for CI engines, Homogenous charge compression ignition Engine.

UNIT V: ALTERNATE FUELS AND EMISSION

Liquid fuels, alcohol, methanol, ethanol; vegetable oil, biodiesel production, properties, advantages and disadvantages, Gaseous fuel - Hydrogen, CNG, LPG, Air pollution due to IC engines, hydrocarbon and CO emission, oxides of nitrogen, aldehydes, sulphur, lead and phosphorus emissions, Catalytic converter, exhaust gas recirculation, Flame ionization detector, non-dispersive infra-red detector, chemiluminescence analyzer, smoke types, Bosch smoke meter, Emission standards.

TEXTBOOKS

1. Ganesan.V, *"Internal Combustion Engines"*, Tata McGraw-Hill, New Delhi, 2015.
2. Ramalingam.K.K, "*Internal Combustion Engines- Theory and practice"*, SciTech publications India Pvt. Ltd., Chennai, 2010.
3. Thipse.S.S, "*Internal Combustion Engines"*, Jaico Publication House, 2010.
4. Thipse.S.S, "*Alternate Fuels"*, Jaico Publication House, 2010.
5. Mathur.M.L and Sharma.R.P, "*A course in Internal Combustion Engines"*, DhanpatRai& Sons, New Delhi, 2010.
6. Heywood.J.B, "*Internal Combustion Engine Fundamentals"*, McGraw Hill International, New York, 2008.
7. Domkundwar.V.M, "*A course inInternal Combustion Engines"*, DhanpatRai& Sons, 2010.
8. Shyam.K.Agrawal, "*Internal Combustion Engines*", New Age International, 2012.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 223	Alternative Sources of Energy	TE	3	0	0	3

UNIT I: SOLAR ENERGY

Solar radiation and its measurements, Types of solar thermal collectors, Solar thermal applications for water heaters, solar stills and solar pond, Solar thermal applications for refrigeration and air- conditioning system, Solar thermal applications for solar dryer, solar cookers and solar furnaces, Sensible and latent heat thermal energy storage systems, Solar thermal power generation systems, Solar photovoltaic systems: basic working principle and components, Applications of solar photovoltaic systems.

UNIT II: WIND ENERGY

Basic principle of wind energy conversion system, Wind data, site selection and energy estimation, Components of wind energy conversion systems, Types of Horizontal axis and Vertical axis wind turbine, Design consideration of horizontal axis wind turbine, Aero foil theory, Analysis of aerodynamic forces acting on the blade, Performance of wind turbines, Introduction to solar and wind hybrid energy systems, environmental issues of wind energy.

UNIT III: OCEAN, HYDRO AND GEOTHERMAL ENERGY

Wave characteristics and wave energy, Tidal energy and its types, Estimation of energy and power in single basin tidal system, Ocean thermal energy conversion for open system, Ocean thermal energy conversion for closed system, Hydro power plants for small, mini and micro system, Exploration of geothermal energy, Geothermal power plants, Challenges, availability, geographical distribution, scope and economics for geothermal plant.

UNIT IV: BIOMASS

Sources of biomass, Pyrolysis, combustion and gasification process, Updraft and downdraft gasifier, Fluidized bed gasifier, Fermentation and digestion process, Fixed and floating digester biogas plants, Design considerations of digester, Operational parameter of biogas plants, Economics of biomass power generation.

UNIT V: DIRECT ENERGY CONVERSION SYSTEMS

Basic principle of thermo electric and thermionic power generations, Fuel cell principles and its classification, Phosphoric acid fuel cell, polymer electrolyte membrane fuel cell, molten carbonate fuel cell and solid oxide fuel cell, Fuel cell conversion efficiency, applications of fuel cell, Magneto hydrodynamic power generation for open cycle, Magneto hydrodynamic power generation for closed cycle, Hydrogen energy: properties and its production methods, Electrolysis, thermo-chemical methods, fossil fuel methods and solar energy methods, Hydrogen storage, transportation and applications.

TEXTBOOKS

1. Tiwari.G.N, Ghosal.M.K, "*Fundamentals of renewable energy sources"*,1st Edition, UK, Alpha Science International Ltd, 2007.
2. Godfrey Boyle, "*Renewable energy"*, 2nd Edition, Oxford University Press, 2010.
3. Twidell.J.W and Weir.A.D, "*Renewable Energy Resources"*,1st Edition, UK,E.&F.N. Spon Ltd, 2006.
4. Domkundwar.V.M, Domkundwar. A.V, "*Solar energy and Non-conventional sources of energy"*, Dhanpat rai & Co. (P) Ltd, 1st Edition, New Delhi, 2010.
5. G.D Rai, "*Non-Conventional Energy Sources"*, Khanna Publishers, 5th Edition, New Delhi, 2011.
6. B.H Khan, "*Non-conventional Energy Resources"*, 2nd Edition, New Delhi, Tata McGraw Hill, 2009.
7. S.P. Sukatme, J.K. Mayak, "*Solar Energy-Principles of thermal collection and storage*", 3rd edition, New delhi, McGraw Hill,2008.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 439	Industrial Engineering	TE	3	0	0	3

UNIT I: WORK MEASUREMENT AND WORK STUDY

Introduction to Work measurement and its Techniques, Production study and Time study, Standard time, Rating factors and Work sampling, Techniques of Work study, Human factors of Work study, Method study, Techniques and procedures of Productivity, Charging techniques, Motion economy principles, SIMO chart, Ergonomics and Industrial design.

UNIT II: PLANT LAYOUT AND MATERIAL HANDLING

Plant location and site selection, Types, need, factors influencing the plant layout, Tools and techniques for developing layout, process chart, flow diagram, string diagram, Template and Scale models, Layout Planning procedure, Assembly line balancing, Material Handling, scope and importance, Types of material handling systems, Factors influencing material handling, Methods of material handling.

UNIT III: WORK DESIGN ERGONIMICS, PRODUCTION & PRODUCTIVITY

Introduction to work design, Work design for increased productivity, The work system, design Introduction to job design, Environmental factors, organizational factors & behavioural factors influencing effective job design. Ergonomics, Objectives system approach of ergonomic model, Man machine system Production and Productivity, Definition of production, function and type of production, Definition of productivity and productivity measurement.

UNIT IV: PRODUCTION PLANNING AND CONTROL

Objectives and Functions of PPC, Aspects of product development and design, Process Planning, Principles of Standardization, Specialization and Simplification, Group Technology, Optimum Batch size, ABC analysis, Value Engineering.

UNIT V: WAGES AND INCENTIVES

Wages and salary administration, Meaning principles and techniques of wage fixation, Job evaluation, Merit rating, Methods of wage payment, Types, Advantages and disadvantages of Incentive scheme, Productivity base incentives, Case Example of Evaluation of incentive scheme.

TEXTBOOKS

1. Khanna.O.P, "*Industrial Engineering and Management*", DhanpatRai Publications Pvt Ltd, 2010.
2. Samuel Eilon, "*Elements of Production Planning and Control"*, McMillan andCo., Digitized, 2007.
3. Kumar.B, "*Industrial Engineering and Management"*, 9th edition, KhannaPublishers, New Delhi, 2005.
4. James M. Apple, "*Principles of Layout and Material Handling"*, Ronald press,2007.
5. Maynard.H, "*Industrial Engineering Handbook"*, McGraw Hill Book Co., NewYork, 2010.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 440	Advanced Fluid Mechanics	TE	3	0	0	3

UNIT I: INVISCID IRROTATIONAL FLOWS

The local continuity equation, path lines, streamlines, and stream functions, newton's momentum equation, equation for newtonian fluid, vorticity and circulation, non-newtonian fluids, moving coordinate systems, irrotational flows and the velocity potential, singularity distribution methods, forces acting on a translating sphere, added mass and the lagally theorem. Theorems for irrotational flow: mean value and maximum modulus theorems, maximum-minimum potential theorem, kelvin's minimum kinetic energy theorem.

UNIT II: EXACT SOLUTIONS OF THE NAVIER- STOKES EQUATIONS

Solutions to the steady-state navier-stokes equations, two-dimensional flow between parallel plates, poiseuille flow in a rectangular conduit, poiseuille flow in a round conduit, couette flow between concentric circular cylinders, unsteady flows: impulsive motion of a plate—stokes's first problem, oscillation of a plate—stokes's second problem, plane stagnation line flow, three-dimensional axi-symmetric stagnation point flow, flow into convergent or divergent channels.

UNIT III: THERMAL EFFECTS AND FLOW STABILITY

Thermal boundary layers forced convection on a horizontal flat plate, the integral method for thermal convection, linear stability theory of fluid flows, thermal instability in a viscous fluid—rayleigh- bénard convection. Stability of flow between rotating circular cylinders: couette-taylor instability.

UNIT IV: TURBULENT FLOWS

Statistical approach—one-point averaging, zero-equation turbulent models, one-equation turbulent models, two-equation turbulent models, stress-equation models, equations of motion in fourier space. Quantum theory models**,** large eddy models.

UNIT V: COMPUTATIONAL METHODS

Numerical calculus, numerical integration of ordinary differential equations, the finite element method, linear stability problems— invariant imbedding and riccati methods, errors, accuracy, and stiff systems, multi-dimensional methods: relaxation methods, surface singularities, one-step methods: forward time, centered space, dufort-frankel method, crank-nicholson method, hybrid method, upwind differencing.

TEXTBOOKS

1. Graebel. W.P, "*Advanced Fluid Mechancis*", 1st Edition, Academic Press, Elsevier Inc., 2007.
2. K. Muralidhar and G. Biswas, " *Advanced Engineering Fluid Mechanics*", 3rd Edition, Narosa Publishers, 2015.
3. Stevan A Jones, "*Advanced Methods for Practical Applications in Fluid Mechanics*", InTech Publishers, 2012.
4. Hyoung Woo Oh, "*Advanced Fluid Mechancis*", InTech Publishers, 2012.
5. Roger Kinsky, "*Fluid Mechanics Advanced Applications*", McGraw-Hill Education Europe, 1997.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 441	Operations Research	TE	3	0	0	3

UNIT I: LINEAR PROGRAMMING

Operation Research and decision making- Development, Definition, Characteristics, Necessity, Scope, Applications, Advantages, Limitations, Objectives, Phases, Types of mathematical models in OR and constructing the model. Linear Programming - Requirements, Assumptions, Applications, Formulation of linear programming problem, Advantages, Limitations, Simplex method - Graphical method of solution, Simplex method - Analytical - Canonical and Standard forms of LPP, Artificial Variables Techniques - Big M-method, Artificial Variables Techniques - Two Phase method, Problems in Artificial Variables Techniques, Assignment models [Balanced, Unbalanced, Maximization] -Mathematical Representation ,Comparison with Transportation models - Hungarian Method of Solution, Assignment models [Travelling Salesman Problem.] (Shortest Cyclic Route Models)

UNIT II: TRANSPORTATION MODELS AND REPLACEMENTMODEL

Transportation problem –Assumption, Definition, Formulation and Solution - North west corner method, Transportation problem – Least cost method, Transportation problem – Vogel's approximation method, Transportation problem – MODI method, MODI method [Unbalance in transportation model] MODI method [Degeneracy in transportation model], Replacement Model, Replacement of items that deteriorate, Gradually, Fail suddenly, Group Replacement policy analysis – Problems.

UNIT III: SEQUENCING AND NETWORK ANALYSIS

Problem of Sequencing, Processing 'n' jobs through two and three machines, Problem of Sequencing, Processing 'n' jobs through two and three machines, Project - Planning, Scheduling, Controlling - Network Analysis – Constructing a project network - Fulkerson'sRule, Network computations – Earliest Completion time of a project and Critical path, Program Evaluation Review Technique, Total Slack, Free Slack, Probability of achieving completion date, Cost Analysis - Crashing the network - Resource Scheduling -Advantages, Limitations, Problems - Distinction between PERT and CPM - LPP Formulation.

UNIT IV: INVENTORY CONTROL AND QUEING THEORY

Introduction – Necessity for Maintaining Inventory, Inventory Costs – Types- Variables in an inventory problem – Lead time, Reorder Level, EOQ, Deterministic Inventory Models – Purchasing model with no shortages, Manufacturing model with no shortages, Purchasing model with shortages, Manufacturing model with shortages, Multi item deterministic model, safety stock, storage quantity discount, Queuing Models - Elements - Kendall's Notation - Poisson arrivals and exponential service times, Waiting time, Idle time cost, Single channel problem, Multi-channel problem, Poisson arrivals and service time.

UNIT V: DECISION THEORY AND GAME THEORY

Steps in Decision theory approach - Decision making Environments-Making under conditions of Certainty, Uncertainty, Conditions of Risk, Steps in Decision theory approach - Decision making Environments-Making under conditions of Certainty, Uncertainty, Conditions of Risk, Decision making conditions – problems, Decision trees. - Utility Theory, Theory of Games, Characteristics Game models - Definition - Rules - Pure Strategy, Optimal solution of two-person zero sum games, mixed strategies, Graphical solution of (2xn) and (mx2) games, Solution of (mxn) games by linear programming.

TEXTBOOKS

1. Premkumar Gupta and Hira, "*Operation Research*", Third Edition S Chand Company Ltd., New Delhi 2003.
2. A.C.S.Kumar, "*Operation Research*", Yes Dee Publishing Ltd., Chennai 2015.
3. Fredric.S.Hilleer and Gerold J. Lieberman, "*Introduction to Operation Research*", 2nd Edition, CBS, 1974.
4. Handy, "A. Taha, "*Operations Research*", 5th Edition, Prentice Hall of India, New Delhi, 1997.
5. Philip and Ravindran, "*Operational Research*", John Wiley, 2000.
6. Sundaresan.V, GanapathySubramanian.K.S, "*Resource Management Techniques: Operations Research*" A.R Publications, 2003.
7. Panneerselvam.K, "*Operation Research*", Prentice Hall of India, 2002.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 442	Advanced Engineering Thermodynamics	TE	3	0	0	3

UNIT I: AVAILABILITY ANALYSIS AND THERMODYNAMIC PROPERTY RELATIONS

Reversible work, availability, irreversibility and second law efficiency for a closed system, availability analysis of simple cycles, exergy analysis and thermodynamic potentials, maxwell relations, generalized relations for changes in entropy, internal energy and enthalpy generalized relations for cp and clausius clapeyron equation and joule – thomson coefficient.

UNIT II: REAL GAS BEHAVIOUR AND MULTI – COMPONENT SYSTEMS

Different equations of state, fugacity, compressibility and principle of corresponding states, use of generalized charts for enthalpy and entropy departure, fugacity coefficient, lee – kesler generalized three parameter tables, fundamental property relations for systems of variable composition. Partial molar properties. Real gas mixtures, ideal solution of real gases and liquid activity, equilibrium in multi-phase systems. Gibbs phase rule for non – reactive components.

UNIT III: CHEMICAL THERMODYNAMICS ANDEQUILIBRIUM

Thermochemistry, first law analysis of reacting systems, adiabatic flame temperature, entropy change of reacting systems, second law analysis of reacting systems, criterion for reaction equilibrium, equilibrium constant for gaseous mixtures, evaluation of equilibrium composition.

UNIT IV: STATISTICAL THERMODYNAMICS

Statistical thermodynamics- introduction, energy states and energy levels, macro and microscales, thermodynamic probability, maxwell–boltzman, fermi–diarc and bose–einstein statistics statistics, distribution function, partition energy, statistical interpretation of entropy, application of statistics to gases-mono-atomic ideal gas.

UNIT V: IRREVERSIBLE THERMODYNAMICS

Conjugate fluxes and forces, entropy production onsager's reciprocity relations thermo – electric phenomena, formulations.

TEXTBOOKS

1. Kenneth WarkJt.m, "*Advanced Thermodynamics for Engineers*", McGrew – Hill Inc., 1995.
2. M.J. Moran and H.N. Shapiro, "*Fundamentals of Engineering Thermodynamics*", John Wiley and Sons, 2003.
3. Yunuscengel, "*Thermodynamics an engineering approach*", McGrew – Hill Inc, 8th Edition, 2015.
4. Bejan, A., "*Advanced Engineering Thermodynamics*", John Wiley and Cons, 1988.
5. Holman, J.P., "*Thermodynamics*", 4th Edition, McGraw – Hill Inc., 1988.
6. Sonntag, R.E., and Van Wylen, G, "*Introduction to Thermodynamics, Classical and Statistical Themodynamics*", John Wiley and Sons, 3rd Edition, 1991.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 443	Finite Element Methods	TE	3	0	0	3

UNIT I: BASIC CONCEPTS OF THE FINITE ELEMENT METHOD

Basics of FEA, Derive the stiffness matrix of Spring, bar and beam elements, Tutorial Problems on spring and bar elements, Derive the stiffness matrix of beam elements, Tutorial Problems on spring and bar elements, Local and global coordinate systems, assembly of elements, calculation of element stress, simple applications, trusses, Drive the stiffness matrix, Tutorial Problems on Trusses-stiffness matrix calculation, Tutorial Problems on Trusses, Member stress calculation.

UNIT II: VARIATIONAL AND WEIGHTED RESIDUAL APPROACHES

Variational problems, Euler's Equation, Example problem, solving first order differential equation using 2-node 1D element, Example problems, solving first order differential equation using 1D-sub-parametric elements, Weighted residual approaches, Galerkin formulation and Point-collocation, Example problems on Galerkin formulation, simple regular beam sections with different types of loads, Example problems on Point-collocation- simple regular beam sections with different types of loads, Weighted residual approaches, Sub-domain collocation, Least-square minimization, Example problems on Sub-domain collocation - simple regular beam sections with different types of loads, Example problems on Least-square minimization - simple regular beam sections with different types of loads.

UNIT III: TWO DIMENSIONAL ISOPARAMETRIC ELEMENTS AND GAUSS NUMERICAL INTEGRATION

Natural coordinate systems, Interpolation function for Triangular Elements (CST, LST and QST).

Interpolation function for 4-node,8-node and 9-node quadrilateral Elements, Element stiffness matrix formulation for two dimensional elements, Gauss Numerical Integration-Derivation of one point and two-point formula. Example Problems on Gauss Numerical Integration using one point and two-point formula (1D problems).

UNIT IV: EIGEN VALUE PROBLEMS FOR ONE-DIMENSION PROBLEMS (DYNAMIC CONSIDERATION)

Formulation- Hamilton's Principle-Characteristic polynomial technique, Element mass matrix formulation for one dimensional Elements (2-node iso parametric and 3-node sup – parametric elements) Example problems for 1-D Problems to find eigenvalues and eigenvectors- using 2-node isoparametric, Example problems for 1-D Problems to find eigenvalues and eigenvectors- using 3-node isoparametric.

UNIT V: STEADYANALYSIS STATE HEAT TRANSFER

Introduction, straight uniform fin analysis, Derivation 1D Element matrices, Example Problems, straight uniform fin analysis, Example Problems, Taper fin analysis, Heat Flex Boundary conditions, Analysis of uniform fins using 1D Quadratic Elements, Two Dimensional Steady state Problems, using CST Elements, Example Problems for 2D steady Problems using CST Elements, 1-D and 2-D simple Problems using any commercial FEA software.

TEXTBOOKS

1. Hutton, D.V., "*Fundamentals of Finite Element Analysis*", McGraw Hill, International Edition, 2004.
2. Segerlind, L.J., "*Applied Finite Element Analysis*", John Wiley & Sons, 1984.
3. Chandrupatla, T.R., Belegundu, A.D., "*Introduction to Finite Elements in Engineering*", Prentice Hall of India, 1997.
4. Zienkiewicz, O.C., "*Finite Elements and Approximation*", Dover International, 2006.
5. Cook R.D., Malkus, D.S., Plesha, M.E., Witt, R.J., "*Concepts and Applications of Finite Element Analysis*", 4th Edition, John Wiley & Sons, 2001.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 411	Artificial Intelligence and Expert Systems	TE	3	0	0	3

UNIT I: INTRODUCTION TO AI

History, Definition of AI and Emulation of human cognitive process, Agents: types, An abstract view of modeling and Elementary knowledge, Computational and Predicate logic, Analysis of compound statements using simple, logic connectives, Nature of Environments.

UNIT II: PROBLEM SOLVING AGENTS

Problem Definition, formulating problems and Searching for solutions, Examples using production rules, Search /Strategies: Uninformed or Blinded search and Breadth first search, Uniform cost search: Depth first search, Depth limited search, Iterative deepening, Depth first search and Bi –directional search. Comparing uniformed search strategies and informed search strategies, Heuristic information and Hill climbing methods. Best First Search; Greedy Best First Search, Branch-and-Bound Search, Optimal search algorithm A* and iterative, deepening A*.

UNIT III: KNOWLEDGE ORGANISATION AND COMMUNICATION

Knowledge organization, manipulation and acquisition. Indexing and Retrieval techniques and Integration of knowledge in memory organization systems, Matching Techniques: Need for matching and simple matching problems, Partial matching, Fuzzy matching and RETE matching algorithm Perception Natural language: Overview of linguistics and Basics emantic analysis, Representation structures and Natural language generation uncertainty. Bayesian Networks and Bayesian Inference.

UNIT IV: PROGRAMMING LANGUAGE

Introduction to LISP: syntax, Input output statements, Numeric functions, User defined Functions, Predicate Logic and declaration of local variables, Interaction and recursion functions Property list and arrays.

UNIT V: EXPERT SYSTEMS

Introduction to expert systems, activities of an expert system, interpretation, prediction and diagnosis, design, planning and monitoring, debugging and repair, instruction and control, acquisition module frames of expert systems, knowledge base, production rules, semantic nets and inference engines, backward chaining and forward chaining.

TEXTBOOKS

1. Schalkoff, R.J., "*Artificial Intelligence: An Engineering Approach"*, McGraw-Hill, 1990.
2. Elaine Rich and Kelvin Knight, "*Artificial Intelligence"*, Tata McGraw Hill, New Delhi, 1991.
3. Stuart Russell and Peter Norvig, "*Artificial Intelligence: A modern approach"*. Prentice Hall, NewJersey, 1995.
4. Donald A. Waterman, *"A Guide to Expert Systems"*, Addison-Wesley Longman Publishing Co.,Inc. Boston, MA, USA ©1985 ISBN:0-201-08313-2.
5. Nilson, N. J., "*Principles of Artificial Intelligence"*, Springer Verlag, Berlin, 1980.
6. Eugene Charniak and Drew McDermot, "*Introduction to Artificial Intelligence"*, Addison WesleyLongman Inc., 1998.
7. Patterson, "*Introduction to Artificial Intelligence and Expert systems"*, Prentice Hall of India, NewDelhi, 1990.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 444	Micro Controller and Its Application in Robotics	TE	3	0	0	3

UNIT I: INTRODUCTION TO 8051 MICROCONTROLLERS

Data representation and Numbering system and its types are binary, decimal, hexadecimal systems, Data conversion from hexadecimal to decimal and decimal to binary, binary addition and subtraction, Introduction and history description about Microcontrollers, Specification and Internal architecture of 8051. Pin description of 8051, Various Addressing modes of 8051 are immediate, direct, indirect, indexed addressing modes, difference between microcontroller with microprocessor. selection criterion for choosing microcontroller.

UNIT II: 8051 PROGRAMMING

Introduction to Assembly language, Instruction sets with syntax, timers and its types, TCON, TMOD, Delay program with and without timer, Interrupts both hardware and software, I/O Ports and its 3 modes of operation, Serial communication and its modes, SCON.

UNIT III: PERIPHERAL INTERFACE

Introduction to External world interfacing with microcontroller, Analog signals and Digital signals, Analog to digital and Digital to Analog conversion andits types, Analog inputs are mechanical switches, relays, Digital outputs are LED,7 segment display and LCD Interfacing. Analog outputs are DC motor, Stepper motor, Servo motor and its interfacing. Digital inputs are keypad and its interfacing.

UNIT IV: OPENSOURCE MICROCONTROLLER AND ITS PROGRAMMING

Introduction to open-source microcontroller, Arduino platform basic knowledge of its hardware and its software environments, Variables, digital inputs and outputs, print and printing with programs. Reading analog signals and PWM signal generation with programs, Conditional statements are if, else and nested if with Programs. Looping statements are for, while and Do while with programs, functions and recursive function with programs, Continuous Serial monitoring and hardware interrupt with programs.

UNIT V: MICROCONTROLLER SYSTEM DESIGN AND APPLICATION

Application of Microcontroller in various fields, Advancement in Microcontroller, Study and Design a home security system using microcontroller, Study and Design a Micro mouse using microcontroller, Study and Design a Unmanned Aerial Vehicle using microcontroller, study and design a smart card using microcontroller, study and design a soccer playing robot using microcontroller.

TEXTBOOKS

1. Mazidi, "*The 8051 micro controller and embedded system*", Pearsoneducation, 2007.
2. Simon Monk, "*Programming Arduino Getting Started with Sketches*", McGraw-Hill Education, 2011.
3. K. Uma rao, Andhe Pallavi, "*The8051 Microcontroller Architecture, Programming and Applications*", Pearson Education India, 2010.

REFERENCES

1. Han-way Huang, "*Using the MCS-51 microcontroller*", Oxford University Press, 2009.
2. Scott Mackenzie, Raphael C. W. Phan, "*The 8051 Microcontroller*", Prentice Hall, 2007.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 445	Machinery Fault Diagnostics and Signal Processing	TE	3	0	0	3

UNIT I: FAILURE ANALYSIS

Failures and failure analysis, failure concepts and characteristics, fault detection sensors, data processing and signal analysis, condition-based maintenance principles, fault analysis planning and system availability, reliability/failure concepts, application of diagnostic maintenance to specific industrial machinery and plants.

UNIT II: FAULT DIAGNOSTICS AND VIBRATION

Principles of maintenance, failure modes effects and criticality analysis, fault diagnostics and prognostics, basics of machinery vibration, engineering applications of vibration, rotor dynamics.

UNIT III: SIGNAL ANALYSIS

Time domain signal analysis, frequency domain signal analysis, computer aided data acquisition, FFT analysis, modulation and sidebands, envelope analysis, cepstrum analysis, order analysis.

UNIT IV: INSTRUMENTATION AND DETECTION

Data recording and transmission, vibration transducers, vibration monitoring, basics of noise and noise monitoring, numerical problems in noise vibration and data, acquisition, unbalance detection, field balancing, misalignment detection, cracked shaft detection, looseness and rub detection, ball and journal bearings, gear fault detection.

UNIT V: EQUIPMENT TESTING AND ANALYSIS

Fans, blowers, compressors, pumps and turbines, contaminant analysis, oil analysis, fault detection in motors and transformers, motor current signature analysis, thermography and ultrasonics, acoustic emission and eddy current testing, radiography,dye penetrant test and visual inspection.

TEXTBOOKS

1. E. S. Tehrani and K. Khorasani, "*Fault diagnostics of a nonlinear system using a hybrid approach*" Springer, 2009.
2. PareshGirdhar, Cornelius Scheffer, "*Practical machinery vibration analysis and predictive maintenance*", Elsevier, 2004.
3. Rolf Isermann, B. Freyermuth, "*Fault Detection, Supervision and Safety for Technical Processes*", Pergamon Press, 2006.
4. J Prasad, C G K Nair, "*Non-Destructive Testing and Evaluation of Materials*", Tata McGraw Hill Education Private Limited, 2008.
5. American Metals Society, "*Non-Destructive Examination and Quality Control*", Metals Handbook, Vol.17, 9th Ed, Metals Park, OH, 1989.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 446	Advanced Strength of Materials	TE	3	0	0	3

UNIT I: INTRODUCTION

Plane Stress - Plane strain relations, General equations of elasticity in Cartesian, polar and spherical co-ordinates equations of equilibrium, Representation of 3-dimentinal stress of tensor, Stress at a point - inclined plane. 3D stress at a point - Principal stress, 3D Stress transformation, Generalized Hooke's law, St.Venant's principle, Compatibility and boundary conditions, Airy's stress function.

UNIT II: UN SYMMETRICAL BENDING AND SHEAR STRESS ON BEAMS

Stress and deflections in beams subjected to unsymmetrical loading – Double (I) symmetry sections. Stress and deflections in beams subjected to unsymmetrical loading –Single symmetry (T) sections. Stress and deflections in beams subjected to unsymmetrical loading –Single symmetry (C) sections. Stress and deflections in beams subjected to unsymmetrical loading – Unsymmetrical (L) sections. Kern of a section, Shear Stress Distribution on beams – Thin-walled sections, Shear Center - Location of shear center for various sections, Shear flow.

UNIT III: CURVED FLEXURAL MEMBERS

CURVED FLEXURAL MEMBERS: Circumferential and radial stresses – winkler bach theory, circumferential and radial stresses for curved beam with restrained ends, deflections in curved flexural members, closed ring subjected to concentrated loading, closed ring subjected to uniform load, chain links, crane hooks.

UNIT IV: TORSION ON NON-CIRCULARSECTIONS

Torsion of rectangular cross section, St. Venant's theory, Elastic membrane analogy, Prandtl's stress function, Torsional stress in hollow thin-walled tubes, Stress due to Rotation: Radial and tangential stresses in solid disc of uniform and varying thickness with allowable speeds, Radial and tangential stresses in ring of uniform and varying thickness with allowable speeds.

UNIT V: STRESSES IN FLAT PLATES AND CONTACT STRESSES

Stresses in circular plates due to various types of loading and end conditions, Stresses in rectangular plates due to various types of loading and end conditions, Buckling of plates, Methods of computing contact stresses, Deflection of bodies in point contact, Deflection of bodies in line contact, Contact stress for various applications.

TEXTBOOKS

1. Arthur Boresi& Omar Sidebottom, "*Advanced Mechanics of Materials,*" John Wiley & Sons, 6th Edition,2002.
2. Seely and Smith, "*Advanced mechanics of materials*", John Wiley International Edn, 1952.
3. Rimoahwnko, "*Strength of Materials*", Van Nostrand., 1970.
4. Den Hartong, "*Advanced Strength of Materials*", McGraw Hill Book Co., New York 1952.
5. Timoshenko and Goodier, "*Theory of Elasticity*", McGraw Hill., 1994.
6. Wang, "*Applied Elasticity*", McGraw Hill., 1979.
7. Case, "*Strength of Materials*", Edward Arnold, London 1957.
8. Robert D. Cook, Warren C. Young, "*Advanced Mechanics of Materials*", Macmillian Pub. Co. 1952.
9. Durelli Phillips and Tso, "*Introduction to the Theoretical and Experimental Analysis of Stress and Strain*",McGraw-Hill, 1958.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 460	Additive Manufacturing Technology	TE	3	0	0	3

UNIT I: INTRODUCTION TO ADDITIVE MANUFACTURING SYSTEMS

History and Development of AM, Need of AM, Difference between AM and CNC, Classification of AM Processes: Based on Layering techniques, Raw materials and Energy sources. AM Process chain, Benefits of AM, Applications of AM, Representation of 3d model in STL format, Repair of STL files, RP Data formats: SLC,CLI,RPI,LEAF,IGES,CT,STEP,HP/GL.

UNIT II: POWDER BASED AM SYSTEMS

Principle and process of Selective Laser Sintering (SLS). Advantages, Limitations and Applications of SLS, Principle and Process of Laser Engineered Net Shaping (LENS), Advantages, Limitations and Applications of LENS, Principle and Process of Electron Beam Melting (EBM), Advantages, Limitations and Applications of EBM.

UNIT III: SOLID AND LIQUID BASED AM SYSTEMS

Stereolithography (SLA): principle, process, materials, advantages, limitations, applications, solid ground curing (SGC): principle, process, materials, advantages, limitations, applications. Fusion deposition modeling (FDM): principle, process, materials, advantages, limitations, applications. Laminated object manufacturing (LOM): principle, process, materials, advantages limitations, applications.

UNIT IV: OTHER ADDITIVE MANUFACTURING SYSTEMS

Three-dimensional printing (3DP): principle, process, advantages, limitations, applications. Ballastic particle manufacturing (BPM): principle, process, advantages, limitations, applications. Shape deposition manufacturing (SDM): principle, process, advantages, limitations, applications, reverse engineering.

UNIT V: TOOLING AND PRE &POST PROCESSING TECHNIQUES IN AM SYSTEMS

Rapid tooling: Classification of Tooling, Direct, and Indirect tooling methods, Soft and Hard tooling methods. Design for AM: Part orientation, Removal of Post processing: Support material removal, Surface texture Improvements, Accuracy supports, following out parts, Interlocking features, Reduction of part count in an assembly. Improvements, Machining Strategy, Aesthetic Improvements, Property enhancements.

TEXTBOOKS

1. Ian Gibson, David Rosan, Brent Stucker, “Additive Manufacturing Technologies”, Springer, 2010.
2. Chua C.K.,Leong K.F., and Lim C.S., “Rapid Prototyping: Principles and Applications”, Second Edition, World scientific Publishers, 2003.
3. LiouW. Liou, Frank W. Liou, “Rapid Prototyping and Engineering applications: A Toolbox for Prototype development”, CRC Press, 2007.
4. Pham D.T. and Dimov S.S., “Rapid Manufacturing; the technologiesand application of RPT and Rapid tooling”, Springer, London 2001.
5. Gebhardt, A., “Rapid prototyping”, Hanser Gardener Publications, 2003.
6. Hilton, P.D. and Jacobs, P.F., “Rapid Tooling: Technologies and Industrial Applications”, CRC press, 2005.
7. RafiqNoorani, “Rapid Prototyping: Principles and Applications in Manufacturing”, John Wiley & Sons, 2006.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 447	Computer Graphics	TE	3	0	0	3

UNIT I: INTRODUCTION

Origin of computer graphics, Interactive graphics display, Display devices, pixels, Algorithms for line and circle, 2D transformation (scaling, rotation, translation), 3D transformation (scaling, rotation, translation) Concatenation transformations.

UNIT II: SPECIAL CURVES

Curve representation, Parametric representation of Bezier curve, Parametric representation of Cubic spline curve, Parametric representation of B-Spline curve, Parametric representation of Rotational curves.

UNIT III: SURFACES

Surface modeling techniques, Mathematical representation and boundaries Coons patch, Mathematical representation of Bi-Cubic patch, Bezier and B-Spline surfaces.

UNIT IV: THREE-DIMENSIONAL COMPUTER GRAPHICS

Boundary representation (B-rep), basic elements and building operations, Constructive solid geometry (CSG), basic elements and building operations, viewing transformations, clipping operations Hidden line removal for curved surfaces, Algorithms for shading and rendering.

UNIT V: GRAPHICS AND COMMUNICATION STANDARDS

Graphical Kernel System, Bit maps and open GL (graphics library) Data exchange standards (IGES, STEP, CALLS, DXF, STL) Communication standards (LAN, WAN).

TEXTBOOKS

1. Donald Hearn and Pauline Baker M. “Computer Graphics”, Prentice Hall, Inc., 2009.
2. Ibrahim Zeid “CAD/Cam Theory and Practice”, McGraw Hill, International Edition, 2010.
3. Harington, Stevan, “Computer Graphics: A Programming Approach”, McGraw Hill, 1983.
4. Plastock, Roy A., &Kally, “Theory and Problems of Computer Graphics”, McGraw Hill, 1986.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 448	Automotive Engineering	TE	3	0	0	3

UNIT I: AUTOMOBILE ARCHITECTURE AND PERFORMANCE

Automotive components, subsystems and their positions of chassis, frame and body, front, rear and four-wheel drives, operation and performance, traction force and traction resistance, power required for automobile.

UNIT II: TRANSMISSION SYSTEMS

Clutch types, coil spring and diaphragm type clutch, single and multi-plate clutch, centrifugal clutch, Gear box types, constant mesh, sliding mesh and synchromesh gear box, layout of gear box, gear selector and shifting mechanism. Overdrive, automatic transmission, Rolling, air and gradient resistance, Propeller shaft, universal joint, slip joint Differential and real axle arrangement, hydraulic Coupling.

UNIT III: WHEEL, TYRES, AND BRAKING SYSTEM

Types of wheels, construction, wired wheels, Tyres, construction, radial, bias & belted bias, slip angle,tread patterns, tyre retreading cold & hot, tubeless tyres. Forces on vehicles, tyre grip, load transfer, braking distribution between axles, stopping distance. Types of brakes, Mechanical, Hydraulic, Air, brakes,Disc& Drum brakes, Engine brakes, anti-lock braking system.

UNIT IV: SUSPENSION AND STEERING SYSTEM

Types-front and rear suspension, conventional and independent type suspension, Leaf springs, coil springs, dampers, torsion bars, stabilizer bars, arms, air suspension systems. Types of steering systems, Ackermann principle, Davis steering gear, steering gear boxes, steering linkages. Power steering, wheel geometry, caster, camber toe in, toe out. Wheel Alignment and balancing.

UNIT V: ELECTRICAL SYSTEM AND ADVANCES IN AUTOMOTIVE ENGINEERING

Battery, general electrical circuits, dashboard instrumentation. Passenger comfort, safety and security, HVAC seat belts, air bags. Automotive Electronics, Electronic Control Unit (ECU). Variable Valve Timing (VVT), Active Suspension System (ASS), Electronic Brake Distribution (EBD) Electronic Stability Program (ESP), Traction Control System (TCS), Global Positioning System (GPS), Electric Hybrid Vehicle.

TEXTBOOKS

1. Kirpal Singh, “Automobile Engineering”, Standard Publishers, Vol-I & II, 2004.
2. Ramalingam, K. K, “Automobile Engineering”, Scitech Publications, 2014.
3. Rajput R K, “A Textbook of Automobile Engineering”, Laxmi Publication, 2015.
4. Crouse, W.H., and Anglin, D.L., “Automotive Mechanics”, Tata McGraw Hill, 2005.
5. Narang, G.B., “Automobile Engineering”, Khanna Publishers, 2001.
6. Kamaraju Ramakrishna, “Automobile Engineering”, PHI Learning Pvt. Ltd, 2012.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 449	Fatigue, Fracture Mechanics and Creep	TE	3	0	0	3

UNIT I: INTRODUCTION TO FATIGUE

Introduction to fatigue, stress and strain cycles, S-N curves, statistical nature of fatigue, low cycle fatigue, High cycle fatigue, basquin equation, Coffin and Manson equation, strain life equation, design for fatigue.

UNIT II: EFFECT OF VARIOUS PARAMETERS ON FATIGUE

Effect of stress concentration on fatigue, size effect, surface effects and fatigue, corrosion fatigue, effect of mean stress on fatigue, engineering analysis of fatigue strength, cumulative fatigue damage, effect of metallurgical variables on fatigue, effect of temperature on fatigue.

UNIT III: FRACTURE MECHANICS

Introduction to fracture mechanics (FM), modes of crack and types of fracture in metals, linear elastic fracture mechanics (LEFM), griffith's theory of brittle fracture, irwin's modification, determination of stress intensity factor (K and Kic). Plane strain fracture toughness.

UNIT IV: APPLICATIONS OF FRACTURE MECHANICS

Theories of elastic and plastic fracture mechanics (EPFM) crack opening displacement (COD), crack tip opening displacement (CTOD), j-integral, ductile fracture, notch effect, concept of fracture curve, fracture under combined stresses. Life prediction and design.

UNIT V: CREEP, STRESS RUPTURE AND HIGHTEMPERATURE MATERIALS

Introduction to high temperature behavior, the creep curves, the stress rupture test, mechanisms of creep and mechanism maps, presentation of engineering creep data, prediction of long-life properties, creep fractures, creep fatigue interaction and creep resistantmaterials.

TEXTBOOKS

1. George E. Dieter, “Mechanical Metallurgy”, McGraw-Hill, 3rdSI metric edition”, 1989.
2. Robert P. Wei, Fracture Mechanics, “Integration of Mechanics, Materials Science and chemistry”, Cambridge University Press, 2010.
3. Richard W. Hertzberg, “Deformation and Fracture Mechanic of Engineering Materials”, John Wiley & sons, 1995.
4. Prashant Kumar, “Elements of Fracture Mechanics”, Tata McGraw-Hill, New Delhi, 2009.
5. Suryanarayana.A.V.K, “Testing of Metallic Materials”, 2nd Edition, BS Publication, Hyderabad, 2007.
6. Davis H.E, Troxell G.E, Hauck G.E.W, “Testing of Engineering Materials”, 4th Edition, McGraw Hill, Int. Students, 1982.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 452	Flexible Manufacturing Systems	TE	3	0	0	3

UNIT I: PRODUCTION SYSTEMS

Types of production system, comparison, plant layout. Functions in manufacturing, manufacturing support system. Automation in production system. Production quantity and product variety, production concepts and mathematical model, tutorial on production rate, production, capacity, utilization, availability, manufacturing lead time for all types of production. Tutorial on manufacturing lead time, work in progress for all types of production, single product scheduling.

UNIT II: GROUP TECHNOLOGY AND FMS

Introduction to GT, formation of part families, part classification and coding system, production flow analysis, machine cell design, clustering algorithm, GT benefits, introduction and evolution of FMS. FMS need and economic justification, components and classification of fms.

UNIT III: FMS PLANNING

Physical planning for FMS, objective, guideline. User-supplier responsibilities in planning, user-supplier role in site preparation, machine tool selection and layout, computer control system, datafiles, types of reports, system description and sizing, factors affecting it. Human resources for FMS, objective, staffing, supervisor role. Quantitative analysis methods for fms, bottle neck and extended bottle neck model, tutorial. FMS benefits and limitation.

UNIT IV: FLEXIBLE MANUFACTURING CELLS

Introduction to manufacturing cells, cell description and classifications, unattended machining, requirement and features, component handling and storage system, cellular versus FMS, system simulation, hardware configuration, plc and computer controllers, communication networks, lean production and agile manufacturing.

UNIT V: FMS SOFTWARE

Introduction to FMS software, general structure and requirements, functional descriptions, operational overview, FMS installation, acceptance testing, performance goals, FMS application in machining, sheet metal fabrication, prismatic component production, FMS development towards factories of the future.

TEXTBOOKS

1. William W. Luggen, “Flexible Manufacturing Cells and Systems”, Prentice Hall, New Jersey, 1991.
2. Mikell P. Groover, “Automation Production Systems &Computer Integrated manufacturing”, Prentice.
3. Jha.N.K, "Handbook of Flexible Manufacturing Systems", Academic Press Inc.,1991.

REFERENCES

1. David J. Parrish, “Flexible Manufacturing”, Butterworth-Heinemann, Newton, MA, USA, 1990.
2. Radhakrishnan.P and Subramanyan.S, “CAD/CAM/CIM”, Wiley Eastern Ltd.,New Age International Ltd., 1994 3.
3. Raouf.A and Ben-Daya.M, Editors, “Flexible manufacturing systems: recent development”, Elsevier Science, 1995.
4. Kalpakjian, “Manufacturing engineering and technology”, Addison-Wesley Publishing Co., 1995.
5. Taiichi Ohno, “Toyota production system: beyond large-scale production”, Productivity Press (India) Pvt. Ltd. 1992.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 453	Combustion Engineering	TE	3	0	0	3

UNIT I: COMBUSTION OF FUEL

Introduction, combustion equations, theoretical air, excess air, air fuel ratio, equivalence ratio, exhaust gas composition, air fuel ratio from exhaust gas composition, heating value of fuels.

UNIT II: THERMODYNAMICS OF COMBUSTION

Thermo-chemistry, first law analysis of reacting systems, adiabatic combustion temperature, second law analysis of reacting systems, criterion for chemical equilibrium, equilibrium constant for gaseous mixtures, evaluation of equilibrium composition, chemical availability.

UNITIII: KINETICS OF COMBUSTION

Rates of reaction, reaction order and complex reactions, chain reactions, arrhenius rate equation, collection theory. Activated complex theory, explosive and general oxidative characteristics of fuels.

UNIT IV: FLAMES

Laminar and turbulent flames premixed and diffusion flames, burning velocity and its determination, factors affecting burning velocity, quenching, flammability and ignition, flame stabilization in open burners.

UNIT V: ENGINE COMBUSTION

Combustion in SI and CI engines, stages of combustion in SI and CI engines, normal combustion and abnormal combustion, emissions from premixed combustion, emission from non-premixed combustion, control of emissions.

TEXTBOOKS

1. Stephen.R.Turns, “An Introduction to Combustion concepts and applications”, McGraw Hill BookCompany, Boston, 3rd Edition, 2011.
2. Ganesan.V, “Internal Combustion Engines”, Tata McGraw-Hill, New Delhi, 2009.
3. Ramalingam.K.K, “Internal Combustion Engines - Theory and practice”, SciTechPublications IndiaPvt. Ltd., Chennai, 2010.
4. Thipse.S.S, “Internal Combustion Engines”, Jaico Publication House, 2010.
5. Thipse.S.S, “Alternate Fuels”, Jaico Publication House, 2010.
6. Mathur.M.L, and Sharma.R.P, “A course in Internal Combustion Engines”, DhanpatRai& Sons, NewDelhi, 2010.
7. Heywood.J.B, “Internal Combustion Engine Fundamentals”, McGraw Hill International, New York,2008.
8. Domkundwar.V.M, “A course inInternal Combustion Engines”, DhanpatRai& Sons, 2010.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 454	Gas Turbine Technology	TE	3	0	0	3

UNIT I: BASICS OF GAS TURBINES

Open cycle single shaft and twin shaft multi speed arrangement, Closed cycle gas turbine operation, Aircraft propulsion, Industrial applications of gas turbines, Environmental issues and future enhancement possibilities.

UNIT II: POWER CYCLES

Ideal cycles method of accounting component losses, design point performance calculations, comparative performance of practical cycles - combined cycle -cognation schemes. Closed cycle gas turbine with reheat, inter- cooling and regenerator, problems.

UNIT III: AXIAL FLOW COMPRESSORS

Axial flow compressor basic operation: elementary theory, factors effecting stage pressure ratio, blockage in compressor annulus - degree of reaction - blade fixing details - sealing materials and material selection for compressor blades, stage performance - design and off design performance characteristics, problems.

UNIT IV: COMBUSTION SYSTEMS AND TURBINES

Types of combustion and combustion requirements, Factors affecting combustion process, Combustion chamber heat calculations, Turbine construction, performance, impeller blade fixing. Cooling of turbine blades, blade vibration and protective coating. Gas turbine turbo chargers and power expanders, vortex theory. Estimation of stage performance.

UNIT V: PERFORMANCE PREDICTIONS

Prediction performance of gas turbines component characteristics, Off design operation - Equilibrium running of gas generator, Methods of displacing of the equilibrium running line, Incorporation of variable pressure losses, Matching procedure for two spool engines, principle of control system.

TEXTBOOKS

1. Saravanamuttoo. H.I.H, Rogers.G.F.C, Henry Cohen, “Gas Turbine Theory”,Pearson Prentice Hall,2009.
2. Mattingly.J.D, “Elements of Propulsion: Gas turbines and Rockets”, McGraw Hill, 2012.
3. Ganesan.V, “Gas Turbines”, Tata McGraw Hill, 3rd Edition, 2010.
4. Yahya S.M, “Turbines, Fans and Compressors”, 3rd Edition, Tata McGraw Hill Publications, 2010.
5. Gopalakrishnan.G, Prithvi Raj D, “Treatise on Turbomachines”, 1st Edition, Chennai, SciTechPublications, 2006.
6. Horlock.J.H, “Advanced Gas Turbine Cycles”, Elsevier Science Ltd, 2003.
7. Venkanna.B.K, “Fundamentals of Turbomachinery”, 4th Edition, New Delhi, PHI Learning Pvt. Ltd,2011.
8. Yahya.S.M, “Gas Tables for compressible flow calculations”, New Age International (P) Ltd, NewDelhi, 6th Edition, 2011.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 455	Fuel Cell Technology	TE	3	0	0	3

UNIT I: INTRODUCTION TO FUEL CELLS AND FUEL CELL THERMODYNAMICS

Introduction and overview of fuel cell technology: A simple fuel cell, fuel cell advantages and disadvantages, Basic fuel cell operation, Layout of a Real Fuel Cell: The Hydrogen–Oxygen Fuel Cell with Liquid Electrolyte. Difference between fuel cell and batteries, fuel choice, Overview of types of fuel cells (with emphasis on PEMFC and DMFC technology) Fuel cell thermodynamics: Thermodynamics review, Application of first and second law to fuel cells, Heat Potential of a fuel: Enthalpy of reaction, Work potential of a fuel: Gibbs free energy, Predicting reversible voltage of a fuel cell under non-standard-state conditions, Basic Parameters of Fuel Cells. Fuel cell efficiency, Comparison with Carnot efficiency.

UNIT II: FUEL CELL ELECTROCHEMISTRY

Fuel cell reaction kinetics, Introduction to electrode kinetics, Conversion of chemical energy to electricity in a fuel cell. reaction rate, Butler -Volmer equation, fuel cell charge and mass transport, Implications and use of fuel cell polarization curve.

UNIT III: TYPES OF FUEL CELLS

Classification of fuel cells, Polymer electrolyte membrane fuel cell (PEMFC), Direct methanol fuel cells (DMFC), Alkaline fuel cell (PAFC) Molten Carbonate fuel cell (MCFC), Solid oxide fuel cell (SOFC), Comparison of fuel cell, Performance behavior.

UNIT IV: HYDROGEN PRODUCTION, STORAGEAND UTILIZATION

Hydrogen: Its merit as a fuel, Production methods: fromfossil fuels, electrolysis, thermal decomposition, photochemical, photocatalytic, hybrid, Hydrogen storage methods: Onboard hydrogen storage, Chemical storage & physical storage, In metal and alloy hydrides, Carbon nanotubes, Glass capillary arrays - pipeline storage and hydrogen utilization.

UNIT V: APPLICATION OF FUEL CELLS INPOWER COGENERATION

Balance of fuel cell power plant, fuel cell power plant structure, cogeneration, fuel cell electric vehicles, motorcycles and bicycles, airplanes, fueling stations, fuel processor and fuel cell stack, safety issues and cost expectation.

TEXTBOOKS

1. O'Hayre, R. P., S. Cha, W. Colella, F. B. Prinz, "Fuel Cell Fundamentals", Wiley, 2006.
2. Viswanathan. B, AuliceScibioh, M, "Fuel Cells – Principles and Applications", Universities Press(India) Pvt., Ltd., 2009.
3. Bagotsky .V.S, "Fuel Cells",Wiley, 2009.
4. DetlefStolten, "Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications", 2010.
5. Larminie .J, Dicks A. "Fuel Cell Systems", 2nd Edition, Wiley, 2003.
6. Barclay .F.J. "Fuel Cells, Engines and Hydrogen", Wiley, 2009.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 413	Design and Modelling aspects of AM	TE	3	0	0	3

UNIT I: ADDITIVE MANUFACTURING (AM)

Fundamentals of Additive Manufacturing; Additive Manufacturing Process chain; Application levels of additive manufacturing; Benefits enabled by additive manufacturing; Current areas of additive manufacturing. Overview of design for Additive Manufacturing (DFAM); Motivation; Potential of additive Manufacturing on Design; Generalizable DFAM strategies; Different design strategies of AM.

UNIT II: DESIGN FOR MANUFACTURING AND ASSEMBLY

Core DFAM Concepts and Objectives: Complex Geometry, Customized Geometry, Integrated Assemblies, Elimination of Conventional DFM Constraints; AM Unique Capabilities: Shape Complexity, Hierarchical Complexity, Functional Complexity, Material Complexity; Exploring Design Freedoms: Part Consolidation and Redesign, Hierarchical Structures, Industrial Design Applications.

UNIT III: TOPOLOGY OPTIMIZATION FOR AM

Motivation towards topology optimization for AM design; Topology optimization methods; Opportunities for Topological Optimization applied to AM; Parametric optimization; Topology optimization and generative design; Steps for topological optimization in AM; Case study.

UNIT IV: ADVANCED DESIGN FOR ADDITIVE MANUFACTURING

3D CAD slicing; Unidirection slicing; Multidirection slicing; 2D path planning; Raster path; Zigzag path; Contour path; Spiral path; Hybrid path; Continuous path; Hybrid and continuous path; Medial axis transformation (MAT) path; Adaptive MAT path.

UNIT V: DESIGN ANALYSIS AND OPTIMISATION

Aims of Using Design Analysis for AM; Special Considerations for Analysis of AM Parts: Material Data, Surface Finish, Geometry, Simplifying Geometry, Mesh-Based Versus Parametric Models, Geometry Distortion; Mesh: Parametric Models, Mesh-Based Models; Boundary Conditions; Optimisation; Topology Optimisation: Objective and Constraints, Common Settings, Post-processing and Interpreting Results; Parametric or Size Optimisation; Build Process Simulation: Layer-by-Layer Simulation; Scan Pattern Simulation; Limitations.

TEXTBOOKS/REFERENCES

1. Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
2. Martin Leary, "Design for Additive Manufacturing", Springer, 2019.
3. Olaf Diegel, Axel Nordin, Damien Motte, "A Practical Guide to Design for Additive Manufacturing", Springer, 2020.
4. Igor Shishkovsky, "New Trends in 3D Printing", Intech Open, 2016.
5. Amit Bandyopadhyay, Susmita Bose, "Additive Manufacturing: Second Edition", Taylor & Francis, CRC Press, 2019.
6. Neil Hopkinson, Richard Hague, Philip Dickens, "Rapid manufacturing-an industrial revolution for the digital age",Wiley, 2006.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 412	Additive Manufacturing Process	TE	3	0	0	3

UNIT I

Introduction to layered manufacturing, Importance of Additive Manufacturing Additive Manufacturing in Product Development. Classification of additive manufacturing processes, Common additive manufacturing technologies; Fused Deposition Modeling(FDM), Selective Laser Sintering(SLS), Stereo Lithography(SLA), Selection Laser Melting (SLM), Jetting, 3D Printing, Laser Engineering Net Shaping (LENS), Laminated Object Manufacturing (LOM), Electron Beam Melting (EBM). Capabilities, materials, costs, advantages and limitations of different systems.

UNIT II

Material science for additive manufacturing-Mechanisms of material consolidation-FDM, SLS, SLM, 3D printing and jetting technologies. Polymer's coalescence and sintering, photo polymerization, solidification rates, Meso and macro structures, Process evaluation: process-structure relationships, structure property relationships.

UNIT III

Applications: Prototyping, Industrial tooling, Aerospace, Automotive, Medical etc. Quality control and reliability: Defects in FDM, SLS and SLM, Critical process parameters: geometry, temperature, composition, phase transformation, Numerical and experimental evaluation: roles of process parameter combination, process optimization.

UNIT IV

CAD Modelling for 3D printing: , 3D Scanning and digitization, data handling &reduction Methods, AM Software: data formats and standardization, Slicing algorithms: -uniform flat layer slicing, adaptive slicing, Process-path generation: Process-path algorithms, rasterization, part Orientation and support generation.

UNIT V

Lab: CAD Modeling: Introduction to CAD environment, Sketching, Modeling and Editing features, Different file formats, Export/Import geometries, Part orientation, Layer slicing, Process path selection, Printing, Numerical and experimental evaluation.

TEXTBOOKS/REFERENCES

1. Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
2. Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", second edition, World Scientific Publishers, 2010.
3. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2011.
4. Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
5. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications.

COURSE CODE	COURSE NAME	COURSE CATEGORY	CREDITS			
			L	T	P	C
ME 434	Elements Of Mechatronics	TE	3	0	0	3

UNIT I: INTRODUCTION TO MECHATRONICS

Introduction to Mechatronics systems, Mechatronics system components and Measurement Systems, Control Systems, Open and Closed Loops Systems temperature control, Water level controller and Shaft speed control, Transfer function: Laplace transform, system in series and System with feedback loop. Sequential Controllers: Washing machine control, Sequential Controllers: Digital camera.

UNIT II: SENSORS AND TRANSDUCERS

Introduction to sensors and transducers and classifications, Principle and working of Resistive, capacitive, inductive and resonant transducers, Optical measurement systems for absolute and incremental encoders, Photo electric sensor and vision system, Fiber optic transducers, Solid state sensors and transducers for magnetic Measurements Temperature measurements, Chemical measurements, piezoelectric sensor and Accelerometers, Ultrasonic sensors and transducers for flow and distance.

UNIT III: ELECTRICAL DRIVES AND CONTROLLERS

Introduction, Electromagnetic Principles, Solenoids and Relays, Electrical drives of stepper motors, servo motors, Operational amplifier, A/D converters & D/A converters, Signal processing, Multiplexer and Introduction to Data acquisition system, Proportional, Integral, Derivative and PID controller, Introduction to Micro controller: M68HC11 and ATMEGA328.

UNIT IV: PROGRAMMABLE LOGIC CONTROLLERS

Basic structure, Programming units and Memory of Programmable logic controller, Input and Output Modules, Mnemonics for programming, Latching and Internal relays, Timers, Counters and Shift Registers, Master relay and Jump Controls, Programming the PLC using Ladder diagram for Simple applications.

UNIT V: MECHATRONICS SYSTEM DESIGN AND APPLICATION

Mechatronics in Engineering Design, Traditional and mechatronics design, Car park barriers using PLC, Pick and Place robots and Bar code reader, Wind screen wiper using stepper motor control, Car Engine management systems, Case studies for Coin counters, Robot walking machine, Boiler control using PID.

TEXTBOOKS

1. Bolton.W, "*Mechatronics*", Addison Wesley, 4th Edition, New Delhi, 2010.
2. Bradley.D.A, Dawson.DBurdN.C.and Loader A.J, "*Mechatronics*", Chapman and Hall Publications,New York, 1993.
3. Jacob Fraden, "*Handbook of Modern Sensors Physics, Designs, and Applications*", Third Edition,Springer-Verlag New York, 2004.
4. James Harter, "*Electromechanics, Principles and Concepts and Devices*", Prentice Hall, New Delhi,1995.
5. David W. Pessen, "*Industrial Automation Circuit Design and Components*", John Wiley, New York,1990.
6. Rohner.P, "*Automation with Programmable Logic Controllers*", Macmillan / McGraw Hill, New York,1996.

7. Brian Morris, "*Automatic Manufacturing Systems Actuators, Controls and Sensors*", McGraw Hill,New York, 1994.
8. Godfrey C. Onwubolu, "*Mechatronics Principles and applications*", Butterworth-Heinemann, NewDelhi, 2006.